Unionization triggers tax incentives to attract FDI

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Abstract

This paper examines tax competition between a unionized and a non-unionized country for the location of an outside firm. We show that unionization offers an extra incentive for the government to attract a foreign competitor to a concentrated domestic market, in order to limit the power of the domestic union. This results in the unionized country's government offering a tax discount (or a subsidy premium) to the outside firm in excess of what is needed to compensate the investor for the higher union wage. In equilibrium, therefore, the unionized country will attract the foreign capital even if it has other location disadvantages, such as a smaller home market.

Keywords: tax competition, trade unions, foreign direct investment

JEL Classification: H25, H73, J58

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1 Introduction

International location competition for mobile capital has been growing rapidly over the last decades. One indicator for this development is a significant fall in statutory corporate tax rates in virtually all developed countries. Whereas the average of the OECD countries statutory corporate tax rates was close to 50% in the early 1980s, this average had fallen to just below 30% in 2004 (OECD, 2007).[1] Recent empirical evidence also shows that this fall in tax levels can indeed be explained by strategic tax competition among OECD countries (Devereux et al. 2008). A second indicator for intensified competition for foreign direct investment (FDI) is the increasing use of investment subsidies that are paid to firms. Table 1 lists 17 cases for the period from 2001 to early 2005 where substantial investment subsidies have been offered by host countries and approved by the EU Commission. These subsidies often account for up to 30% of the present value of the investment, and in some cases for even more.[2]

A striking fact in Table 1 is that the highest subsidies are paid for firms that engage in regions which are characterized by weak economic activity and high unemployment (Eastern Germany and Southern Italy), but simultaneously are part of countries with strong trade unions that succeed in keeping up wages even in low-productivity regions.[3] This suggests that fiscal policies are used to compensate investors for the location disadvantages of facing high wages without benefitting from positive spillovers in an industrial core region. It also raises the further question of whether high investment subsidies might have the additional aim of affecting the policy of trade unions, offering them more incentives to exert wage restraint in exchange for higher employment.

[1] When simultaneous changes in corporate tax bases are taken into account, the drop in effective average tax rates is somewhat less, but nevertheless substantial. See Devereux et al. (2002).

[2] Note that the subsidy payments collected in Table 2 cover only direct monetary transfers and thus represent merely a lower bound for the overall value of the incentive package. The latter often includes additional measures, such as the free provision of public infrastructure.

[3] Cahuc and Zylberberg (2004, p. 371), show for the OECD countries that collective bargaining coverage and general union density have been changing over the last few decades, but without a clear pattern or trend across countries. The coverage rate in Germany and Italy has traditionally been above 80%, whereas it is only around 50% in the UK and well below 20% in the USA. See also Freeman (2007) for an account of the differences in labor market institutions in the OECD and elsewhere.

Table 1: Approved investment subsidies in EU member states (2001-2005)

Company (sector[a])	Date of approval	Host country (city/region)	State aid (million €[b])	Aid intensity (%)[c]
Nissan	01/2001	U.K. (Sunderland)	60	18.6
Volkswagen	07/2001	Germany (Dresden)	75	12.3
Daimler Chrysler	12/2001	Germany (Thuringia)	57	30.9
Infineon (semiconductors)	04/2002	Germany (Saxony)	219	19.8
ST Microelectronics	04/2002	Italy (Sicily)	542	26.3
Renault	06/2002	Spain (Valladolid)	18	14.3
Vauxhall	09/2002	U.K. (Ellesmere Port)	15	6.4
Iveco (utility vehicles)	10/2002	Italy (Puglia)	109	44.0
BMW	12/2002	Germany (Leipzig)	363	30.1
Solar World (solar cells)	03/2003	Germany (Saxony)	73	35.0
BMW	05/2003	Austria (Steyr)	16	15.3
Volkswagen	06/2003	Spain (Navarra)	20	6.4
AMD (microelectronics)	02/2004	Germany (Saxony)	545[d]	22.7[d]
Infineon (semiconductors)	03/2004	Portugal (Porto)	42	29.0
DHL Airways (logistics)	04/2004	Germany (Leipzig)	70	28.0
Peugeot Citroen	09/2004	U.K. (Ryton)	30	9.8
De Tomaso (vehicles)	01/2005	Italy (Calabria)	81	60.0

[a] automobiles, unless otherwise stated [b] 1 British Pound is converted to 1.5 €

[c] present value of state aid divided by present value of investment [d] upper limit

Source: Official Journal of the European Communities, C and L (http://eur-lex.europa.eu)

This is the starting point for the analysis in this paper. Our purpose is to study how the presence of a domestic union affects the incentives of governments to grant tax concessions, or even investment subsidies. For this purpose we set up a model where a unionized and a non-unionized country, which additionally differ in size, compete for the location of a single outside firm. We show that the government of the unionized country has a greater incentive to attract the foreign firm, other things being equal, in order to 'tame' the domestic union's wage demands. This results in the unionized country's government offering a tax discount (or a subsidy premium) to an outside firm in excess of what is needed to compensate the investor for the higher wages caused by union power. Therefore, the unionized country will be able to attract the FDI for a wide range of parameter values, even if its market is smaller than that of the competing non-unionized country.

Our analysis relates to two different strands in the literature. The first set of papers analyses tax competition for FDI in models of imperfectly competitive product markets and with various country asymmetries. This 'bidding-for-firms' literature was initiated by Black and Hoyt (1989), and it has since been applied to tax/subsidy competition between countries that differ in size (Haufler and Wooton, 1999), factor endowments (Davies, 2005), the number of domestic competitors (Bjorvatn and Eckel, 2006) and the pattern of firm ownership (Mittermaier, 2007). Related results have been derived in the 'new economic geography' literature where agglomeration effects give the core country a competitive advantage and allow it to tax positive location rents (see Kind et al., 2000; Baldwin and Krugman, 2004; Ottaviano and van Ypersele, 2005; Borck and Pflüger, 2006). In these models, however, firms and governments are the only agents whose choices are explicitly analysed. An exception is Munch (2003) who finds in a model without governmental action that with falling trade costs, firms will move to the location where unions are less strong.

A second and parallel strand in the literature has focused on the effects that unionization has on foreign direct investment.[4] Mezzetti and Dinopoulos (1991) investigate the role of unionization on a firm's exporting versus FDI decision. Leahy and Montagna

[4]This literature is embedded in a more general literature that analyzes the interaction between unionization, imperfect competition in goods markets, and economic integration. See e.g. Brander and Spencer (1988), Huizinga (1993), Driffill and van der Ploeg (1995), and Naylor (1998).

(2000) analyze how foreign direct investment is affected by different degrees of wage setting centralization. Naylor and Santoni (2003) show, among other results, that foreign direct investment is less likely in a given country the greater is its union's bargaining power. Finally, Lommerud et al. (2003) show that economic integration can lead to more foreign direct investment when labor markets are unionized, even though the direct effect of market integration is to reduce the transport cost of exporting. These papers, however, consider only trade unions and firms as active players in the model while ignoring government tax policies. Skaksen (2005) analyzes a single government's incentives to subsidize inward FDI with imperfect labor markets and finds that with final goods being complements, subsidies might improve global welfare.

This paper is, to our knowledge, the first to combine the decisions of firms, trade unions and governments in a tax competition setting where governments move first and are thus able to influence the policy of trade unions in the second stage.[5] The tax decisions of governments and the wage policies of unions then jointly determine the decisions of firms in the third stage. In what follows, Section 2 describes the general set-up of the model. Section 3 deals with the location and output decisions of firms. Section 4 analyzes the wage policies pursued by the trade union. Section 5 then moves on to the tax and subsidy decisions of the two governments. Section 6 discusses the robustness of our results with respect to alternative model assumptions. Section 7 concludes.

2 The model

We consider a model of two countries $i \in \{A, B\}$ which compete for the entry of a firm from a third country C. Countries A and B are generally of different size. The population of countries A and B taken together is normalized to 1 and assumed to be immobile across countries. A share n of the total population live in country A, whereas $1 - n$ residents live in country B. Prior to the potential entry of the outside firm, each of the countries A and B is already hosting one firm in the industry. Let

[5]There is also a small literature on tax and social policy competition when labor markets are unionized and capital is internationally mobile (see Lejour and Verbon, 1996 or Fuest and Huber, 1999). In this literature, however, product markets are perfectly competitive and thus there are no distinct output and location decisions of individual firms.

a and b denote the existing firms in countries A and B, respectively, whereas c is the potential entrant. All firms in this industry produce a homogeneous good, denoted x. Households demand good x and a numéraire good, z, which is produced by perfectly competitive firms. Preferences are assumed to be identical for all consumers and across countries. Per-capita utility in each country is given by

$$u_i = \alpha x_i - \frac{1}{2}\,\beta x_i^2 + z_i \qquad i \in \{A, B\}. \tag{1}$$

To keep our analysis as simple as possible, and to focus squarely on the competition for the foreign firm, our analysis in the main text assumes that there is no trade between countries A and B. This implies that each country can choose between a market structure of domestic monopoly in the case where firm c is not attracted, and a duopoly situation in the case where it is. We emphasize, however, that all results are qualitatively similar (although the analysis is substantially more complicated), if costly trade is permitted between countries A and B.[6] Intuitively, it is well known from the new trade literature (e.g. Horstman and Markusen, 1992), that competition in the country where the foreign firm sets up production remains more intense in this extended framework, because the presence of trade costs acts as an imperfect shield for the firms in, say, market A from competitors in country B. Eliminating trade altogether therefore acts so as to maximize the differential impact that the foreign entrant has on the market structure for good x in its host country, vis-à-vis the other country.

In both countries $i \in \{A, B\}$, each household supplies one unit of labor. A household employed in the z industry receives the competitive real wage $\bar{w}$, which is identical across countries. An important asymmetry in our model is that the imperfectly competitive sector x is unionized in country A, but not in country B. Hence, in country A, the wage in the x industry can be above the competitive wage $\bar{w}$. However, only a (endogenous) fraction of all workers in country A, denoted s_A, will find employment in the x sector. The remainder of country A's workforce is employed in the z sector and earns the competitive wage $\bar{w}$. Workers in country A are homogeneous and their allocation to the two sectors is not explicitly modelled; there are simply some 'lucky' workers who earn more than the competitive wage. Since the preferences of all workers are identical, we need not keep track of the different income groups in country A, but

[6] This case is analyzed in the appendix and its results are discussed in more detail in Section 6.

can focus on the average income earned in this country. In country B, all workers earn the wage $\bar{w}$, irrespective of the sector in which they work.

To derive the budget constraints for both countries, we assume that in each country the profit income earned by the local firm is redistributed to the domestic worker-consumers in equal per-capita shares. One can either think of the local firm in sector x as being in the hands of the local government, or of the government being able to fully tax away all profits earned by the indigenous firm. Moreover, we assume that both governments dispose of lump-sum instruments in order to finance subsidies or, in case they are able to tax the outside firm c, redistribute tax proceeds. With these assumptions, the per-capita budget constraints in the two countries are

$$\begin{aligned} w_A s_A + \bar{w}(1 - s_A) + \frac{(\pi_a + t_A)}{n} &= z_A + p_A x_A, \\ \bar{w} + \frac{(\pi_b + t_B)}{1 - n} &= z_B + p_B x_B. \end{aligned} \tag{2}$$

Here w_A denotes country A's union-determined wage in sector x, π_j are the profits of the local firms, t_i are the tax revenues in country i obtained from the outside firm c (negative in the case where subsidies are paid) and p_i is the consumer price of good x in country i.

Maximizing the representative consumer's utility function in each country, subject to the budget constraint and aggregating over individuals gives the market demand functions for good x in each country:

$$X_A = \frac{n(\alpha - p_A)}{\beta}; \qquad X_B = \frac{(1 - n)(\alpha - p_B)}{\beta}. \tag{3}$$

These market demand functions are independent of the exogenous income components in (2) due to the quasi-linearity of the utility function.

On the production side, wages are the only variable costs in both sectors. In sector x, we scale units such that one unit of labor produces one unit of output; hence, in each country the variable cost of production is constant and equals the wage rate. This variable cost has to be paid both by the local firm and by the potential entrant c. We assume that the outside firm c will set up at most one plant, either in country A or in country B. One interpretation is that production requires a specific factor (e.g. entrepreneurial services) which is in fixed supply. For example, the foreign-owned firm

c might have only one suitable manager to run a plant in one of the two countries. Alternatively, firm c is not willing to venture into two new markets at the same time, but has decided to start its engagement in one of the markets A or B. [7]

In order to examine the impact of union power on tax competition for the outside firm, we model a three-stage game. In the first stage, the two competing governments simultaneously and non-cooperatively choose a lump-sum tax or subsidy on the entry of the outside firm, which represents either an 'entry fee' (in the case of a tax) or a 'welcome gift' (in the case of a subsidy). The objective of governments in stage one is to maximize the overall utility of their respective population. Whether the tax on the entry of the outside firm is positive or negative in equilibrium depends on the interplay of two counteracting forces. On the one hand the entry of the outside firm is the only way for each government to increase competition in sector x. On the other hand, admitting the outside firm c to an imperfectly competitive industry implies that the industry's profits will be shared with foreigners.

In the second stage, the union in country A chooses the wage rate that maximizes the wage surplus of its workers over and above the competitive wage bill. The trade-off for the union is that attracting the outside firm increases local output in the unionized sector, but at the same time the union may have to moderate its wage, relative to the wage that it would optimally charge the domestic monopolist. Finally, in the third stage the foreign firm decides to enter either market A or market B (or none of them) and equilibrium quantities are chosen by the firms in each market.

The sequence of events underlying our analysis implies that the government of country A can strategically adjust its tax policy in order to affect the wage claims of the local union. This order of moves seems appropriate when the government's policy variable is interpreted in a wide sense, as a general policy stance towards increasing competition in local markets by way of attracting FDI. Such a policy is clearly of a more long-term nature than the periodic wage negotiations in which trade unions are engaged. We will also show, however, that our main results continue to hold when the sequence of moves in the analysis is altered.[8]

[7] The fact that c is foreign-owned, implying profit repatriation, is less restrictive than it may seem: In equilibrium, profits across locations will be equalized anyway.

[8] This will be discussed in Section 6.

3 Stage three: The firms

In the usual way, the model is solved by backward induction. Firms act last in our game, basing their decisions on the taxes and wages set by the other players. Firms a and b, the domestic incumbents, will decide about their output quantities, taking account of the simultaneous decisions of the outside firm. Firm c decides where to locate and then produces the same quantity in the chosen market as the respective incumbent firm, since it faces the same wage rate and hence cost of production. Firms observe market conditions according to (3) and maximize their profits. We assume that firms compete à la Cournot.

To derive equilibrium outputs we need to distinguish between two regimes, depending on whether firm c locates in country A (Regime A, or RA for short) or in country B (RB). Let superscripts denote the regime for which a given value is calculated, whereas subscripts denote the countries or firms in question. Using this notation, production quantities in the two regimes are

$$\begin{aligned} (RA): \qquad & x_a^A = x_c^A = \frac{n\,(\alpha - w_A)}{3\,\beta}, \qquad && x_b^A = \frac{(1-n)\,(\alpha - \bar{w})}{2\,\beta}\,; \\ (RB): \qquad & x_a^B = \frac{n\,(\alpha - w_A)}{2\,\beta}, \qquad && x_b^B = x_c^B = \frac{(1-n)\,(\alpha - \bar{w})}{3\,\beta}\,. \end{aligned} \tag{4}$$

Using (3) and noting that demand for good x must equal local supply in each country due to the absence of trade, yields equilibrium prices in the two regimes

$$\begin{aligned} (RA): \qquad & p_A^A = (\alpha + 2w_A)/3, \qquad p_B^A = (\alpha + \bar{w})/2; \\ (RB): \qquad & p_A^B = (\alpha + w_A)/2, \qquad p_B^B = (\alpha + 2\bar{w})/3. \end{aligned} \tag{5}$$

These prices lead to regime-specific profit levels of

$$\begin{aligned} (RA): \qquad & \pi_a^A = \pi_c^A = n\,(\alpha - w_A)^2/(9\,\beta), \qquad \pi_b^A = (1-n)\,(\alpha - \bar{w})^2/(4\,\beta); \\ (RB): \qquad & \pi_a^B = n\,(\alpha - w_A)^2/(4\,\beta), \qquad \pi_b^B = \pi_c^B = (1-n)\,(\alpha - \bar{w})^2/(9\,\beta). \end{aligned} \tag{6}$$

Equations (5)-(6) shows the effects of the location decision of the mobile firm c. Given that the incumbent firms in A and B are assumed to be internationally immobile, market conditions in the host country of the outside firm change from monopoly to duopoly, reducing aggregate profits and increasing consumer surplus in this market. In country A, a further distributional consequence is that the x sector will grow, giving

more workers the opportunity to earn a wage above the competitive level. This effect will be important for the union's wage decision below.

Firm c will be indifferent where to settle down when its net-of-tax profits are the same in the two countries. It is ex ante unclear which country will be the more attractive location for the outside firm, as markets are generally of different size and need not have the same wages and taxes. The general condition for c being indifferent between locations A and B is:

$$\pi_c^A - t_A = \pi_c^B - t_B \iff \frac{n\,(\alpha - w_A)^2 - (1-n)\,(\alpha - \bar{w})^2}{9\,\beta} = t_A - t_B.$$

This equation can be solved for the maximum wage that the union in country A can set and still make the firm no worse off than if it settled in country B. We denote this wage by w_A^A and adopt the convention that the firm will locate in country A whenever it is indifferent between the two locations.[9] This critical wage depends on the tax rates decided by the both governments in the first stage of the game and is given by

$$w_A^A = \alpha - \frac{\sqrt{n\,\left[9\,\beta\,(t_A - t_B) + (1-n)\,(\alpha - \bar{w})^2\right]}}{n}. \tag{7}$$

If the union in country A sets a wage $w_A \leq w_A^A$ then the firm will settle in country A (Regime A). If the wage set by the union is $w_A > w_A^A$ then the union will instead settle in country B (Regime B). The wage that the outside firm c is willing to pay in country A and still settle in this location falls when the tax rate in country A is high (or that in country B is low), and it rises when the competitive wage $\bar{w}$ (which is to be paid in country B) is high. Finally, it is straightforward to show that w_A^A is rising in n, as the outside firm will want to settle in the larger market, other things being equal.

4 Stage two: The union

In line with virtually the entire related literature, we adopt a 'monopoly union' model for our analysis. This approach is a benchmark for wage determination with maximum union power, allowing firms only to adjust quantities optimally in the third stage of

[9] Of course, it must also be ensured that the outside firm c will make positive profits in equilibrium in its preferred location.

the game. Stated differently, the union chooses its optimal point on the firms' labor demand curve.[10] However, the trade-off faced by the union is enriched in the present model as wage restraint will not only increase the output of the incumbent firm but it may also induce the outside firm c to enter the market and expand output in the unionized sector.

The union's objective is to maximize the domestic wage surplus over the competitive wage bill. Denoting this wage surplus by Ω we get

$$\max_{w_A} \quad \Omega = n\left[s_A\, w_A + (1 - s_A)\ \bar{w} - \bar{w}\right] = n s_A (w_A - \bar{w}) = X_A (w_A - \bar{w}), \tag{8}$$

where s_A and $(1 - s_A)$ are the population shares working in the x sector and the z sector, respectively, and the last equality follows from the fact that demand of good x in country A equals its supply (since the good is not tradeable). Again we have to derive the optimal union policy separately for the cases where the outside firm settles in country A or in country B. An assumption we make here is that the union neglects the effect its wage policy has on prices and profits. which in principle could be taken into account as union members are also consumers and, at least indirectly, firm a shareholders. However, we ignore this as there is only one sector involved, which is smallish in relation to the whole economy, and we also consider this to be more realistic in terms of union behavior.

Let us start with Regime B. In this regime the union will set the wage rate such that the wage surplus is maximized under a domestic market structure of monopoly. Total demand for good x is then given by $X_A = x_a^B$ in (4). From (8), the wage rate that maximizes the wage surplus is then

$$w_A^B = \frac{(\alpha + \bar{w})}{2} \tag{9}$$

[10]The model could be extended to allow for Nash bargaining between unions and firms, hence incorporating the more general 'right-to-manage' framework, rather than just its special case of the monopoly union. This extension would imply that the incumbent firm gets some power to decide on the wage rate and it would thus be necessary to analyze the strategic interests of firm a. In particular, firm a could agree to a high local wage in order to keep out competition from the outside firm. The additional effects arising in such a more general model of wage determination are interesting in their own right, but are beyond the scope of the present analysis.

and the wage surplus for the union in country A amounts to

$$\Omega_A^B = \frac{n\,(\alpha - \bar{w})^2}{8\,\beta}\ . \tag{10}$$

If firm c is instead to settle in country A, then the union cannot charge a higher wage than w_A^A given in (7). In this case the wage rate that the union can set is thus bound from above by the condition to attract the outside firm. Let us assume for the moment that the upper bound (7) is indeed binding and hence the union will not find it optimal to charge a wage below w_A^A when the firm settles in country A. Total production of good x in country A is then given by $X_A = x_a^A + x_c^A$ [cf. eq. (4)]. Substituting into (8), the union's wage surplus when it sets the wage according to (7) is

$$\Omega_A^A = \frac{2}{3\beta}\,[\sqrt{n}\,(\alpha - \bar{w}) - \delta\,]\,\delta\,, \tag{11}$$

where

$$\delta \equiv \sqrt{9\beta(t_A - t_B) + (1-n)(\alpha - \bar{w})^2}\,. \tag{12}$$

The union in country A compares the wage surplus in the case where it is able to attract the outside firm, and in the case where it chooses instead the 'outside option' of letting the firm go to country B and extracting a high wage from the domestic monopolist. Hence the union compares Ω_A^A in (11) with Ω_A^B in (10). Since the term δ includes the tax differential $t_A - t_B$ the union's choice between accommodating the outside firm or not will be affected by the tax rates that governments choose in the first stage. Setting $\Omega_A^A = \Omega_A^B$ yields the maximum tax differential that will still induce the union to set the wage w_A^A and hence attract the outside firm in equilibrium. This tax differential is[11]

$$(t_A - t_B)^1 = \frac{(25n - 16)(\alpha - \bar{w})^2}{144\beta}. \tag{13}$$

As long as $t_A - t_B$ is below this critical value, the union will be better off (or at least as well off) with the outside firm than without and hence the location equilibrium will be in Regime A. Once $t_A - t_B$ passes the critical threshold in (13), the union will no longer try to attract the outside firm and will set w_B^A according to (9). In this case the location equilibrium will thus be in Regime B.

[11] As (11) is a quadratic equation in the tax differential, there are two tax differentials that ensure $\Omega_A^A = \Omega_A^B$. Since we are searching for the highest possible tax differential that is compatible with an equilibrium in Regime A, only the higher of these two is relevant.

At this stage we cannot exclude the possibility that the union will find it optimal to charge a wage *below* the maximum wage that is compatible with a location equilibrium in Regime A. In other words we also have to consider the case where the constraint $w_A < w_A^A$ is not binding. In this case the union's wage maximization in Regime A gives

$$\frac{\partial \Omega_A^A}{\partial w_A} = \frac{2n(\alpha + \bar{w} - 2w_A)}{\beta} = 0 \quad \Leftrightarrow \quad \tilde{w}_A^A = \frac{\alpha + \bar{w}}{2}\,, \tag{14}$$

where $\tilde{w}_A^A$ denotes the union's unconstrained wage optimum in Regime A, which corresponds to the union's optimal wage in Regime B [eq. (9)]. We derive the tax differential for which w_A^A in (7) equals $\tilde{w}_A^A$ in (14). This is

$$(t_A - t_B)^2 = \frac{(20n - 16)(\alpha - \bar{w})^2}{144\beta}. \tag{15}$$

Since w_A^A is falling in $(t_A - t_B)$ while $\tilde{w}_A^A$ is independent of taxes, any tax differential below this critical value will imply that the union finds it in its own interest to reduce the wage below w_A^A and set the wage according to (14). We label this case Regime $A2$. In contrast, we denote by Regime $A1$ the case where the union's wage policy is determined by (7). We can thus characterize the equilibrium wage policy of the union in country A in each of the three regimes, as a function of the tax differential decided by governments in the first stage. Starting with high values of $t_A - t_B$ and then successively lowering the tax rate in country A gives

$$\begin{array}{lll}
(RB): & w_A = w_A^B = (\alpha + \bar{w})/2 & \text{if} \quad (t_A - t_B) > (t_A - t_B)^1; \\
(RA1): & w_A = w_A^A = \alpha - (\delta\sqrt{n}/n) & \text{if} \quad (t_A - t_B)^2 < (t_A - t_B) < (t_A - t_B)^1; \\
(RA2): & w_A = \tilde{w}_A^A = (\alpha + \bar{w})/2 & \text{if} \quad (t_A - t_B) < (t_A - t_B)^2;
\end{array} \tag{16}$$

where δ is given in (12) and $(t_A - t_B)^1$ and $(t_A - t_B)^2$ are given in (13) and (15).

5 Stage one: The governments

In the first stage of the game, the two governments choose a lump-sum tax or subsidy on the entry of the outside firm. We assume that each government maximizes the welfare of worker-consumers in its jurisdiction. The optimal policy for each country is derived by comparing the welfare levels in the case where the country hosts the firm, and in the case where it does not. National welfare in each country is obtained from

the individual utility functions (1) where the (per-capita) budget constraints (2) are used to substitute out for z_i. Employing the first-order condition of the consumers' optimization problem and aggregating over households in the two countries gives the following national welfare measures:

$$U_A = n\, u_A = (\alpha - p_A)\frac{X_A}{2} + \Omega_A + n\bar{w} + \pi_a + t_A; \tag{17a}$$

$$U_B = (1-n)u_B = (\alpha - p_B)\frac{X_B}{2} + (1-n)\bar{w} + \pi_b + t_B. \tag{17b}$$

It is then straightforward to derive our first result:

Proposition 1 *In Regime A, where country A attracts the firm, the equilibrium tax differential is always given by* $(t_A - t_B)^1$ *in* (13) *and the union will set the wage according to* w_A^A *in* (7).

Proof: See Appendix 1.

The first part of the proof consists of showing that the tax equilibrium can never lead to a wage policy in Regime $A2$, where the union sets a wage below w_A^A in (7). Intuitively, by choosing a wage below w_A^A (which just keeps the outside firm indifferent between the two locations), the union would leave a location rent to the outside firm if it settles in country A. Hence raising t_A in Regime $A2$ (and thus the tax differential, for any given level of t_B) does not affect the regime-specific wage $\tilde{w}_A^A$ and the only effect is to increase country A's tax revenue at the expense of firm c's profits. This clearly must be beneficial for country A.

The second part of the proof shows that optimal tax policy in country A always implies an equilibrium at the boundary of Regimes A and B, rather than in the interior of Regime $A1$. Intuitively, w_A^A is the union's optimal wage policy in Regime $A1$, which is a falling function of $(t_A - t_B)$. Therefore a tax rise in country A reduces the wage rate and hence the distortion in sector x , since the entry tax for the outside firm does not distort output decisions at the margin. For this reason the government of country A will always use its taxing power to the fullest extent as a means to induce wage restraint. In sum, therefore, the government of country A will fully exploit its taxing power vis-à-vis the domestic union and the foreign firm. If the equilibrium is in Regime A, the union in country A will receive no rent over and above the wage surplus that it obtains in

Regime B, and the outside firm will only obtain the profits that it could also earn in country B.

From Proposition 1, we know that the equilibrium wage rate in Regime A is always given by w_A^A in (16). Hence we can exploit the fact that, in equilibrium, the union's wage surplus is equal in Regimes A and B and $\Omega_A^A = \Omega_A^B = n(\alpha - \bar{w})^2/(8\beta)$. Substituting this along with (3) and p_A^A and π_a^A from (5) and (6) into (17a) yields country A's welfare in Regime A as a function of the two tax rates:

$$U_A^A = 4t_A - 3t_B + \frac{(8-5n)(\alpha-\bar{w})^2}{24\beta} + n\bar{w}. \tag{18a}$$

In Regime B, welfare in country A is instead derived using p_A^B and π_a^B from (5) and (6) along with (10) and $t_A = 0$ in (17a). This gives

$$U_A^B = \frac{7n(\alpha-\bar{w})^2}{32\beta} + n\bar{w} \tag{18b}$$

Setting $U_A^A = U_A^B$ and noting that U_A^A is a rising function of t_A gives the best offer (denoted by a superscript o) that country A is willing to make to the outside firm. This is the minimum tax that country A is willing to accept, or the maximum subsidy that country A is willing to pay, in order to host the outside firm:

$$t_A^o = \frac{1}{4}\left[3t_B + \frac{(\alpha-\bar{w})^2}{96\beta}\,(41n-32)\right]. \tag{19}$$

Note that t_A^o is a rising function of t_B since a higher entry tax in country B will imply a higher wage rate set by country A's union and thus a more severe distortion in the x- sector. Moreover, t_A^o is rising in n as a larger home market implies larger profits in the x sectors, which are shared with the foreign firm.

In a similar way we can compute the best tax offer that country B is willing to make to the firm. In Regime A, where country B's tax collections are zero, we substitute p_B^A and π_b^A from (5) and (6) along with $t_B = 0$ into (17b). This yields

$$U_B^A = (1-n)\left[\frac{3(\alpha-\bar{w})^2}{8\,\beta} + \bar{w}\right]. \tag{20a}$$

Alternatively, if country B attracts the firm, we use p_B^B and π_b^B from (5) and (6) in (17b). In Regime B, national welfare in country B will then amount to

$$U_B^B = t_B + (1-n)\left[\frac{(\alpha-\bar{w})^2}{3\,\beta} + \bar{w}\right]. \tag{20b}$$

Setting $U_B^A = U_B^B$ gives country B's best offer, or the minimal entry tax that country B will require from the outside firm:

$$t_B^o = \frac{(1-n)\,(\alpha - \bar{w})^2}{24\,\beta}. \tag{21}$$

The best offer t_B^o is strictly positive, i.e., country B will only be willing to host the firm if it receives a positive entry fee. The reason is that the entry of the foreign firm will simultaneously reduce the profits by country B's incumbent firm and lead to an efficiency gain as the market becomes less concentrated. In equilibrium the first of these effects dominates the second, thus requiring positive tax receipts for country B to be willing to host the firm. Moreover note that t_B^o is independent of t_A. This is because in the present model the interdependence of tax rates arises only through the wage policy of country A's union [see eq. (7)], but this is not relevant for welfare in country B.

The equilibrium in the bidding game is then derived as follows. The two countries will continuously reduce their tax rates until the first country has reached its *best offer* and will therefore not be willing to reduce its tax rate any further. The other country will marginally underbid the best offer of its rival and host the firm. From Proposition 1, we can thus derive country A's optimal tax policy from the best offer that country B is willing to make to the outside firm.

Let us first consider under which conditions country A will host the firm in equilibrium. For this purpose we substitute (21) into the equilibrium tax differential $(t_A - t_B)^1$ in (13). This gives the maximum, and hence (nationally) *optimal* tax rate t_A^* that country A can charge and still attract the firm:

$$t_A^* = \frac{(19n-10)(\alpha - \bar{w})^2}{144\beta}\ . \tag{22}$$

Note that the optimal tax rate charged by country A is not necessarily positive and in fact will be negative in the benchmark case where countries are of equal size ($n = 0.5$). The reason for this difference is that the government of country A is constrained in its tax policy by the presence of a domestic union. Any lump-sum tax on the firm in excess of t_A^* will cause the union to set a wage rate that makes it unattractive for the foreign firm to enter market A.

Substituting country A's optimal tax rate (t_A^*) and country B's best offer (t_B^o) into (18a) yields country A maximum welfare in Regime A:

$$U_A^{A*} = \frac{(32n-5)(\alpha-\bar{w})^2}{72\beta} \, .$$

Setting this expression equal to U_A^B in (18b) leads to a critical size of country A equal to $n^c = 4/13 \approx 0.31$. Since the difference $U_A^{A*} - U_A^B$ is a rising function of n, attracting the firm will be welfare superior for country A for any $n > n^c$.[12] Hence there is a range of parameter values where the unionized country also has the smaller market, yet still attracts the outside firm in equilibrium. It can further be verified that the outside firm indeed makes positive net profits when locating in country A.[13]

In the opposite case where country B hosts the firm, the equilibrium is characterized by country A making its best offer (19) while country B charges the highest possible level of t_B that is compatible with Regime B. This implies that country B will set its tax rate such that country A's best offer in (19) is marginally higher than the maximum tax differential that country A can afford to attract the firm [eq. (13)]. Solving for the level of t_B that equates t_A in (19) and in (13) gives

$$t_B^* = \frac{(\alpha-\bar{w})^2}{288\beta}\,(32-77n)\,, \tag{23}$$

If country B stays marginally below this level of tax, country A cannot charge a tax rate above its best offer without inducing its union to switch to a high-wage policy and hence the equilibrium must be in Regime B. Country B will find it attractive to host the firm when t_B^* in (23) exceeds t_B^o in (21). Consistent with the result above, this condition is met whenever $n < n^c = 4/13$.

Taken together, these results determine the equilibrium location of the outside firm and the equilibrium tax rate imposed by the host country for each of the different values of the country size parameter n. For $n > 4/13$ country A will host the firm and the

[12] It is easily verified that the same result can be obtained from the condition that country A's optimal tax rate t_A^* in (22) must be at least as high as its best offer t_A^o in (19), where the latter is evaluated at t_B^o in (21).

[13] From the gross profit expression for π_c^A in (6), the wage equation (16) and the two tax rates (21) and (22), we get net profits of $\pi_c^A - t_A^* = 5\,(1-n)\,(\alpha-w)^2/(72\,\beta)$ which is unambiguously positive. By construction, this is the same level of net profits that the outside firm could earn in country B.

equilibrium tax rate is given by (22). In contrast, when $n < 4/13$, country B hosts the firm and the equilibrium tax rate is given by (23). We summarize our results in

Proposition 2 *In the tax/subsidy game between two countries that differ with respect to union power and size, there is a critical market size parameter* $n^c = 4/13$ *such that for all* $n \geq n^c$ *the unionized country (country A) attracts the outside firm in equilibrium, whereas for* $n < 4/13$ *the non-unionized country (country B) hosts the firm.*

The result in Proposition 1 is surprising at first glance as the unionized country seems to be at a disadvantage in the location competition for the outside firm. In the absence of a union, it is always the larger country which wins the competition for an outside firm (see Section 6 for further discussion). First intuition would thus suggest that the unionized country A needs to have a larger market than country B in order to attract the firm. Proposition 1 shows, however, that exactly the opposite is true and having a union can indeed *offset* a (limited) size disadvantage that country A has vis-à-vis country B. The intuition for this result is, however, straightforward. Country A has a stronger incentive to attract the outside firm, as this will help in moderating the wage claims of the domestic union. In country B only the product market distortion is ameliorated when the foreign firm c enters the market. In contrast, in country A the efficiency gain in sector x is further raised by the fact that the unionized wage will fall when the foreign firm enters the market. Substituting (21) and (22) in (16) shows that the equilibrium wage in Regime A is $w_A^A = (\alpha + 3\bar{w})/4$, which is unambiguously less than the wage rate set by the union in the case of a domestic monopoly [see Regime B in (16)].

Note, however, that the greater likelihood to attract the union does *not* imply a higher per capita welfare in country A, as compared to country B. Instead we get the stark result that per-capita welfare is always lower in country A, in either of the two possible location regimes and for any distribution of population size. This is summarized in

Proposition 3 *In either Regime A or Regime B, and for any level of* $n < 1$*, per-capita welfare in the unionized country (country A) is less than per-capita welfare in the non-unionized country (country B).*

Proof: See Appendix 2.

The intuition for this proposition is as follows. In Regime A the distortion in the x sector that arises from the monopoly in country B is just equal to the sum of the two distortions arising from union power and duopoly competition in country A.[14] Hence per-capita consumer surplus is the same in both countries. In country B however, all rents accrue to the domestic monopolist, whereas in country A rents are shared between the trade union, and the two duopolists. Since firm c is owned by foreigners and the profits of this firm cannot be fully taxed away by the government of country A (because the firm could alternatively settle in country B, making positive net profits there), the sum of all rents earned by the residents of country A is less, in per-capita terms, than the rents earned by country B's residents. In Regime B, an unmitigated 'double marginalization' problem arises in country A, due to the simultaneous existence of a monopoly firm and a monopoly union. As a result, the consumer price for good x is unambiguously higher than in country B and market efficiency is accordingly lower. This translates into a lower per-capita welfare in country A vis-a-vis country B.

6 Discussion

In this section we relate our results to those found in the existing literature and discuss their robustness to alternative model assumptions. It is known from existing work on tax competition in oligopolies that the country with the larger home market will always win the investment, other things being equal (e.g. Haufler and Wooton, 1999 and Bjorvatn and Eckel, 2006). This result can be reproduced in our framework, if we assume that wages are at their competitive levels in both countries.[15] In contrast to

[14]Substituting the equilibrium wage in country A, $w_A^A = (\alpha + 3\bar{w})/4$, into country A's price equation (5) shows that the consumer price for good x equals $p_A^A = (\alpha + \bar{w})/2$. This just equals the monopoly price in country B in this regime (p_B^A).

[15]In this case prices and quantities chosen by firms in the last stage are given as in Section 3, where $w_A = \bar{w}$ is substituted in the expressions for country A. In the first stage, the best tax offer of country B is unchanged from (21). Similar reasoning yields country A's best offer in the absence of a union, which equals $t_A^o = [n(\alpha - \bar{w})^2]/(24\beta)$. In this setting the condition for country A to win the investment reduces to $n \geq 0.5$.

previous work, however, the equilibrium tax is always positive in our model when unions are absent. This is due to the existence of a domestic incumbent in each country whose profits fall when a foreign competitor enters the domestic market. More fundamentally, the presence of a union in country A gives this country an incentive to improve its best offer to the firm, implying a lower tax or even a subsidy. In equilibrium this leads to the possibility that the *smaller* region attracts the firm, but to do so it will have to pay a subsidy in equilibrium whenever $n \leq 0.5$ [cf. eq. (22)]. We chose the most straightforward way to model union power asymmetry by assuming a competitive labor market in B. We expect our results to qualitatively carry over to a case where country B does have a union, but a less powerful one than A. The case with symmetric union power in A and B would lead to the standard result that the bigger country wins the investment.

At the same time, adding a first stage where governments decide on taxes or subsidies for a mobile firm fundamentally changes the relationship between union wage setting and foreign direct investment. In the absence of government policies, a higher degree of union power reduces the likelihood of a given country to attract FDI (Naylor and Santoni, 2003) and this negative relationship becomes more pronounced when trade costs fall (Lommerud et al., 2003). In the present model, in contrast, the unionized country has a greater likelihood to attract FDI, other things being equal, due to the generous tax/subsidy policies that its government enacts in order to influence the union's behavior.

Next we examine the robustness of our results when some of the assumptions are changed. In Appendix 3 we analyze the case where trade in good x takes place, but per-unit transport costs τ are incurred when shipping goods between countries A and B. The main complication that arises in this setting is that equilibrium prices and quantities in each country now depend on the wage rates in *both* locations. To limit the complexity of the resulting expressions we confine the analysis in Appendix 3 to the case where countries are of equal size ($n = 0.5$).[16] It is shown in the appendix that, with equal market size, the unionized country will attract the firm in equilibrium. By

[16] A further simplifying assumption made in Appendix 3 is that exogenous trade costs are low enough so that the union cannot shut down trade by choosing sufficiently high wages. This last possibility is explicitly analysed in Lommerud et al. (2003).

continuity, this result will continue to hold for small differences in country size. Hence the qualitative result in Proposition 2 carries over to an extended model with trade between countries A and B, even though the critical value at which the regime switch occurs will of course be different in a model with trade. Moreover it is also shown in Appendix 3 that, for $n = 0.5$, the unionized country has lower (per capita) welfare than the non-unionized country. Hence Proposition 3 also carries over to a model with costly trade, at least when countries are of similar size.

Another issue is whether and how the results in our benchmark model without trade are affected when the sequence of play is altered. One alternative scenario is where the union's decisions are of a longer-term nature than tax policies and hence the union in country A chooses the wage rate before the two governments set taxes. The result that the unionized country can attract the firm even if it has the smaller market carries over to this alternative setting. In fact, the critical size parameter n^c, at which the switch of regimes occurs, is exactly the same as in our benchmark analysis.[17] This can be explained as follows. When the union has the first-mover advantage it is able to appropriate the rents that arise from the location of the outside firm. Hence the union will voluntarily moderate wages in order to attract the firm, if this increases its wage surplus. At the critical level of country size n^c, however, no rents arise because the efficiency gains from a lower wage rate in country A are just outweighed by the smaller size of its market. For $n > n^c$ the changed sequence matters instead, as the union can now charge the maximum wage at which country A's government is still willing to set the tax sufficiently low in order to attract the firm. In comparison to our benchmark case this will lead to higher wages and thus a lower average utility in country A.

Finally, it is also possible that the outside firm has already settled in one of the countries before country A's union chooses the local wage rate. Hence tax rates are determined in the first stage, the outside firm's location choice is made in the second stage and the wage in country A is set in the third stage. In the fourth and final stage the three firms choose output levels, given that the location of all firms has already been fixed. In this case the union will set the same monopoly wage in both Regimes A and B, as the outside firm is immobile at the time when the wage rate in country A is determined. Hence tax

[17] The complete set of results for this case, as well as for the case discussed below, are available from the authors upon request.

policy is unable in this case to induce wage moderation. As a result the critical country size at which the unionized country is able to attract the firm in equilibrium now rises above $n = 0.5$. Moreover, average welfare in country A is lower in this case than in any of the other scenarios. The general lesson from these alternative sequences of play is that wage moderation can still be expected when unions move prior to governments, but it is crucial that mobile firms can react with their location decisions to the wage rate they face in the unionized country.

7 Conclusion

In this paper we have set up a model of tax competition between two countries that differ with respect to both market size and the degree of unionization. In this model we have shown - contrary to what first intuition would suggest - that market power in the labor market raises the likelihood that the unionized country attracts an internationally mobile firm, in the sense that it can win the foreign direct investment project even if it offers the smaller market. The core reason for this result is that the government of the unionized country will provide a generous tax environment as a way to induce union wage moderation. Foreign direct investment is crucial here because it offers a discrete increase in employment opportunities when the union 'cooperates' in attracting the mobile firm. We have also argued that this basic effect is independent of whether tax policies or wage policies are set first, as long as the location decision of the internationally mobile firm is made after the wage decision of unions. This result may help explain why high subsidies are commonplace in locations with high wages and union power. It also offers the testable hypothesis that a higher degree of union power will lead to more generous tax and subsidy policies towards foreign direct investment.

Our model can be extended in several ways. One possible extension is to widen the set of policy instruments in the hands of the government and also include trade or competition policies. We would expect, however, that the overall effect of the policy package would still be to foster inward foreign direct investment, in order to increase the incentives for unions to go for more jobs, rather than higher wages. Another possibility is to relax the assumption of a monopoly union and replace it by a bargaining game between the union and the firm(s). Giving the incumbent firm in the unionized country

the power to bargain over wages will add a further strategic dimension to the model, as the incumbent firm may accept high wages in order to keep foreign competitors out of its home market. This is an issue that we hope to address in future research.

Appendix

Appendix 1: Proof of Proposition 1

To derive country A's welfare in Regime A we first calculate $X_A = 2n(\alpha - w_A)/(3\beta)$. Using this in the wage surplus definition (8) and substituting the resulting expression along with p_A^A and π_a^A from (5) and (6) into (17a) yields

$$U_A^A = \frac{n}{3\beta}(\alpha - w_A)\,(\alpha + w_A - 2\bar{w}) + n\bar{w} + t_A. \tag{A.1}$$

In Regime $A2$, substitute $\tilde{w}_A^A$ from (16) into (A.1). This yields

$$U_A^{A2} = \frac{n}{4}(\alpha - \bar{w})^2 + n\bar{w} + t_A.$$

Hence $\partial U_A^{A2}/\partial t_A = 1$ throughout Regime $A2$, implying that it is optimal for country A's government to raise taxes until Regime $A1$ is reached.

In Regime $A1$, substitute w_A^A from (16) into (A.1). This yields

$$U_A^{A1} = \frac{\delta}{3\beta}\left[2\sqrt{n}(\alpha - \bar{w} - \delta\right] + n\bar{w} + t_A.$$

Differentiating with respect to t_A gives

$$\frac{\partial U_A^{A1}}{\partial t_A} = \frac{2}{3\beta}\left[\sqrt{n}(\alpha - \bar{w} - \delta\right]\ \frac{\partial \delta}{\partial t_A} + 1 > 0,$$

since the term in the squared bracket equals $\Omega_A^A/\delta > 0$ and $\partial\delta/\partial t_A > 0$ from (11). Hence, in Regime $A1$, country A's government will raise taxes until the borderline to Regime B is reached. This implies that country A sets its tax according to (13). ■

Appendix 2: Proof of Proposition 3

In Regime A substituting p_A^A from (5), $X_A^A = x_a^A + x_c^A$ from (4), π_a^A from (6), $\Omega_A^A = \Omega_A^B$ from (10) and t_A^* from (22) into (17a) and dividing by n yields per-capital welfare in country A in this regime

$$\frac{U_A^A}{n} = u_A^A = \frac{(32n - 5)(\alpha - \bar{w})^2}{72\beta n} + \bar{w}. \tag{A.2}$$

Similarly substituting p_B^A from (5), $X_B^A = x_b^A$ from (4), π_b^A from (6) and $t_B = 0$ into (17b), dividing by $(1-n)$ and expanding the RHS by n gives

$$\frac{U_B^A}{(1-n)} = u_B^A = \frac{27n(\alpha-\bar{w})^2}{72\beta n} + \bar{w}. \tag{A.3}$$

Comparing (A.2) and (A.3) shows that $u_A^A < u_B^A \quad \forall \quad 4/13 \leq n < 1$, where $n \geq 4/13$ must hold in Regime A from Proposition 2.

In Regime B we substitute p_A^B from (5), $X_A^B = x_a^B$ from (4), π_a^B from (6), Ω_A^B from (10) and $t_A = 0$ into (17a). Dividing by n yields country A's average welfare in Regime B

$$\frac{U_A^B}{n} = u_A^B = \frac{5(\alpha-\bar{w})^2}{16\beta} + \bar{w}. \tag{A.4}$$

For country B, substituting p_B^B from (5), $X_B^B = x_b^B + x_c^B$ from (4), π_b^B from (6) and t_B^* from (23) into (17b) and dividing by $(1-n)$ gives

$$\frac{U_B^B}{(1-n)} = u_B^B = \frac{5(\alpha-\bar{w})^2}{9\beta} + \bar{w} + \frac{(\alpha-\bar{w})^2}{288\beta}(32-77n). \tag{A.5}$$

Since the positive first term on the RHS of (A.5) exceeds the corresponding term in (A.4) and the last term in (A.5) is positive in Regime B, where $n < 4/13$ from Proposition 2, we get $u_A^B < u_B^B \quad \forall \quad n < 4/13$. Together with the result for Regime A, this completes the proof. ■

Appendix 3: The model with trade

We adopt the segmented market hypothesis in the framework of a 'reciprocal dumping' model à la Brander and Krugman (1983). For expositional ease, we assume countries of equal size, i.e. $n = 0.5$. We assume that trade costs are below the prohibitive level so that two-way trade always takes place. The game in the last stage is changed in that there are now three active firms in both markets. With per unit trade costs of τ, solving the third stage of the games yields profits of

$$\begin{aligned}
\pi_a^A &= \pi_c^A = \frac{(\alpha - 2w_A^A + \bar{w} - 2\tau)^2}{32\beta;} + \frac{(\alpha - 2w_A^A + \bar{w} + \tau)^2}{32\beta};\\
\pi_b^A &= \frac{(\alpha + 2w_A^A - 3\bar{w} - 3\tau)^2}{32\beta} + \frac{(\alpha + 2w_A^A - 3\bar{w} + 2\tau)^2}{32\beta};\\
\pi_a^B &= \frac{(\alpha - 3w_A^B + 2\bar{w} - 3\tau)^2}{32\beta} + \frac{(\alpha - 3w_A^B + 2\bar{w} + 2\tau)^2}{32\beta};\\
\pi_b^B &= \pi_c^B = \frac{(\alpha + w_A^B - 2\bar{w} - 2\tau)^2}{32\beta} + \frac{(\alpha + w_A^B - 2\bar{w} + \tau)^2}{32\beta}.
\end{aligned}$$

The first terms in these expressions refer to profits in market A, whereas the second terms give the profits in market B. By analogy to the benchmark model without trade we can infer a wage rate in country A for which the outside firm c is just indifferent between the two locations. This wage rate, which depends on the exogenous trade cost parameter, taxes and also on country A's wage rate in Regime B is:

$$w_A^A = \frac{1}{4}\left[2\alpha + 2\bar{w} - \tau - \sqrt{(2\alpha - 4\bar{w} - \tau + 2w_A^B)^2 + 64\beta(t_A - t_B)}\right]. \tag{A.6}$$

Employing our analysis in the main part of the paper (cf. Proposition 1) we assume that the union will find it optimal to just set the wage at this level, if it wants to attract the firm. The union's alternative is again to forgo the outside firm and impose the surplus-maximizing wage on the domestic monopolist. The latter is given by

$$w_A^B = \frac{1}{12}\left(2\alpha + 10\bar{w} - \tau\right) \ . \tag{A.7}$$

This wage rate can be substituted into (A.6). Defining the union surplus as in (8), equating the regime-specific expressions in Regimes A and B ($\Omega_A^A = \Omega_B^A$) solving for the tax differential ($t_A - t_B$) and choosing the larger of the two solutions to the quadratic equation yields

$$(t_A - t_B)^1 = \frac{(3\sqrt{6} - 17)(2\alpha - 2\bar{w} - \tau)^2}{1152\beta}, \tag{A.8}$$

which is unambiguously negative. To get country B's best offer (t_B^o) we use (17b) – taking account of changed quantities due to trade – , equate the welfare levels in the cases where country B hosts the firm and where it does not ($U_B^A = U_B^B$) and solve for t_B. In the presence of trade with country A, country B's welfare will depend on the trade union's optimally chosen wage in both regimes (and hence also on t_A). However, country B's government anticipates the wages that country A's union will set in each regime [eqs. (A.6) and (A.7)] and it also accounts for the fact that country A's government sets taxes according to (A.8) in order to minimize the union's surplus. Using this information, country B's best offer is

$$t_B^o = \frac{4(47 - 21\sqrt{6})(\alpha - \bar{w})^2 + \tau[(72\sqrt{6} - 572)(\alpha - \bar{w}) + (1391 - 15\sqrt{6})\tau]}{4608\beta}. \tag{A.9}$$

From (A.8) and (A.9) we can derive country A's optimal tax rate t_A^*:

$$t_A^* = -\frac{4(7 + 3\sqrt{6})(\alpha - \bar{w})^2 + \tau[4(25 - 2\sqrt{6})(\alpha - \bar{w}) - (441 - \sqrt{6})\tau]}{1536\beta}. \tag{A.10}$$

Country A will attract the outside firm in equilibrium if its welfare in the case where it hosts the firm exceeds its welfare in the case where it does not. Using (17a) to calculate country A's utility in the two regimes gives

$$U_A^A - U_A^B = \frac{(9\sqrt{6} - 19)(2\alpha - 2\bar{w} - \tau)^2}{2304\beta} > 0 \tag{A.11}$$

so that country A is indeed better off if it hosts the outside firm. Hence the unionized country will attract the firm in an equilibrium with trade when the two countries are of equal size. This shows that Proposition 2 carries over qualitatively to a scenario with trade in good x. Moreover it can be shown that, for any non-prohibitive level of τ, welfare in country A is again lower than welfare in country B:

$$U_A^A - U_B^A = -\frac{(2\alpha - 2\bar{w} - \tau)[2(47 - 13\sqrt{6})(\alpha - \bar{w}) - (43 - 11\sqrt{6})\tau]}{1536\beta} < 0. \tag{A.12}$$

Hence Proposition 3 also extends to the case where good x is traded between countries A and B.

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