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Fiscal Federalism

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OPTIMAL COUNTRY'S POLICY TOWARDS MULTINATIONALS WHEN LOCAL REGIONS CAN CHOOSE BETWEEN FIRM-SPECIFIC AND NON-FIRM-SPECIFIC POLICIES [*]

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ABSTRACT: This paper looks at a county's central government optimal policy in a setting where its two identical local regions compete for the attraction of footloose multinationals to their sites, and where the considered multinationals strictly prefer this country to the rest of the world. For the sake of reality the model allows the local regions to choose between the implementation of firm-specific and non-firm-specific policies. We find that, even though the two local regions are identical, some degree of regional tax competition is good for country's welfare. Moreover, we show that the implementation of the regional firm-specific policies weakly welfare dominates the implementation of the regional non-firm-specific ones. Hence the not infrequent calls for the central government to ban the former type of policies go against the advice of this paper.

JEL Codes: F23, H25, H71

Keywords: FDI, regional, tax competition, concurrent taxation, bargaining, tax posting, footloose multinational, optimal policy, country's welfare

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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, there is substantial evidence that the sub-national governments' role in the competition for footloose multinationals is becoming more important. This is apparent in the following citation.

> [I]t is also important to incorporate sub-national governments into the competitive framework. In federal nations and large countries with decentralised administration it is often sub-national governments that deliver incentive packages and contribute most to both intra-national and international competition (from Charlton (2003), page 15) ...
>
> [and in page 25] Competition is strong among sub-national governments, which often compete more fiercely with each other than with overseas locations.

A similar opinion is expressed in Bjorvatn and Eckel (2006).

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 2006). Moreover, since the early 1990s, the same type of regional competition has begun to proliferate in developing countries such as Brazil (see Versano, Ferriera, and Afonso 2002), China (see Xu and Yeh 2005) and India (see Schneider 2004), to mention only a few.

This paper looks at a county's central government optimal policy in a setting where two of its local regions compete for the attraction of footloose multinationals to their sites and where the considered multinationals strictly prefer this country to the rest of the world (i.e., the country has some advantage in terms of strategic location, productivity etc.). 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) model the fact that the tax competition between countries takes the form of a tax holiday. 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. Behrens and Picard (2008) present a model in which governments bid for firms by taxing/subsidizing setup costs and were the firms choose both the number and the location of the plants they operate. Borcka and Pflüger (2006) look at tax competition in the context of the 'new economic geography settings'. They find that if the mobile factor is completely agglomerated in one region, it earns an agglomeration rent which can be taxed. Closer integration first results in a 'race to the top' in taxes before leading to a 'race to the bottom'. 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 survey can be found in Dembour (2003). This literature focuses on horizontal tax competition when mobile multinationals face discrete location choices, which is the main feature shared with our paper. However, unlike in our paper, in this literature there is no central government intervening in the competition between lower level jurisdictions.

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). One difference between the public finance literature on tax competition and the literature on competition for foreign direct investment, mentioned in the previous paragraph, is that the latter deals with markets of imperfect competition while the former usually assumes perfect competition. A second difference is that in the public finance literature the inter-jurisdiction competition for firms occurs in a closed economy setting. Thirdly, in the public finance literature the competition is for capital rather than for firms facing discrete location choices. Notice that only the second type of competition allows the implementation of firm-specific policies.

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. That paper finds that the central government asymmetric tax treatment of the two identical regions welfare-dominates the symmetric one. In other words, it is optimal for the central government to set a high enough tax in one of the regions (the non-favoured one) in order to increase the bargaining power of the other (favoured) region, vis-à-vis the multinational.

The present paper is similar to Parcero (2007), but for the sake of reality it allows more flexibility to the local governments at the time of choosing their policies (incentives) towards footloose multinationals. That is, whether they are firm-specific or non-firm-specific policies. The effect of this choice on country's welfare is assessed.

In reference to the firm-specificity's degrees of the incentives provided by the states in the U.S., Fisher and Peters (1999) (page 1) writes the following:

> One could organize these incentives into five classes, from the most specific to the most general:
>
> **A.** One-time deals negotiated with a specific firm, such as the property tax exemption ... or an agreement to finance road access to a site.
>
> **B.** Grants and loans provided under programs that receive annual state appropriations, where the firm must apply for funding.
>
> **C.** Programs that require no explicit funding and that allow a degree of local government discretion. This would include property tax abatements in some places (where the abatement is discretionary or the abatement schedule can vary) ...
>
> **D.** Tax incentives for new investment that function as automatic entitlements: investment tax credits or jobs tax credits under the

> state corporate income tax, and local property tax abatements in many places.
>
> **E.** Features of the tax code that apply to every corporation, but that benefit some more than others and that are often advertised by economic development agencies as reasons to locate in that state. Examples are single-factor apportionment, exemption of inventories from property taxation, and exemption of fuel and utilities from the sales tax.

The previous discussion and quotation suggest 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.[1] Thus, the present paper is about tax competition and excludes any competition in terms of infrastructure provision or regulation.

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[2] 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. As will be seen later, the advantage of the 'tax-posting regime' is that by pre-committing to non-negotiation, it has the potential to provide a higher 'bargaining power' to the region.[3]

The following results are found. Firstly, as in Parcero (2007) we find that the central government asymmetric tax treatment of the two identical regions welfare-dominates the symmetric one. Secondly, we find that under some parameter constellations, if the tax in the non-favoured region (the region where the central government tax is higher) is too high, a conflict of interests is created between the central government of the country (who aims to maximize the country's welfare) and the favoured region. That is, the central government would prefer the favoured region implements the tax-bargaining regime, but this region finds it optimal to implement the tax-posting regime, which attracts only the high-rent multinational.

Interestingly, this conflict of interests is resolved by reducing the central government tax in the non-favoured region. Thus, the complete elimination of the competition coming from the second region is not optimal for the country (as it would be in Parcero 2007). In other words, some regional tax competition is desirable and hence the central government tax in the non-favoured region

[1] For economy of language we will refer to the present value of the rents produced by a multinational as simply 'the rent'. Moreover, this paper makes the simplifying assumption that the multinationals do not produce externalities to the host region.

[2] The use of lump-sum taxes is a convenient simplification.

[3] The assumption that tax discrimination is not possible under the tax-posting regime is a simplifying one, because our main results would still apply under a less restrictive one. Moreover, notice that the fact that bargaining allows a higher price discrimination than a price-posting is well recognized. For instance, Spier (1990) considers a model with two types of buyers, differing in their willingness to pay for one unit of a good. Like us, Spier argues that the advantage for a seller of implementing bargaining is that it offers flexibility, whereas the disadvantage is that more surplus is retained by the buyer; see also Bester (1993).

should not be too high. The reason for this result is that a certain degree of competition from the non-favoured region drives the favoured region to adopt the tax-bargaining regime, which is the optimal one for the country; i.e., the conflict of interests is resolved.

Finally, we also show that the implementation of the regional tax-bargaining regime weakly welfare dominates the implementation of the regional tax-posting regime. In the case that our choice of proxies for the policy's firm-specificity degrees were an appropriate simplification of the reality, this result could be used to refute those criticisms to inter-regional tax competition that are specifically addressed to the regional implementation of firm-specific policies. Hence, the not infrequent call for the central government to ban this type of regional policies goes against the advice of this paper. Therefore, if a country had to (and had the capacity to) restrict the regional ability of policy making in some way, our paper would advocate the restriction of the non-firm-specific policies, rather than the firm-specific ones.

The structure of the paper is as follows. 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). At these stages both regions have already chosen their tax regimes (in stage 2) and they know the central government tax in each region (set in stage 1). 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 (there are two symmetric cases here). 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 solves the first stage of the game, where the optimal central government tax in each region has to be found. The results are analyzed in section 7. Section 8 concludes.

2 The basic model

In modelling inter-region tax competition for foreign investment, 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 - it acts as a Stackelberg leader. 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). It would be more realistic to assume a limited commitment capability, though, the qualitative predictions of the paper would not be affected. Moreover, our assumption is common in the economics literature on 'price-posting vs. bargaining', where sellers rather than governments commit to an irrevocable pricing policy. If anything, governments seem to have better commitment tools than private sellers.

We assume a fourth-stage game involving the central government, G, two local regions, R_j for $j \in (1, 2)$, and 'a' multinational, M_i,[4] 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}

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

will be omitted hereafter. Finally, all players have complete information at the time of making their decisions.

The sequence of the game is shown in Figure 1. In the first stage of the game, in order to maximize the expected country's welfare, G 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.[5] 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[6]

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

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, R_1's ex-post payoff and the country's ex-post welfare are respectively given by the following three expressions.[7]

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

[5] 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 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.

[6] 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 tide break rules to make it clear which region is the winning one.

[7] 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.

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

$$w_i = \begin{cases} t_{i1} + g_1 & \text{if } v_i - g_1 - t_{i1} \geq 0 \\ 0 & \text{if } v_i - g_1 - t_{i1} < 0 \end{cases}. \tag{4}$$

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 and expected country's welfare are straightforward from (3) and (4), given that we know that the probabilities of M_h and M_l showing up are q and $(1-q)$.

In order to get the results mentioned in the introduction it is necessary to find the expected country's welfare and expected regional payoffs under different values of the set (g_1, g_2) (first stage of the game). However, we first 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:

Sub-game (b,p) **or** (b,p)**:** One region is committed to tax-posting while the other is committed to tax-bargaining.

Sub-game (p,p)**:** Both regions are committed to tax-posting.

Sub-game (b,b)**:** 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 in order to find G's optimal policy in the first stage.

Let us now take a short look at a case where there appears the aforementioned conflict of interests between G and R_1. In particular and as a motivation let us consider the consequences of G setting $g_1 = v_l$ and $g_2 = v_h$, which will be discussed in more detail later. In this case R_2 cannot lure any M_i's type and so it does not exert any competition to R_1. On the one hand, if R_1 bargains and splits the surplus with M_i, it gets nothing if the firm is M_l's type and it gets $\pi_1 = (v_h - v_l)/2$ if it is M_h's type. In any case both types of firms locate in R_1, so the expected country's welfare is $w = v_l + q(v_l - v_h)/2$. On the other hand, if R_1 posts a tax $t_1 = v_h - v_l$, it gets nothing if the firm is M_l and it gets a payoff $\pi_1 = v_h - v_l$ if it is M_h. Since posting induces M_l to locate abroad, the expected country's welfare is $w = qv_h$. Clearly, R_1 prefers to post, but G would be content to have R_1 posting if and only if $v_l + q\frac{v_h - v_l}{2} \leq qv_h$. On the contrary, G would prefer R_1 to bargain if this inequality is not satisfied. The question we want to answer is: what is the central government's best policy under the latter circumstances? Thus, in order to simplify our calculations the following assumption is made:

Assumption 1: $v_l + q\frac{v_h - v_l}{2} > qv_h \Leftrightarrow q < \frac{2v_l}{v_h + v_l}$.

The main results of this paper appear when the parameter values satisfy assumption 1. For these parameter values there is a conflict of interests between G and the winning region and, as a consequence, some competition between the regions is good for the country's welfare. 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. Notice that from assumption 1 the following lemma can be derived.

Lemma 1 *It will never be optimal for the country to set $g_j > v_l$ in both regions; so it must be the case that $g_j \leq v_l$ for at least one region j.*

This is because, as we have already said, assumption 1 implies that it is not optimal to only attract M_h. Additionally and in order to limit the analysis to non-trivial cases the following assumption is also made:

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, which are then used in section 6 to compute the sub-game-perfect equilibrium of the entire game.

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.[8]

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)), 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 $\max(s_{ip} - t_p, 0)$.[9] That is, M_i's outside option is the maximum between what M_i obtains by locating in R_p and its participation constraint, which requires M_i not to get a negative payoff.[10] R_b has no outside option.

An agreement (division) of the bargaining game is a pair $x = (x_{R_b}, x_{M_i})$, in which x_k for $k = R_b, M_i$, is player k's share of the pie. The set of possible agreements is $X = \{(x_{R_b}, x_{M_i}) \in R^2 : x_{R_b} + x_{M_i} = 1 \text{ and } x_k \geq 0\}$. Each player is concerned only about the payoff he receives, and prefers to receive more rather than less.

As in Osborne and Rubinstein we assume that the first player making an offer is the one without outside option; i.e., R_b in our case. R_b and M_i can take actions only at times in the (infinite) set $T = \{0, 1, 2, ...\}$. We assume that R_b and M_i have time preferences with the same constant discount factor $\delta < 1$, and that their payoffs, in the event that M_i opts out in period t, are $(0, \delta^t(s_{ip} - t_p))$.

At $t = 0$ R_b proposes a division x of the pie (a member of X). M_i may accept this proposal, reject it and opt out, or reject it and continue bargaining.[11] In the first two cases the negotiation ends; in the first case the payoff vector is

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

[9] In the bargaining jargon, what a player gets when she takes up her next-best alternative (what she gets when she "opts out") is called the player's outside option.

[10] 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'.

[11] Following Osborne and Rubinstein we only allow M_i to opt out and it can only do that when responding to an offer; this ensures uniqueness of the equilibrium outcome. It should be stressed that this is indeed the standard assumption —see, De Meza and Lockwood (1998) or Muthoo (1999).

$s_{ib}x$, and in the second case it is $[0, \max(s_{ip} - t_p, 0)]$. If M_i rejects the offer and continues bargaining, play passes into the next period, when it is M_i's turn to propose another division, x'; then R_b may accept or reject this division. In the event of rejection, another period passes, and once again it is R_b's turn to make an offer.

The following lemma states the solution of the bargaining game. It shows the parameter values[12] under which M_i decides to build the new plant in R_b, R_p or not to come to the country at all. Moreover, the lemma also reveals the payoffs for R_b, R_p and M_i as functions of the value t_p chosen in the third stage of the game.

Lemma 2 *In the limit as $\delta \to 1$ the bargaining game described above 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 $\psi_{i,b} = s_{ip} - t_p$, $\pi_{ip} = t_p$ 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 $(\pi_{ib}, \psi_{i,b}) = (s_{ib}/2, s_{ib}/2)$ 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 $(\pi_{ib}, \psi_{i,b}) = (t_p + g_p - g_b, s_{ip} - t_p)$ 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 $(\pi_{ib}, \psi_{i,b}) = (t_p + g_p - g_b, s_{ip} - t_p)$ 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:[13]

$$t_{ib} = \begin{cases} \underset{R_b \text{ gets } M_i}{\begin{matrix}\min\left(\frac{s_{ib}}{2},\right. \\ \left. t_p + g_p - g_b\right)\end{matrix}} & \text{if} \begin{cases} g_b \leq v_i \ \& \ [t_p > g_b - g_p \text{ or} \\ (t_p = g_b - g_p \ \& \ g_b \leq g_p)] \end{cases} \\ \underset{R_b \text{ does not get } M_i}{0} & \text{if} \begin{cases} g_b > v_i \text{ or } [t_p < g_b - g_p \text{ or} \\ (t_p = g_b - g_p \ \& \ g_b > g_p)]. \end{cases} \end{cases} \tag{5}$$

The reaction function (5) will be needed in stage 3 of the game in order to find R_p's equilibrium tax, t_p^*.

[12] The parameter values obviously refers to v_l, v_h and q. However, notice that in stages 2, 3 and 4 of the game, g_1 and g_2 will be parameter values as well. Similarly, we will see bellow that the tax set by the tax poster in stage 3 becomes a parameter in stage 4. Following this reasoning it should always be clear what we mean by "parameter values".

[13] 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 subscript in t_p.

If the parameter values are such that the conditions in the second curly bracket of (5) 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 (5) 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, $\psi_{i,b} = \max(\frac{s_{ib}}{2}, s_{ip} - t_p)$. 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 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., $g_b \leq g_p$);[14] we refer to it as the sub-game (b,p)[15] 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 assumption 2 and lemma 1, the two cases can be written as:

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

$$\textbf{sub-game } (p,b) \quad : \quad g_p < g_b,\, g_p \leq v_l \text{ and } g_b \leq v_h. \tag{7}$$

In the following lemma we determine both regions' equilibrium taxes and payoffs for the sub-game (b,p).

Lemma 3 *Given (6) (in this case the favored region chooses the bargaining regime), both regions equilibrium taxes in the sub-game (b,p) are*

$$t_p^* \geq 0 \tag{8}$$

and

$$t_{ib}^* = \min\left(\frac{s_{ib}}{2}, t_p^* + g_p - g_b\right), \tag{9}$$

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 sub-sections, 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 both lure the foreign firm away from R_b and receive a non-negative payoff – 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,

[14] Recall that first the central government decides which one is the favored region and then the regions decide whether to bargain or to tax-post.

[15] 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.

as is clear in row 1 of Table 4, R_p expects to get a zero payoff. Moreover, because $t_p^* \geq g_b - g_p$, there is multiple equilibria in the sub-game (b,p), which is payoff equivalent for R_p, but not for R_b. We will comment more on this in footnote 24.

We have already found the equilibrium taxes and regional payoffs for the sub-game where the favored region chooses the bargaining regime (i.e., sub-game (b,p)), and we move on now to 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 types. Moreover, the present sub-game is more complex because, in order to maximize its expected payoff, R_p faces two restricted maximization problems.[16] That is, for all $\iota \in$ (h 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 types $-$ i.e., when $\iota = h$ only type M_h is attracted while when $\iota = lh$ both M_i types are attracted.[17] These restricted maximization processes result in two R_p's restricted optimal taxes, $t_{p_\iota}^*$ $\forall \iota \in$ (h and lh), and the corresponding R_b's optimal taxes, t_{ib}^*[18]. With these taxes we can calculate the two vectors of restricted equilibrium expected payoffs, $\left[\Pi_{p_\iota}^*(p_\iota,b), \Pi_b^*(p_\iota,b)\right]$ $\forall \iota \in$ (h and lh).[19]

Finally, the restricted equilibrium tax, $t_{p_\iota}^*$, providing the highest expected payoff to R_p is the sub-game's (unrestricted) 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 payoffs, $\left[\Pi_{p_\iota}^*(p_\iota,b), \Pi_b^*(p_\iota,b)\right]$, are straightforward. Thus, we first need to solve the two restricted maximization problems, which is done in the following lemma.

Lemma 4 *Given (7) (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 know 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

[16] 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.

[17] 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.

[18] 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 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.

[19] M_i's payoffs will not be reported because for our purpose it is enough to know whether or not M_i goes to a particular region.

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, in effect, Bertrand-type tax competition between the regions.

The following lemma shows the regional equilibrium expected payoffs. We assume $g_1 \leq g_2$; i.e., R_1 is the favoured region.

Lemma 5 *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 $s_{ij} = v_i - g_j$ $\forall i \in (l, h)$ and $\forall j \in (1, 2)$.*

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 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 type or both M_i types, is weakly increasing in g_2, reflecting the fact that a raise in g_2 lessens the competition effect from R_2.

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 $s_{ij} = v_i - g_j$. Moreover, as in the previous section, assume $g_1 \leq g_2$; 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 6 *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 more interested in. This is done in the following lemma.

Lemma 7 *Given $g_1 \leq g_2$, $g_1 \leq v_l$ (from lemma 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 6. 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 Central government optimal policy

Before moving on to solve the first stage of the game let us find the expected country's welfare associated with each of the vectors of payoffs in Table 4. This is done in Table 5 by using expression (4) and the fact that M_h and M_l show up with probabilities q and $(1-q)$. Bear in mind that, as it will become clear bellow, any expected country's welfare in Table 5 would only apply if it is incentive compatible for R_1 and R_2.

In the first stage of the game the central government has to find the value of (g_1, g_2) that maximizes the country's welfare. In order to simplify this task we make the following claim.

Claim 1 *In the equilibrium of the whole game R_1 finds it optimal to implement the tax-bargaining regime.*

We show that claim 1 is true at the end of the proof to lemma 8. Now, based on it we only need to look at the restricted maximization problem where the central government maximizes the country's welfare, subject to R_1 finding it optimal to implement the tax-bargaining regime. However, before carrying out this maximization problem we need to consider a particular issue. Notice in Table 4 that R_2 is indifferent between the tax-posting and tax-bargaining regimes because it always gets a payoff of zero. Hence, R_2 would choose each of these regimes with some positive probabilities, say $\alpha \in (0,1)$ and $1-\alpha$ respectively. Thus, R_1's expected payoff from implementing the tax-bargaining regime is[20]

$$\Pi_1^e(b, \cdot) = \alpha \Pi_1^*(b, b) + (1-\alpha)\, \Pi_1^*(b, p), \tag{10}$$

where the symbol $\cdot$ indicates that R_2 may be playing any tax regime. Notice that, from the previous sections we know that Π_1^* is R_1's expected payoff over the fact that M_i can be of type l or h. Once this expectation has taken, Π_1^e is R_1's expected payoff over the fact that R_2, which is indifferent between the two tax regimes, implements each of them with some positive probabilities.

[20] Notice that we keep the adopted convention of not explicitly writing the regional payoff as dependent on the set (g_1, g_2), even though they do depend on it; i.e., in (10) we write $\Pi_1^e(b, \cdot)$ instead of $\Pi_1^e(g_1, g_2, (b, \cdot))$. However, for the sake of clarity, in (11) we prefer to write $w^e(g_1, g_2, (b, \cdot))$ instead of $w^e(b, \cdot)$.

Moreover, using claim 1 we can write the expected country's welfare as

$$w^{e}\left(g_{1}, g_{2},(b, \cdot)\right)=\alpha w^{*}\left(g_{1}, g_{2},(b, b)\right)+(1-\alpha) w^{*}\left(g_{1}, g_{2},(b, p)\right). \tag{11}$$

For the sake of clarity we will consider the following two scenarios:

Scenario B: v_h and the set (g_1, g_2) are such that $\frac{s_{h1}}{2} \leq s_{h2}$. This means that, for instance, when both regions implement the tax-bargaining regime, M_h's outside option is binding.

Scenario N: v_h and the set (g_1, g_2) are such that $\frac{s_{h1}}{2} > s_{h2}$. This means that, for instance, when both regions implement the tax-bargaining regime, M_h's outside option is non-binding.

Using (10), (11) and Tables 4 and 5 and given Claim 1, the optimal central government policy restricted to scenario B is[21][22]

$$\left(g_{1}^{B}, g_{2}^{B}\right)= \underset{g_1, g_2}{\arg\max}\; w^{e}\left(g_{1}, g_{2},(b, \cdot), B\right), \tag{12a}$$

$$st: \Pi_{1}^{e}\left((b, \cdot), B\right) \geq \Pi_{1}^{e}\left((p, \cdot), B\right). \tag{12b}$$

where, for instance, $\Pi_1^e((p, \cdot), B)$ is R_1's expected payoff from implementing the tax-posting regime for a particular set (g_1, g_2) where scenario B applies.

Similarly, using (10), (11) and Tables 4 and 5 and given Claim 1, the optimal central government policy restricted to scenario N is

$$\left(g_{1}^{N}, g_{2}^{N}\right)= \underset{g_1, g_2}{\arg\max}\; w^{e}\left(g_{1}, g_{2},(b, \cdot), N\right), \tag{13a}$$

$$st: \Pi_{1}^{e}\left((b, \cdot), N\right) \geq \Pi_{1}^{e}\left((p, \cdot), N\right). \tag{13b}$$

Notice that, in a similar fashion we could obtain the optimal central government policy restricted to R_1 finding it optimal to implement the tax-posting regime, say

$$\left(g_{1}^{P}, g_{2}^{P}\right)= \underset{g_1, g_2}{\arg\max}\; w^{e}\left(g_{1}, g_{2},(p, \cdot)\right), \tag{14a}$$

$$st: \Pi_{1}^{e}\left((p, \cdot), N\right) \geq \Pi_{1}^{e}\left((b, \cdot), N\right). \tag{14b}$$

It will become clear later that we do not need to solve this last maximization problem because it will be enough to show that $w^e\left(g_1^P, g_2^P, (p, \cdot)\right)$ is not higher than a particular value. In this fashion we will also show that claim 1 is true.

Finally, conditional on claim 1 being true, the unrestricted optimal central government policy would be the one producing the highest country's welfare among the restricted optimal policies obtained in (12) and (13).

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[21] Notice that if (12b) was satisfied as an equality, the choice of the tax-bargaining regime would not be R_1's unique equilibrium; because R_1 would be indifferent between both regimes. However, in the maximization problem (12) we want the tax-bargaining regime to be R_1's unique optimal regime because, as will be clear later, the country's welfare will be lower if R_1 chooses the tax-posting one. One way of achieving this unique equilibrium would be to write (12b) as a strict inequality. An alternative approach, which is the one adopted here, is to write (12b) as a weak inequality and adopt the tide break rule that R_1 chooses the tax-bargaining regime with probability one when the restriction binds. This procedure will allow us to avoid the use of epsilons and so to simplify the notation.

[22] Given that we already know that R_2 is indifferent between the two tax regimes, we are not writing R_2's incentive compatibility constraint in (12). Clearly, this constraint is always satisfied.

In the following lemma we obtain the central government optimal policy restricted to the fact that R_1 implements the tax-bargaining regime and scenario B applies, $\left(g_1^B, g_2^B\right)$; moreover, we find out whether this policy is also a global optimal one.

Lemma 8 *The country's optimal policy, restricted to the fact that R_1 implements the tax-bargaining regime and scenario B applies, is*

$$\left(g_1^B, g_2^B\right) = \left(v_l, \frac{v_h + g_1}{2}\right). \tag{15}$$

Given that R_2 is indifferent between the two tax regimes, the equilibrium sub-game is (b,b) if R_2 implements the tax-bargaining regime and (b,p) if R_2 implements the tax-posting one. However, in both cases the country's welfare is the same and equal to:

$$w^e\left(g_1^B, g_2^B, (b,\cdot), B\right) = q\frac{v_h + v_l}{2} + (1-q)\, v_l. \tag{16}$$

This policy is not welfare dominated by policy $\left(g_1^N, g_2^N\right)$ (in (13)) and, given assumption 1, it welfare-dominates policy $\left(g_1^P, g_2^P\right)$ (in (14)). Thus, $\left(g_1^B, g_2^B\right)$ is 'an' (unrestricted) equilibrium policy for the first stage of the game.

Proof. See appendix E. ■

Policy $\left(g_1^B, g_2^B\right)$ is 'an' rather than 'the' equilibrium policy because we do not know yet whether or not $\left(g_1^N, g_2^N\right)$ is another unrestricted equilibrium policy. The following lemma is crucial to elucidate whether or not policy $\left(g_1^B, g_2^B\right)$ is 'the only' equilibrium of the first stage of the game.

Lemma 9 *Any central government policy where R_1 implements the tax-bargaining regime and scenario N applies, $(g_1, g_2, (b,\cdot), N)$, is welfare dominated and so it cannot be an optimal one for the country.*

Proof. See appendix F. ■

From lemmas 8 and 9 we get the following proposition.

Proposition 1 *Given assumption 1, policy $\left(g_1^B, g_2^B\right)$ in (15) is the unique global (unrestricted) equilibrium and the country's welfare is the one in (16).*

Proof. The proof is straightforward from lemmas 8 and 9. ■

7 Analysis of the results

A clear implication of the proposition 1 is that, as in Parcero (2007), the central government asymmetric tax treatment of the two identical regions (i.e., the implementation of policy $\left(g_1^B, g_2^B\right)$ in (15)) welfare-dominates the symmetric one. This is the case because, by setting a higher tax in one of the regions the central government increases the bargaining power of the other region, vis-à-vis the multinational.

7.1 The existence of a conflict of interests

Proposition 1 leads us to the following question. Why is it the case that policy (g_1^B, g_2^B) dominates any policy $(g_1, g_2, (b, \cdot), N)$? The main difference between the two is that policy (g_1^B, g_2^B) makes M_h's outside option binding while any policy $(g_1, g_2, (b, \cdot), N)$ does not. At first we would be inclined to think that making M_h's outside option not to bind (i.e., to make the second region less competitive) would be welfare improving for the country or at least not welfare reducing.

In order to have a closer look at this particular result, hereafter we adopt the notation introduced in page 11 and so $t^*_{p_{lh}}$ ($t^*_{p_h}$) refers to the case where R_1 adopts a tax posting regime with a level of tax 'attracting both M_i types' ('only attracting M_h'), while b refers to the case where R_1 implements the tax-bargaining regime.

Recall from the proof to lemma 9 that, for the relevant case where $g_1 = v_l$, a tax $g_2 > \frac{v_h+g_1}{2}$ results in R_1 not finding it optimal to implement the tax-bargaining regime. Indeed, in appendix G we additionally show that R_1 finds it optimal to implement $t^*_{p_h}$, which results in a lower country's welfare than the case where R_1 implements b. Thus, given $g_1 = v_l$ and $g_2 > \frac{v_h+g_1}{2}$, there is a conflict of interests between the central government (who aims to maximize the country's welfare) and the favored region. That is, the tax-bargaining regime is the optimal one for the former, but $t^*_{p_h}$ is the preferred option by the latter.

In order to have a better understanding of this conflict of interests let us look at Figure 2, where $g_1 = v_l$ and assumption 1 is satisfied. Figure 2a focuses on the regional side of the conflict of interests by comparing R_1's expected payoffs from its implementation of $t^*_{p_h}$, b or $t^*_{p_{lh}}$. The 'thick' line indicates R_1's expected payoff from implementing $t^*_{p_h}$ [23] while the 'dashed' line indicates its expected payoff when implementing b (from row 4 of Table 4).[24] Notice that R_1's expected payoff from implementing $t^*_{p_{lh}}$ is equal to zero and so it coincides with the horizontal axis.[25] We see that when $g_2 > \frac{v_h+v_l}{2}$, R_1 finds it optimal to implement $t^*_{p_h}$, while when $g_2 \leq \frac{v_h+v_l}{2}$ R_1 prefers b.[26] Hence the maximum

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[23] To get this expected payoff it is easier to look at row 3a of Table 2 and row 3 of Table 3 than looking at Table 4. However, be aware that in Table 2 you should replace the subscripts p and b by the subscripts 1 and 2. Alternatively, the same expected payoff can be obtained from the second term inside the maximum operator in row 2b (3b) of Table 4 when R_2 implements the tax-bargaining (tax-posting) regime.

[24] For the interval ($v_l \leq g_2 \leq \frac{v_h+v_l}{2}$) in Figure 2a, the dashed line assumes that R_2 chooses the tax-bargaining regime. Hence, R_1 payoff is $\Pi_1^*(b, b) = q(g_2 - g_1) + (1-q)0$ (from row 4 of Table 4).

On the contrary, if R_2 implements the tax-posting regime, R_1's payoff would be equal to $\Pi_1^*(b, p) = q(g_2 - g_1 + t_2^*) + (1-q)0$ (from row 1 of Table 4). As we already explained in page 11, in this case there is more than one equilibrium t_2^*, subject to inequality (8) being satisfied. Hence, R_1's payoff from implementing the tax-bargaining regime would be on or above the dashed line in Figure 2a - i.e., triangular area A. However, notice that the fact that row 1 of Table 4 applies (i.e., area A) would not eliminate the conflict of interest; for, the latter happens when $g_2 > \frac{v_h+v_l}{2}$.

[25] This is better seen in rows 1 to 2 of Table 3 and rows 1a and 2a of Table 2. Again, be aware that in Table 2 you should replace the subscripts p and b by the subscripts 1 and 2 (also recall that $g_1 = v_l$). Alternatively, the same expected payoff can be obtained from the first term inside the maximum operator in row 2b (3b) of Table 4 when R_2 implements the tax-bargaining (tax-posting) regime.

[26] As in footnote 21 we are using the tie break rule that when indifferent between the two tax regimes, R_1 chooses the tax-bargaining one with probability one. This tie break rule is

value of g_2 compatible with R_1 implementing b is $g_2 = \frac{v_h+v_l}{2}$.

Similarly, Figure 2b compares the expected country's welfare from R_1's implementation of $t^*_{p_h}$, b or $t^*_{p_{lh}}$. The 'thick' line indicates the expected country's welfare when R_1 implements $t^*_{p_h}$;[27] the 'dashed' line indicates the expected country's welfare when R_1 implements b (from row 4 of Table 5)[28]; and the 'dashed-dotted' line indicates the expected country's welfare when R_1 implements $t^*_{p_{lh}}$.[29]

It is clear in Figure 2 that whenever the outside option for M_h's is non-binding (i.e. $g_2 > \frac{v_h+v_l}{2}$) the conflict of interests between the central government and the winning region appears. That is, the tax-bargaining regime is the optimal one for the former, but $t^*_{p_h}$ is the preferred option by the latter. One way of looking at this conflict of interests is as if the favored region produces a negative externality to the central government. This is the case because the two levels of governments share the same tax base, but the local region does not take the central government payoff into account when choosing its tax regime.

Finally, given $g_1 = v_l$, from Figures 2a and 2b we get that the unrestricted maximum country's welfare is achieved, as stated in proposition 1, when $g_2 = \frac{v_h+v_l}{2}$; i.e., policy $\left(g_1^B, g_2^B\right)$ is implemented. Clearly, no conflict of interests exists in this case because the competition from the non-favored region prevents the favored one from implementing $t^*_{p_h}$ and instead drives it to adopt the tax-bargaining regime; which is the optimal one for the country. Therefore, we can conclude that the complete elimination of the competition coming from the non-favoured region is not optimal for the country. In other words, some competition is desirable, hence the central government tax in the non-favoured region should not be too high.

Notice that in our setting the conflict of interests is created only if the regions have a choice between the two tax regimes. Hence, there is no conflict of interests when the two regions can only implement the tax-bargaining regime; see Parcero (2007). Similarly, from row 3 of Tables 4 and 5 we get that the conflict of interests does not appear either if the two regions can only implement the tax-posting regime. In this last case the expected country's welfare would be maximized, for instance, by setting g_2 sufficiently high and $g_1 = 0$. Under these taxes the expected country's welfare would be equal to the favoured region's expected payoff, $w^* = \Pi_1^* + g_1 = \Pi_1^*$; hence when the favored region maximizes its own expected payoff it would also be maximizing the expected country's welfare.

In what follows we compare the conflict of interests with similar results in two different pieces of literature. Firstly, there is the result in the *concurrent taxation literature*, which stems from two levels of government sharing the same tax base. The result in question is the fall in the central government tax base as

indicated in Figure 2a by drawing the dashed line marginally above the thick one (for the interval $v_l \leq g_2 \leq \frac{v_h+v_l}{2}$).

[27] This expected welfare can be obtained from the second term inside the maximum operator in rows 2b and 3b of Table 5.

[28] Notice that, as it was the case in footnote 24, the dashed line assumes that, R_2 also chooses the tax-bargaining regime. On the contrary, if R_2 chose the tax-posting regime we would have a situation similar to the one explained in footnote 24 and so the country's welfare would be given by the triangular area A'. Again, the conflict of interests would not be affected.

[29] This expected country's welfare can be obtained from the first term inside the maximum operator in row 2b (3b) of Table 5 when R_2 implements the tax-bargaining (tax-posting) regime.

a consequence of a rise in the regional tax rate (a negative vertical externality); see Keen and Kotsogiannis (2002). In our paper and Keen and Kotsogiannis's one the conflict of interests is produced because, from the country's welfare point of view, the regional tax is higher than the optimal one. However, the means by which the country's welfare loss is produced differs in the two approaches. On the one hand, in Keen and Kotsogiannis' paper this loss is produced by the fact that there is an over-provision (under-provision) of the regional (central government) public good; i.e., a misallocation of resources. On the other hand, the country's welfare loss in our paper comes from the low appropriation of foreign rents (i.e., low tax revenues), as a consequence of only attracting the high type multinational.

Secondly, there is the *double marginalization problem* as it is known in the *industrial organization literature*. This problem appears when a monopolist upstream firm sells to a monopolist downstream firm by implementing a linear price; see Tirole (1998). The independent actions of the two firms result in a final good's price (in an aggregated profit) which is higher (lower) than the optimal price (aggregated profit) under vertical integration. However, there are some differences between our conflict of interests and the *double marginalization problem*. On the one hand, the latter appears in a situation where both the upstream and downstream firms post prices and there is no price discrimination between different types of buyers. On the other hand, it is well known that the *double marginalization problem* can be resolved by vertically integrating the two monopolies; though, in our setting this vertical integration (which is equivalent to a change from a federal to a unitarian political system) does not appear to be an optimal option. This will be shown at the end of the following sub-section.

7.2 Country's welfare under different scenarios of regional autonomy

Let us now look at whether or not some of the following three scenarios are better than others in terms of country's welfare. *Scenario* (*i*): the regions of the country can choose between the implementation of the tax-bargaining and the tax-posting regimes. *Scenario* (*ii*): the regions of the country can only implement the tax-bargaining regime. *Scenario* (*iii*): the regions of the country can only implement the tax-posting regime. We get the following results:

Proposition 2 *Firstly, scenarios* (*i*) *and* (*ii*) *provide the same equilibrium expected country's welfare. Secondly, when the attraction of only M_h is the optimal country's policy in each of the three scenarios,*[30] *they produce the same expected country's welfare. Thirdly, when the attraction of both M_i types is the optimal country's policy under at least one of the three scenarios, scenarios* (*i*) *and* (*ii*) *would 'strictly' welfare dominate scenario* (*iii*). *Thus, we can conclude that scenarios* (*i*) *and* (*ii*) *'weakly' welfare dominate scenario* (*iii*).

Proof. In order to prove the proposition we need to identify the equilibrium expected country's welfare under each of the three scenarios. First, notice that whether scenario (*i*), (*ii*) or (*iii*) applies, the maximum expected country's welfare restricted to only M_h being attracted is

$$w_{(h)} = qv_h, \tag{17}$$

[30] For this to be the case, assumption 1 has to be removed.

which can be achieved by setting $g_2 = g_1 = v_h$.

Equilibrium expected country's welfare under scenario (i): We know from proposition 1 that the maximum expected country's welfare under scenario (i), and when it is optimal for the country to attract both M_i types (i.e., assumption 1 applies), is the one in expression (16). This, together with (17) results in the equilibrium expected country's welfare under scenario (i) being equal to

$$w^*_{(i\ \&\ ii)} = \max\left(q\frac{v_h + v_l}{2} + (1-q)\, v_l, qv_h\right). \tag{18}$$

Equilibrium expected country's welfare under scenario (ii): The expected country's welfare attainable under scenario (ii), and when it is optimal for the country to attract both M_i types (i.e., assumption 1 applies), is clearly the one in row 4 of Table 5. (We know that both M_i types would be attracted because $g_1 \leq v_l$). In this case the central government optimal taxes are $g_1 = v_l$ and $g_2 \geq \frac{v_h+g_1}{2}$. (This is because the expected country's welfare in row 4 of Table 5 is non-decreasing in g_2 and, for any $g_1 < v_l$ and $g_2 \geq \frac{v_h+g_1}{2}$, it is strictly increasing in g_1). Thus, the maximum expected country's welfare when it is optimal for the country to attract both M_i types is $w = q\frac{v_h+v_l}{2} + (1-q)\, v_l$, which is equal to the one in (16). This, together with (17) results in the equilibrium expected country's welfare under scenario (ii) being equal to the one in (18). Notice that the first statement of the proposition is proved.

Equilibrium expected country's welfare under scenario (iii): The expected country's welfare attainable under scenario (iii) is the one in row 3 of Table 5.[31] Thus, the optimal central government taxes are $0 \leq g_1 \leq v_l$ and $v_l < g_2 \leq v_h$,[32] which results in the expected country's welfare

$$w^*_{(iii)} = \max(v_l, qv_h). \tag{19}$$

Finally, in order to prove the second and third statements of the proposition we compare the equilibrium expected country's welfare under scenarios (i) and (ii), which are identical, with the one in scenario (iii). On the one hand, it is clear from the second term inside the maximum operators in (18) and (19) that, when the attraction of only M_h is the optimal country's policy in each of the three scenarios, they produce the same expected country's welfare. On the other hand, when the attraction of both M_i types is the optimal country's policy under scenarios (i) and (ii) (i.e., the first term inside the maximum operator in (18) is higher than the second one), any of these scenarios would 'strictly' welfare dominate scenario (iii). This would be the case whether, under scenario (iii), it is optimal to attract both M_i types or only M_h; (contrast (19) with the first term inside the maximum operator in (18)). Thus, we can conclude that scenario (iii) is weakly welfare dominated by scenario (i) and (ii). ■

From the previous proposition we get that scenarios (i) and (ii) provide the same country's welfare (given by (18)). However, scenario (i) has a slight disadvantage with respect to scenario (ii). Because of the existence of the conflict of interests between the central government and the favoured region, in scenario (i) the central government has to carefully calibrate the tax in the

[31] Notice that the country's welfare in row 3 of Table 5 was not affected by assumption 1 and so, whether or not this assumption applies, it may be optimal for the country to attract both M_i types or just M_h.

[32] The inequalities $0 \leq g_1$ and $g_2 \leq v_h$ come from assumption 2.

non-favoured region, $g_2 = \frac{v_h + g_1}{2}$ – in order for the competition exerted by the latter to be neither too high nor too low. Yet, if the central government gets this fine-tuning wrong,[33] the country's welfare under scenario (i) would be lower than the one in expression (18). Hence, scenario (ii) may be slightly preferred to scenario (i).

Let us now show a policy recommendation that is derived from proposition 2. Assume a country is characterized by scenario (i) and that, at a particular point in time, it can decide whether or not to restrict the regional governments' ability of policy making. In particular, the regional governments can be restricted from implementing the tax-bargaining or the tax-posting regimes.[34] Then, from proposition 2 we obtain the policy recommendation that it is not optimal for the country to restrict the regional governments from their ability to choose the tax-bargaining regime. Furthermore, from the previous paragraph discussion we also obtain that it may be optimal to restrict the regional ability of implementing the tax-posting regime. Though, this last result is weaker than the first one.

Notice that, if the regional governments were restricted from the implementation of both tax regimes, the taxation of multinationals would become the exclusive responsibility of the central government (we move from a federal to a unitarian political system). Given that the central government posts its taxes, it is easy to see that this last scenario would provide the same country's welfare as scenario (iii), which is welfare dominated (from proposition 2).

Finally, let us take a moment to reconsider the appropriateness of our assumption that the central government can only implement tax-posting and not tax-bargaining. On the one hand, notice that if the central government implements a tax-bargaining when the regions cannot implement any tax regime, it would result in a lower country's welfare than scenario (ii). This is the case because, under scenario (ii) the country is implementing a 'bargaining-with-reservation-tax regime'[35], which provides a higher aggregate payoff (country's welfare) than a simple 'bargaining regime'. In particular, the 'bargaining-with-reservation-tax regime' advantages the 'bargaining regime' in that the favoured region bargains over a surplus from which a non-negotiable 'reservation tax' is taken by the central government. On the other hand, my conjecture is that the central government implementation of tax-bargaining would also be welfare dominated in other scenarios; besides it would be very difficult to be modelled as well (in particular in the case that the regions also implement tax-bargaining). Anyhow, the consideration of the central government implementing tax-bargaining could be a matter for future research.

8 Conclusion

This paper has looked at a country's central government optimal policy in a setting where its local regions compete for the attraction of a footloose multinational to their sites, and where the considered multinational strictly prefers this country to the rest of the world. For the sake of reality we have built a

[33] Though, the mechanism through which this could happen is not explicitly modeled in our paper.

[34] This may be done, at least to some extent, at a stage of constitutional change or, perhaps, by the passing of a federal law.

[35] In a different context, this bargaining regime is referred by Wang (1995) as 'bargaining with reservation price', which revenue dominates a simple bargaining.

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.

As in Parcero (2007) we have found that the central government asymmetric tax treatment of the two identical regions welfare-dominates the symmetric one. In other words, it is optimal for the central government to set a high enough tax in one of the regions (the non-favoured one) in order to increase the bargaining power of the other (favoured) region, vis-à-vis the multinational.

We also found that, under some parameter constellations, if the tax in the non-favoured region is too high, a conflict of interests is created between the central government of the country and the favoured region. That is, the central government would prefer the favoured region implements the tax-bargaining regime (attracting both types of multinationals), but this region finds it optimal to implement the tax-posting regime (only attracting the high rent multinational). Interestingly, this conflict of interests is avoided by a calibrated reduction in the central government tax in the non-favoured region. Thus, some regional tax competition is desirable, hence the central government tax in the non-favoured region should not be too high. The reason for this result is that a certain degree of competition from the non-favoured region drives the favoured one to adopt the tax-bargaining regime, which is the optimal one for the country.

We have also shown that the implementation of the regional tax-bargaining regime weakly welfare dominates the implementation of the regional tax-posting regime. Consequently, in the case that our choice of proxies for the policy's firm-specificity degrees were an appropriate simplification of the reality, our paper's advice would be against the banning of the regional implementation of firm-specific policies. Moreover, if a country had to (and had the capacity to) restrict the regional ability of policy making in some way, our paper would advocate the restriction of the non-firm-specific policies, rather than the firm-specific ones.

Finally, by focusing on the taxation side, this paper has only looked at one aspect of the regional policy's firm-specificity degree. Further research is needed in order to consider other aspects. For instance, when the policy's firm-specificity is in terms of regional infrastructure provision instead of taxation. That is, whether the infrastructure is built in advance or after a particular multinational shows up; the latter allowing the infrastructure to be more tailor made. Perhaps the main difference of this alternative approach would be that it increases the rents created by the different types of multinationals.

9 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 3 bellow (respectively in expressions (20) and (22) bellow).

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, $\psi_{i,b} = s_{ip} - t_p$, and R_b's payoff is calculated as follows: $s_{ib} - \psi_{i,b} = t_p + g_p - g_b$.

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 whenever $t_p < g_b - g_p$ **and** $t_p \leq s_{ip}$, R_p would attract M_i (at a loss because $\pi_{ip} = t_p < 0$) while whenever $t_p \geq g_b - g_p$ **or** $t_p > s_{ip}$, R_p would not attract M_i.

Notice that, given that (6) implies $g_b \leq v_l$, we can be certain that $g_b - g_p \leq s_{ip}$ $\forall i \in (l, h)$. Hence, the previous paragraph results simplify to: Whenever $t_p < g_b - g_p$, R_p would attract both M_i types at a loss while whenever $t_p \geq g_b - g_p$, R_p would not attract any M_i type. However, notice that 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 $t_p^* \geq 0$ and (6), we get that R_b's equilibrium tax (from the first row of (5)) is $t_{ib}^* = \min\left(\frac{s_{ib}}{2}, t_p^* + g_p - g_b\right)$ while R_b's equilibrium expected 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 assumption 2 and lemma 1.

C

The proof proceeds as follows. First, given (7), we determine each local equilibrium tax-poster's tax $t_{p_\iota}^*$ $\forall \iota \in (h \text{ and } lh)$. Second, for each local equilibrium and using (5) we get the corresponding t_{ib}^*. Third, for each local equilibrium we get (by using Table 1) the corresponding vector of payoffs, $\left[\Pi^*_{p_\iota}(p_\iota, b), \Pi^*_b(p_\iota, b)\right]$. Finally, the sub-game's equilibrium expected payoffs for R_p and R_b are obtained.

We have the following two local equilibria:

Local equilibrium 1: R_p attracts both M_i types (rows 1a to 2b of Table 2): Given (7), from Table 1 we get that R_p would attract both M_i types if

$$t_p \leq \min\left[(g_b - g_p;\ v_h - g_p); (g_b - g_p;\ v_l - g_p)\right] \tag{20}$$

which, given assumption 2, is equivalent to

$$t_p \leq \min(g_b - g_p;\ v_l - g_p). \tag{21}$$

Thus, $t^*_{p_{lh}}$ (from (21)), $\Pi^*_{p_{lh}}(p_{lh}, b)$ (from Table 1) as well as the parameter values under which they apply (using assumption 2 and lemma 1) are shown: *i)* In row 1a of Table 2 when in (21) $\min(g_b - g_p; v_l - g_p) = g_b - g_p$ (i.e., $g_b \leq v_l$) and *ii)* in row 2a of Table 2 when $\min(g_b - g_p; v_l - g_p) = v_l - g_p$ (i.e., $v_l < g_b$).

Let us now move on to find the corresponding values of 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 (5) 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 $t^*_{p_{lh}} = v_l - g_p$ and $v_l < g_b$ from row 2a of Table 2, we know from (5) 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).

Local equilibrium 2: R_p attracts only M_h (rows 3a and 3b of Table 2): Given (7), from Table 1 we get that R_p would only attract M_h if

$$\min(g_b - g_p;\ v_l - g_p) < t_p \leq \min(g_b - g_p;\ v_h - g_p). \tag{22}$$

Given assumption 2, the previous inequality is equivalent to

$$\min(g_b - g_p;\ v_l - g_p) < t_p \leq g_b - g_p, \tag{23}$$

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 (23)), $\Pi^*_{p_h}(p_h, b)$ (from Table 1) as well as the parameter values under which they apply (using assumption 2 and lemma 1) 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 (5)) 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 assumption 2, lemma 1 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[36]

$$t_1 \leq \min(t_2 + g_2 - g_1, s_{i1}) \ \text{ for } i \in (l, h), \tag{24}$$

[36] 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.

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 types go to different regions. This, together with $g_1 < g_2$ guarantees that R_2 will not get any M_i 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.[37] 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

$$t_2 = 0. \tag{25}$$

Then, replacing t_2 from (25) into (24) for $i = l$ we get that in order for R_1 to get M_l it is necessary that

$$t_{1l} \leq \begin{cases} g_2 - g_1 & \text{if } g_2 \leq v_l \\ s_{l1} & \text{if } v_l < g_2. \end{cases} \tag{26}$$

Similarly, replacing t_2 from (25) into (24) for $i = h$ we get that in order for R_1 to get M_h it is necessary that

$$t_{1h} \leq \begin{cases} g_2 - g_1 & \text{if } g_2 \leq v_h \\ s_{h1} & \text{if } v_h < g_2. \end{cases} \tag{27}$$

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 types and when it attracts only M_h are respectively given by the following two expressions

$$\Pi_1^* (p_{lh}, p) = t_1 \tag{28a}$$
$$\Pi_1^* (p_h, p) = qt_1. \tag{28b}$$

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 (27) does not need to be considered. This is not a problem because, given $g_2 = v_h$, the tax in the first row of (27) is exactly the same as the one in the second row. Thus, from (26), (27) and (28) 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.[38] Needless to say that R_2 gets an expected payoff of zero. Finally, it is clear that the case where the central government sets the same tax in both regions is $g_1 = g_2 \leq v_l$ (by using lemma 1); this case is contemplated in row 1 of Table 3.

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

[37] 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.

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

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.

E

It is clear in rows 1 and 4 of Table 5 that $w^* (g_1, g_2, (b, \cdot))$ is weakly increasing in g_1 and g_2. Hence, given scenario B and if R_1's incentive compatibility was not a problem (i.e., (12b) was satisfied), it would be optimal in (12a) to set g_1 and g_2 in their maximum values subject to lemma 1 and scenario B – i.e., $\left(g_1^B, g_2^B\right) = \left(v_l, \frac{v_h+g_1}{2}\right)$. Indeed, R_1's incentive compatibility is guaranteed by this set of taxes; this is because, by using (10) and Table 4 it is straightforward to see that (12b) is satisfied.[39] Thus, from (12a) we get that the country's optimal policy, restricted to R_1 implementing the tax-bargaining regime and to scenario B, is the one in (15). Hence, from (11) and rows 1 and 4 of Table 5 we get that the expected country's welfare is the one in (16).

Furthermore, the restricted optimal policy (15) is unique because, as stated in the previous paragraph, $w^* (g_1, g_2, (b, \cdot))$ is weakly increasing in g_1 and g_2. Hence $w^e (g_1', g_2', (b, \cdot), B) < w^e \left(g_1^B, g_2^B, (b, \cdot), B\right) \forall (g_1', g_2') < \left(g_1^B, g_2^B\right)$.

Finally, let us show that the restricted optimal policy $\left(g_1^B, g_2^B\right)$ becomes 'an' equilibrium policy for the first stage of the game. The following inequality is required

$$w^e \left(g_1^B, g_2^B, (b, \cdot), B\right) \geq \max \left\{w^e \left(g_1^N, g_2^N, (b, \cdot), N\right), w^e \left(g_1^P, g_2^P, (p, \cdot)\right)\right\}. \quad (29)$$

In order to prove that inequality (29) is satisfied it is enough to show that $w^e \left(g_1^N, g_2^N, (b, \cdot), N\right)$ and $w^e \left(g_1^P, g_2^P, (p, \cdot)\right)$ cannot be higher than particular values, which we now proceed to find. From (11), lemma 1 and rows 1 and 4 (rows 2 to 3) of Table 5 respectively, it is clear that [40]

$$w^e \left(g_1^N, g_2^N, (b, \cdot), N\right) \not> q\frac{v_h + v_l}{2} + (1-q)\, v_l, \quad (30)$$

$$w^e \left(g_1^P, g_2^P, (p, \cdot)\right) \not> \max \{v_l, qv_h\}. \quad (31)$$

Hence, from (16) and (30) we get

$$w^e \left(g_1^B, g_2^B, (b, \cdot), B\right) \not< w^e \left(g_1^N, g_2^N, (b, \cdot), N\right) \quad (32)$$

while, given assumption 1, from (16) and (31) we get

$$w^e \left(g_1^B, g_2^B, (b, \cdot), B\right) > w^e \left(g_1^P, g_2^P, (p, \cdot)\right). \quad (33)$$

Thus, as stated in this proposition, inequality (32) implies that policy $\left(g_1^B, g_2^B\right)$ is not welfare dominated by policy $\left(g_1^N, g_2^N\right)$ while inequality (33) implies that

[39] See note for the referees provided in a separate file.

[40] We use $\not>$ instead of $\leq$ because, at this stage, we do not know whether or not it can be satisfied as an equality.

policy $\left(g_1^B, g_2^B\right)$ welfare-dominates policy $\left(g_1^P, g_2^P\right)$. Hence, the restricted optimal policy $\left(g_1^B, g_2^B\right)$ is 'an' equilibrium policy for the first stage of the game. Moreover, from the last two sentences we conclude that claim 1 is true.

F

If the regional incentive compatibility was not a problem (i.e., (13b) was satisfied), the expected country's welfare would be equal to (using (11), lemma 1 as well as rows 1 and 4 of Table 5):

$$w^e\left(g_1, g_2, (b, \cdot), N\right) = q\frac{v_h + g_1}{2} + (1-q)\frac{v_l + g_1}{2}. \tag{34}$$

It is clear that when $g_1 < v_l$, the expected country's welfare in (34) is lower than the one in (16), and both are equal when $g_1 = v_l$. Thus, if there were a case where a tax policy $\left(g_1, g_2, (b, \cdot), N\right)$ is not welfare dominated, it must be when $g_1 = v_l$. Let us write this particular policy as

$$\left(g_1', g_2', (b, \cdot), N\right) = \left(g_1 = v_l,\ g_2 > \frac{v_h + g_1}{2}\right). \tag{35}$$

However, under scenario N and with $g_1 = v_l$, the tax-bargaining regime is not incentive compatible for R_1 (i.e., inequality (13b) is not satisfied) and so it cannot be an equilibrium regime for the country. Notice that, given (35) and whether R_2 implements the tax-bargaining or the tax-posting regime, for inequality (13b) to be satisfied it is necessary that (using (10) as well as rows 1, 4 and 2b of Table 4)[41]

$$q\frac{s_h}{2} + (1-q)\frac{s_l}{2} \geq q\left(g_2 - g_1\right). \tag{36}$$

Then, in order to show that inequality (13b) does not apply it is enough to prove that inequality (36) is not satisfied. Replacing $g_2 > \frac{v_h+g_1}{2}$ (from (35)) by $g_2 = \frac{v_h+g_1}{2} + \xi$ for $\xi > 0$ in (36) and given $g_1 = v_l$, we find that (36) is equivalent to $\xi < 0$, which obviously does not hold.

Thus, we have just shown that, given $g_1 = v_l$, R_1 would not find it optimal to implement the tax-bargaining regime; hence any tax policy $\left(g_1, g_2, (b, \cdot), N\right)$ provides a lower country's welfare than policy $\left(g_1^B, g_2^B\right)$.

G

We already know from lemma 9 that, given (35), R_1 prefers the tax-posting regime to the tax-bargaining one. Let us now be more specific and show that R_1 would choose $t_{p_h}^*$ instead of $t_{p_{lh}}^*$. From (35) we get that $g_2 > v_l$; hence in order for R_1 to choose $t_{p_h}^*$ instead of $t_{p_{lh}}^*$ it is required that (from rows 2a and 3a of Table 2 if R_2 implements the tax-bargaining regime and from rows 2 and 3 of Table 3 if R_2 implements the tax-posting regime),

$$q\left(g_2 - g_1\right) > s_{l1}. \tag{37}$$

which, given (35), clearly applies.

[41] Notice that from (35) we get $v_l < g_2$, as required by the conditions in row 2b of Table 4.

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Figure 1: Sequence of events

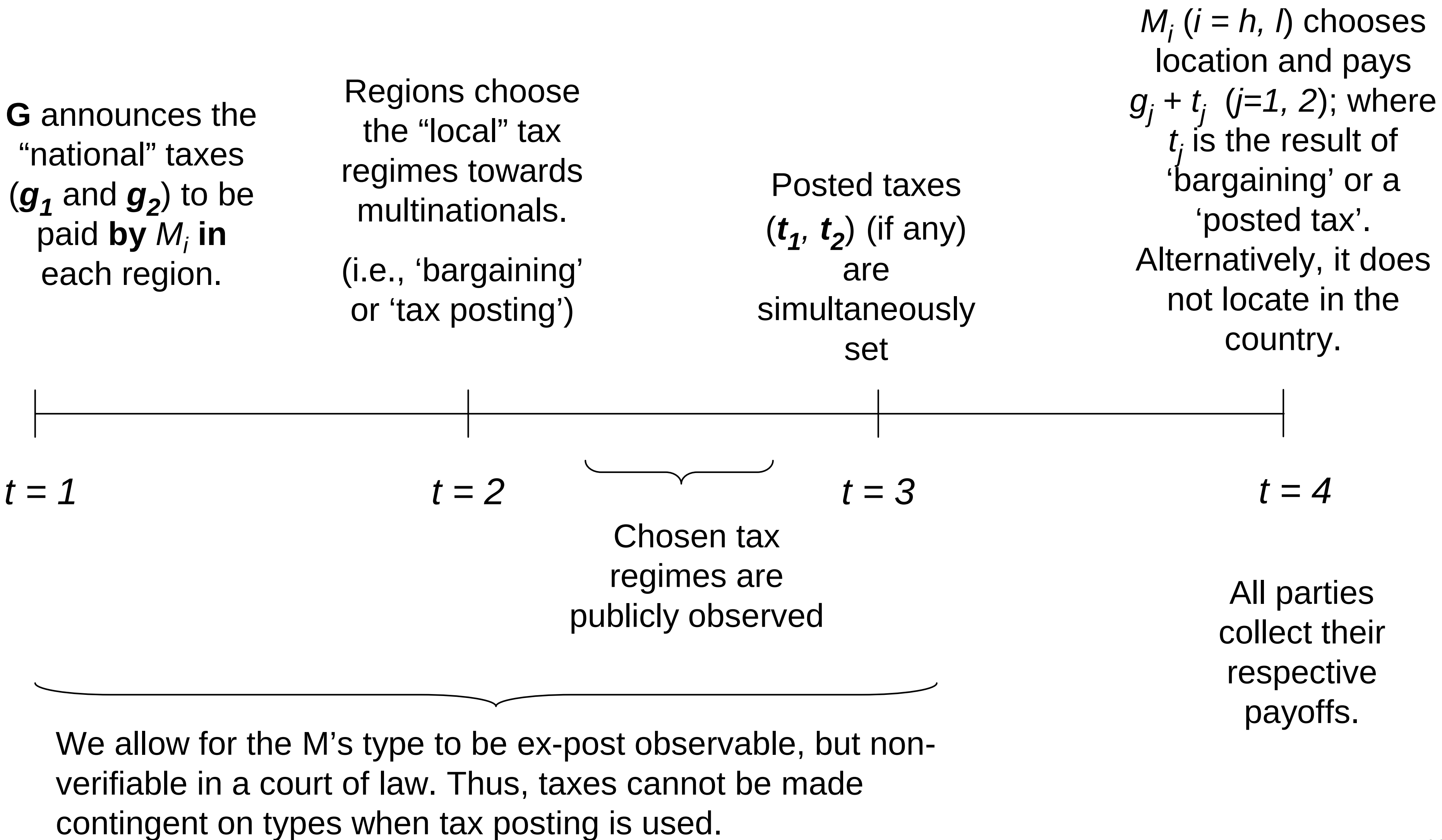
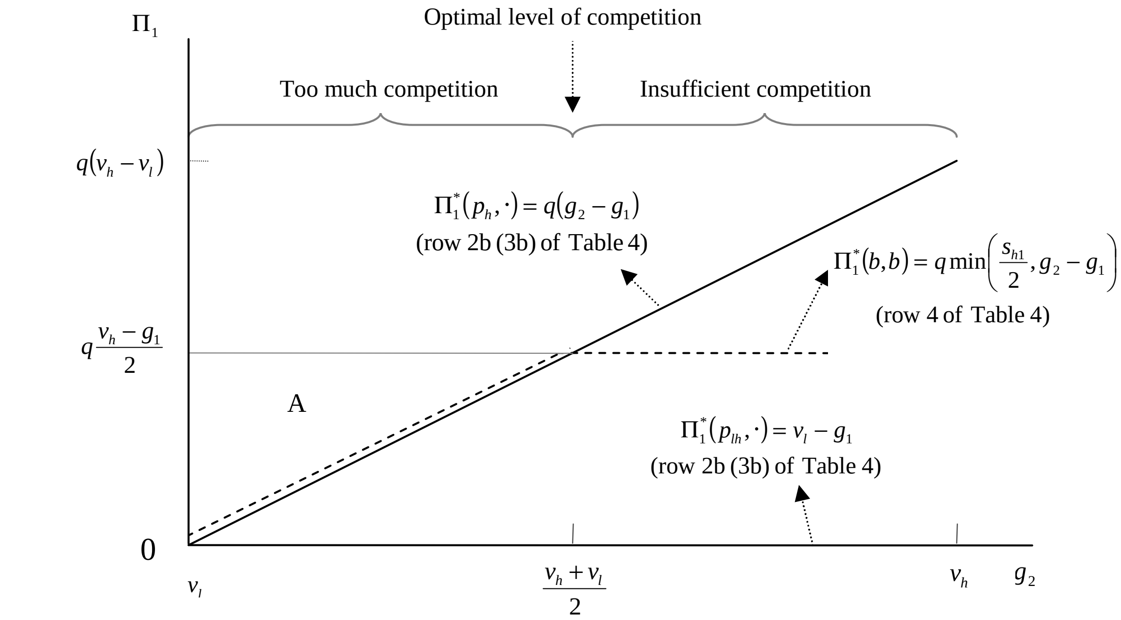
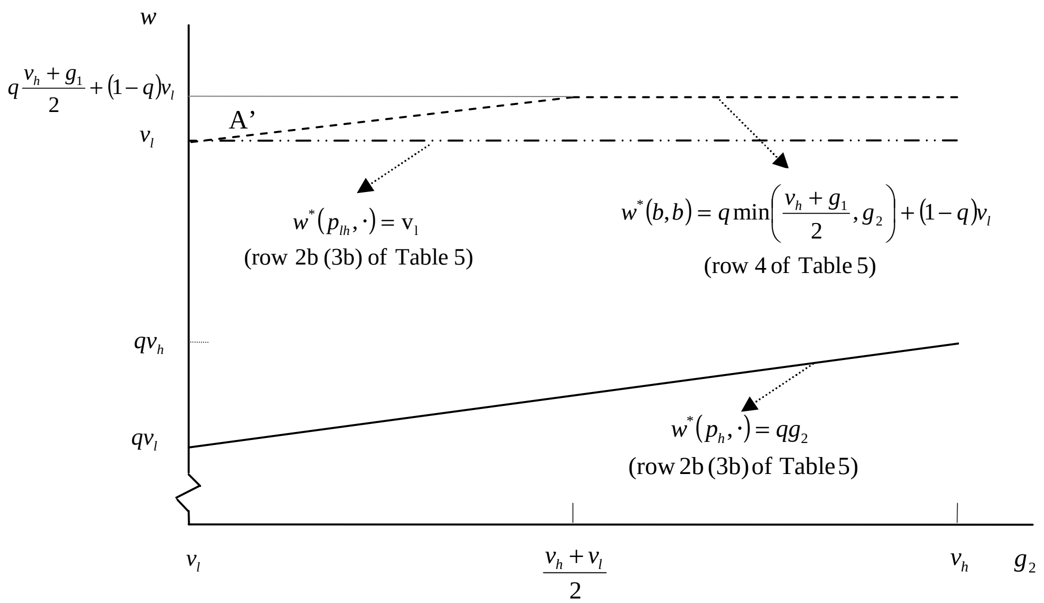


Figure 2: Conflict of interests between the central government and the favored region



(a)



(b)

Note: In Figure 2, assumption 1 is satisfied and $g_1 = v_l$.

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	ψ_i	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) 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) $t^*_{p_{lh}} = v_l - g_p$ **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)	$g_2 - g_1$	$\Pi_1^*(p_{lh}, p) = g_2 - g_1$	$0 \leq g_1 \leq g_2 \leq v_l$
2)	s_{l1}	$\Pi_1^*(p_{lh}, p) = s_{l1}$	$0 \leq g_1 \leq v_l < g_2 \leq v_h$ & $s_{l1} \leq q(g_2 - g_1)$
3)	$g_2 - g_1$	$\Pi_1^*(p_h, p) = q(g_2 - g_1)$	$0 \leq g_1 \leq v_l < g_2 \leq v_h$ & $s_{l1} < q(g_2 - g_1)$

Table 4: Regional expected equilibrium payoffs for all the sub-games

	Regional expected equilibrium payoffs for each sub-game[(1)]
1	$\begin{pmatrix}\Pi_1^e(b,p)\\ \Pi_2^e(b,p)\end{pmatrix} = \begin{pmatrix} q\min\left(\frac{s_{h1}}{2}, g_2-g_1+t_2^*\right)+(1-q)\min\left(\frac{s_{l1}}{2}, g_2-g_1+t_2^*\right)\\ 0\end{pmatrix}$
2	$\begin{pmatrix}\Pi_1^e(p,b)\\ \Pi_2^e(p,b)\end{pmatrix} = \begin{cases} \begin{pmatrix} g_2-g_1\\ 0\end{pmatrix} & \text{if } g_1 \leq g_2 \leq v_l \quad \textbf{(a)} \\ \begin{pmatrix} \max\left(s_{l1}; q\left(g_2-g_1\right)\right)\\ 0\end{pmatrix} & \text{if } g_1 \leq v_l < g_2 \quad \textbf{(b)} \end{cases}$
3	$\begin{pmatrix}\Pi_1^e(p,p)\\ \Pi_2^e(p,p)\end{pmatrix} = \begin{cases} \begin{pmatrix} g_2-g_1\\ 0\end{pmatrix} & \text{if } g_1 \leq g_2 \leq v_l \quad \textbf{(a)} \\ \begin{pmatrix} \max\left(s_{l1}; q\left(g_2-g_1\right)\right)\\ 0\end{pmatrix} & \text{if } g_1 \leq v_l < g_2 \quad \textbf{(b)} \end{cases}$
4	$\begin{pmatrix}\Pi_1^e(b,b)\\ \Pi_2^e(b,b)\end{pmatrix} = \begin{pmatrix} q\min\left(\frac{s_{h1}}{2}, g_2-g_1\right)+(1-q)\min\left(\frac{s_{l1}}{2}, g_2-g_1\right)\\ 0\end{pmatrix}$

Table 5: Expected equilibrium country's welfare for all the sub-games

	Expected equilibrium country's welfare for each sub-game[(1)]
1	$w^e(b,p) = q\min\left(\frac{v_h+g_1}{2}, g_2+t_2^*\right)+(1-q)\min\left(\frac{v_l+g_1}{2}, g_2+t_2^*\right)$
2	$w^e(p,b) = \begin{cases} g_2 & \text{if } g_1 \leq g_2 \leq v_l \quad \textbf{(a)} \\ \max\left(v_l; qg_2\right) & \text{if } g_1 \leq v_l < g_2 \quad \textbf{(b)} \end{cases}$
3	$w^e(p,p) = \begin{cases} g_2 & \text{if } g_1 \leq g_2 \leq v_l \quad \textbf{(a)} \\ \max\left(v_l; qg_2\right) & \text{if } g_1 \leq v_l < g_2 \quad \textbf{(b)} \end{cases}$
4	$w^e(b,b) = q\min\left(\frac{v_h+g_1}{2}, g_2\right)+(1-q)\min\left(\frac{v_l+g_1}{2}, g_2\right)$

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

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