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International trade and economic integration when labour markets are generally unionised

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Abstract

The paper develops a theoretical framework in which international trade occurs between economies with imperfectly competitive product markets and unionised labour markets. We are able to investigate the impact on both product and labour market outcomes of increased product market integration across the trading economies. Our strongest result is the finding that increased integration leads monopoly unions to set higher Nash equilibrium wages. In other words, a more competitive product market does not necessarily generate a more competitive labour market.

JEL classification: F15; J5; L13

Keywords: International trade; Reciprocal dumping; Tariffs; Economic integration; Wage determination; Union bargaining

1. Introduction

As international trade restrictions are increasingly removed through economic agreements associated with GATT, NAFTA and economic integration within the European Union, the implications of increased trade for labour market outcomes become increasingly important. However, whilst labour economists have considered union–firm bargaining in the context of imperfectly

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competitive labour and product markets (see, for example, Dowrick, 1989), such analysis has lacked an international trade dimension. Equally, whilst there is a well-established international trade literature motivating trade in homogeneous products as the reciprocal dumping outcome of oligopolistic rivalry in imperfectly competitive product markets (see Brander, 1981; Brander and Krugman, 1983), such international trade models have not considered the case of trade between economies each with unionised labour markets.[1] In the current paper, we attempt to integrate these literatures, developing a framework in which international trade occurs between economies with imperfectly competitive product markets and unionised labour markets, focussing on the effects of product market integration on wage determination.

Our strongest result is the surprising finding that, within a context of reciprocal international trade, reductions in trade costs lead to higher union-set wages.[2] That is, as product markets become more integrated, monopoly unions will choose higher wages. This finding refines the results derived in the work of Huizinga (1993) and Sørensen (1993), who develop an interesting framework in which to examine the labour market effects of a dichotomous shift from a no-trade to a full-trade equilibrium. Our work can be thought of as tracing out the effects of a more continuous reduction in trade costs from an initial situation in which trade does anyway take place.

As Brander (1981) has observed, a substantial portion of world trade occurs in similar products and between similar countries. Brander (1981) and Brander and Krugman (1983) are able to demonstrate how oligopolistic rivalry naturally gives rise to such reciprocal dumping and hence serves as an independent cause of intra-industry international trade. Brander and Spencer (1988) extend the model in various respects, focussing on the case in which wages in one of the two countries are not exogenously given but instead are the result of a union-firm wage bargain. This is an important extension to the international trade model, given the prevalence of union influence over wages in many sectors of modern industrialised economies. Mezzetti and Dinopoulos (1991) take this analysis further, identifying the importance of the union's relative preferences between wages and employment.

In a recent paper in this Journal, Zhao (1995) develops a similar unionised international oligopoly framework, but focuses on the issue of direct foreign intra-industry investment, rather than on trade, which is our focus. Whereas Zhao finds that cross-hauling direct foreign investment causes the negotiated wages to decrease, our work shows that increased product cross-hauling, generated by lower trade costs, can lead to higher union-set wages. This contrast is

[1] As we shall discuss further, the models of Brander and Spencer (1988) and of Mezzetti and Dinopoulos (1991) consider the case in which a union is present in only the 'domestic' market.

[2] It is the case, however, that this wage is always less than the wage which would obtain if trade costs were sufficiently high as to preclude the possibility of trade.

very interesting. It suggests, ceteris paribus, that whilst the reduction in restrictions on international investment-capital mobility are likely to lead to lower bargained wage outcomes, increased international product mobility can lead to higher wages in a unionised environment. In other words, the impact on wage outcomes of increased economic integration in Europe, for example, is likely to depend on whether the accelerated reduction on non-tariff barriers and other trade costs associated with the international movement of products dominates the reduction in costs associated with direct foreign investment.

In the class of models associated with Brander et al., reciprocal dumping (or 'cross-hauling') occurs despite the existence of a per unit cost of trade. This cost can be interpreted in various ways: for example, as either a transaction or transport cost or as a tariff cost. Accordingly, the framework can be applied to the question of the likely impact of increased product market integration, interpreted as reductions in unit costs of trade. This issue is, of course, a matter of prominent policy relevance in view of the widening and deepening of free trade arrangements and of economic unions. Where such agreements involve countries or blocs of countries with very different wage determination processes, then the Brander–Spencer/Mezzetti–Dinopoulos approach is likely to provide an appropriate framework for analysis. For example, in the context of NAFTA there are a number of industries for which there is no unionisation in one country but considerable union influence over wages in another. However, for the case of trade agreements covering industries with high union coverage in more than one country (which is likely to be particularly relevant in many European[3] markets), the framework requires further development in order to capture the full strategic richness of the situation.

In the current paper, then, we consider the case in which international trade occurs as a result of oligopolistic rivalry between firms, each of which confronts a union at the wage-setting stage. We examine how the presence of unions in both countries affects the strategies of the various players. Our chief objective is to consider the effects of reductions in trade costs on the key economic variables. We are able to consider the impact on output, employment, prices, profit, consumer surplus, union utility and welfare. Our main focus, however, concerns the impact on wages. In particular, we are interested in the question: does a reduction in the costs associated with trade necessarily lead to a fall in the bargained wage?

A priori, one might suppose that as trade costs fall, increased competition in the product market would feed, through the Marshallian conditions of labour demand, into downward pressure on wages. Against this, in a macroeconomic context, Danthine and Hunt (1994) have argued that economic integration, by

[3] Indeed, given the well-known stylised fact of the high proportion of intra-industry trade within European trade (see, for example, Greenaway and Milner, 1986), the Brander–Krugman framework is particularly appropriate.

implicitly reducing the degree of centralisation of wage bargaining, might cause upward pressure on wage demands of unions which no longer have a strict incentive to internalise the price effect of wage increases. In the current paper, we are concerned exclusively with the context of intra-industry trade. Consequently, we do not address such macroeconomic aspects of the model.

As Gaston and Trefler (1994) have observed, there is a substantial empirical literature establishing that protection can induce inefficiency and reduce wages. Combining detailed information for the US on both labour market outcomes and on tariff (and non-tariff) barriers to international trade, Gaston and Trefler (1994) themselves find that tariffs are negatively correlated with industry wage premia. Our work can be further interpreted as providing a possible theoretical framework in which this empirical finding can be explained.

The layout of the rest of the paper is as follows. Section 2 presents the formal model of generally unionised international oligopoly. Section 3 examines the comparative static effects of increased product market integration within the model, focussing on the behaviour of wages. Section 4 closes the paper with conclusions and further remarks.

2. A model of general unionised international oligopoly

Following Brander (1981) and Brander and Krugman (1983), we assume that there are two identical countries (A and B) and that in each country there is one firm (Firm 1 in Country A and Firm 2 in Country B) producing some non-differentiated commodity, C. There is a constant cost of t per unit of the commodity exported. Initially, we shall interpret this cost as capturing all costs associated with international trade, such as transactions, transport and tariff costs. Each firm regards each country as a separate market and chooses the profit-maximising quantity for each market separately, and on the Cournot assumption that the other firm's output in each market is given.

We assume that each firm confronts a monopoly trade union (Union 1 and Union 2) which has the objective of rent maximisation and that each union comprises all the workers employed by its respective firm. Further, we assume that each firm retains the right to choose the employment level, and that non-collusive behaviour characterises the labour market: i.e., each union takes the other union's wage demand as given when forming its own chosen wage. The sequence of decision making is as follows. In Stage 1, each union chooses a wage taking as given the wage set by the other union and taking into account the firm's labour demand function. In Stage 2, each firm chooses its output (and hence employment) levels for the separate product markets, taking as given both (i) the output decisions of the other firm and (ii) the wage set by its own union. When setting wages, each union must take into account not only (a) the Cournot rivalry between firms in the product market, but also (b) the Cournot rivalry

between unions over jobs.[4] Additionally, it is, of course, the case that labour demand will depend upon the cost of trade, t.

We now turn to the formal model.

2.1. Firms' profits

Firm 1's profits can be written as

$$\Pi_1 = (p_A - w_1)x + (p_B - w_1 - t)u\,. \tag{1}$$

Similarly, for Firm 2 we have

$$\Pi_2 = (p_A - w_2 - t)\,y + (p_B - w_2)\,v\,, \tag{2}$$

where p_i is the price of coommodity C in country i, w_j is the wage paid by firm j, t is the constant unit trade cost, x is production by Firm 1 for consumption in Country A, u is production by Firm 1 for consumption in B, y is production by Firm 2 for consumption in A and v is production by Firm 2 for consumption in B.

We assume that the marginal product of labour is constant, and is normalised to unity. Thus, we can discuss output and employment interchangeably. Finally, we assume for simplicity that product demand is linear.[5] Hence,

$$p_A = a - b(x + y)\,, \tag{3}$$

$$p_B = a - b(u + v)\,. \tag{4}$$

2.2. Union utility

We assume that each union aims to maximise rents. Hence, union 1's utility can be written as

$$U_1 = (w_1 - \bar{w})\,(x + u)\,, \tag{5}$$

where $\bar{w}$ is the competitive or reservation wage level and is common to both countries. We shall assume that when setting wages, unions do not take into account the effect of the wage on the overall price level. This is justifiable as long as the product produced by the firm does not constitute a large share of the workers' consumption bundle. Similarly, for Union 2 we have that

$$U_2 = (w_2 - \bar{w})\,(y + v)\,. \tag{6}$$

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[4] It is this labour market rivalry which, we believe, is novel in the analysis of intra-industry trade.

[5] It is not difficult to show that similar results obtain under the assumption of iso-elasticity in product demand (see Naylor, 1995).

2.3. Strategic interaction and labour demands

The behaviour of each union-firm pair is modelled as a two-stage game. In Stage 1 the union sets the wage, taking into the account the employer's labour demand schedule and taking as given the wage set in the rival union-firm pair. In Stage 2, the firm sets output and employment, given the wage, and taking output of the rival firm as given. We solve the model by backward induction. First, we consider Stage 2.

Stage 2: Substituting Eqs. (3) and (4) into Eqs. (1) and (2), respectively, yields

$$\Pi_1 = (a - b(x + y) - w_1)x + (a - b(u + v) - w_1 - t)u \tag{7}$$

and

$$\Pi_2 = (a - b(x + y) - w_2 - t)y + (a - b(u + v) - w_2)v\,. \tag{8}$$

From these profit expressions, we can derive the following first-order conditions for profit-maximisation:

$$\frac{\partial \Pi_1}{\partial x} = a - 2bx - by - w_1 = 0$$

$$\Rightarrow x = \frac{a - w_1}{2b} - \tfrac{1}{2}y\,, \tag{9}$$

$$\frac{\partial \Pi_1}{\partial u} = a - 2bu - bv - w_1 - t = 0$$

$$\Rightarrow u = \frac{a - w_1 - t}{2b} - \tfrac{1}{2}v\,, \tag{10}$$

$$\frac{\partial \Pi_2}{\partial y} = a - 2by - bx - w_2 - t = 0,$$

$$\Rightarrow y = \frac{a - w_2 - t}{2b} - \tfrac{1}{2}x \tag{11}$$

$$\frac{\partial \Pi_2}{\partial v} = a - 2bv - bu - w_2 = 0$$

$$\Rightarrow v = \frac{a - w_2}{2b} - \tfrac{1}{2}u\,. \tag{12}$$

Each of the Eqs. (9)–(12) can be interpreted as a firm's output reaction function with respect both to the rival firm's output in the relevant product market and to the wage set by the firm's own union. Eqs. (9)–(12) can then be solved in order to obtain output by each firm in each market as reaction functions with respect to the two unions' chosen wages. These are shown in

Eqs. (13)–(16) and represent the labour demand curves faced by each union, given the wage set by the rival union.

$$x = \frac{1}{3b}[a - 2w_1 + w_2 + t], \tag{13}$$

$$u = \frac{1}{3b}[a - 2w_1 + w_2 - t], \tag{14}$$

$$y = \frac{1}{3b}[a - 2w_2 + w_1 - t], \tag{15}$$

$$v = \frac{1}{3b}[a - 2w_2 + w_1 + t]. \tag{16}$$

Eq. (13), then, represents Firm 1's demand for labour to produce output for consumption in Country A, in the context of intra-industry trade. Eq. (14) describes Firm 1's demand for labour to produce for export to Country B. In both cases, w_2 and t are taken as given. Taken together, Eqs. (13) and (14) define total demand for labour supplied by Union 1.

Summation of the two demand schedules defined by Eqs. (13) and (14) produces a kink in the total labour demand curve facing Union 1, represented by $L_1^d(w_1 | w_2, t)$ in Fig. 1.

On the upper segment of the kinked demand schedule, w_1 is sufficiently high (for given w_2, t) that Firm 1 does not export: i.e., $u = 0$. On the lower segment, w_1 is sufficiently low that Firm 1 does export. As t falls, for given w_2, the upper segment of the demand schedule shifts down to the left. This is clear from Eq. (13) – x falls as t falls – implying that Union 1's share of the Country A market is eroded by the induced increase in imports when the trade cost falls. Conversely, the lower segment of the demand schedule shifts up and to the right as falling trade costs allow a greater volume of exports, *ceteris paribus*. In terms of Eq. (14), u rises as t falls.

By the same reasoning, it follows that Union 2 also faces a kinked total labour demand schedule. We turn next to examine union wage-setting behaviour in the light of these labour demand relations. First, we note that whilst in general there are four possible types of outcome implied by the different combinations of $u = 0$, $u > 0$, $y = 0$ and $y > 0$, in this paper we shall restrict our attention to the case of pure strategy equilibria associated with intra-industry trade in which both $u > 0$ and $y > 0$. This involves the assumption that tariff costs are below some critical level. This is analysed further in an appendix.

Stage 1: In Stage 1 each union will choose a wage to maximise its rent, taking into account the labour demand function of the employer. A union's preferred wage might lie either to the left or to the right of the kink in the labour demand curve shown in Fig. 1. From Fig. 1, it is clear that any union-preferred outcome

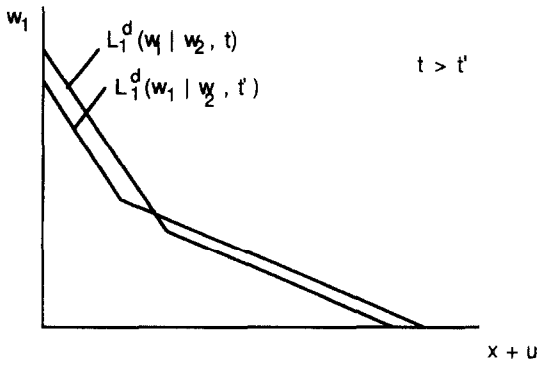

Fig. 1. Kinked labour demand under reciprocal trade.

is the more likely to lie to the right of the kink, the lower is the trade cost, t. In the current paper, we focus exclusively on cases in which t is sufficiently low as to induce each union to prefer wage outcomes on the lower segment of its respective labour demand curve.

Consider the problem facing Union 1. Union 1 will choose w_1 such that

$$w_1 = \underset{w_1}{\operatorname{argmax}} \{U_1 = (w_1 - \bar{w})(x + u)\}. \tag{17}$$

Substituting Eqs. (13) and (14) in Eq. (17), we obtain

$$w_1 = \underset{w_1}{\operatorname{argmax}} \left\{U_1 = \frac{1}{3b}(w_1 - \bar{w})(2a - 4w_1 + 2\bar{w}_2 - t)\right\}, \tag{18}$$

where $\bar{w}_2$ is the wage set by Union 2 and which Union 1 takes as given.

From Eq. (18), it follows that the first-order condition for union utility maximisation is given by

$$\frac{\partial U_1}{\partial w_1} = \frac{1}{3b}(2a - 8w_1 + 2\bar{w}_2 + 4\bar{w} - t). \tag{19}$$

From Eq. (19), it follows that the union will set the wage as

$$w_1 = \tfrac{1}{8}(2a + 2\bar{w}_2 + 4\bar{w} - t). \tag{20}$$

This equation can be interpreted as Union 1's wage reaction function with respect to the given wage set by Union 2.

Similarly, Union 2 will set the wage w_2 such that

$$w_2 = \tfrac{1}{8}(2a + 2\bar{w}_1 + 4\bar{w} - t), \tag{21}$$

where $\bar{w}_1$ is the wage set by Union 1 and which Union 2 takes as given.

Solving Eqs. (20) and (21) yields the Bertrand equilibrium level for wages, w_1, w_2:

$$w_1 = w_2 = \tfrac{1}{6}(2a + 4\bar{w} - t)\,. \tag{22}$$

From Eq. (22), we can substitute back into the labour demand functions Eqs. (13)–(16) to obtain the levels of output and employment. Further substitution into Eqs. (1)–(6) then yields the equilibrium levels for prices, profits and union utility, as shown in Eqs. (23)–(25):

$$p_A = \tfrac{1}{9}[5a + 4\bar{w} + 2t] = p_B\,, \tag{23}$$

$$\Pi_1 = \frac{1}{18^2 b}\{[4(a - \bar{w}) + 7t]^2 + [4(a - \bar{w}) - 11t]^2\} = \Pi_2\,, \tag{24}$$

$$U_1 = \frac{1}{27b}[2(a - \bar{w}) - t]^2 = U_2\,. \tag{25}$$

Hence, we can provide expressions for both consumer surplus and welfare. Consumer surplus is given by

$$\mathrm{CS_A} = \mathrm{CS_B} = \frac{2}{81b}[2(a - \bar{w}) - t]^2\,. \tag{26}$$

With regard to welfare, the appropriate definition depends upon the interpretation of t. Initially, we interpret t as a trade tariff. Hence, given rent-maximisation as the specified union objective, it follows that welfare can be defined as

$$W_\mathrm{A} = \Pi_1 + \mathrm{CS_A} + U_1 + T_\mathrm{A}\,, \tag{27}$$

where $T_\mathrm{A} = tu$ is the tariff revenue accruing to the government in Country A. By substitution, it can be shown that

$$W_\mathrm{A} = W_\mathrm{B} = \frac{2}{81b}[7(a - \bar{w}) + t]\,[2(a - \bar{w}) - t]\,. \tag{28}$$

In the following section, we consider the comparative static properties of the model, focussing on the impact of increased economic integration.

3. Implications of integration

In this section of the paper, we shall focus on the impact of reductions in t, the unit cost associated with international intra-industry trade within the model. This represents our method for describing an increase in product market integration. We establish a number of propositions.

Proposition 1. From an initial situation of reciprocal intra-industry trade, an increase in product market integration, ceteris paribus, *will induce each union to*

choose a higher wage level. The resulting Bertrand equilibrium wage will consequently increase with integration.

Consider the case of Union 1. From Eq. (20), it follows that, for given w_2,

$$\frac{\partial w_1}{\partial t} = -\tfrac{1}{8} < 0 . \tag{29}$$

Hence, as t falls, Union 1 will raise its own-wage. Similarly, Union 2 will choose a higher wage, for given w_1, following the fall in t. As each union raises its chosen wage, the relevant segment of the labour demand schedule facing the other union shifts further to the right, inducing a further increase in each union's chosen wage. In equilibrium, each union will choose a higher wage following the fall in t. It is clear from (22) that

$$\frac{\mathrm{d}w_1}{\mathrm{d}t} = -\tfrac{1}{6} < 0 . \tag{30}$$

The intuition for this result is described with reference to Fig. 2.

As t falls, *ceteris paribus*, a given wage demand by Union 1 leads both to a reduction in jobs in Firm 1 to satisfy the domestic market but also to an increase in jobs for export. That the latter effect dominates the former can be seen with reference to Eqs. (13) and (14): essentially, the total demand for Union 1 labour increases as t falls because there is a net reduction in the firm's marginal cost of labour, for $u > 0$, and for a given w_1. Trade in the final product, and hence labour demand both increase. The union responds to this by setting a higher wage and hence obtaining a higher level of utility, as shown in the shift from a to b in Fig. 2, for a given wage set by the rival union. There is then a secondary re-inforcing effect as the higher wage of the rival enables a further

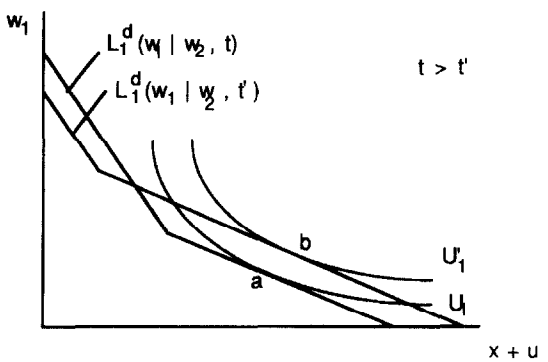

Fig. 2. The impact of a fall in t on the union's preferred wage.

increase in union-set wages. There is then convergence at a higher wage level. This result emerges as a special feature of the reciprocal trade regime. If trade is in one direction only, then the union which bargains with the non-exporting firm (and hence faces the steep upper segment of the kinked labour demand curve) will choose a lower wage when t falls, and this will, additionally, moderate the wage demand of the other union. Related to this, Brander and Spencer (1988) considered a setting similar to ours but in which a union was present in one country only. In such a case, it is clear that the unionised economy will, *ceteris paribus*, be in the high-wage, zero-export regime and hence will moderate its wage demands in response to a fall in t.

Under reciprocal dumping, then, increased product market integration leads to a higher level of union-set wages in both countries. We now turn to investigate the associated impact of a fall in t on the other variables in the model.

Proposition 2. Product market integration leads to: an increase in output, employment, union utility, consumer surplus and welfare and to a reduction in product price.

It is straightforward to demonstrate these results. The output (and hence employment) result is clear from Fig. 2 and the fall in product price necessarily follows from this: confirmed by inspection of Eq. (23). With respect to union utility, it is clear from Eq. (25) that

$$\frac{\mathrm{d}U}{\mathrm{d}t} < 0 \quad \text{if } t < 2(a - \bar{w}) .$$

This condition must be satisfied within the regime we are considering in which $u > 0, y > 0$. Union utility is rising as t falls because both total employment and the wage level are rising.

As for consumer surplus, it follows from Eq. (26) that

$$\frac{\mathrm{d}(\mathrm{CS})}{\mathrm{d}t} < 0 .$$

A reduction in t causes consumer surplus to rise as the price is falling whilst consumption is increasing.

Finally, it follows from Eq. (28) that

$$\frac{\mathrm{d}W}{\mathrm{d}t} < 0 ,$$

which establishes that a reduction in t is welfare-enhancing, on the interpretation of t as a tariff cost. If, instead, t is interpreted as comprising, at least in part, transport or other transactions costs, then T should not fully enter the definition

of W. T is, of course, falling with t. Thus, the proposition is still valid if W is specified to omit (some of) T.

Proposition 3. Product market integration initially leads to a fall in profits of each firm if t is sufficiently large, but profits rise with integration as t becomes sufficiently small.

From Eq. (24) it follows that

$$\frac{d\Pi}{dt} \geq 0 \quad \text{if } t \geq 8(a-\bar{w})/85,$$

$$\frac{d\Pi}{dt} < 0 \quad \text{if } t < 8(a-\bar{w})/85.$$

Suppose t is initially high. Then as t falls, firms lose out because product price is falling with increased product market competition and wages are rising as a result of the strategic behaviour of unions. These adverse effects on profit outweigh the beneficial effect to firms of the reduced cost, t. As t becomes very small, however, the cost reduction effect dominates.

Our results on the wage effects of integration differ from those obtained in recent and related models developed by Danthine and Hunt (1994) and by Driffill and van der Ploeg (1993, 1995). In Danthine and Hunt (1994), the foreign sector imposes greater product market competition which serves to moderate union wage increases: integration can lower wages. The reason for the difference between this result and our opposite finding lies in the different ways in which integration is modelled in the two papers. In Danthine and Hunt, integration is represented by an increased substitutability in preferences between the two countries' (baskets of) goods. This increases the derived labour demand elasticity. In contrast, in our paper the nature of product market competition means that integration leads to a parallel outward shift of the linear labour demand curve (see Fig. 2), causing a reduction in elasticity, at each wage level, and hence induces each union to choose a higher wage.[6] In Driffill and van der Ploeg (1993), trade liberalisation tends to lower real product wages but can raise real consumption wages. In this model, however, unions restrain wage demands as they internalise the effects of wages on the price index. In Driffill and van der Ploeg (1995), there is free entry of firms and the impact of changes in union wages on the number of competitors is highly sensitive to the tariff rate, hence

[6] It is worth stating that whilst we have proved our results only under the assumption of linear product demand, it does not follow that the results cannot be supported under non-linear demand. In Naylor (1995), it is shown that the inverse relation between wages and the trade cost goes through under iso-elastic demand, so long as the elasticity is sufficiently low.

causing labour demand elasticity to increase as the tariff rate falls. It is interesting to note that in the Driffill and van der Ploeg (1995) paper, union wages can be non-increasing in the tariff rate when the number of firms is fixed.

4. Conclusions and further remarks

This paper has focused on reciprocal international trade under generally unionised labour markets, and has examined the impact of increased product market integration on outcomes in both product and labour markets. We have assumed that the traded good is a homogeneous commodity and that international trade occurs as a result of oligopolistic rivalry between firms. In this way the model differs from otherwise similar models developed by Driffill and van der Ploeg (1993, 1995). Our main finding is the surprising result that such integration leads unions to increase their wage demands. As a consequence, whilst both consumer surplus and union utility are increasing in integration, profits are liable to fall. Overall, increased economic integration is found to be welfare-enhancing. One corollary of our results is that a more competitive product market does not necessarily generate a more competitive labour market.

We have restricted our analysis to the case of monopoly union wage-setting. This simplifying assumption has enabled us to derive algebraic results concerning the effects of the integration of imperfectly competitive product markets in a setting of generally unionised labour markets. Further research should extend the model to the more general right-to-manage model. Nonetheless, the monopoly union model is instructive per se as it informs us about the impact of integration on unions' preferred behaviour. It is worth stating that our results are not dependent on the assumption of rent-maximising behaviour by unions: a general Stone–Geary utility function will support the results. Similarly, if we allow the reservation wage to differ across the two countries, we still find that a reduction in trade costs raises wages.

There are a number of potential directions for further work. First, the paper has focussed on the case of the growing integration of identical economies. It would be interesting to consider various initial differences across the integrating countries, such as in market structure, union preferences and bargaining power. Second, we have restricted our analysis to the case of reciprocal-dumping, under the assumption that initial trade costs are sufficiently low as to generate two-way trade in the standard Brander–Krugman setting, but with unions. As trade costs rise above this level, however, it can be shown that the derived union-wage reaction functions become discontinuous with the result that different trade regimes emerge. A full analysis of the equilibria associated with these different regimes is left for further work.

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Appendix A

As noted in the text, there are in general four possible outcomes implied by the combinations of $u = 0$, $u > 0$, $y = 0$ and $y > 0$. In this appendix, we consider these different possibilities and derive the values of t under which the pure strategy equilibria will be characterised by intra-industry trade, as assumed within the text.

From Eq. (14), it follows that, for given values of w_2 and t, exports from Country A will be just equal to zero if the following condition on w_1 is satisfied:

$$w_1 = (a + w_2 - 2t)/2 . \tag{A.1}$$

Similarly, exports from Country B will just equal zero if

$$w_2 = (a + w_1 - 2t)/2 . \tag{A.2}$$

These conditions are represented in Fig. 3, and define the boundaries between the four possible trade regimes. Regime 1 (R1) shows the case in which $u > 0$, $y > 0$ and there is, therefore, intra-industry trade. In Regimes 2 and 3 there is asymmetric trade and in Regime 4 w_1 and w_2 are such that, given t, no trade takes place.

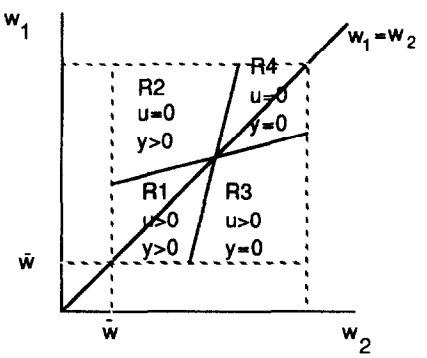

Fig. 3.

The boundary conditions intersect at $w_1 = w_2 = a - 2t$. As t increases, the area representing possible intra-industry trade equilibria diminishes until it disappears when $w_1 = w_2 = a - 2t = \bar{w}$, that is when $t = (a - \bar{w})/2$. This can be interpreted as the prohibitive tariff at which intra-industry trade ceases to be feasible, given our assumptions on the nature of product market competition. It does not follow, of course, that all values of t below the prohibitive level will yield intra-industry trade equilibria: this will depend on the nature of wage-setting behaviour, i.e. on the choices made by unions. In w_1, w_2-space we can represent each union's wage reaction function with respect to the wage choice of the rival union. Each union's reaction function will be discontinuous. Consider Union 1: at low values of w_2 it does not try to compete in Country B but instead chooses a high-wage strategy. As w_2 rises, Union 1 raises its wage until, at some critical value of w_2 (which will depend on t) it switches to a low-wage strategy, under which it is able to capture some share of the market in Country B. The two unions' discontinuous reaction functions are shown in Fig. 4.

The intersection of the low-wage segments of the two reaction functions yields, of course, the intra-industry trade equilibrium defined in Eq. (22). As t rises this equilibrium moves down the 45° line, whilst the discontinuous segments of the reaction functions shift outward from their respective axes. There is a critical value of t at which intra-industry trade is just supported. This is the value of t such that the reaction functions intersect at the point of discontinuity, as shown in Fig. 5.

We now derive the formal expression for this critical value of t. The switching point in the wage-strategy of Union 1 occurs when w_2 and t are such that the locally optimal utilities associated with the alternative strategies are equal. The optimal utility associated with the high-wage strategy is given by

$$U_1^H = (w_1 - \bar{w})(x), \tag{A.3}$$

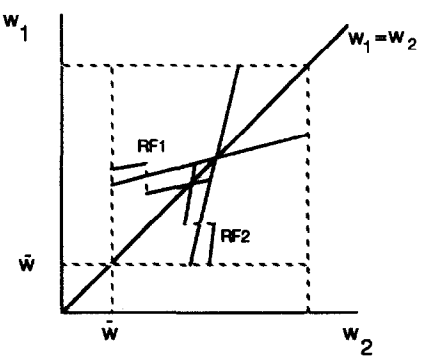

Fig. 4.

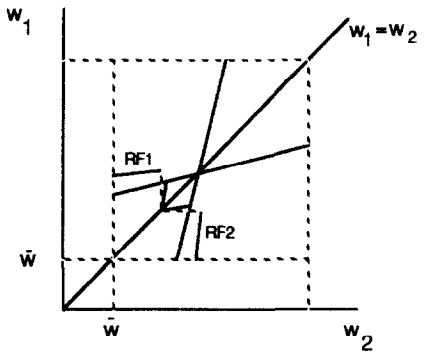

Fig. 5.

where, from Eq. (13), $x = (a - 2w_1 + w_2 + t)/3b$ and $w_1 = \text{argmax}[U_1^H]$. It is straightforward to show that

$$U_1^H = \frac{1}{12b}[a + w_2 + t - \bar{w}]^2 . \tag{A.4}$$

Similarly, the optimal utility associated with the low-wage strategy is given by

$$U_1^L = (w_1 - \bar{w})(x + u), \tag{A.5}$$

where, from Eqs. (13) and (14), $x + u = (2a - 4w_1 + 2w_2 - t)/3b$ and $w_1 = \text{argmax}[U_1^L]$. Hence, it is readily shown that

$$U_1^L = \frac{1}{24b}[2a + 2w_2 - t - 4\bar{w}]^2 . \tag{A.6}$$

From Eqs. (A.4) and (A.6), $[U_1^H] = [U_1^L]$ iff:

$$w_2 = 2\bar{w} - a + \frac{1 + \sqrt{2}}{2 - \sqrt{2}} t . \tag{A.7}$$

For the switching point to coincide with the point of intersection of the low-wage segments of the two reaction functions, Eq. (A.7) must be satisfied simultaneously with Eq. (22), re-written here as

$$w_1 = w_2 = \tfrac{1}{6}(2a + 4\bar{w} - t) . \tag{A.8}$$

Hence, the critical value of t above which intra-industry trade will not be supported in a pure strategy equilibrium occurs when both Eqs. (A.7) and (A.8)

are satisfied, that is at

$$t = \frac{8}{13 + 9\sqrt{2}}(a - \bar{w}) \tag{A.9}$$

or, t is approximately equal to $0.311(a - \bar{w})$.

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