Unionisation triggers tax incentives to attract foreign direct investment*

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Abstract

This paper analyses tax competition between a unionised and a non-unionised country for the location of an outside firm. We show that unionisation increases the incentive for the government to attract a foreign investor, in order to affect the behaviour of the domestic union. This results in the unionised 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 unionised country attracts the foreign investment, even if it has no other location advantages.

Keywords: tax competition, trade unions, foreign direct investment

JEL Classification: H87, H25, F21, J58

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1 Introduction

In most OECD countries, and in many developing countries, the potential benefits from foreign direct investment (FDI) in the form of higher employment, intensified competition in product markets, and positive productivity spillovers on other sectors of the economy are increasingly perceived by policy makers. The employment argument, in particular, has become a highly important one. In many OECD countries employment in multinational firms now accounts for more than 25% of total employment in the manufacturing sector.\footnote{In 2005, employment in multinational firms as a percentage of total manufacturing employment was, for example, 33.1% in Belgium, 26.4% in France, 15.2% in Germany, 48.0% in Ireland, 33.8% in Sweden, 27.6% in the United Kingdom and 11.2% in the United States. See OECD (2008).} At the same time, multinational firms are able to choose among an increasing number of potential investment locations, particularly in Eastern Europe and Southeast Asia, which offer low wages, an educated workforce, and rapidly expanding domestic markets. This has led to a number of highly publicised cases of plant relocations from rich OECD countries to lower-cost regions. A recent example is the telecommunications firm Nokia, which closed its production unit in the German city of Bochum in 2008 while at the same time opening up a new plant in Jucu, Romania.

As a result of these developments the competition among potential host countries to attract internationally mobile firms has tightened visibly during the last decades. This can be seen in the corporate tax changes, in particular the reduction of statutory tax rates, that many countries have undertaken since the 1980s (see Devereux et al., 2002). A second and even more direct indicator is the increasing use of direct location subsidies that are paid to foreign firms. Table 1 provides a selective list of 21 cases for the period from 2000 to 2007 where substantial investment subsidies (above 20 million Euro) have been offered by host countries and approved by the European Commission. These subsidies often account for 25 to 30 percent of the present value of the investment, and in some cases for even more.\footnote{Note that the subsidy payments collected in Table 1 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.}

A striking fact in Table 1 is that, in absolute terms, the highest subsidies are paid to firms that operate in regions characterised by weak economic activity and high un-
Table 1: Approved investment subsidies in EU member states (2000-2007)

<table>
<thead>
<tr>
<th>Investing company (sector)</th>
<th>headquarter country</th>
<th>Date of approval</th>
<th>Host country (city/region)</th>
<th>Subsidy (mill.€)</th>
<th>Aid intensity$^a$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investor from Rest of World</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AGC/Glaverbel (glass)</td>
<td>Japan</td>
<td>06/2000</td>
<td>Greece (Kavala)</td>
<td>41</td>
<td>48%</td>
</tr>
<tr>
<td>Motorola (semiconduct.)</td>
<td>U.S.A.</td>
<td>07/2000</td>
<td>Scotland (Edinburgh)</td>
<td>172</td>
<td>6%</td>
</tr>
<tr>
<td>Nissan</td>
<td>Japan</td>
<td>01/2001</td>
<td>U.K. (Sunderland)</td>
<td>60$^b$</td>
<td>19%</td>
</tr>
<tr>
<td>Ford</td>
<td>U.S.A.</td>
<td>07/2003</td>
<td>Belgium (Genk)</td>
<td>45</td>
<td>4%</td>
</tr>
<tr>
<td>AMD (microelectronics)</td>
<td>U.S.A.</td>
<td>02/2004</td>
<td>Germany (Saxony)</td>
<td>545$^c$</td>
<td>23%</td>
</tr>
<tr>
<td>DOW PET (synthetics)</td>
<td>U.S.A.</td>
<td>04/2004</td>
<td>Germany (Saxony)</td>
<td>28</td>
<td>23%</td>
</tr>
<tr>
<td>e-glass (glass)</td>
<td>Hong Kong</td>
<td>04/2004</td>
<td>Germany (Saxony-A.)</td>
<td>42</td>
<td>35%</td>
</tr>
<tr>
<td>AMD (microelectronics)</td>
<td>U.S.A.</td>
<td>07/2007</td>
<td>Germany (Saxony)</td>
<td>262</td>
<td>12%</td>
</tr>
<tr>
<td>Kia Motors</td>
<td>Korea</td>
<td>12/2007</td>
<td>Slovakia (Stredné Sl.)</td>
<td>32</td>
<td>15%</td>
</tr>
<tr>
<td>Investor from Europe</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ST Microelectronics</td>
<td>Switzerland</td>
<td>04/2002</td>
<td>Italy (Sicily)</td>
<td>542</td>
<td>26%</td>
</tr>
<tr>
<td>European Optic Media</td>
<td>Austria</td>
<td>06/2003</td>
<td>Germany (Thuringia)</td>
<td>35</td>
<td>35%</td>
</tr>
<tr>
<td>Volkswagen</td>
<td>Germany</td>
<td>06/2003</td>
<td>Spain (Navarra)</td>
<td>20</td>
<td>6%</td>
</tr>
<tr>
<td>Infineon (semiconduct.)</td>
<td>Germany</td>
<td>03/2004</td>
<td>Portugal (Porto)</td>
<td>42</td>
<td>29%</td>
</tr>
<tr>
<td>Peugeot Citroen</td>
<td>France</td>
<td>09/2004</td>
<td>U.K. (Ryton)</td>
<td>30$^b$</td>
<td>10%</td>
</tr>
<tr>
<td>National investor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volkswagen</td>
<td>Germany</td>
<td>07/2001</td>
<td>Germany (Dresden)</td>
<td>75</td>
<td>12%</td>
</tr>
<tr>
<td>Infineon (semiconduct.)</td>
<td>Germany</td>
<td>04/2002</td>
<td>Germany (Saxony)</td>
<td>219</td>
<td>20%</td>
</tr>
<tr>
<td>Iveco (utility vehicles)</td>
<td>Italy</td>
<td>10/2002</td>
<td>Italy (Puglia)</td>
<td>109</td>
<td>44%</td>
</tr>
<tr>
<td>BMW</td>
<td>Germany</td>
<td>12/2002</td>
<td>Germany (Leipzig)</td>
<td>363</td>
<td>30%</td>
</tr>
<tr>
<td>Wacker (silicon wafers)</td>
<td>Germany</td>
<td>02/2004</td>
<td>Germany (Saxony)</td>
<td>120</td>
<td>28%</td>
</tr>
<tr>
<td>DHL Airways (logistics)</td>
<td>Germany</td>
<td>04/2004</td>
<td>Germany (Leipzig)</td>
<td>70</td>
<td>28%</td>
</tr>
<tr>
<td>De Tomaso (vehicles)</td>
<td>Italy</td>
<td>01/2005</td>
<td>Italy (Calabria)</td>
<td>81</td>
<td>60%</td>
</tr>
</tbody>
</table>

$^a$ present value of state aid divided by present value of investment

$^b$ 1 British Pound is converted to 1.5 €

$^c$ upper limit

Source: Official Journal of the European Communities, C and L (http://eur-lex.europa.eu)
employment, but simultaneously are part of countries with strong trade unions that succeed in keeping up wages even in low-productivity regions. This is true, in particular, for Eastern Germany and Southern Italy, where the collective bargaining coverage rate is above 80% of the workforce.\textsuperscript{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. To some extent this reflects the European Union’s regulations on state aid, which specify that location subsidies are only permitted to compensate investors for a demonstrated cost disadvantage in comparison to a feasible alternative location. The question remains, however, why unionised countries are also willing to provide high subsidies, the cost of which have to be fully borne by them.\textsuperscript{4}

A further motivation for our analysis comes from several empirical studies that find a surprising positive correlation between the degree of unionisation and the likelihood of a given location to attract foreign multinationals (Coughlin et al., 1991; Friedman et al., 1992). As stressed by Friedman et al. (1992, p. 416), in their analysis “[t]he most puzzling result is on unionization.” While these empirical studies control for regular business tax rates, they do not incorporate discriminatory tax concessions or investment subsidies that host government grant to individual international investors. In line with the examples in Table 1, one potential explanation for the positive effect of unionisation on inward FDI could thus be that unionised countries (or states) have more incentives to subsidise foreign investment, as compared to their less unionised neighbours.

Against this background the present paper analyses how the presence of a domestic

\textsuperscript{3}In contrast, this coverage rate (the percentage of employees for whom the wage negotiated by the union is binding) is only about 50% in the UK and 20% in the United States and Japan (Cahuc and Zylberberg, 2004, p. 372). In Eastern Europe, coverage rates have fallen dramatically in several countries and were about 35% in Hungary and 50% in Slovakia in 2001 (EIRO, 2002, Table 1).

\textsuperscript{4}A further important question is why more than 80% of the subsidies to industry in the OECD take the form of investment subsidies, rather than direct subsidies to employment, even if their purpose is to counteract labour market rigidities (see Fuest and Huber, 2000, Table 1). One answer to this question is that employment subsidies may strengthen the position of trade unions, whereas investment subsidies can induce more competition in both product and labour markets. Fuest and Huber (2000) show, in a model where firms with different productivities bargain with unions over both wages and employment, that an investment subsidy financed by a labour tax increases the number of active firms and generates welfare gains by reducing the rents of workers.
union affects the incentives of governments to grant specific tax concessions, or even direct investment subsidies, in order to attract a foreign multinational enterprise (MNE). Our main result is that if a unionised and a non-unionised country compete for FDI, the unionised country will attract the investment in equilibrium, even if it has no other location advantages. This occurs because the government of the unionised country will offer a location subsidy to the outside firm which more than compensates the investor for the higher wages caused by union power. The fundamental argument behind this result is simple. In concentrated markets where firms set prices above marginal (wage) costs, unions exerting their market power to raise wages above their competitive levels aggravate the distortions in the economy. This gives the unionised country’s government a strong incentive to reduce the existing inefficiencies, but it cannot curtail the union’s wage setting power directly. Hence attracting FDI serves as a second-best instrument, giving the union an incentive to lower its wage demand, in exchange for higher employment in the multinational firm.

We develop our main result in a model where a unionised and a non-unionised country form an integrated market and compete for the location of a single, multinational firm. We model a five-stage game where governments compete through location taxes or subsidies in the first stage, the union sets the wage in the second stage and the MNE chooses its location in the third stage. In the fourth stage the union may re-optimise its wage policy and in the fifth stage all firms choose output levels. We also show that our main result carries over to an extended setting with trade costs. In this case, the unionised country may be able to attract the outside firm, even if it has other location disadvantages, such as a smaller home market.

Our analysis relates to two different strands in the literature. The first set of papers analyses the effects of unionised labour markets on foreign direct investment. Mezzetti and Dinopoulos (1991) investigate the role of unionisation in a firm’s exporting versus FDI decision. As recently shown by Mukherjee (2008), these two modes of serving a foreign market may also be simultaneously chosen by a cost-minimising firm when labour markets are unionised. Leahy and Montagna (2000) analyse how FDI is affected

5These contributions are part of a more general literature that analyses the interaction between unionisation, 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).
by different degrees of wage setting centralisation. Lommerud et al. (2003) show that unionisation can simultaneously induce FDI and cause job losses in the unionised country. However, most of the papers focusing directly on the link between unionisation and inward FDI find a negative effect; see e.g. Naylor and Santoni (2003), or Munch (2003). Our model incorporates this effect in that, other things being equal, unionisation reduces the likelihood of a country to attract FDI. However, by also endogenising tax policies we show that the negative effect of unionisation on FDI can be more than offset by an optimally chosen subsidy offered by the unionised country’s government.

A second and parallel strand in the literature has analysed tax competition for FDI in models of imperfectly competitive product markets. 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 exogenously differ in size (Haufler and Wooton, 1999), the valuation of employment gains (Barros and Cabral, 2000), factor endowments (Davies, 2005), or the number of domestic competitors (Bjorvatn and Eckel, 2006). A general finding of this literature is that countries can tax the profits of a single internationally mobile firm to the extent that they possess a location advantage, relative to their closest competitor. When there are two internationally mobile firms, the taxing power of the competing countries is even increased and the countries might be able to extract all profits from the duopolistic firms (Ferrett and Wooton, 2010). Related results have been derived in the ‘new economic geography’ literature where agglomeration effects and a larger market size allow the core country to tax positive location rents (Kind et al., 2000; Baldwin and Krugman, 2004; Ottaviano and van Ypersele, 2005; Borck and Pflüger, 2006). None of these models, however, incorporates trade unions as an additional player in the competition for FDI.

We are aware of only one other paper which combines unionisation and tax competition in a model with endogenous location decisions of mobile firms. This is the fair wage model of Egger and Seidel (2010). In their model, however, the labour market distor-

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6Skaksen (2005) analyses the incentives for a single country to attract a foreign firm to a unionised market with a domestic incumbent. This model focuses on complementarities between the outputs produced by the incumbent and the mobile firm, however, and does not incorporate location competition between two potential host countries. There is also a small literature on tax and social policy competition when labour markets are unionised and capital is internationally mobile (see Lejour and
tion is exogenously given by the fair wage preferences of workers and can therefore not be affected by tax policies. Hence Egger and Seidel (2010) obtain the ‘conventional’ result that the country with stronger fair wage preferences will be at a disadvantage in attracting FDI. We show in this paper that results change fundamentally when the extent of the labour market distortion can be affected by government tax policy.

The remainder of this paper is organised as follows. Section 2 describes the general set-up of the model. Section 3 analyses the interaction of union and firm behaviour in the last four stages of our game. Section 4 turns to the tax and subsidy decisions of the two governments in the first stage. Section 5 discusses the robustness of our results with respect to alternative model assumptions. Section 6 concludes.

2 The model

We consider a region of two countries $i \in \{A, B\}$ which compete for FDI from a multinational firm that has its home base in a third country $C$. The multinational firm, labelled $c$, produces a homogeneous output good $x$ and competes with one incumbent firm in the region, which is located in country $A$ and labelled $a$. The market for good $x$ is thus characterised by duopoly competition and the two possible scenarios are either that firms $a$ and $c$ both produce in country $A$, or that they produce in different countries. The two firms compete in quantities. The regional market for good $x$ is completely integrated, with no trade costs arising between $A$ and $B$ in our benchmark model. Hence we consider ‘export-platform FDI’ (e.g. Ekholm et al., 2007) where the firm from the outside country $C$ locates in one of the countries in the region (in $A$ or in $B$) and serves the entire regional market from there. Regional trade is balanced through a numéraire good $z$, which is produced under conditions of perfect competition.

The core difference between the two countries in the region is that sector $x$ is unionised (Verbon, 1996 or Fuest and Huber, 1999). In this literature product markets are perfectly competitive and thus there are no distinct output and location decisions of individual firms.

The ‘countries’ can also be thought of as subnational units (such as U.S. states), as long as their labour market institutions and taxing powers are completely independent.

In section 5 we extend the model to allow for positive trade costs. In this section we also briefly discuss the case of price competition between firms.
in country A, but not in country B. To give an example in a European context, we could think of country A as being Germany (more specifically, a state in Eastern Germany), whereas country B is a less unionised country, for example Hungary (cf. footnote 3). The existence of an immobile, incumbent firm a in country A ensures that the union has the ‘outside’ option to raise the wage rate in this firm, should the multinational firm decide to locate in country B.

In production, wages are the only variable costs in both sectors. In the numéraire sector, $1/\bar{w}$ units of labour are needed in both countries to produce one unit of good $z$. Free trade equalises the price for good $z$ in A and B at unity and the competitive wage rate at $\bar{w}$. In sector $x$ one unit of capital is needed for each firm to produce any output. We assume that the multinational firm disposes of only one unit of capital and hence can set up at most one plant, either in A or in B. As an example, the fixed factor in sector $x$ could be entrepreneurial services and firm $c$ is assumed to have only one suitable manager in the region. The fixed costs are assumed to be equal for FDI in countries A and B and are ignored in the following.\(^9\) Once the fixed factor is installed, one unit of labour produces one unit of good $x$. In the non-unionised country B, the competitive wage rate $w_B \equiv \bar{w}$ is also paid in sector $x$. In the unionised country A, the sector-specific union endogenously chooses the wage rate $w_A \equiv w$. We assume a monopoly union model where the union sets the nominal wage so as to maximise the wage surplus in sector $x$, with firms consequently adjusting their output optimally.

On the demand side, the total population of countries A and B is normalised to unity. Each household in A and B exogenously supplies one unit of labour, which is mobile across sectors but immobile across countries. A share $n$ of the total population lives in country A, whereas $1 - n$ residents live in country B. We exclude extreme values for $n$ and assume that the workforce in both countries is sufficiently large to ensure that the outside firm $c$ can produce its desired quantity in the country of its choice.

The preferences of households are identical for all consumers and across countries. Per-capita utility in each country is of the quasi-linear and quadratic form

$$u_i = \alpha x_i - \frac{1}{2} \beta x_i^2 + z_i \quad \forall i \in \{A, B\}. \quad (1)$$

\(^9\)As we will show, the after-tax profits of firm $c$ in the host country are always positive and we assume that they exceed the fixed costs.
As only sector $x$ in country $A$ is unionised, an endogenous fraction $s$ of country $A$’s workforce will find employment in this sector at wage $w$. The remainder of country $A$’s workforce is employed in the $z$ sector and earns the competitive wage $\bar{w}$. Workers in $A$ 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 can focus on the average income in country $A$ for most of the analysis. In country $B$, all workers earn the same wage $\bar{w}$.

To derive the country-specific budget constraints, we assume that both governments use lump-sum instruments in order to finance subsidies or, in case they are able to tax the outside firm $c$, redistribute tax proceeds. Moreover we assume that the profit income earned by the local firm in country $A$ is redistributed to the domestic worker-consumers in equal per-capita shares. With these assumptions, the (average) per-capita budget constraints in the two countries are:

$$ws + \bar{w}(1-s) + \frac{(\pi_a + t_A)}{n} = z_A + px_A,$$

$$\bar{w} + \frac{t_B}{1-n} = z_B + px_B. \quad (2)$$

Here $\pi_a$ denotes the profits of the incumbent firm in country $A$, $t_i$ are the tax revenues in country $i$ obtained from the outside firm $c$ (negative, if subsidies are paid) and $p$ is the common consumer price of good $x$ in the integrated region.

Maximising 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 $x$. These are independent of the exogenous income components in (2) due to the quasi-linearity of utility:

$$X_A = \frac{n(\alpha - p)}{\beta}; \quad X_B = \frac{(1-n)(\alpha - p)}{\beta}; \quad X_A + X_B = \frac{(\alpha - p)}{\beta}. \quad (3)$$

National welfare is obtained from the individual utility functions (1). We use the per-capita budget constraints (2) to substitute out for $z_i$, employ the first-order condition of the consumers’ optimisation problem and aggregate over households using (3). Moreover, we allow for an exogenous, positive externality $\sigma$ that the location of the outside firm $c$ exerts on the host country. This externality is the same for both countries and it is meant to capture, in a highly simplified way, the empirical finding that multinational enterprises (MNEs) often generate positive productivity spillovers on the host
country’s economy. In our model we assume that this technological spillover increases the production of the numéraire good in the host country of the FDI by $\sigma > 0$ units. This gives the following national welfare measures:

$$U_A = n u_A = (\alpha - p)\frac{X_A}{2} + \pi_a + sn(w - \bar{w}) + n\bar{w} + t_A + \sigma; \quad (4a)$$

$$U_B = (1 - n) u_B = (\alpha - p)\frac{X_B}{2} + (1 - n)\bar{w} + t_B + \sigma; \quad (4b)$$

where $t_i$ and $\sigma$ are zero for the country that does not attract the outside firm. Hence the location of firm $c$ matters for country $B$ through its effects on the price for good $x$, tax revenue collections and the productivity spillover $\sigma$. For country $A$, it is furthermore relevant how domestic wage and profit income in the $x$ sector are affected by the location choice of the MNE.

In order to examine the impact of union power on tax competition for the outside firm, we model a five-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. The objective of governments is to maximise the overall utility of their respective population, as given in (4a)–(4b). In the second stage, the union in country $A$ chooses the wage rate that maximises the wage surplus in sector $x$. The trade-off for the union is that attracting the outside firm increases local output in the unionised sector, but at the same time the union may have to moderate its wage claim in order to induce firm $c$ to come. In the third stage, the foreign firm decides to enter either market $A$ or market $B$. In the fourth stage, country $A$’s union may renegotiate the wage set in stage 2, but this is possible only when the MNE does not locate in country $A$. In the fifth stage, output levels are chosen by the firms, in response to the wage rates faced in the respective host countries.

The above sequence of moves implies that the location choice of the MNE is made only after the union in country $A$ has committed to the wage rate that it would set.

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10 As is established in an extensive literature, such spillovers originate from a superior knowledge of multinational firms, which may be transferred to the host country by means of movements of highly skilled staff, or by demonstration effects. See Görg and Strobl (2001) for an empirical meta-analysis of studies that estimate productivity spillovers of MNEs on host countries.

11 Assuming lump-sum instruments is analytically convenient, but it also captures the character of many existing subsidy schemes. See Table 1 in the introduction.
if the MNE located in country A. Put differently, if country A attracts the mobile firm, then its union cannot renegotiate the wage after firm c has settled there. This assumption is motivated by the increasing international mobility of MNEs, which can easily relocate production, if changing cost conditions in the host country make it unattractive to stay. Our example of Nokia’s relocation from Germany to Romania in the introduction has already shown that the location decisions of MNEs are not permanent and a firm may close a plant in one country and re-open in another, if (relative) production costs change after an initial location decision has been made. More generally, the inherently ‘footloose’ nature of multinationals has been stressed in the recent theoretical international trade literature\textsuperscript{12} and this hypothesis has been supported by several empirical studies.\textsuperscript{13} If this argument, and the evidence in favour of it, is incorporated into our model, then it calls for a sequence of play where the outside firm chooses its location only after the wage rate has been set by country A’s union. The same argument does not apply, however, when the union is confronted only with the incumbent firm a, which is internationally immobile. In this case the union can indeed re-optimise the wage, once the MNE has decided to settle in country B.

Our timing of events also implies that governments set tax policies before country A’s union decides on the wage. To motivate this assumption, we interpret the policy variable broadly, as a tax-subsidy combination that represents a general policy stance towards attracting FDI. Such a policy is arguably of a more long-term nature than the wage setting decision of trade unions and it implies that the government of country A can strategically adjust its tax policy to affect the wage claims of the local union. In section 5 we analyse the robustness of our results under alternative assumptions about the sequence of events.

\textsuperscript{12}Caves (1996) argues forcefully that MNEs can react promptly to adverse cost changes in the host country and shift production elsewhere. Markusen (2002, pp. 6-7) lists a high share of intangible assets, or ‘knowledge capital’, as a general characteristic of MNEs. The importance of intangibles like patents or brand names implies that relocation costs are low, relative to the transferred values.\textsuperscript{13} Görg and Strobl (2003) compare the exit probabilities of national and multinational firms in Ireland and find that multinational firms are significantly more likely to exit, other things being equal, when sectoral conditions change adversely. For the United States, Bernard and Jensen (2007) show that plants owned by either U.S. or foreign multinationals are significantly more likely to close than single-plant firms, if other relevant firm characteristics are controlled for.
3 Stages 2-5: The interaction of union and firms

3.1 Stage 5: Output

The model is solved by backward induction, ensuring subgame perfectness. In the last stage the two firms \( a \) and \( c \) simultaneously and non-cooperatively choose their output quantities, given the marginal costs in their country of production. The (variable) cost function for firm \( j \in \{a, c\} \) is \( \kappa_j = w_i x_j \) where \( w_i \) is the unit labour cost in the host country \( i \) and \( x_j \) is firm \( j \)'s output. Both firms observe market conditions according to (3) and maximise their profits.

In what follows we distinguish between two regimes, depending on whether firm \( c \) locates in country \( A \) (Regime A, or RA for short) or in country \( B \) (Regime B, or RB). Let superscripts denote the country in which the outside firm settles (i.e., the regime), whereas subscripts denote the countries, or firms, for which a given value is calculated.

With this notation, the output of firm \( j \in \{a, c\} \) in country \( i \in \{A, B\} \) is

\[
(RA) : \quad x^A_a = x^A_c = \frac{(\alpha - w^A)}{3\beta}; \quad (5a)
\]

\[
(RB) : \quad x^B_a = \frac{(\alpha + \bar{w} - 2w^B)}{3\beta}, \quad x^B_c = \frac{(\alpha - 2\bar{w} + w^B)}{3\beta}, \quad (5b)
\]

where \( w^A \) and \( w^B \) denote country \( A \)'s (sector-specific) wage rate in Regimes A and B, respectively. In Regime A duopoly competition is symmetric, as the regime-specific wage rate in the host country (\( w^A \)) is the same for both competitors. In Regime B, the outside firm \( c \) faces the competitive wage rate \( \bar{w} \) in country \( B \), whereas the incumbent \( a \) faces the wage rate \( w^B \) that country \( A \)'s union sets when it cannot attract the MNE.

In conjunction with (3) this determines the equilibrium price of good \( x \) in the two regimes as a function of regime-specific wages

\[
(RA) : \quad p^A = (\alpha + 2w^A)/3; \quad (6)
\]

\[
(RB) : \quad p^B = (\alpha + w^B + \bar{w})/3.
\]

These prices lead to regime-specific expressions for the consumer surplus \( CS_i \)

\[
(RA) : \quad CS^A_A = \frac{2n(\alpha - w^A)^2}{9\beta}, \quad CS^A_A = \frac{2(1 - n)(\alpha - w^A)^2}{9\beta};
\]

\[
(RB) : \quad CS^B_A = \frac{n(2\alpha - w^B - \bar{w})^2}{18\beta}, \quad CS^B_B = \frac{(1 - n)(2\alpha - w^B - \bar{w})^2}{18\beta}; \quad (7)
\]
and to regime-specific gross profit levels $\pi_j^i$ (ignoring fixed costs of production)

\begin{align}
(\text{RA}) & : \quad \pi_A^a = \pi_A^c = \frac{(\alpha - w^A)^2}{9 \beta}; \\
(\text{RB}) & : \quad \pi_B^a = \frac{(\alpha - 2w^B + w)^2}{9 \beta}, \quad \pi_B^c = \frac{(\alpha - 2\bar{w} + w^B)^2}{9 \beta}.
\end{align}

(8)

3.2 Stage 4: The union’s wage renegotiation in Regime B

There are two widely used models of trade union behaviour in labour economics, the monopoly union model (as a special case of the more general right-to-manage model), and the efficient bargaining model. Both of these models are able to explain some, but not all, of the stylised facts in labour markets (Oswald, 1993). In the more narrowly related literature on the interaction between unionisation and FDI, however, virtually all contributions employ the monopoly union model. This approach provides a benchmark where wages are determined unilaterally by the union, whereas firms adjust their labour demand optimally in a later stage of the game. Stated differently, the union chooses its preferred point on the firms’ labour demand curve. We also adopt the monopoly union approach in this paper.

A further modelling choice is at which level the wage setting in country A takes place. In the following we assume that wages are set at the sectoral level, and hence that the same wage rate $w$ applies for all firms in sector $x$ of country A. One reason for this specification is that, at least in continental Europe, collective wage bargaining occurs predominantly at the industry level (see Cahuc and Zylberberg, p. 375, Table 1). Moreover, even if wage bargaining occurs at the firm level, these wage negotiations will typically be interdependent due to the competition for, and the intra-sectoral mobility of, workers with similar qualifications. These competitive processes exert pressure to eliminate wage differentials within the same sector. As emphasised by Calmfors (1993, p. 170), the correlation of wage outcomes negotiated at the firm level is particularly high in tradeable sectors, such as the unionised $x$ sector in our analysis.

Finally, we assume that the sector-specific union in country A is interested only in the nominal wage, and it neglects the effects of its wage setting behaviour on the output price in sector $x$. This is a simplification, but one that can be motivated rather straightforwardly. Since the union cares only about the workers in the $x$ industry, it
ignores the share of the output price increase that falls on workers in country A’s numéraire industry z. Moreover, the union also ignores the effects of the price increase of good x that are transmitted to the residents of country B as a result of market integration. In sum, therefore, the unionised workers in country A have few incentives to exert wage restraint in order to keep down the consumer price of good x.

In Regime B, the sector-specific union faces only one local firm in the x sector, the internationally immobile incumbent a. Given the above assumptions, the union maximises the sector-specific wage surplus, subject to the optimal output adjustment of firm a in (5b). Denoting the sectoral wage surplus by Ω, the regime-specific maximisation problem is

\[(RB) : \max_{w^B} \Omega^B = ns(w^B - \bar{w}) = x_a^B(w^B - \bar{w}).\]  

(9)

The wage rate that maximises the objective function of the union is

\[w^B = \frac{(\alpha + 3\bar{w})}{4},\]  

(10)

resulting in a wage surplus for country A’s union in Regime B equal to

\[\Omega^B = \frac{(\alpha - \bar{w})^2}{24\beta}.\]  

(11)

### 3.3 Stage 3: The location decision of the MNE

We assume that the MNE sets up a subsidiary in either country A or country B. Firm c will be indifferent as to where to settle down when its net-of-tax profits are the same in the two countries. From (8) and the lump-sum taxes \(t_i\) this condition reads

\[\pi^A_c - t_A = \pi^B_c - t_B \iff \frac{(\alpha - w^A)^2 - (\alpha - 2\bar{w} + w^B)^2}{9\beta} = t_A - t_B.\]  

(12)

In what follows we assume that the MNE will locate in country A whenever it is indifferent between the two locations. At the time when it takes its location decision, firm c correctly anticipates that, in Regime B, the union will renegotiate the wage with the remaining incumbent firm in its jurisdiction and set \(w^B\) according to (10). Substituting this wage into (12) we can then solve for the wage rate in Regime A that keeps the firm indifferent between the two locations. The relevant solution is

\[w^A_{\text{max}} = \alpha - \frac{\delta}{4}, \quad \delta \equiv \sqrt{25(\alpha - \bar{w})^2 + 144\beta(t_A - t_B)}.\]  

(13)
Equation (13) gives the maximum wage that the outside firm $c$ is willing to pay in country $A$, as a function of the tax differential $(t_A - t_B)$. The critical wage rate $w_{\text{max}}^A$ 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.

### 3.4 Stage 2: The union’s wage setting decision

We now analyse the union’s wage setting decision. This wage is announced to the outside firm before the latter takes its location decision, but it will remain effective only if the union in country $A$ wants to attract the FDI and thus induces Regime $A$ in equilibrium. Hence our analysis in this section is confined to Regime $A$. Recall also from our discussion in section 3.2 that in this regime the union must choose a sectoral wage that applies for both firms $a$ and $c$. The union maximises the regime-specific wage surplus

$$(RA): \quad \max_{w^A} \Omega^A = ns(w^A - \bar{w}) = (x^A_a + x^A_c)(w^A - \bar{w}), \quad (14)$$

subject to the condition that the wage rate must be sufficiently low to attract the outside firm. Let us assume for the moment that the upper bound on $w^A$ in eq. (13) is indeed binding so that the union chooses the wage rate $w_{\text{max}}^A$. Substituting (13) and the firms’ output choices (5a) into (14), the union’s wage surplus in Regime $A$ is then

$$\Omega^A = \frac{[4(\alpha - \bar{w}) - \delta] \delta}{24 \beta}, \quad (15)$$

where $\delta$ is given in (13).

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 incumbent. Hence the union compares $\Omega^A$ in (15) with $\Omega^B$ in (11). Since the term $\delta$ includes the tax differential $(t_A - t_B)$, the union’s decision of whether to attract the outside firm will be affected by the tax rates that governments choose in the first stage. We assume that the union wants to attract the outside firm in the case where its wage surplus in Regimes $A$ and $B$ is just equal. Then setting $\Omega^A = \Omega^B$ yields the highest possible tax differential that will still induce the union to set the wage $w_{\text{max}}^A$. This tax differential
is denoted by a superscript $H$ and given by

$$ (t_A - t_B)^H = -\frac{(9 - 2\sqrt{3})(\alpha - \bar{w})^2}{72\beta} < 0. \quad (16) $$

We can directly infer from (16) that country $A$’s tax rate has to remain below $t_B$, in order for a Regime $A$ equilibrium to be feasible. Once $(t_A - t_B)$ surpasses the critical threshold in (16), the union will not find it profitable to attract the outside firm, and the location equilibrium will be in Regime $B$.

At this stage we cannot exclude the possibility that the union finds it optimal to charge a wage below the maximum wage that is compatible with a location equilibrium in Regime $A$. In this case condition (12) is not binding and the union’s unconstrained wage rate in Regime $A$, labelled $\tilde{w}$, is obtained by differentiating (14), using the firms’ output choices (5a). The resulting wage rate is

$$ \frac{\partial \Omega^A}{\partial \tilde{w}^A} = \frac{2(\alpha + \bar{w} - 2\tilde{w}^A)}{3\beta} = 0 \quad \Leftrightarrow \quad \tilde{w}^A = \frac{\alpha + \bar{w}}{2}. \quad (17) $$

We can then derive a tax differential $(t_A - t_B)^U$, which is defined by the equality of $w^A_{\text{max}}$ in (13) and the unconstrained wage $\tilde{w}^A$ in (17). This is

$$ (t_A - t_B)^U = -\frac{7(\alpha - \bar{w})^2}{48\beta} < 0, \quad (18) $$

which is unambiguously lower than $(t_A - t_B)^H$ in (16). Since $w^A_{\text{max}}$ is falling in $(t_A - t_B)$ whereas $\tilde{w}^A$ is independent of taxes, any tax differential below this critical value implies that $\tilde{w}^A < w^A_{\text{max}}$. In this case the tax rate in country $A$ is so low, relative to that of country $B$, that the union is not constrained by the condition to attract the outside firm. It optimally chooses $\tilde{w}^A$ according to (17) and since this wage is below $w^A_{\text{max}}$, the outside firm will surely locate in country $A$. We label this case Regime $A2$. In contrast, we denote by Regime $A1$ the case where the condition to attract the outside firm is binding and the union’s optimal wage is given by (13).

---

14Equation (15) is quadratic in the tax differential so that there are two solutions for $(t_A - t_B)$ that solve $\Omega^A = \Omega^B$. In between these two solutions the union prefers Regime $A$ to Regime $B$. Of the two solutions only the higher one, $(t_A - t_B)^H$, is of interest for our analysis. The second solution, denoted by $(t_A - t_B)^L$, is irrelevant because, at that low level of $t_A$, the constraint to make the outside firm indifferent between Regimes $A$ and $B$ is not binding for the union. Hence its optimal wage will be determined from an unconstrained problem, as is shown below in eq. (17).
Figure 1 illustrates the different regimes and shows the union’s optimized wage surplus as a function of the tax differential \( t_A - t_B \). The function \( \Omega^A(t_A - t_B) \) is concave and intersects the horizontal line with the wage surplus \( \Omega^B \) at the two tax differentials \((t_A - t_B)_L \) and \((t_A - t_B)_H \) (cf. footnote 14). Thus, for \( t_A - t_B > (t_A - t_B)_H \) the wage surplus in Regime A would fall below the threshold level \( \Omega^B \), implying that the union chooses a wage that leads to Regime B. For values of \((t_A - t_B)\) in between \((t_A - t_B)_U \) and \((t_A - t_B)_H \) the union is constrained by the requirement to attract the outside firm (Regime A1). For \( t_A - t_B < (t_A - t_B)_U \) this constraint is no longer binding. Hence the union chooses the wage \( \tilde{w}^A \) and attains its maximum wage surplus, \( \Omega^{A*} \), which is constant for all \( t_A - t_B < (t_A - t_B)_U \) (Regime A2).

We conclude this section by summarising the optimal wage policies of country A’s union, as a function of the taxes decided by governments in the first stage. These wages induce, in turn, location equilibria in the three regimes B, A1 and A2. Starting with high values of \( t_A - t_B \) gives:

\[
\begin{align*}
(RB): & \quad w = w^B = (\alpha + 3\bar{w})/4 \quad \text{if} \quad (t_A - t_B) > (t_A - t_B)_H; \\
(RA1): & \quad w = w_{\max}^A = \alpha - \delta/4 \quad \text{if} \quad (t_A - t_B)_U \leq (t_A - t_B) \leq (t_A - t_B)_H; \\
(RA2): & \quad w = \tilde{w}^A = (\alpha + \bar{w})/2 \quad \text{if} \quad (t_A - t_B) < (t_A - t_B)_U;
\end{align*}
\]  

where \( \delta \) is given in (13) and \( (t_A - t_B)_H \) and \( (t_A - t_B)_U \) are given in (16) and (18).

4 Stage 1: The governments

In the first stage, the two governments play a tax competition game with the strategic choices being lump-sum taxes or subsidies on the entry of the outside firm. The payoffs are given in (4a)–(4b). In a first step we substitute regime-specific output choices (5a)–(5b) in the union’s objectives (14) and (9) and use this along with prices, consumer surplus and profits from (6)–(8) in (4a)–(4b). This yields indirect utilities for each country in Regime A:

\[
\begin{align*}
V^A_A &= \frac{2n(\alpha - w^A)^2}{9\beta} + \frac{(\alpha - w^A)^2}{9\beta} + \frac{2(w^A - \bar{w})(\alpha - w^A)}{3\beta} + n\bar{w} + t_A + \sigma, \\
V^A_B &= \frac{2(1-n)(\alpha - w^A)^2}{9\beta} + (1-n)\bar{w};
\end{align*}
\]  

(20a)
and analogously in Regime $B$:

$$V_A^B = \frac{n(2\alpha - \bar{w} - w_B)^2}{18\beta} + \frac{(\alpha - 2w_B + \bar{w})^2}{9\beta} + \frac{(\alpha - \bar{w})^2}{24\beta} + n\bar{w};$$

$$V_B^B = \frac{(1 - n)(2\alpha - \bar{w} - w_B)^2}{18\beta} + (1 - n)\bar{w} + t_B + \sigma.$$  \hfill (20b)

In the expressions for $V_A$, the first term equals the consumer surplus, the second term is profit income from firm $a$, and the third term denotes the wage surplus $\Omega$. For country $B$, the first terms in $V_A^B$ and $V_B^B$ give the consumer surplus in market $x$.

To solve the tax competition game we proceed in two steps. We first derive the properties that a candidate tax equilibrium in Regime $A$ must have and then show that there is indeed a unique equilibrium of the first-stage game in Regime $A$. In the first step we show that in any candidate tax equilibrium in Regime $A$, the government of country $A$ wants to raise the tax rate up to the point where neither the outside firm nor the trade union receive a rent over their next best alternatives. This is given in:

**Lemma 1** If country $A$ is not too small ($n \geq 0.4$), then in any candidate tax equilibrium in Regime $A$ the tax differential is given by $(t_A - t_B)^H$ in (16), and the union sets the wage according to $w_{\text{max}}^A$ in (13).

**Proof:** See Appendix 1.

The technical proof for the lemma is relegated to the appendix, but the reasoning behind this result is easily explained with the help of Figure 1. First it is straightforward to see that, for any level of $t_B$, country $A$ will never set a tax that leads to an equilibrium in Regime $A2$. In this regime the wage rate is given by $\bar{w}^A$ in (17), which is independent of taxes. Hence in this regime an increase in taxes does not reduce the union’s wage surplus and its 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 country $A$’s optimal tax policy always implies that the union is not left with a wage surplus that exceeds its surplus in Regime $B$ [eq. (11)]. In other words, any candidate tax equilibrium will be at the boundary of Regimes $A1$ and $B$, rather than in the interior of Regime $A1$. Intuitively, a tax increase in country $A$ replaces wage surplus accruing to workers in sector $x$ by an equal amount.
of tax revenue. Lowering the wage rate, however, also creates an efficiency gain because it reduces the wage-induced output distortion in sector \( x \). In contrast, the lump-sum entry tax for the outside firm does not distort output decisions at the margin.

Lemma 1 holds only under the condition that \( n \geq 0.4 \) and hence that the population share of country A is not too small (see Appendix 1). Intuitively, a sufficiently high level of \( n \) ensures that country A internalises a substantial part of the increase in consumer surplus that results from lower wages in its \( x \) sector. A sufficiently strong effect on its consumer surplus will then induce country A to raise taxes, and thereby lower wages, throughout Regime A1. If \( n \) were instead very low, then country A would want to raise the wage rate and increase the union’s wage surplus at the expense of foreign consumers. This would lead to country A choosing a tax rate within Regime A1, to accommodate a higher wage demand of its union. This type of beggar-thy-neighbour policy is implausible, however, as countries generally do not have sufficient market power to improve their terms of trade by raising unionised wages. Our following analysis therefore focuses on the case where the condition \( n \geq 0.4 \) is fulfilled.

Lemma 1 has two implications that greatly simplify the tax competition game below. First, since country A’s optimal tax policy implies a tax differential equal to (16) for each value of \( t_B \), we can derive the wage rate that must necessarily hold in any candidate Regime A equilibrium. Substituting (16) in (13) gives

\[
(w^A)^* = \alpha - \left(\frac{2 + \sqrt{3}}{4}\right)(\alpha - \bar{w}) = \bar{w} + \left(\frac{2 - \sqrt{3}}{4}\right)(\alpha - \bar{w}).
\]

(21)

Note that this wage rate is above the competitive wage rate \( \bar{w} \), but it is below the wage rate that the union charges from the domestic incumbent in Regime B [see eq. (10)].

Second, Lemma 1 also implies that the union’s wage surplus is identical in the two regimes. Substituting (21) in (5a) and in the union’s objective function in Regime A [eq. (14)] gives country A’s wage surplus in any (potential) Regime A equilibrium:

\[
(\Omega^A)^* = \frac{(\alpha - \bar{w})^2}{24\beta} = \Omega^B.
\]

(22)

These results allow us to express regime-specific national welfare in each country as a function of exogenous parameters and tax rates only. We substitute \((w^A)^*\) from (21)
and $w^B$ from (10) into (20a) and (20b), respectively. This gives for Regime $A$:

$$V^A_A = \frac{[6 + (2n + 1)(7 + 4\sqrt{3})](\alpha - \bar{w})^2}{144\beta} + nw + t_A + \sigma;$$  

$$V^A_B = \frac{(7 + 4\sqrt{3})(1 - n)(\alpha - \bar{w})^2}{72\beta} + (1 - n)\bar{w};$$  

and analogously for Regime $B$:

$$V^B_A = \frac{(20 + 49n)(\alpha - \bar{w})^2}{288\beta} + n\bar{w}, \quad V^B_B = \frac{49(1 - n)(\alpha - \bar{w})^2}{288\beta} + (1 - n)\bar{w} + t_B + \sigma.$$  

(23b)

To derive the tax equilibrium, we set up the best response functions of the two governments. Starting with country $A$, its government will never make a tax offer that leaves the country worse off in Regime $A$, as compared to the allocation that results in Regime $B$. Hence, setting $V^A_A = V^B_A$ in (23a) and (23b) gives country $A$’s best offer tax rate $t^o_A$. This is the minimum tax that country $A$ is willing to accept, or the maximum subsidy that it is willing to pay, in order to host the firm:

$$t^o_A = \left[\frac{(16\sqrt{3} - 21)(1 - n) - 24\sqrt{3} + 15}{288\beta}(\alpha - \bar{w})^2\right] - \sigma. \quad (24)$$

Note that country $A$’s best offer tax rate is negative, even if no technological externality arises from FDI (i.e., if $\sigma = 0$). Hence country $A$ is willing to subsidise the outside firm, if it is forced to do so by a sufficiently low tax rate of country $B$. The willingness to pay subsidies results from the additional employment in the $x$ sector generated by the foreign investment. Country $A$’s best offer tax rate $t^o_A$ is further reduced (i.e., the subsidy is increased) by the full value of the technological spillover effect $\sigma$.

Moreover, we know from Lemma 1 that in any candidate equilibrium in Regime $A$, country $A$’s best response to the tax rate of country $B$ is implied by the critical tax differential $(t_A - t_B)^H$ in (16). Hence country $A$’s best response function is\(^\text{15}\)

$$t_A = \left\{ \begin{array}{ll}
    t_B - \frac{(9 - 2\sqrt{3})(\alpha - \bar{w})^2}{72\beta} & \text{if } t_B \geq \tilde{t}_B \quad (RA), \\
    \frac{[(16\sqrt{3} - 21)(1 - n) - 24\sqrt{3} + 15](\alpha - \bar{w})^2}{288\beta} - \sigma & \text{if } t_B < \tilde{t}_B \quad (RB). 
\end{array} \right.$$  

\(^{15}\text{Strictly speaking, the lower branch of country } A\text{’s best response function is a correspondence, as any value of } t_A \text{ that does not attract the outside firm yields the same welfare level for country } A.\)
The threshold value $\tilde{t}_B$, below which country $A$ stops matching successively lower taxes offered by country $B$ is given from substituting $t^*_A$ in (16):

$$\tilde{t}_B = \frac{[(16\sqrt{3} - 21)(1 - n) + 51 - 32\sqrt{3})(\alpha - \bar{w})^2}{288\beta} - \sigma . \quad (26)$$

In a similar way, we can set up the best response function of country $B$. This country’s best offer tax rate $t^*_B$ is obtained from equating $V^A_B = V^B_B$ in (23a) and (23b):

$$t^*_B = \frac{(16\sqrt{3} - 21)(1 - n)(\alpha - \bar{w})^2}{288\beta} - \sigma . \quad (27)$$

In the absence of spillovers ($\sigma = 0$), country $B$’s best offer tax rate is positive. The reason is that in Regime $B$ the union in country $A$ will set the high wage $w^B$ from (10), harming $B$’s consumers. Country $B$ wants to be compensated for this loss in consumer surplus by positive tax revenues, in order to be willing to attract the FDI.

In Regime $B$, country $B$’s best response to any given level of $t_A$ is to offer a tax rate that is marginally below the one implied by (16). If instead $t_A$ is so low that country $B$ no longer wants to attract the firm, then it will still want to ensure by its tax offer that the union in country $A$ does not receive a wage above $(w^A)^*$ in (21). The reason is that country $B$’s consumers are unambiguously hurt by high wages in country $A$. In this case country $B$ will just bid the tax implied by (16), as this ensures that country $A$ receives the firm. Hence the best response function of country $B$ is

$$t_B = \begin{cases} 
  t_A + \frac{(9 - 2\sqrt{3})(\alpha - \bar{w})^2}{72\beta} - \varepsilon & \text{if } t_A > \tilde{t}_A \quad (RB), \\
  t_A + \frac{(9 - 2\sqrt{3})(\alpha - \bar{w})^2}{72\beta} & \text{if } t_A \leq \tilde{t}_A \quad (RA);
\end{cases} \quad (28)$$

where $\varepsilon$ is a small positive number and $\tilde{t}_A$ is the threshold tax of country $A$ that makes country $B$ unwilling to attract the outside firm. It is derived by substituting $t^*_B$ in (16):

$$\tilde{t}_A = \frac{[(16\sqrt{3} - 21)(1 - n) + 8\sqrt{3} - 36](\alpha - \bar{w})^2}{288\beta} - \sigma < 0 . \quad (29)$$

Note that the structural difference between the best response functions lies in the lower branches of (25) and (28), respectively. Country $A$ is indifferent between all allocations in Regime $B$, due to the fixed wage rate in country $B$. In contrast, country $B$ prefers the allocation in Regime $A$ that minimises the wage rate $w^A$ and uses its tax policy accordingly.
To find the equilibria of the tax game we must look for mutually consistent pairs of tax offers. From (25) and (28) the equilibrium will be in Regime A if \( \tilde{t}_A > t_A^o \) holds. Intuitively, this implies that starting from high tax rates which are successively lowered, country B drops out of the bidding game before country A does. Conversely, a Regime B equilibrium is characterised by \( \tilde{t}_A < t_A^o \) (or, alternatively, by \( \tilde{t}_B > t_B^o \)). Comparing (24) and (29) shows that \( \tilde{t}_A - t_A^o = (32\sqrt{3} - 51)(\alpha - \bar{w})^2/(288\beta) > 0 \) is always fulfilled in our model. Hence there will be a tax equilibrium in Regime A with country A bidding the subsidy \( \tilde{t}_A \), whereas country B bids its reservation tax rate \( t_B^o \). This core result of our analysis is summarised in

**Proposition 1** In the tax/subsidy game between two countries that differ with respect to union power, the unionised country (country A) offers a location subsidy and attracts the outside firm in equilibrium. In particular, the tax pair

\[
\{\tilde{t}_A, t_B^o\} = \left\{ \frac{[(16\sqrt{3} - 21)(1 - n) + 8\sqrt{3} - 36](\alpha - \bar{w})^2}{288\beta} - \sigma, \frac{(16\sqrt{3} - 21)(1 - n)(\alpha - \bar{w})^2}{288\beta} - \sigma \right\}
\]

is an equilibrium of the tax competition game in the first stage, with the outside firm locating in country A.

**Proof:** See Appendix 2.

Proposition 1 is surprising at first glance, as the unionised country seems to be at a disadvantage in the location competition for the outside firm. Crucially, however, country A has an incentive to offer a subsidy to the firm which exceeds the MNE’s cost disadvantage of producing in country A. By subsidising the MNE, the government of country A can induce the union to moderate its wage in exchange for higher employment in sector \( x \) [recall from (10) and (21) that \( w^B > (w^A)^* \)], thus reducing the inefficiencies in country A’s labour and product markets.

Eq. (30) also shows that the positive spillover effect \( \sigma > 0 \), which is identical for the two countries, is fully reflected in a lower tax rate of the country attracting the outside

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16Since the outside firm receives a subsidy in this equilibrium, its after-tax profits exceed before-tax profits. Hence, a sufficient condition for firm \( c \) to locate in country A is that the fixed costs \( F \) of setting up a subsidiary do not exceed firm \( c \)'s before-tax profits.
firm in equilibrium (country $A$). Hence all benefits from the spillover accrue to firm $c$, as a result of tax competition between the two potential hosts.

********** Figure 2 about here **********

The tax competition game is illustrated in Figure 2. The figure shows that the equilibrium tax pair (30) is not the only one in our first-stage game. In fact, all tax rates $\tilde{t}_A \geq t_A \geq t_A^0$ are matched by mutually consistent tax rates of country $B$ [see the lower branch of eq. (28)]. Hence all these tax combinations lead to equilibria in Regime $A$ and have the property that the tax differential equals $(t_A - t_B)^H$ in (16). The reason for this multiplicity of equilibria is that, whenever country $A$ lowers its tax below $\tilde{t}_A$, country $B$ will fully match this tax reduction in order to minimise the unionised wage in country $A$, while at the same time ensuring that it does not attract the outside firm.

The particular Nash equilibrium given in (30) may, however, be regarded as the dominant equilibrium in our analysis (cf. Fudenberg and Tirole, 1991, pp. 20-21). This is because it is the Pareto optimal equilibrium from the perspective of the two governments taken together. Any other of the Nash equilibria involves lower tax revenues for country $A$ (to the benefit of the outside firm $c$) and no welfare change in country $B$. For this reason we will focus on the tax vector (30) in the following. At the same time, it is worth emphasising again that all possible Nash equilibria lie in Regime $A$.

We can compare the welfare levels in countries $A$ and $B$ in the tax competition equilibrium to the case where tax/subsidy instruments are not available (i.e., $t_A$ and $t_B$ are exogenously set to zero). In the absence of taxes, country $A$ cannot offer the outside firm any compensation for its higher wage and hence the firm will always locate in country $B$. Proposition 2 shows that being able to attract the outside firm by means of subsidies always lead to a welfare gain for country $A$, relative to the no-tax equilibrium

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17In the existing literature on tax competition for FDI, the country that loses the competition for FDI is typically indifferent between all bids that do not attract the outside firm(s). Hence a refinement of Nash equilibrium can be invoked to exclude multiple equilibria by arguing that countries will never play weakly dominated strategies. See, for example Barros and Cabral (2000, Figure 1), or Ferrett and Wooton (2010). The same argument cannot be used in the present analysis, however, because country $B$ is not indifferent between its bids in Regime $A$. 

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22
in Regime $B$. Moreover global welfare, defined as the sum of utilities in countries $A$ and $B$ plus firm $c$’s profits, also rises in the Regime $A$ equilibrium with tax competition, as compared to the no-tax equilibrium in Regime $B$. This is summarized in:

**Proposition 2** In comparison to a situation where tax rates are exogenously constrained to zero and the equilibrium is in Regime $B$, the tax competition equilibrium in Regime $A$ leads to: (i) higher welfare in country $A$; (ii) higher welfare in country $B$, if $\sigma$ is not too large; (iii) an increase in global welfare, defined as $V_A + V_B + \pi_c$.

*Proof:* See Appendix 3.

The intuition for these results is as follows. The subsidy paid by country $A$ in the tax competition equilibrium just compensates the outside firm for the higher wage that it has to pay in country $A$, and it transfers the rent from the technological spillover to the firm. However, country $A$ appropriates the efficiency gains that result from a Regime $A$ equilibrium. Global welfare rises because country $A$’s union accepts a lower wage in exchange for the higher employment in the outside firm, resulting in higher aggregate output of good $x$.\(^{18}\) For country $B$ there are offsetting effects. In the tax competition equilibrium, country $B$’s consumers gain from a lower wage rate in Regime $A$, but country $B$ loses the windfall gain from the technological spillover $\sigma$, which accrues to this country in the Regime $B$ equilibrium without taxes. Hence the welfare change in country $B$ is positive only if the spillover is not too large. The change in the outside firm’s profits is just the mirror image of the welfare change in country $B$. Therefore, the welfare increase in country $A$ equals the global welfare gain when FDI takes place in country $A$ as a result of (asymmetric) tax competition. In sum, tax competition serves to counteract the negative effects of trade unions in the present model.

Nevertheless, unions remain harmful for country $A$, as is seen from comparing per capita welfare, net of profit income, in countries $A$ and $B$. Subtracting country $A$’s profit income from (20a) and denoting the resulting welfare level by $(V_A^A)^w$ yields for

\(^{18}\)The output expansion is seen by substituting (21) and (10) in (6). This shows that the price for good $x$ in the integrated market is lower, and output is accordingly higher, when both firms produce in country $A$ at unit labour costs $w^A$, as compared to Regime $B$ where the outside firm produces in country $B$ at costs $\bar{w}$, but the incumbent firm in country $A$ has high unit labour costs $w^B$. 23
the comparison of per-capita utility:
\[
\frac{(V_A^w)}{n} - \frac{V_B^A}{(1-n)} = \frac{1}{n} \left[ (\Omega^A)^* + \hat{I}_A + \sigma \right] = \frac{[24\sqrt{3} - 45 + n(21 - 16\sqrt{3})](\alpha - \bar{w})^2}{288\beta n} < 0.
\]
This raises the question of why a union exists in country A, given that its presence is welfare-reducing, on average. One answer to this question is the presence of redistributive effects. The following proposition specifies the conditions under which unionised workers in country A are better off than they would be in the absence of the union:

**Proposition 3** If the share of country A’s workers in the unionised sector is below a critical value \( s^c \approx 0.39 \), then per-capita welfare of unionised workers in country A is higher than in the absence of the union.

**Proof:** See Appendix 4.

Proposition 3 holds if the share of country A’s workers in the \( x \) sector does not exceed a critical threshold. Intuitively the losses from having the union accrue equally to all workers through a reduction in consumer surplus, whereas the gains are concentrated among the group of unionised workers. The more workers are employed in the competitive sector \( z \) the higher is the share of the aggregate welfare costs of the union that are shifted to this group, and hence the more likely is it that the welfare of unionised workers can rise.

## 5 Extensions and discussion

In this section we examine the robustness of our results when some of the assumptions underlying our benchmark model are changed.

First, we briefly consider the case of price competition between the two active firms. In our benchmark model with homogeneous goods and no trade costs, Bertrand competition effectively eliminates all union power. The reason is that if the MNE locates in country B and faces the marginal wage \( \bar{w} \), the incumbent firm in country A will not have positive sales in the integrated market, unless the wage in this country also drops to \( \bar{w} \). This implies that the union loses its outside option and its wage surplus in equilibrium can be driven to zero by an optimising strategy of country A’s government. In
sum Bertrand competition is unable to account for empirically observed union power in the simple trade setting modelled here.

Next, we allow for exogenous variations in the welfare weight $\gamma$ of profit income in country $A$. In our benchmark model we have assumed that all sources of income are weighted equally, implying a value of $\gamma$ equal to one. More generally, $\gamma < 1$ represents a case where the government discounts profit income, relative to tax revenue and consumer surplus, whereas $\gamma > 1$ gives profit income a higher weight. The latter case can be interpreted as a reduced form representation of a lobbying model where firms make contributions to politicians in exchange for policies that raise their gross profits (see Grossman and Helpman, 1994). The welfare function in country $A$ then changes to:

$$U_A = n u_A = (\alpha - p) \frac{X_A}{2} + \gamma \pi_a + sn(w - \bar{w}) + n\bar{w} + t_A + \sigma.$$

It is shown in Appendix 5 that Proposition 1 is maintained for this generalised welfare function, as long as $\gamma \geq \gamma^c \approx 0.78$. Hence our result that country $A$ will attract the outside firm in equilibrium carries over to lobbying models and to objective functions where country $A$’s government does not discount domestic profits too heavily. Intuitively, the efficiency gains from the outside firm locating in country $A$ (cf. Proposition 2) partly accrue in the form of higher profits for the incumbent firm $a$, which faces a lower wage rate in Regime $A$. Therefore, country $A$ will internalise most of the efficiency gains, and choose its tax policy accordingly, provided that these profits enter its objective function with sufficient weight.

Another relevant extension arises when positive trade costs are incurred for shipping goods between countries $A$ and $B$. Following the related literature (e.g. Lommerud et al., 2003), we employ a segmented markets model where firms set prices separately in each market. In this setting with imperfect market integration, the relative size of national markets becomes directly relevant for the question of who attracts the firm in equilibrium. This case is analysed in Appendix 6. While the calculations are considerably more tedious, the basic mechanisms at work in this extended model are completely analogous to those in our benchmark case.

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The results of the model with trade costs are presented graphically in Figure 3. On the horizontal axis is country A’s market share in the region (n), whereas the vertical axis graphs per-unit transport costs τ between countries A and B. The upward sloping curve gives the locus of all (n, τ) combinations where optimised welfare in the two regimes is just equal for country A. As shown in Appendix 6, all equilibria in Regime A are then below and to the right of this curve, whereas equilibria in Regime B are to the left.

The graph combines two asymmetries that have been analysed in the previous literature. In the presence of transport costs, the larger country wins the competition for an outside firm, other things being equal (Haufler and Wooton, 1999). If instead two countries of equal size compete for an outside firm and trade costs partially separate markets, then the MNE will choose the less competitive environment and locate in the country without an incumbent firm (Bjorvatn and Eckel, 2006). These findings are also incorporated in Figure 3, as a larger domestic market size n makes it more likely for country A to attract the outside firm, whereas high transport costs strengthen the competitive advantage of country B, which does not have an incumbent firm.

When a sector-specific union is added to a model that includes these asymmetries, first intuition would suggest that the unionised country A needs to have other, compensating advantages in order to attract the FDI. Figure 3 shows, however, that the opposite is true and country A can win the competition for the outside firm, even if it has the smaller home market and it already hosts an incumbent firm. This occurs in the area underneath the regime frontier, but to the left of n = 0.5. Hence, the fact that country A has a domestic union is able to simultaneously offset two other (albeit limited) location disadvantages. In this sense Proposition 1 carries over to the more general setting analysed here.

When the trade costs in Figure 3 exceed a critical threshold \( \bar{\tau} \), trade will cease in at least one of the two regimes (see Appendix 6 for details). When trade costs become so high as to make exports from A to B unprofitable in Regime A, it is obvious that a Regime B equilibrium must result in order for B’s residents to be able to consume good x. Hence the case of prohibitively high trade costs requires a symmetric set-up with one internationally immobile, incumbent firm in each of countries A and B. In this case it is again true that the unionised country will attract the outside firm, even if it has a (limited) market size disadvantage vis-à-vis country B. Thus Proposition 1
also generalises to a setting with prohibitively high trade costs, if the model is adjusted to incorporate symmetric market conditions in the two countries.\footnote{See our working paper version, Haufler and Mittermaier (2008), for a full analysis of this case.}

Another alternative setting arises when the union’s wage policy affects all workers and causes unemployment in country $A$. In this model, the numeraire good $z$ is not produced with labour, but from an endowment of non-labour assets.\footnote{See Moriconi and Sato (2009) for a similar approach in a different policy setting. The complete sets of results for this extension, and the ones discussed in the following paragraphs, are available from the authors upon request.} Again, we address this issue in a setting with prohibitively high trade costs and an internationally immobile, incumbent firm in each of countries $A$ and $B$. Unemployed individuals in country $A$ receive an exogenous reservation wage $w^R$, which can be interpreted as the value of leisure for an unemployed worker. This reservation wage replaces the employment opportunities in the $z$ sector in our benchmark model. The reservation wage in country $A$ lies below country $B$’s wage rate $\bar{w}$, thus capturing the welfare costs of unemployment. In this model it can be shown that an exogenous reduction in $w^R$ (representing rising welfare costs of unemployment) increases the subsidy that country $A$ is willing to pay for the location of the outside firm. Therefore a lower critical market size of country $A$ is needed to ensure a Regime A equilibrium. In comparison to our benchmark case, which is equivalent to assuming $w^R = \bar{w}$, an equilibrium in Regime A is thus even more likely, other things being equal, if unemployment is incorporated into the analysis.

In the following we revert again to our benchmark model of an integrated region with zero trade costs. An important issue is whether, and how, the results of our model are affected when the sequence of play is altered. One alternative scenario is that 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. This setting changes the distribution of rents in comparison to our benchmark case. If the union in country $A$ has a first-mover advantage it will choose the sector-specific wage $w$ so as to just make country $A$’s government willing to set a sufficiently low tax rate in order to attract the outside firm. In other words, the government of country $A$ will then always have to bid its best offer tax rate $t^*_A$ [see eq. (24)]. However, it will still be true that the unionised country attracts the FDI in equilibrium and hence Proposition 1 carries
over to this alternative sequence of moves.

Another important assumption regarding the sequence of events is that the outside firm makes its location choice only after the wage is set by country A’s union. As we have discussed in section 2 this assumption can be motivated by the footloose nature of multinational firms, which allows them to relocate at low costs should the union increase its wage. In a more general set-up these relocation costs are explicitly introduced in a two-period framework where all stages of the first period are repeated in the second period, except for the stage where governments set taxes or subsidies. The simplest variant of this two-period model arises when the two governments set their policies only in period 1 and taxes are imposed, or subsidies are offered, conditional only upon the firm’s location decision in this period. Country A’s union can, however, re-optimise the wage rate in period 2 and the outside firm may relocate thereafter, albeit at a cost.

In this setting, it is straightforward to show that firm c will always (re-) locate in country B in the second period, if relocation costs are sufficiently low. This is an obvious result since no taxes or subsidies are paid in period 2, and hence there is no reason for the firm to accept a higher wage in country A than in country B. The interesting question is, however, whether country A can still attract the firm in the first period, where tax and subsidy policies are feasible. It turns out that this first-period analysis is completely analogous to our benchmark case, except that the outside firm has to be compensated for the lump-sum relocation costs that it faces when initially locating in country A (given that it will relocate in country B in period 2). Hence country A will attract the firm in period 1, if the efficiency gains resulting from the alleviation of labor and product market distortions in this country exceed the relocation costs of the firm. This condition is fulfilled for highly mobile firms with correspondingly low relocation costs. In this case aggregate welfare rises when the firm initially locates in country A (cf. Proposition 2), and hence the first-period location equilibrium will again be in Regime A.

The model just described can be interpreted as capturing the empirical observation that wages can be adjusted more often than tax policies. However, the model implies the complete absence of government activity in period 2. This is less than satisfactory, as it imposes the restriction that government subsidies cannot be made contingent on the duration of the firm’s presence in country A. This restriction is doubtful from both
a theoretical and an empirical perspective. A more general two-period model would thus allow governments to determine, in the first stage of the game, their optimal policies for both periods. In this case, it should then be possible that country A not only attracts the outside firm in period 1, but also keeps it in period 2, despite the union’s wage renegotiation. A rigorous analysis of this complex scenario is, however, beyond the scope of the present paper.

As a final note, we have chosen the most straightforward way to model asymmetric union power by assuming that a union is present in country A, whereas the labour market in country B is competitive. We expect our results to carry over qualitatively to the case where a union is also present in country B, but is less powerful than that of country A. If union power is fully symmetric in countries A and B, then the equilibrium location of the outside firm will be indeterminate, unless other relevant asymmetries are introduced into the model.

6 Conclusion

In this paper we have analysed a model of tax competition between two countries in an integrated region, of which one has a sector-specific union in an imperfectly competitive market, whereas the other country’s labour market is perfectly competitive. This model leads to the seemingly counterintuitive result that it is the unionised country which attracts an internationally mobile firm in equilibrium. In a model extension with positive trade costs, the unionised country can win the FDI even if it has other location disadvantages, such as a smaller home market. The core reason underlying our results is that the government of the unionised country will provide a generous tax environment to the firm as a means to induce wage moderation from its domestic union. Foreign

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22 For example, in the Nokia case mentioned in the introduction, the German state of Northrhine-Westphalia reclaimed parts of the subsidies that it had granted to Nokia’s Bochum plant during the 1990s, when this production unit was abandoned again in 2008.

23 A still different case arises when governments cannot commit to future tax policies, but they can re-optimise their policies at the beginning of period 2. In this case a hold-up problem arises that is well-known, for example, from the literature on tax holidays (e.g. Doyle and van Wijnbergen, 1994). A related setting is studied by Haupt and Krieger (2009), who analyse a two-period model of tax competition with relocation costs of imperfectly mobile firms (but without unions).
direct investment plays a crucial role in this process because it offers a discrete increase in employment opportunities when the union ‘cooperates’ in attracting the mobile firm. Our analysis may help to explain why high investment subsidies are commonplace in locations with high wages and union power. At the same time it may also provide a possible explanation for the puzzling result in several empirical studies that a high degree of unionisation is positively correlated with the likelihood of a given location to attract multinationals (Coughlin et al., 1991; Friedman et al., 1992). While these studies typically incorporate the regular rates of business taxes, they do not include specific location subsidies, on which the present analysis has focused. Incorporating such (direct or indirect) subsidies as an explanatory variable would thus allow a direct test of our theoretical hypotheses.

Our model can be extended in several directions. One possible route is to widen the set of policy instruments in the hands of governments and to include distortionary taxes. We would expect that the overall policy package in the unionised country is still more generous towards international investors, and hence that the unionised country will attract more FDI, other things being equal. A second possible extension is to relax the assumption of a monopoly union and replace it by a bargaining game between the union and the firm(s). In this setting the varying number of firms with which wages are negotiated in the different regimes would also affect the equilibrium outcomes. Finally, and most ambitiously, an extended model could allow for multi-period interactions between governments, the union and the multinational firm, when the latter can relocate in response to changing conditions in its host country but incurs some costs of doing so. We leave the analysis of these extensions to future research.
Appendix 1: Proof of Lemma 1

We start from country A’s indirect utility in Regime A, $V_A^A$, as given in (20a). In Regime A2, where the union’s wage is not constrained by the condition to attract the outside firm, we substitute $\bar{w}^A$ from (17) into (20a). This gives

$$V_A^{A2} = \frac{(2n + 7)(\alpha - \bar{w})^2}{36\beta} + n\bar{w} + t_A + \sigma.$$  

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

In Regime A1, we substitute $w_{max}^A$ from (13) into (20a). This gives

$$V_A^{A1} = \frac{\delta^2(2n - 5) + 24\delta(\alpha - \bar{w})}{144\beta} + n\bar{w} + t_A + \sigma,$$

where $\delta(t_A, t_B)$ is given in (13). Maximising with respect to $t_A$, for any given level of $t_B$, yields

$$t_m^A = \frac{(16 - 5n)(5n - 4)(\alpha - \bar{w})^2}{144(2 - n)^2\beta} + t_B.$$  

(A.2)

The second-order condition for a maximum is fulfilled, as

$$\frac{\partial^2 V_A^{A1}}{\partial t_A^2} = -\frac{864\beta(\alpha - \bar{w})\delta^{-3/2}}{\delta} < 0.$$  

(A.3)

Hence country A either sets $t_m^A$ in (A.2), or it raises its tax until it reaches the border to Regime B, where $(t_A - t_B)^H$ holds as given in (16). For any given $t_B$, country A thus wants to raise its tax throughout Regime A1 iff $t_m^A > t_A^H$. This condition is fulfilled if

$$\frac{(16 - 5n)(5n - 4)(\alpha - \bar{w})^2}{144(n - 2)^2\beta} - \frac{2\sqrt{3} - 9}{72\beta} (\alpha - \bar{w})^2 > 0 \quad \Leftrightarrow \quad n > 2 \left(3\sqrt{3} - 5\right) \approx 0.39.$$  

(A.4)

Hence, for any $n \geq 0.4$ the tax differential in any candidate equilibrium in Regime A is given by $(t_A - t_B)^H$ in (16). □

Appendix 2: Proof of Proposition 1

We first show that country A cannot gain from deviating from $\tilde{t}_A$ when country B sets $t_B = t_B^0$. First, consider $t_A < \tilde{t}_A$, which leads to a tax pair in the interior of Regime A1 [eq. (19)]. Differentiating (A.1) with respect to $t_A$ and re-substituting $\delta$ from (13) gives

$$\frac{\partial V_A^{A1}}{\partial t_A} = 2(n - 2) + \frac{12(\alpha - \bar{w})}{\delta}.$$  

(A.5)
Evaluating (A.5) at (30) and using \( n \geq 0.4 \) from Lemma 1 shows that \( \partial V^A_1 / \partial t_A > 0 \) at \( (\tilde{t}_A, t_B^*) \). Hence reducing \( t_A \) below \( \tilde{t}_A \) would be welfare-decreasing for country \( A \).

If instead \( t_A > \tilde{t}_A \) then, from the construction of \( \tilde{t}_A \), we get \( (t_A - t_B) > (t_A - t_B)^H \). Hence from (19) the union of country \( A \) will induce an allocation in Regime \( B \). Substituting \( \tilde{t}_A \) from (29) into \( V^A_1 \) [eq. (23a)] and comparing with \( V^B_1 \) [eq. (23b)] gives

\[
V^A_1 - V^B_1 = \frac{(32\sqrt{3} - 51)(\alpha - \bar{w})}{288\beta} > 0. \tag{A.6}
\]

Hence welfare in country \( A \) falls if \( t_A > \tilde{t}_A \), implying that \( \tilde{t}_A \) is country \( A \)'s optimal tax choice if \( t_B = t_B^0 \).

Next we ask whether country \( B \) can gain from deviating from \( t_B^0 \) when \( t_A \) is set at \( \tilde{t}_A \). If country \( B \) sets \( t_B < t_B^0 \) then \( (t_A - t_B) > (t_A - t_B)^H \), resulting in an allocation in Regime \( B \). By construction, \( t_B^0 \) is the minimum tax rate that country \( B \) needs to levy in order to be equally well off in Regime \( B \) as compared to Regime \( A \), i.e., \( V^B_1 (t_B^0) = V^A_1 \).

Since \( V^B_1 \) is rising in \( t_B \) [cf. (23b)], it must be true that \( V^B_1 (t_B < t_B^0) < V^A_1 \) and hence country \( B \) is worse off if it chooses \( t_B < t_B^0 \).

Finally we consider \( t_B > t_B^0 \). In this case the allocation remains in Regime A1 and there are no direct effects on welfare in country \( B \). However, from (13) the wage rate \( w^A_{max} \) rises as the union in country \( A \) exploits its increased wage setting power, reducing \( V^B_1 \) from (20a). Thus country \( B \) will be worse off by raising \( t_B \) above \( t_B^0 \). With neither country having an incentive to deviate from its tax policy, taking into account the adjustments in later stages of the game, the tax pair \( (\tilde{t}_A, t_B^0) \) represents a subgame-perfect Nash equilibrium of the first-stage game. \( \square \)

**Appendix 3: Proof of Proposition 2**

From eq. (8), the outside firm’s profits in country \( A \) are \( (\alpha - w^A)^2 / 9\beta \), and the profits in country \( B \) are \( (\alpha - 2\bar{w} + w^B)^2 / 9\beta \). From the maximization of the trade union [eqs. (10)], \( w^B > \bar{w} \), which implies from the trade union’s arbitrage condition that \( w^A > \bar{w} \) must also hold. Hence \( \pi^B_0 > \pi^A_0 \), implying that the outside firm always locates in country \( B \) when taxes are exogenously constrained to zero.

In Regime \( B \), welfare in country \( A \) is given by \( V^A_1 \) in (23b). In the tax competition equilibrium in Regime \( A \) country \( A \)'s welfare is given by \( V^A_1 \) in (23a), where the equilib-
rium tax rate $\tilde{t}_A$ from (30) must be substituted. This yields a welfare gain for country $A$ from the tax competition game, which is given in (A.6).

For country $B$ welfare in the absence of taxes is given by $V_B^B$ in (23b) where $t_B$ is set to zero. In the tax competition equilibrium in Regime $A$ country $B$'s welfare is given by $V_B^A$ in (23a). The welfare difference for country $B$ is thus:

$$V_A^A - V_B^B = \frac{(1 - n)(\alpha - \tilde{w})^2(16\sqrt{3} - 21)}{288\beta} - \sigma, \quad (A.7)$$

which is positive only if $\sigma$ is not too large.

Finally, firm $c$’s profits in the absence of taxes are given by $\pi_B^c = 25(\alpha - \bar{w})/144\beta$. The after-tax profits in the tax competition game are $\pi_c^A - \tilde{t}_A$. Substituting in from (21) and (30) and forming the difference yields

$$\pi_c^A - \tilde{t}_A - \pi_c^B = \frac{-(1 - n)(16\sqrt{3} - 21)(\alpha - \tilde{w})^2}{288\beta} + \sigma, \quad (A.8)$$

which is negative if $\sigma$ is not too large. Adding up (A.6)-(A.8) shows that the the change in global welfare from the tax competition game, in comparison to a scenario without taxes, equals the isolated welfare change in country $A$:

$$V_A^A - V_B^B \equiv V_A^A + V_B^A + \pi_c^A - \tilde{t}_A - (V_A^B + V_B^B + \pi_c^B) = \frac{(32\sqrt{3} - 51)(\alpha - \bar{w})}{288\beta} > 0.$$  

This demonstrates that global welfare is higher in the tax competition equilibrium, as a result of firm $c$ locating in country $A$. □

### Appendix 4: Proof of Proposition 3

From (20a) country $A$’s indirect utility, net of firm profits (superscript $w$), in Regime $A$ is

$$(V_A^A)_w = \frac{2n(\alpha - w^A)^2}{9\beta} + \frac{2(w^A - \bar{w})(\alpha - w^A)}{3\beta} + nw + t_A + \sigma.$$  

We substitute $(w^A)^*$ from (21) and $\tilde{t}_A$ from (30). To obtain the per capita welfare of a unionised worker, we divide tax revenues and consumer surplus by $n$ but the wage surplus by $sn$, as only the share of workers in sector $x$ enjoys the wage surplus. This gives

$$v_A^{\text{union}} = \left[ \frac{7 + 4\sqrt{3}}{72} + \frac{1}{24ns} + \frac{(21 - 16\sqrt{3})n + 24\sqrt{3} - 57}{288n} \right] \frac{(\alpha - \bar{w})^2}{\beta} + \bar{w}. \quad (A.9)$$

33
In the absence of a trade union, both countries are indifferent about attracting the firm, except for the technological externality \( \sigma \). This leads to \( t_i = -\sigma \) in equilibrium and both countries are indifferent about being in Regime A or B. Hence per capita welfare (without profit income) of all workers in country A amounts to

\[
v_{A}^{\text{union}} = \frac{2(\alpha - \bar{w})^2}{9\beta} + \bar{w}. \tag{A.10}
\]

Equating per capita welfare in (A.9) and (A.10) and solving for \( s \) yields the critical share \( s^c \) where unionised workers are indifferent between having the union or not:

\[
s^c = \frac{4}{19 - 8\sqrt{3} + 5n}. \tag{A.11}
\]

This share is falling in \( n \) and thus reaches its minimum at the maximum value of \( n \), which is unity. In this case \( s^c(n = 1) \approx 0.394 \). Hence \( s < 0.394 \) is a sufficient condition for each unionised worker to gain from having the union. □

**Appendix 5: The valuation of profit income in country A**

When profit income in country A is valued with the exogenous factor \( \gamma \), its welfare expressions in (20a) and (20b) change to:

\[
V_A^A = \frac{2n(\alpha - w^A)^2}{9\beta} + \frac{\gamma(\alpha - w^A)^2}{9\beta} + \frac{2(w^A - \bar{w})(\alpha - w^A)}{3\beta} + n\bar{w} + t_A + \sigma, \tag{A.12}
\]

\[
V_A^B = \frac{n(2\alpha - \bar{w} - w^B)^2}{18\beta} + \frac{\gamma(\alpha - 2w^B + \bar{w})^2}{9\beta} + \frac{(\alpha - \bar{w})^2}{24\beta} + n\bar{w}. \tag{A.13}
\]

With this extension, the condition that ensures Lemma 1 to hold (see Appendix 1) generalises to:

\[
144 - (7 + 4\sqrt{3})(2n + \gamma - 5)^2 > 0. \tag{A.14}
\]

Condition (A.14) is the more likely to hold, the larger is country A’s population size \( n \) and the larger is the valuation \( \gamma \) of firm \( a \)’s profits. Focusing on combinations of \( n \) and \( \gamma \) for which (A.14) is fulfilled, we can substitute \( (w^A)^* \) from (21) and \( w^B \) from (10) into (A.12) and (A.13), respectively. This gives for country A’s welfare in Regime A:

\[
V_A^A = \frac{[6 + (2n + \gamma)(7 + 4\sqrt{3})](\alpha - \bar{w})^2}{144\beta} + n\bar{w} + t_A + \sigma.
\]

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and analogously in Regime $B$:

$$V_B^A = \frac{(12 + 49n + 8\gamma)(\alpha - \bar{w})^2}{288\beta} + n\bar{w}.$$  

Setting $V_A^A = V_B^A$ gives a changed value for country $A$’s best offer:

$$t^o_A = -\frac{[(6 + 8\sqrt{3})\gamma + n(16\sqrt{3} - 21)](\alpha - \bar{w})^2}{288\beta} - \sigma. \quad (A.15)$$

In contrast, $t^o_B$ and hence $\tilde{t}_A$ are unchanged from (29). Comparing (A.15) and (29) gives the following condition for $\tilde{t}_A > t^o_A$, and hence for the tax competition equilibrium to lie in Regime $A$:

$$\tilde{t}_A > t^o_A \iff \gamma > \gamma^c \approx 0.78. \quad (A.16)$$

**Appendix 6: The model with positive trade costs**

We assume that there is a per unit trade cost of $\tau$ on each unit of good $x$ shipped between countries $A$ and $B$, whereas trade in the $z$ industry remains free. Assuming segmented markets, so that firms can maximise profits in each market independently, profits in the final stage of the game are

$$\pi_A^A = \pi_c^A = \frac{n(\alpha - w^A)^2}{9\beta} + \frac{(1 - n)(\alpha - \tau - w^A)^2}{9\beta}$$

if the outside firm $c$ goes to $A$. If it goes to $B$ then

$$\pi_a^B = \frac{n(\alpha + \bar{w} + \tau - 2w^B)^2}{9\beta} + \frac{(1 - n)(\alpha + \bar{w} - 2\tau - 2w^B)^2}{9\beta},$$

$$\pi_c^B = \frac{n(\alpha - 2\bar{w} - 2\tau + w^B)^2}{9\beta} + \frac{(1 - n)(\alpha - 2\bar{w} + \tau + w^B)^2}{9\beta}. \quad (A.17)$$

The quantities produced in the two regimes are

$$x_a^A = x_c^A = \frac{n(\alpha - w^A)}{3\beta} + \frac{(1 - n)(\alpha - \tau - w^A)}{3\beta}$$

and

$$x_a^B = \frac{n(\alpha + \bar{w} + \tau - 2w^B)}{3\beta} + \frac{(1 - n)(\alpha + \bar{w} - 2\tau - 2w^B)}{3\beta},$$

$$x_c^B = \frac{n(\alpha - 2\bar{w} - 2\tau + w^B)}{3\beta} + \frac{(1 - n)(\alpha - 2\bar{w} + \tau + w^B)}{3\beta}. \quad (A.18)$$
respectively. In stage 4, using these quantities in (9) and maximising with respect to \( w \) in Regime \( B \) gives

\[
w^B = \frac{1}{4} [\alpha + 3\bar{w} + (3n - 2)\tau], \quad \Omega^B = \frac{[\alpha - \bar{w} + (3n - 2)\tau]^2}{24\beta}
\]

(A.19)
as the union’s wage and the wage surplus in Regime \( B \). In stage 3, equating the multinational’s gross profit differential in the two countries to \((t_A - t_B)\), as in (12), solving this term for \( w^A \) and substituting \( w^B \) from (A.19) gives

\[
w^A = \alpha - (1 - n)\tau - \frac{1}{4}\sqrt{25(\alpha - \bar{w})^2 - 10(9n - 2)\tau(\alpha - \bar{w}) + (2 - n)(47n + 2)\tau^2 + 144(\tau_A - \tau_B)}
\]

(A.20)
which collapses to (13) for \( \tau = 0 \). In stage 2, we use (A.20) and (A.18) to calculate the wage surplus \( \Omega^A \). Equating this to \( \Omega^B \) in (A.19) yields

\[
(t_A - t_B)^H = \frac{1}{72\beta} \left[ -9(\alpha - \bar{w})^2 + 2(25n - 8)\tau(\alpha - \bar{w}) + n(23n - 48)\tau^2 + 2\sqrt{3\alpha - 3\bar{w} - 4(\alpha - \bar{w})\tau}(\alpha - \bar{w} + n\tau - \tau) \right],
\]

(A.21)
which reduces to (16) for \( \tau = 0 \).

In the first stage of the game, the governments maximise welfare in a way analogous to (20a) and (20b). The firms’ profits are given in (A.17) and the wage surplus of country \( A \)’s union is obtained by inserting (A.18) into (9) and (14). Consumer surplus in the different regimes amounts to

\[
CS^A_A = \frac{2n}{9\beta} (\alpha - w^A)^2, \quad CS^A_B = \frac{2(1 - n)}{9\beta} (\alpha - w^A - \tau)^2,
\]
\[
CS^B_A = \frac{n}{18\beta} (2\alpha - \bar{w} - \tau - w^B)^2, \quad CS^B_B = \frac{(1 - n)}{18\beta} (2\alpha - \bar{w} - \tau - w^B)^2
\]

(A.22)
Substituting (A.19), (A.20) and (A.21) into the welfare terms and equalizing country \( B \)’s welfare in the two regimes, we derive country \( B \)’s best offer tax rate as

\[
t^o_B = -\sigma + \frac{1}{288\beta} \left\{ -\left[ 7\alpha - 7\bar{w} - (3n + 2)\tau \right]^2 \\
+ 4 \left[ \sqrt{7(\alpha - \bar{w})^2 + 2(5n - 6)\tau(\alpha - \bar{w}) - (n^2 + 4n - 4)\tau^2 + 4\mu(\alpha - \bar{w} + n\tau - \tau) - 4n\tau} \right]^2 \right\}
\]

(A.23)
where
\[ \mu \equiv \sqrt{3(\alpha - \bar{w})^2 - 2(2 - n)\tau(\alpha - \bar{w}) + (4 - 5n)n\tau^2}. \]

It is straightforward to show that Lemma 1 also holds for \( n \geq 0.4 \) when \( \tau > 0 \). Intuitively this is because the presence of trade costs makes it less attractive for country A to pursue a beggar-thy-neighbour policy by means of high unionised wages. Hence we can add the tax differential \((t_A - t_B)^H\) from (A.21) to (A.23) to derive the tax rate that country A will optimally offer in a candidate Regime A equilibrium. Substituting this tax rate to get maximised Regime A welfare, \((V_A^A)^*\), and subtracting \(V_A^B\) determines under which conditions country A wants to host the firm. This difference is
\[
(V_A^A)^* - V_A^B = \frac{1}{288 \beta} \left\{ -51(\alpha - \bar{w})^2 + 2(127n - 38)(\alpha - \bar{w})\tau + n(197n - 324) - 12\right\} + 32\mu[\alpha - \bar{w} + (n - 1)\tau] \right\} , \quad \text{(A.24)}
\]

where \( \mu \) is defined above. Setting this welfare difference equal to zero yields the locus of all \((n, \tau)\) combinations where country A is indifferent about attracting the firm or not. This is the upward sloping curve labelled \((V_A^A)^* = V_A^B\) in Figure 3. Below this line \((A.24)\) is positive and a Regime A equilibrium results, whereas above the line \((A.24)\) is negative and the equilibrium is in Regime B.

To obtain the lowest prohibitive level of trade costs where firm \( a \) stops exporting to country B, we substitute the equilibrium wages \((A.19)\) and \((A.20)\) into the profit terms \((A.17)\) and set profits equal to zero. This yields a lowest prohibitive trade cost level of \( \bar{\tau} = (\alpha - \bar{w})/(3n + 2) \), which arises in Regime B. This upper limit on \( \tau \) is represented by the downward sloping curve in Figure 3.
Literature


Figure 1: Regimes, tax differentials and union welfare
Figure 2: The tax competition equilibrium in Regime A
Figure 3: Location of firm $c$ as a function of trade costs and market size

\[ \bar{\tau} = \frac{(\alpha - \bar{w})}{(2 + 3n)} \]

\[ (V^A)^s = V^B \]

Note: The figure is drawn for $\alpha = 10$, $\bar{w} = 8$, $\beta = 9$.  

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