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Unionized Oligopoly, Trade Liberalization and Location Choice

by

Kjell Erik Lommerud, Frode Meland, Lars Sørgard

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Unionized Oligopoly, Trade Liberalization and Location Choice*

Kjell Erik Lommerud† Frode Meland† Lars Sørgard‡

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Abstract

In a two-country reciprocal dumping model, with one country unionized, we analyze how wage setting and firm location are influenced by trade liberalization. We show that trade liberalization can induce a unionized firm to move all production abroad. This can not prevail in a corresponding, non-unionized model. Trade liberalization has a non-monotonic effect on wages. For a given location choice, trade liberalization increases national welfare in the unionized country. When a shift of some or all production to the foreign country occurs, national welfare can be reduced.

1 Introduction

Closer international economic integration is perhaps one of the most important societal trends in the last half of the 20^{th} century. Increased specialization, larger scales of production and harsher competitive pressures are likely to benefit consumers across the globe. Still, the globalization of our

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†Both: University of Bergen, Fosswinckelsgt. 6, N-5007 Bergen, Norway. E-mail: kjell.lommerud@econ.uib.no and frode.meland@econ.uib.no.

‡Norwegian School of Economics and Business Administration, Helleveien 30, N-5045 Bergen, Norway. E-mail: lars.sorgard@nhh.no.

economies is viewed with scepticism and fear by many. Will trade liberalization mean the end to decent pay and job security? Will the good jobs disappear to non-unionized foreign countries with more lax labor regulations, with "a great sucking sound", as Ross Perot so famously put it? In short; does globalization give capital the upper hand? Borjas and Ramey (1995) argue that increased trade can reduce the possibility for blue-collar workers to extract rents from their firm, and that this can help explaining the rising wage inequality in the United States - and find empirical support for their view. This type of studies is an important back-drop for the present work. More precisely, in a theoretical model with a trade union present in only one country, we ask how trade liberalization affects wages as well as firms' location choice.

A growing body of research studies theoretical models of international unionized oligopoly.[1] In turn, a subset of these papers study the impact of reduced trade barriers in an international unionized oligopoly framework. The papers that perhaps are closest to our own work are Naylor (1998, 1999). A key point in Naylor's analysis is that in many popular models of wage determination, wage claims are governed by the elasticity of labor demand rather than firms' profitability. When trade costs are lowered, there will be harsher competiton among the participants in an international oligopoly, but the output of the firms will go up, which in his framework (for a situation with two-way trade between the countries initially) implies that labor demand becomes less elastic. So while firms suffer a profit loss, unions will choose to set higher wages.[2] Because of the output expansion, employment nevertheless goes up, so unionized labor wins on both counts. This is undeniable a more rosy account of the impact of trade liberalization on the situation of unionized labor than the popular notions that for example are expressed in the above Ross Perot quote. The purpose of this paper is to extend Naylor's reasoning by allowing for foreign direct investment. We give firms two FDI options: production can be moved partially abroad, meaning that production

[1] A seminal paper is Brander and Spencer (1988). Their main focus is on how unions influence optimal strategic trade policy. Also Dowrick (1989) includes a trade union model where oligopoly rents are the source of union power. Mezzetti and Dinopoulos (1991) and Bughin and Vannini (1995) investigate the interrelationship between unionism and a firm's choice between serving a foreign market through exports or by investing abroad. In a different set-up, Zhao (1995) studies unionized international oligopoly and cross-hauling foreign direct investment. Straume (2001) studies the scope for collusion among firms and unions in an international oligopoly situation. However, none of these studies addresses how closer economic integration affects outcomes in unionized oligopolies.

[2] This inverse relationship between trade costs and wages is also found in Driffil and van der Ploeg (1995). It is consistent with some empirical findings from US manufacturing industries [see Gaston and Trefler (1994)].

for the foreign market is moved to that country, or fully abroad, meaning that also production for the previous home market is moved out. Precisely because of the tendency to wage increases after trade liberalization that Naylor points out, trade liberalization gives firm an increased incentive to capital flight, which is not the case in a corresponding model without unions. We will discuss later how firms choose between the two forms of capital flight, but at a general level we conclude that the capital flight option to a large extent restores the view that unionized labor has little to benefit from trade liberalization, even though the problem perhaps is more a job loss problem than a wage cut problem. We further show that trade liberalization can have a negative impact on welfare, so it is not only that unionized workers lose, but the gains of other groups are not big enough to offset this.

Foreign direct investments have been gaining in importance in world economic relations in recent decades. At the same time there has been a strong momentum towards trade liberalization. This is an apparent puzzle, as lower trade costs should favor serving a foreign market through exports rather than through building up production capacity abroad. The usual explanation is that this is the interplay of opposing forces: Trade liberalization points at more exports, but "something else" (as the fixed costs of establishing foreign plants going down in parallel with the marginal trade cost) leads the firms to undertake more FDI [see, e.g., Markusen and Venables (1998)]. Our point is that in an international unionized oligopoly model it can be explained how trade liberalization can *cause* FDI.[3]

We use - as does Naylor - a standard linear demand international oligopoly model with segmented markets, where monopoly unions set wages, but where employment determination is left to the discretion of the firm. Economic integration is pictured as a marginal decrease of the trade cost that is incurred when goods are delivered from one country to the other. Driffil and van der Ploeg (1993, 1995) study economic integration in a similar way, but apply a model of monopolistic, rather than oligopolistic competition.[4] Alternatively, Sørensen (1993, 1994) and Huizinga (1994) compare autarchy with full integration. It is noteworthy that these latter models yield predictions that sometimes are in apparent contradiction to those that come out of Naylor's analysis. For example, they predict that trade liberalization leads the union

[3]However, the only empirical study which, to our knowledge, tests on a disaggregate level the relationship between trade costs on the one hand and exports/FDI on the other, does not support the standard theoretical prediction. Feinberg, Keane and Bognanno (1998) test how MNCs and their affiliates responded to US-Canada tariff reductions. They find that tariff reductions led to more foreign direct investment rather than more exports.

[4]The main focus in these latter articles is on the effects of national versus international unionism.

wage to fall, whereas Naylor predicts that it will rise. The contradiction is only apparent, though, because also Naylor's model predicts that the wage under autarchy is higher than the one under full integration. But *given* that trade costs are sufficiently low as to induce two-way trade, a still lower trade cost will increase the wage. It can be argued that Naylor's modeling approach encompasses that of Sørensen and Huizinga, which is why we have chosen to work with a model quite close to Naylor's framework.[5]

Our model is, however, different from Naylor's work along especially two important dimensions.We have already mentioned that a central focus in this paper is on the choice firms make between exports and FDI. Naylor assumes that a firm can only supply a foreign market through exports, while foreign direct investment is ruled out by assumption.[6] Another important difference between Naylor's work and ours lies in the fact that he studies a situation where unions are equally powerful in the two relevant countries. We study trade liberalization where a union is active in one of the countries, but not in the other, perhaps a natural assumption when capital flight is of key interest.[7] The motivation for modeling such an asymmetry is that there are indications that labor market structures differ even between countries that are apparently quite similar. For example, wage rates vary a great deal between European countries.[8] Of course, both our assumption of non-unionized labor in the foreign country and Naylor's assumption of equally powerful trade unions should be seen as benchmark cases.

We would also like to mention that even if the results that are highlighted in the introduction apply in the case of trade liberalization from initially "low" trade costs ("low" being defined by the existence of two-way (cross-hauling) trade between the countries), we will investigate the effects of trade liberalization for all possible levels of initial trade costs. This is in line with Naylor (1999), but not Naylor (1998).

The paper is organized as follows: Section 2 presents the model outline.

[5] Andersen and Sørensen (1993) and Danthine and Hunt (1994) model trade liberalization as an increase in the elasticity of substitution between domestic and foreign goods.

[6] This applies both for Naylor's 1998 paper and the 1999 one. Naylor and Sanoni (1998), however, explicitly consider foreign direct investment in a framework corresponding to that used in Naylor (1998, 1999). This time the possibility of serving a foreign market through exports is ruled out by assumption, so again the choice between exports and foreign direct investment is not studied.

[7] Munch (1999) investigates a two-country general equilibrium model where bargaining power of unions differs among countries. Note, however, that he does not raise the issue whether a firm should export or install a local production unit in the foreign country.

[8] Durand, Madaschi and Terribile (1998) find significant cross-country differences in manufacturing wages between European countries, even if cross-country differences in productivity are taken into account.

The model can be described as a three-stage game. In section 3, we analyze the third stage of the game in which firms in an international oligopoly choose outputs. Given the nature of the previous stages of the game, we have to consider three possible trade/location regimes at this stage. In section 4, we analyze the second stage of the game in which monopoly unions set wages. Again, outcomes are regime-contingent. In section 5, we analyze the firm's subgame perfect location choice. We show how these choices vary with trade costs. We also consider the non-union benchmark case as a comparison with our main results. Section 6 discusses welfare implications and section 7 concludes.

2 The model

We consider two countries, denoted H (home) and F (foreign), and two producers, denoted A and B. Initially, producer A is located in the home country and producer B similarly resides in the foreign country.[9] There is a monopoly trade union in country H, whereas labor is assumed non-unionized in country F. Output is produced in a constant returns to scale process, with labor as the only input. Letting x and y denote A's sales and u and v denote B's sales in the home and foreign countries, respectively, we assume inverse demand in the two countries to be symmetric and given by:

$$p = a - b(x + u) \tag{1}$$

$$q = a - b(v + y) \tag{2}$$

$a, b > 0$. p is the price in the home country, while q is the price in the foreign country.

The difference in unionization across the two countries is assumed to imply higher costs of production in the home country relative to the foreign one. More specifically, we model a situation where the competitive wage in the two countries are equal ($\overline{w} \geq 0$) and the union in the home market sees this wage level as their reservation wage, setting wages to maximize a simple

[9] We could have extended the model by, say, introducing $n > 1$ foreign firms. That would change our quantitative results, such as the cutoff points between the regimes. However, it can be shown that our main findings would not change.

Stone-Geary type utility function:[10]

$$U = (w - \overline{w})z \tag{3}$$

z is A's production in the home market and equals $x + y$ in the case of no FDI.[11] $\overline{w} < a$ is assumed.

Given our assumptions, B is located in a low cost country, and we assume that this producer continues to produce only in that country. We look at a situation where FDI is potentially undertaken by firm A, and focus on two different ways for that firm to invest abroad. A can sink some fixed cost $J > 0$ to establish a new production facility in the foreign country, able to supply that market. We will call this strategy regime II. Regime I is the base case of no investment. However, by sinking another fixed cost G, A can instead move the entire home production unit to the foreign country, enabling A to produce for both countries in the low-cost country. This strategy is referred to as regime III. The relative cost of these two investment strategies will be discussed later.

We assume competition between the two producers to be Cournot and adopt the segmented market hypothesis. Thus both firms choose separate quantities for the two markets. Furthermore, there is a per unit cost of trade, denoted $t \geq 0$, which is incurred by both producers if they attempt to export to the other country. Trade liberalization in our model is seen as a marginal reduction in this cost.

We model the game structure as follows: First, the home firm chooses whether to invest in the foreign market by either of the two ways described above, or not to invest at all. The most irreversible decision is arguably the one made by producer A concerning his location choice. In line with this reasoning, it is natural to let this decision be taken first. Next, we assume unions to set wages, whereupon the producers simultaneously choose quantities.[12]

[10] In this model, depending on trade costs and wages, either none, only one or both firms will export. Given that the wages are endogenously determined, it is not clear how the union and the firm should reach an agreement on whether to export, deter imports or adapt to imports. In a right-to-manage set-up this choice would have to be bargained over in parallel with wage determination. Using the monopoly union set-up allows both these decisions to be taken by the union, evading the problem. This consideration applies equally to the models of Naylor (1998, 1999).

[11] We have chosen this form for union utility to enable direct comparison of profits and union utility. Union utility and profits are here measured in terms of the same unit.

[12] This sequence of moves is the same as in Naylor and Santoni (1998), Bughin and Vannini (1995), Zhao (1995) and Collie and Vandenbussche (1998). On the other hand, if the trade union could credibly commit to a wage, results would change as unions could deter investment through their choice of wage level.

We solve, of course, by backward induction and the following sections discusses the three different stages starting with the production decision at stage three.

3 Stage 3: Production

We distinguish among three basic scenarios at the production stage: Either firm A has not invested (regime I), or it has invested in either of the two possible ways (regime II or III). In addition, the wage levels have already been determined. In addition to the three regimes, we also study a non-union benchmark where the wages in the two countries are assumed constant and equal.

3.1 Regime I

Here, the firm has not invested. Thus a simple two-plant, two country Cournot duopoly prevails where the two producers choose quantities as follows:

$$x, y = \arg\max_{x,y}[(a - b(x + u) - w)x + (a - b(v + y) - w - t)y] \quad (4)$$

$$u, v = \arg\max_{u,v}[(a - b(v + y) - \overline{w})v + (a - b(x + u) - t - \overline{w})u] \quad (5)$$

This is of course subject to the constraint that all production quantities should be non-negative.

It is easily demonstrated that the equilibrium sales are:

$$x, u = \begin{cases} \frac{1}{3}\frac{a-2w+t+\overline{w}}{b}, \frac{1}{3}\frac{a+w-2t-2\overline{w}}{b} & if \quad w \geq 2t + 2\overline{w} - a \\ \frac{a-w}{2b}, 0 & if \quad w < 2t + 2\overline{w} - a \end{cases} \quad (6)$$

$$v, y = \begin{cases} \frac{a-\overline{w}}{2b}, 0 & if \quad w \geq \frac{a+\overline{w}-2t}{2} \\ \frac{1}{3}\frac{a+w+t-2\overline{w}}{b}, \frac{1}{3}\frac{a+\overline{w}-2w-2t}{b} & if \quad w < \frac{a+\overline{w}-2t}{2} \end{cases} \quad (7)$$

A lower wage set by the union leads to higher output of the unionized firm in its home market and lower sales in this market by the foreign competitor. If the wage is sufficiently low, the foreign competitor will be totally shut out of the unionized firm's home market. Moreover, if the wage is below some treshold, the unionized firm will be able to export into the neighboring

market, and the lower the wage, the higher the market share of firm A and the lower the share of firm B, also in the foreign market.

3.2 Regime II

In this case, producer A has two plants, one in each country. Firm A's plant in the foreign country has by assumption lower costs than the one situated in the home country and will be used to supply the foreign country.

Given this assumption, the two producers choose quantities as follows:

$$x, y = \arg\max_{x,y}[(a - b(x + u) - w)x + (a - b(v + y) - \overline{w})y] \tag{8}$$

$$u, v = \arg\max_{u,v}[(a - b(v + y) - \overline{w})v + (a - b(x + u) - t - \overline{w})u] \tag{9}$$

The Nash equilibrium entails the same production levels as in regime I for the two firms in market H. This is secured by the segmented market hypothesis and the fact that production technology exhibits constant returns to scale, leaving the production decisions for the two markets independent. However, production for the foreign market changes:

$$v = y = \frac{1}{3}\frac{a - \overline{w}}{b} \tag{10}$$

This is simply the usual single market, linear demand Nash equilibrium where both firms have costs $\overline{w}$.

If the union sets a lower wage, this will still have the same effect in the home market, that the domestic market share goes up and that the foreign firm might even choose not to enter this market at all. In the foreign market, though, the link between union wage and market shares is broken. In regime II, unionized labor no longer has to take into account the effect of their wage decision on exports.

3.3 Regime III

Finally, if firm A chooses to move the entire home plant abroad, incurring a cost of G, production for the two markets are symmetric and for the case of the foreign country, equal to the production derived for regime II. For the home market, however, the situation has changed and the two producers now compete on equal basis, both incurring a trade cost when producing for market H.

$$x = u = \begin{cases} \frac{1}{3}\frac{a-\overline{w}-t}{b} & if \quad t \leq a - \overline{w} \\ 0 & if \quad t > a - \overline{w} \end{cases}$$

Of course, in regime III unionized labor no longer has a role to play, so all production levels are independent of union wages.

3.4 Non-union benchmark

In this case, we assume both producers to have marginal costs equal to $\overline{w}$. It is easily verified that the following equilibrium production patterns then emerge (for regime III they are the same as for the unionized case, so this is excluded):

$$x^I, y^I = v^I, u^I = \begin{cases} \frac{a-\overline{w}+t}{3b}, \frac{a-\overline{w}-2t}{3b} & if \quad t < \frac{a-\overline{w}}{2} \\ \frac{a-\overline{w}}{2b}, 0 & if \quad t \geq \frac{a-\overline{w}}{2} \end{cases} \tag{11}$$

$$y^{II} = v^{II} = \frac{a-\overline{w}}{3b}, x^I = x^{II}, u^I = u^{II} \tag{12}$$

The expressions found in this section constitute the equilibrium production patterns *given* wages and type of foreign direct investment. We now turn to union wage setting, which will also be contingent upon the chosen type of FDI.

4 Stage 2. Wage setting

In regime III, the unionized firm has moved all production facilities abroad, and the union no longer has a role to play. However, in regime I and II, the union faces different employment possibilities, which will induce it to follow different wage policies in the two regimes. We start out by investigating regime I, where there is no FDI. This means that we will be close to the model in Naylor (1999), and the differences between this wage schedule and the one found in Naylor, stems from the fact that here only one economy is unionized, not both. The regime I wage schedule and the consequent union utility levels can be derived straightforwardly from the expression found in

the previous section:

$$w^I = \begin{cases} \frac{1}{4}a - \frac{1}{8}t + \frac{3}{4}\overline{w} & if \quad t \leq (3\sqrt{2}-4)(a-\overline{w}) \\ \frac{1}{4}a + \frac{1}{4}t + \frac{3}{4}\overline{w} & if \quad (3\sqrt{2}-4)(a-\overline{w}) < t < \frac{5}{7}(a-\overline{w}) \\ 2t + 2\overline{w} - a & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{1}{2}(a+\overline{w}) & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{13}$$

$$U^I = \begin{cases} \frac{1}{48b}(2a - t - 2\overline{w})^2 & if \quad t \leq (3\sqrt{2}-4)(a-\overline{w}) \\ \frac{1}{24b}(a + t - \overline{w})^2 & if \quad (3\sqrt{2}-4)(a-\overline{w}) < t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{b}(a - t - \overline{w})(2t + \overline{w} - a) & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{1}{8b}(a-\overline{w})^2 & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{14}$$

In figure 1, we have plotted the wage level (top) and utility (bottom) against the trade cost (deflated by $(a - \overline{w})$) :

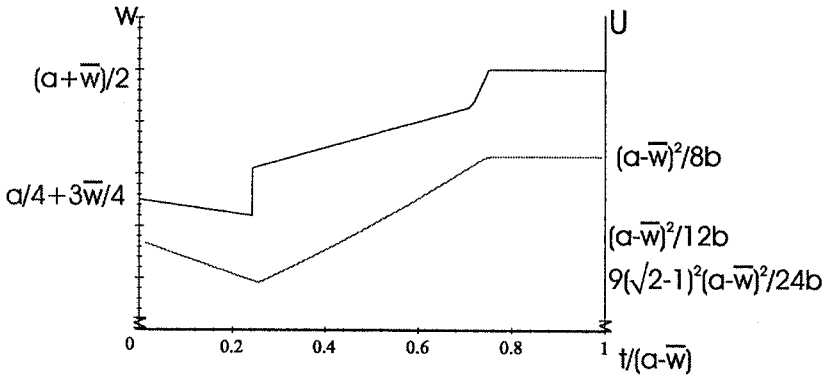

Figure 1. Union wage level and utility under regime I.

The wage function in regime I (and union utility) is piecewise linear with four segments, due to the following argument:

1. For small values of the trade cost, the union chooses to induce the unionized firm to export due to the employment benefit this induces

relative to a higher wage that does not induce the firm to export. In this situation, a lower trade cost increases wage demands because total production by the unionized firm gets less dependent upon the wage level as trade costs drop. This benefits the union. Qualitatively, this is the same effect as is central in Naylor's work (1998, 1999), but quantitatively, the wage increase following a trade cost reduction is smaller here than in Naylor's model. The Naylor model features an additional union in the foreign country. The two unions act as Bertrand competitors in a wage game to attract employment. Their wage levels are strategic complements. If both unions respond to the above incentive to increase wages as response to a trade cost reduction, this in turn gives both unions a strategic complementarity "push" to increase wages further.

2. Higher trade costs means less exports. As trade costs increase, the union benefits less and less from their export-inducing low-wage strategy (utility drops). At some point ($t = (3\sqrt{2} - 4)(a - \overline{w})$) it starts to pay for the union to opt for a high wage strategy that induces the home firm only to produce for the home market. There is a discontinuous rise in wage levels as the union switches employment strategy.[13] Beyond the switching point, wages increase with trade costs. Higher trade costs make home production by firm A less dependent upon wages, as imports from the foreign market competitor are reduced, to the benefit of the union.

   In Naylor's framework, this one-way trade, increasing-wage segment of the wage schedule is not present. This comes from our assumption of unionization in one country only, that naturally brings about one-way trade. Also, due to only modelling one union, we find a pure strategy equilibrium for intermediate trade costs, contrary to Naylor (1999).

3. There is a wage level that the union can set that just makes it unprofitable for firm B to export to the union's home market. For low trade costs, this import-deterring wage is too low relative to the employment benefits created by such a strategy. This changes as the trade cost becomes high enough: In the trade cost interval $\frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w})$, the import-blockading wage is precisely the optimal strategy. We are then in seeming autarchy, since no exports or imports take place, but the *possibility* of trade still influence outcomes.

[13] Union utility is of course not exhibiting any discontinuity at this point, because the union makes the switch at the point of indifference between the two strategies.

4. At some point, more precisely for $t > \frac{3}{4}(a - \overline{w})$, the proper autarchy wage – that is, the wage set if there was an exogenous ban on trade, is high enough to block imports, so from this point the proper autarchy wage prevails. In the language of industrial organization, imports no longer need to be *deterred*, but are *blockaded*.

We now turn to regime II, where production for the foreign market has been moved out to that country. In essence, from the viewpoint of the union, regime II is simply regime I without the export option. The wage and union utility in regime II is then simply:

$$w^{II} = \begin{cases} \frac{1}{4}a + \frac{1}{4}t + \frac{3}{4}\overline{w} & if \quad t < \frac{5}{7}(a - \overline{w}) \\ 2t + 2\overline{w} - a & if \quad \frac{5}{7}(a - \overline{w}) \leq t \leq \frac{3}{4}(a - \overline{w}) \\ \frac{a+\overline{w}}{2} & if \quad t > \frac{3}{4}(a - \overline{w}) \end{cases} \tag{15}$$

$$U^{II} = \begin{cases} \frac{1}{24}\frac{(a+t-\overline{w})^2}{b} & if \quad t < \frac{5}{7}(a - \overline{w}) \\ \frac{(a-t-\overline{w})(2t+\overline{w}-a)}{b} & if \quad \frac{5}{7}(a - \overline{w}) \leq t \leq \frac{3}{4}(a - \overline{w}) \\ \frac{1}{8}\frac{(a-\overline{w})^2}{b} & if \quad t > \frac{3}{4}(a - \overline{w}) \end{cases} \tag{16}$$

In regime II, the wage schedule is now piecewise linear with *three* segments. The low-wage strategy for the lowest trade costs, to induce exports, no longer makes sense. In reference to figure 1, the utility and wage level continues to drop as trade costs fall below $t = (3\sqrt{2}-4)(a - \overline{w})$. This means that the high-wage strategy wage line with one-way trade is prolonged into the range with the lowest values of t. Even though the wage now *drops* with lower trade costs, the wage is *higher* than it would be if no investment was undertaken. From the firm's viewpoint, this could constitute a serious negative effect from a regime II investment:

Remark 1 *For $t < (3\sqrt{2}-4)(a - \overline{w})$, a regime II investment has a negative strategic effect on the labor market in the home country. The union will choose a higher wage in regime II relative to regime I because it is no longer possible to induce exports by choosing a low wage.*

Note, however, that even if the domestic wage bill increases if FDI is chosen, this in no way means that the *total* wage bill goes up. Moreover, the fact that the wages are higher does not mean that union utility is higher, as the union would have chosen a lower wage voluntarily if it could induce exports.

5 Stage 1. Location choice

In this section, we start out discussing the non-union case to establish a benchmark. We then go on to discuss the effects determining the location choice when the home labor market is unionized.

5.1 Non-union benchmark

Profits for this case (denoted Π_{NU}) can easily be derived from the equilibrium production quantities from section 3 (eqs. (11) and (12), fixed costs excluded)

$$\Pi_{NU}^{I} = \begin{cases} \frac{1}{9b}[2(a-\overline{w})^2 - 2t(a-\overline{w}) + 5t^2] & if \quad t < \frac{a-\overline{w}}{2} \\ \frac{(a-\overline{w})^2}{4b} & if \quad t \geq \frac{a-\overline{w}}{2} \end{cases} \tag{17}$$

$$\Pi_{NU}^{II} = \begin{cases} \frac{2(a-\overline{w})^2+2t(a-\overline{w})+t^2}{9b} & if \quad t < \frac{a-\overline{w}}{2} \\ \frac{13(a-\overline{w})^2}{36b} & if \quad t \geq \frac{a-\overline{w}}{2} \end{cases} \tag{18}$$

$$\Pi_{NU}^{III} = \begin{cases} \frac{1}{9}\frac{(a-\overline{w})^2}{b} & if \quad t > a-\overline{w} \\ \frac{1}{9b}[(a-\overline{w})^2 + (a-\overline{w}-t)^2] & if \quad t \leq a-\overline{w} \end{cases} \tag{19}$$

The following figure plots these profits as a function of the trade cost:

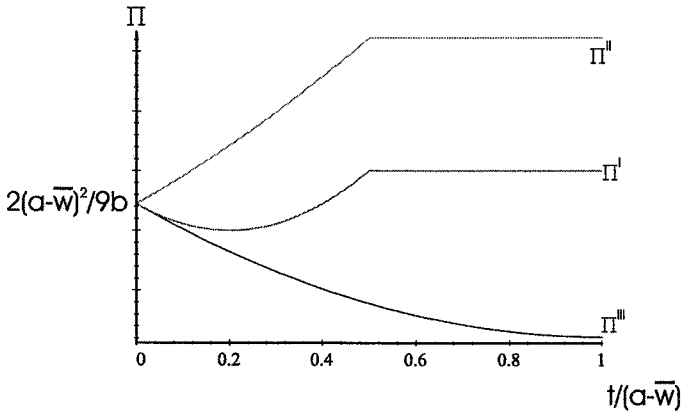

Figure 2. Profits in the non-unionized case.

In regime I, a reduction in trade cost has an ambiguous effect on producer A's profit. Lower trade cost results in more intense rivalry between firms. On the one hand, producer A is hurt by facing a more competitive rival - a rival with a lower trade cost - in its home market. On the other hand, producer A gains by becoming a more competitive rival in its neighboring market. In addition, producer A saves trade cost on its existing quantity of trade. The larger the amount of trade initially, the more goods are actually

physically transported between the countries, and the larger the direct cost saving. This explains why a reduction in trade cost has a negative impact on profits for high values of t - where trade is limited - and a positive impact on profits for low values of t.

In regimes II and III, the relationship between trade cost and profits is more straightforward. In regime II, producer A does not participate in international trade. The only effect of lower trade cost is a more competitive rival in country H, which hurts the profit of producer A. In regime III, both producers face lower trade costs to country H. As a result, both gain from a lower trade cost.

The figure also nicely illustrates the next proposition:

Proposition 2 *In the non-unionized case, moving all production abroad is never beneficial. For $t \geq \frac{a-\overline{w}}{2}$ firm A will invest in a plant to serve the foreign market (regime II) if the cost of this investment is less than the profit capture made possible by this investment in the foreign market ($\frac{1}{9b}(a-\overline{w})^2$). For $t \leq \frac{a-\overline{w}}{2}$, a trade cost reduction will make it less profitable/ more unprofitable to undertake this latter form of foreign direct investment.*

Proof. The proof of the two first parts of this proposition is straightforward. For a regime II investment when the starting point is not double autarchy, we have $\frac{d}{dt}(\Pi^{II}_{NU} - \Pi^{I}_{NU}) = \frac{4(a-\overline{w})-8t}{9b}$ This is positive for $t < \frac{a-\overline{w}}{2}$. ■

The intuition is also straightforward: Moving all production abroad makes transport to the foreign market cheaper and makes firm A more competitive in the foreign market, but this is more than outweighed by higher transport costs to the previous home market and the lost shelter from competition at home. The middle part of the proposition refers to regime II investment with double autarchy as starting point. Investing abroad then is the only way to gain access to the foreign market, but the profit earned must be compared with the fixed costs. When we are not in initial autarchy, the regime II option would only be chosen in order to avoid trade costs when serving the other market (tariff-jumping), and a lower trade cost makes this option less profitable. We can then conclude:

Remark 3 *In the non-unionized case, trade liberalization by itself does not trigger foreign direct investment.*

5.2 Location choice under unionization

Under unionization, FDI choices are steered not only by trade-cost jumping considerations; international wage differences also matter. Unionization

raises wages above the competitive level, which generally increases the attractiveness of FDI. This is a level effect. However, as we have seen, wages are dependent upon the trade costs and the strategy chosen. This will in turn influence how trade liberalization affects FDI decisions.

At stage 1, firm A will choose how and if it should invest abroad, anticipating the labor and product market responses to the strategy chosen.

Profits in regime I (for firm A), gross of any fixed investment cost, are easily calculated:

$$\Pi^I = \begin{cases} \frac{1}{72b}\left(4(a-\overline{w})^2 - 4(a-\overline{w})t + 37t^2\right) & if \quad t \leq \left(3\sqrt{2}-4\right)(a-\overline{w}) \\ \frac{1}{36b}\left(a+t-\overline{w}\right)^2 & if \quad \left(3\sqrt{2}-4\right)(a-\overline{w}) < t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{b}\left(-a+t+\overline{w}\right)^2 & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{1}{16b}\left(a-\overline{w}\right)^2 & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{20}$$

Profits gross of investment costs in regime II are similarly given by:

$$\Pi^{II} = \begin{cases} \frac{1}{36b}\left(5(a-\overline{w})^2 + 2(a-\overline{w})t + t^2\right) & if \quad t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{9b}(10(a-\overline{w})^2 - 18(a-\overline{w})t + 9t^2) & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{25}{144b}\left(a-\overline{w}\right)^2 & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{21}$$

The simplest case concerns regime III, where gross profits are as for the non-unionized case:

$$\Pi^{III} = \begin{cases} \frac{1}{9b}[(a-\overline{w})^2 + (a-\overline{w}-t)^2] & if \quad t \leq a-\overline{w} \\ \frac{1}{9b}\left(a-\overline{w}\right)^2 & if \quad t > a-\overline{w} \end{cases} \tag{22}$$

These profits are illustrated in the following figure as a function of trade costs:

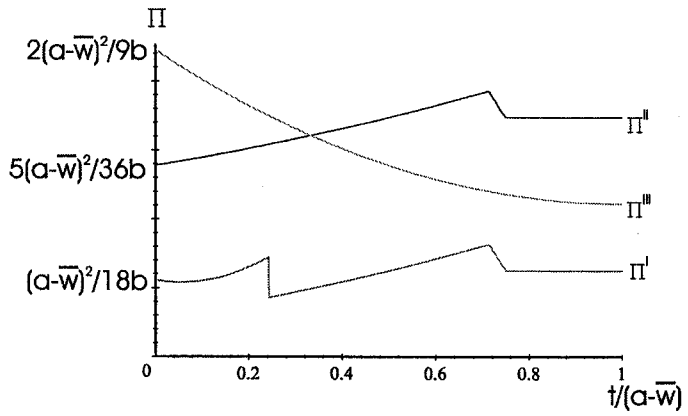

Figure 3. Profits for the unionized case

As we have already discussed, Π^{III} is the same as for the non-union case. We start out by commenting the shape of the Π^{I} curve (the case with no FDI). We start from high values of t and look at how trade liberalization changes profits. At the highest values of the trade cost we are in proper autarchy (blockaded imports). No trade takes place and the possibility of trade does not influence outcomes. Profits are at the one-market monopolist level (with unionized labor). The next segment still describes an autarchy situation, but here the union's wage is set, as it were, to deter imports from the foreign country. The lower the trade cost, the lower the wage, and the higher the profits. The third segment of the profit curves apply for one-way trade, from the low-cost foreign producer into firm A's home market. The lower the trade cost, the more competitive becomes the foreign firm. It is true that the union lowers the wage in response to this, but as we see, this does not rescue profits from falling with trade liberalization in this segment. The fourth and last segment describes two-way trade between the countries, which occurs at the lowest trade costs. Naylor's paradoxical result was that wages rise with lower trade costs here. The wages, though, are generally lower in this segment than would they have been if the union did not have to consider the impact on exports of their wage claims. The domestic firm gains easier access to the foreign market, at the same time the foreign firm gains easier access to the domestic market. The net effect is as for the non-union case: For high trade costs (within the two-way trade interval) a trade cost reduction reduces profits, while the inverse is true for low trade costs. However, due to the increasing wages, a trade cost reduction is profitable in a smaller interval than for the non-union case. It is worth noting that profits shoot up discontinously just at the point where the domestic firm starts to export.

There are two differences between profit curves Π^{I} (no FDI) and Π^{II}(FDI only to serve the foreign market). For intermediate and large trade costs (the three segments to the right where the domestic firm does not export, $t \geq (3\sqrt{2}-4)\,(a-\overline{w})$), the profits in regime I and II differ only by a constant. Establishing a foreign plant to serve the foreign market is here the only way to access the foreign market (due to excessive trade costs). The constant difference in profits represent the profits gained from this market access in equilibrium, $(\frac{1}{9b}(a-\overline{w})^2)$. For the three right-most segments of the profits curve, the effect of a marginal reduction in trade costs therefore is the same as in the no-FDI case. The second difference is that we do not have a two-way trade segment for the lowest trade costs: The foreign market is per definition served by a foreign plant, so there is no reason why a union should moderate its wage claims to induce exports.

For high trade costs, FDI is simply a matter of market access. For low

trade costs, FDI regulates *how* a foreign market shall be accessed, and union discipline also comes into the picture. Even if partial FDI can lift domestic wages, the number of domestic jobs go down, so the total wage bill falls.

Let us now consider the incentives for FDI in a unionized oligopoly. In the following Figure we report the profitability of each of the two forms of FDI relative to no investment, given that $G = J = 0$:

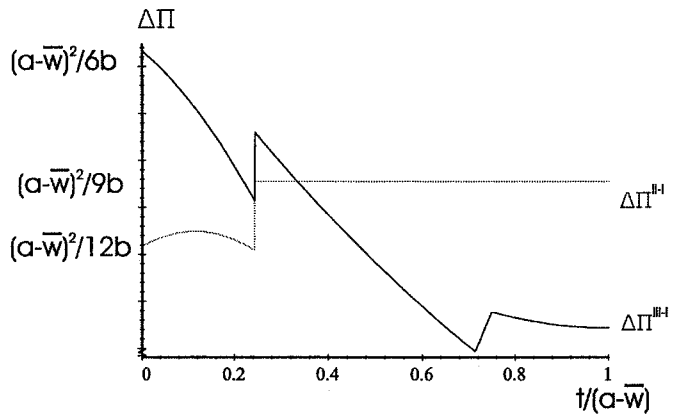

Figure 4. FDI-incentives

Note that if the investment cost is sufficiently close to zero, it will always be profitable for the firm to move either part of its production or all its production abroad. In contrast, in the non-unionized case moving all production abroad was never profitable. The intuiton is straight forward. With a union there will always be a cost disadvantage by being located in the home country, and moving abroad would save costs. Then we have the following result:

Proposition 4 *In contrast to the non-unionized case, moving all production abroad can be beneficial for the unionized firm.*

The proof is left for the interested reader.

The slope of the curves in figure 4 tells us how trade liberalization affects the incentives to move production abroad for each of the two FDI cases (move some or all production abroad). A negative slope means that lower trade costs increases the profitability of FDI. We see from the figure that for almost all values of t a trade liberalization increases the profitability of moving all production abroad, and for some medium values of t a trade liberalization increases the profitability of moving some of the production abroad.

In the latter case, the reason is that trade liberalization triggers higher wages in regime I and lower wages in regime II which, in turn, makes the FDI alternative more attractive.[14] In the former case, moving all production abroad still avoids the higher wages in regime I. However, there is an additional mechanism at work. Lower trade costs would make it less costly to transport the good from abroad to the home country, which makes it more profitable to move all production abroad. Then we have the following remark:

Remark 5 *In the unionized case, trade liberalization may trigger foreign direct investment.*

Next, let us let us consider *what type* of FDI the domestic firm will choose, given that one of the forms of investment is taken for granted. Assuming $G = J$, we can plot the difference in profits for the two strategies:

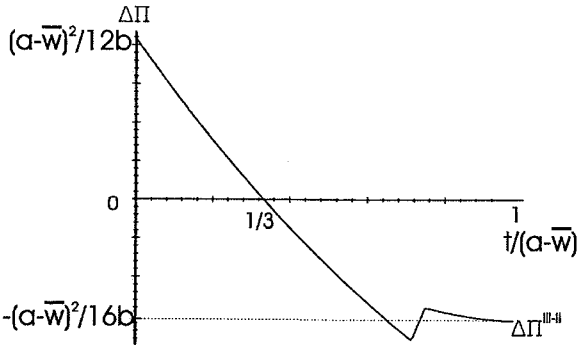

Figure 5. Relative profits from the two types of investment.

The actual investment strategy will of course depend upon the costs of the two FDI-choices. Assuming for the moment that the costs are equal, $G = J$, we see that if the costs are lower than the profits from market capture ($\frac{1}{9b}(a - \overline{w})^2$), firm A will prefer to invest in a new plant abroad for high trade costs, while moving the entire plant is more profitable for low trade costs. This is in line with our previous discussion. If investment costs are higher than $\frac{1}{9b}(a-\overline{w})^2$, the firm would choose not to invest for high levels of trade costs, but it could still opt to move all production abroad for low values of the trade costs. The profit gain from FDI can be substantially higher than the profit gain from pure market access. For low levels of trade costs, the "wage-jumping" effects are becoming more and more important as

[14]This argument also applies when figure 4 shows $\Delta\Pi^{II-I}$ to be increasing in trade costs. However, as we have seen, a trade cost reduction will eventually make profits in regime I increase with lower trade costs because the volume of trade becomes large, whereas profits in regime II drop in the relevant interval of trade costs. Thus in this case, the regime II FDI option becomes *less* profitable.

trade costs fall. Thus even though the costs of investment far outweigh the possible equilibrium profits in the foreign market, lower trade costs might induce a firm to shift all production abroad.

We could argue that G could be substantially different from J. In some industries, building a new plant might be much less expensive than moving the entire production equipment abroad. In other industries, the opposite might be the case. This does not change the above analysis in any fundamental way. Of course the cheaper alternative becomes more profitable relative to the other, expanding the trade cost interval where that alternative will be chosen. But as we see from the figure, G has to exceed J by no less than three fourths' of the duopoly profits in country F ($\frac{1}{12b}(a-\overline{w})^2$) to make building a new plant a better alternative than moving all production abroad no matter the level of trade costs.

If a trade cost reduction was accompanied by a reduction in the costs of investment, the results would not change significantly. For instance if both costs of moving all production abroad and investing in a new plant became cheaper, the two strategies become more profitable relative to non-investment, but the relative profitability of the two strategies are practically the same. If only one of the costs decrease (for instance investing in a new plant includes buying new machinery that is cheaper now, due to harsher international competition), this will make the relevant strategy more profitable, but still there could be a rather large difference in profitability of the two investment schemes. We summarize the discussion as follows:

Remark 6 *For a wide range of investment costs, the optimal investment strategy involves moving all production abroad for low trade costs, while for high trade costs, either the unionized firm would choose not to invest at all, or investing in a new plant abroad covering that market, and retaining the plant at home.*

6 Welfare analysis

In this section we compare equilibrium profits with union utility and consumer surplus. We assume consumer surplus to be approximated by the usual triangle under the demand curve given by:

$$CS^i = \frac{b}{2}(x^i + u^i)^2 \tag{23}$$

where i denotes the regime in question.

Before we go on to investigate the welfare implications of *shifting* regime by investing abroad, we determine the effects of a trade cost reduction *within*

each of the three possible regimes. We have already discussed the profit and union utility responses to a trade cost reduction in all regimes, so let us start by discuss how trade liberalization affects consumer surplus.

6.1 Consumer surplus

Using the results from the previous sections, we can readily calculate consumer surplus in the three different regimes:

$$CS^I = \begin{cases} \frac{49}{1152b}\left(2(a-\overline{w})-t\right)^2 & if \quad t \leq \left(3\sqrt{2}-4\right)(a-\overline{w}) \\ \frac{1}{288b}\left(7(a-\overline{w})-5t\right)^2 & if \quad \left(3\sqrt{2}-4\right)(a-\overline{w}) < t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{2b}\left(a-\overline{w}-t\right)^2 & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{1}{32b}\left(a-\overline{w}\right)^2 & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{24}$$

The above expression also depicts consumer surplus in regime II for $t > \left(3\sqrt{2}-4\right)(a-\overline{w})$. However, the regime II consumer surplus is given by $\frac{1}{288b}\left(7(a-\overline{w})-5t\right)^2$ for $t \leq \left(3\sqrt{2}-4\right)(a-\overline{w})$. For regime III, consumer surplus is given by:

$$CS^{III} = \frac{2}{9b}\left(a-\overline{w}-t\right)^2 \tag{25}$$

These expressions are plotted against trade costs in figure 6:

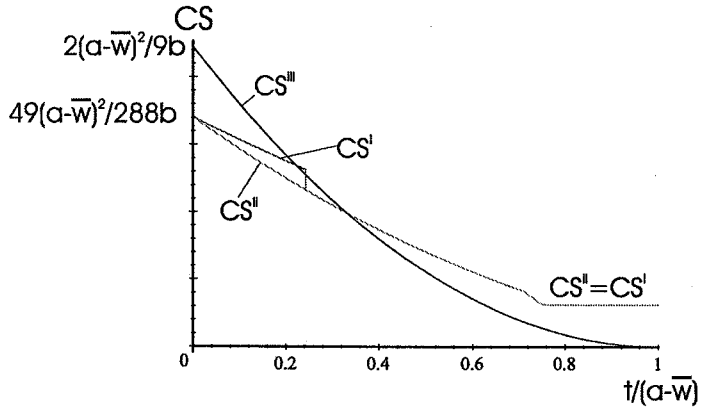

Figure 6. Consumer surplus in the three regimes.

As we would expect, consumer surplus is everywhere non-increasing in trade costs, no matter the investment strategy chosen by firm A. When we compare regimes I and II, consumers are only affected by this type of investment for low trade costs (when there is two-way trade): FDI then takes

away the home workers incentive to moderate wage claims, so prices go up and output down, and consumers lose. As we can observe from the figure, for low trade costs consumer surplus in regime III is larger than in either of the two other regimes. Competition is harsher after a complete outward move of production and for low trade costs the extra cost of transport back to the home market is of little significance, so in sum consumers benefit.

6.2 National welfare

We will now briefly discuss how national welfare changes with trade costs within each of the three regimes, before turning to discussing if firm A has correct FDI-incentives from a welfare viewpoint.

National welfare in the three regimes can readily be calculated as the sum of consumer surplus, union utility and profits for firm A. We assume that the costs of investment are real resource costs, and they influence national welfare through their deduction in firm $A's$ net profits. However, initially we leave these costs out, since they only apply if the firm decides to change regimes.

National welfare in the three regimes is:

$$NW^I = \begin{cases} \frac{356(a-\overline{w})^2-356t(a-\overline{w})+665t^2}{1152b} & if \quad t \leq (3\sqrt{2}-4)(a-\overline{w}) \\ \frac{23(a-\overline{w})^2-10t(a-\overline{w})+15t^2}{96b} & if \quad (3\sqrt{2}-4)(a-\overline{w}) < t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{2}(a-\overline{w}-t)\frac{a-\overline{w}+t}{b} & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{7}{32}\frac{(a-\overline{w})^2}{b} & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{26}$$

$$NW^{II} = \begin{cases} \frac{1}{288}\frac{101(a-\overline{w})^2-30t(a-\overline{w})+45t^2}{b} & if \quad t < \frac{5}{7}(a-\overline{w}) \\ \frac{1}{18}\frac{11(a-\overline{w})^2-9t^2}{b} & if \quad \frac{5}{7}(a-\overline{w}) \leq t \leq \frac{3}{4}(a-\overline{w}) \\ \frac{95}{288}\frac{(a-\overline{w})^2}{b} & if \quad t > \frac{3}{4}(a-\overline{w}) \end{cases} \tag{27}$$

$$NW^{III} = \begin{cases} \frac{1}{9}\frac{(a-\overline{w})^2}{b} & if \quad t > a-\overline{w} \\ \frac{1}{9}\frac{4(a-\overline{w})^2-6t(a-\overline{w})+3t^2}{b} & if \quad t \leq a-\overline{w} \end{cases} \tag{28}$$

This can be illustrated in the following figure (assuming again that $G = J = 0$):

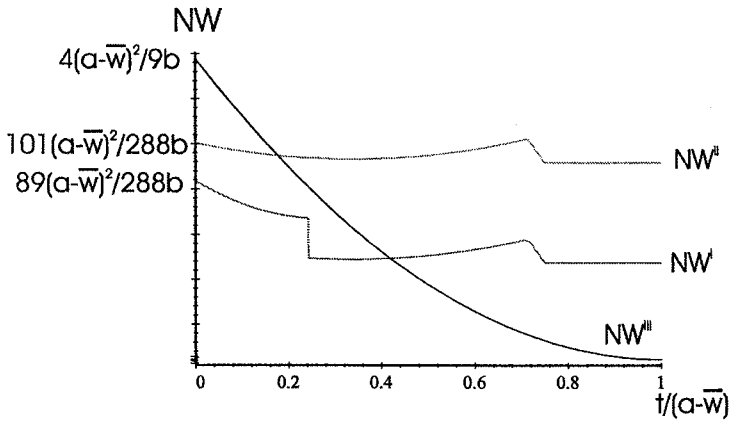

Figure 7. National welfare in the three regimes.

We see that even *within* a given regime, trade liberalization can be detrimental to national welfare. To illustrate this, let us consider the case with one-way trade. In regime I and II that is the third segment of the national welfare curves from the left. A lower trade cost is good for consumers, as the foreign firm becomes a more potent competitor in the market under study. Domestic firms and workers suffer. In sum the effect on welfare is negative. A basic reason is that the increased profits earned by the foreign firm as trade is liberalized, does not count in national welfare.

We now turn to study whether or not the domestic firm has correct investment incentives from a welfare viewpoint. As we observe from the figure, national welfare in regime II is always higher than for regime I (remember that investment costs are set to zero). For the case of high trade costs, this is entirely due to the profits accrued by investing abroad, as union utility and consumer surplus is not affected by this move. However, for low trade costs ($t < (3\sqrt{2} - 4)(a - \overline{w})$), the difference is lower due to unions lowering their wage demands to induce exports in regime I, which in turn gives lower domestic prices, higher union utility and higher profits from the home market for firm A. National welfare is only higher in regime III for low trade costs. In this case, the higher profits and the possibly increased consumer surplus from investing abroad more than compensate for the drop in union utility that follows a complete move of all production equipment.

When we take into account the costs of investment, the picture of course changes. But as we saw from section 5, for high trade costs, a regime II investment will typically be undertaken by firm A if the cost of this investment is lower than the equilibrium profits in the foreign market. Thus:

Remark 7 *For high trade costs, an investment strategy as suggested by Remark 6 will be undertaken if and only if it is welfare improving.*

For low trade costs, the above result does not apply. Focusing on the two-way trade situation, we can show that there might be over-investment:

Proposition 8 *For $t < (3\sqrt{2}-4)(a-\overline{w})$, a regime I producer has, from a national welfare point of view, too large investment incentives.*

Proof. For $t < (3\sqrt{2}-4)(a-\overline{w})$, the following identities are easily calculated:

$$\Delta NW = NW^{III} - NW^{I} = \frac{1}{1152}\frac{156(a-\overline{w})^2 - 412t(a-\overline{w}) - 281t^2}{b} \tag{29}$$

$$\Delta\Pi = \Pi^{III} - \Pi^{I} = \frac{1}{72}\frac{12(a-\overline{w})^2 - 12t(a-\overline{w}) - 29t^2}{b} \tag{30}$$

Now,

$$\Delta NW - \Delta\Pi = -\frac{1}{1152}\frac{36(a-\overline{w})^2 + 220t(a-\overline{w}) - 183t^2}{b} \tag{31}$$

It is easily shown that $\Delta NW^{I} - \Delta\Pi^{I} < 0$ in the relevant interval $t < (3\sqrt{2}-4)(a-\overline{w})$. Thus if the firm is initially a regime I producer, for costs G of moving production abroad such that $\Delta NW < G < \Delta\Pi$, the firm will invest and this will lead to decline in national welfare.[15] ■

If the firm shifts all production abroad, union utility will of course fall. Furthermore, consumer surplus rises (except in the special case of a shift from regime I to regime III for t close to $(3\sqrt{2}-4)(a-\overline{w})$; see figure 5). However, the rise in consumer surplus is smaller if firm A is initially a regime I producer. It can be shown that the fall in union utility is larger than the gain in consumer surplus (for t close to $(3\sqrt{2}-4)(a-\overline{w})$ there is no gain). Consequently, national welfare increases by less than profits from the investment.

The above results suggest that a transition from high to low trade costs might bring about too large investments. Our next result reverses this notion if trade costs fall from a situation where they are already sufficiently small to induce two-way trade:

Proposition 9 *A trade cost reduction makes the potential problem of too much investment lower.*

[15] We also assume that G is such (relative to J) that the regime III investment is better for the firm than the regime II investment, in line with remark 6.

Proof. We have (in the relevant interval)

$$\frac{d}{dt}(\Delta NW - \Delta\Pi) = -\frac{1}{1152}\frac{220(a-\overline{w}) - 366t}{b} < 0$$

■

Starting with regime I, we know that a trade cost reduction increases wages and union utility. It can easily be shown (indeed it is evident from figure 5) that the gain in consumer surplus from a transition to regime III is larger the smaller the trade cost. These two effects work in opposing directions as to the total effect of a trade cost reduction. However, the latter effect dominates the first, and consequently the sum of consumer surplus and union utility from such a move increases. As a result, the difference between national welfare and profits decreases.

In this paper, the focus has been on a regime I producer choosing whether and how to invest. However, as we have seen (Remark 6), for high trade costs a regime II investment has seemed the obvious choice, while a regime III investment similarly was the more profitable option for low trade costs. One might then wonder what would happen *over time* when trade costs fall. If a firm has initially (for high trade costs) made a regime II investment, will it be profitable to shift all production abroad in the wake of a trade cost reduction? Our model is static, so we will not devote a lot of time to this subject. However, following the above procedure, one can fairly easily show that if a transition from regime II to regime III still involves sinking some fixed costs (not necessarily equal to G), firm A still has too large investment incentives for $\frac{1}{27}(a-\overline{w}) < t < (3\sqrt{2}-4)(a-\overline{w})$. For $t \leq \frac{1}{27}(a-\overline{w})$, however, the situation is reversed.[16] It is similarly easy to show that a trade cost reduction (for $t < (3\sqrt{2}-4)(a-\overline{w})$) reduces the profit gain from investment relative to the gain in national welfare, and thus Proposition 9 goes through for $t > \frac{1}{27}(a-\overline{w})$. However, for $t \leq \frac{1}{27}(a-\overline{w})$ the scope of socially *suboptimal* investment increases.

In this section we have thus shown that a trade cost reduction might indeed lead to shifting out production to the foreign country. This hurts the home union, and can lead to lower national welfare.

[16] For the regime II to regime III transition, the following identity can easily be calculated:

$\Delta NW - \Delta\Pi = \frac{1}{288}\frac{3(a-\overline{w})^2 - 82t(a-\overline{w}) + 27t^2}{b}$

The expression is positive for $t < \frac{1}{27}(a-\overline{w})$ and negative otherwise. A transition from regime II to regime III involves a larger gain in consumer surplus and a smaller drop in union utility than a transition from regime I to regime III. For low trade costs ($t < \frac{1}{27}(a-\overline{w})$), the rise in consumer surplus from moving abroad outweighs the fall in union utility (it drops as trade costs fall in regime II), thus making the national welfare gain from a regime III investment larger than the increase in profits.

7 Concluding remarks

What shall we make of all this? This is not the place to repeat all our findings. We narrow our focus to the question of whether or not trade liberalization between a unionized and a non-unionized country seriously weakens the position of unionized labor. Naylor's result, in a somewhat different model format, that trade liberalization increases the union-set wage and utility can be seen as an optimistic "no" response to this question. In broad terms, we have reached the opposite conclusion: Precisely because trade liberalization has this tendency to increase union wages, the firm's incentive to move out production to a non-unionized economy is strengthened. Moreover, the incentive for a full move of all production rather than a limited move only of production destined for the foreign market, is also strengthened. Unionized labor can lose from trade liberalization, but the problem might very well be one of job losses, rather than wage cuts. From a welfare viewpoint, trade liberalization can be detrimental to welfare. On basic reason is that fixed investment costs are undertaken mainly to win a distributional battle between firm owners and unionized labor.

Speculatively, one could argue that after decades of economic integration, even further trade liberalization should probably start form quite low levels of trade costs. Moreover, we know that foreign direct investments become more and more important relative to trade. These are precisely the circumstances where further trade liberalization hurts the interests of unionized workers. One should of course be careful about drawing strong policy conclusions from a highly stylized model. But in broad terms our analysis suggest that strong unions and trade liberalization do not sit well together. The right wing version of this is to say that weaker unions would be good, since production would then not be forced out of the country at the expense of national welfare. A left wing alternative is that trade liberalization is the problem, since it undermines the efforts of ordinary workers to obtain a living wage.

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