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International Trade, Union Wage Premia, and Welfare in General Equilibrium

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International Trade, Union Wage Premia, and Welfare in General Equilibrium

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Abstract

We study how two distinct forms of globalisation, trade cost reductions and opening up of trade in previously shielded sectors, affect sector-specific wages, employment levels and aggregate welfare in a two-country model of general oligopolistic equilibrium (GOLE) with partly unionised labour markets. We find that both forms of globalisation increase union coverage, and they also lead to a lower union wage premium in shielded sectors. In contrast, the union wage premium in open sectors and aggregate welfare are affected differently by the two types of globalisation. Trade cost reductions in open sectors always lead to higher union wage premia and to lower aggregate welfare, while an increased number of open sectors lowers the union wage premium, and it may also increase welfare.

JEL-Classification: F12, F15, F16

Keywords: Globalisation, Unions, Non-traded Goods, General Oligopolistic Equilibrium

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1 Introduction

There is what appears to be a secular trend towards greater economic integration, but at the same time sectors that produce non-traded goods, and are therefore exempt from international competition, still make up an important part of the world economy.[1] In this paper we explore the implications of economic integration in countries where some sectors of the economy are shielded from international competition, and where the workforce is partially unionised.

A large theoretical literature suggests that the openness of a sector to international trade is a key determinant of a union's ability in this sector to negotiate a premium over the wage workers would get in a perfectly competitive labour market. The standard framework employed in the literature is the unionised oligopoly model with symmetric countries, and Sørensen (1993) and Huizinga (1993) have shown independently from each other that in this framework moving from autarky to free trade reduces the union wage premium. Subsequently Naylor (1998, 1999) has shown that this early theoretical result, while in line with the public perception that globalisation has a negative effect on labour unions' ability to set high wages, needs to be qualified. In particular, Naylor has pointed out that the effect of trade liberalisation on the union wage is non-monotonic: there is a critical level of trade costs below which unions switch to a low-wage strategy, thereby allowing the unionised firm to become competitive in the export market. Further incremental reductions in trade costs lead to an *increase* in union wages until free trade is reached, at which point the wage has regained some but not all of its initial loss.[2] This suggests that,

[1] See the evidence provided in De Gregorio et al. (1994) and Bettendorf and Dewachter (2007).

[2] Munch and Skaksen (2002) allow for the presence of both fixed and variable trade costs and show that the results are sensitive to which of these costs are lowered. Bastos, Kreickemeier and Wright (2009) modify the symmetric unionised oligopoly model by introducing wage bargaining and open shop unions, and they show that in this case wages under free trade may be higher than under autarky. There is also a large literature looking at an asymmetric setup with unions present in only one of the countries, see Brander and Spencer (1988), and Mezzetti and Dinopoulos (1991). The asymmetric oligopoly model has been extended by Lommerud, Meland and Sørgard (2003) to allow for FDI, while Straume (2003) and Lommerud, Straume and Sørgard (2006) look at international mergers, and Lommerud, Meland and Straume (2006) focus on technological change.

ceteris paribus, the union wage in sectors that are open to international trade is lower than the union wage in non-traded goods sectors, which are exempt from international competition.

What is lacking in the theoretical literature just described, but has been a corner stone in much of the earlier trade literature with perfectly competitive goods and factor markets, is the general equilibrium link between sectors of traded and non-traded goods induced by the mobility of workers.[3] Similarly, one would expect that for trade unions the general equilibrium links between traded and non-traded sectors should matter, but how exactly is not well understood so far. One compelling story about the nature of these links is told in Moene and Wallerstein (1995). Referring to the Scandinavian tradition of "solidaristic wage bargaining", whereby union wages were centrally negotiated for both traded and non-traded sectors, they point out that the desired effect of this arrangement has been to keep the wages of construction workers, who are mainly employed in non-traded sectors, low. Due to the lack of international competition in these sectors, profits and therefore potential wages under decentralised bargaining were high. Since construction workers are to some extent employed in traded sectors as well, this would have driven up labour cost in these sectors, and harmed the wage prospects of unionised production workers in the sectors open to international competition.[4]

In the present paper, we set up a multi-sector general equilibrium model that also features traded and non-traded goods, with labour unions present in a subset of both types of sectors. The presence of non-unionised sectors means that there is an endogenously determined competitive wage that clears the labour market. The ability of unions to set wages in organised sectors, whether open or closed to international competition, is affected by the competitive wage, which provides the outside option for workers and does not depend on the trading status of the sector in question. The basis for our framework is the model of general oligopolistic equilibrium (GOLE) by Neary (2009) featuring a continuum

[3] See Corden and Neary (1982) and Neary (1988).

[4] See also Rasmussen (1992). In the literature on exchange rate targeting and inflation targeting the co-existence of shielded and non-shielded sectors has also featured prominently, with examples including Vartiainen (2002), Holden (2003) and Meland (2006).

of sectors, each of which has a small and exogenous number of firms that compete with each other in Cournot fashion in an integrated world market.[5] In order to bring to the forefront the role played by unions as well as the distinction between open and shielded sectors, we eliminate from the model all other asymmetries between sectors. In particular, we abstract from inter-sectoral differences in production technologies. In contrast to Neary (2009) there is therefore no trade based on comparative advantage in our model. Rather, we follow Brander and Krugman (1983) in assuming segmented markets, which leads to intra-industry trade in the open sectors for sufficiently low values of trade costs.[6] We find that due to the lack of goods market competition, unions in the shielded sectors set higher wages than unions in the open sectors. In this framework there are two facets of globalisation. We look at the reduction of trade costs in the open sectors, and also, as in Falvey and Kreickemeier (2005), at an increase in the proportion of sectors that are open to international trade. In either case, unionised workers in the shielded sectors do not face foreign competition directly, but are still affected by general equilibrium effects operating via the integrated labour market for non-unionised workers.

Two key variables in our analysis are the absolute union wage premia in the shielded and open sectors, respectively, i.e. the differences between the union wage in a sector and the competitive wage. These wage premia govern the difference in output levels between unionised and non-unionised firms and the sector level. We show that – perhaps surprisingly – a reduction of trade costs in open sectors leads to an increase in the union wage premium in the open sectors, and a decrease in the shielded sectors. As a result, the share of the workforce employed in unionised firms decreases in the open sectors and increases in the shielded sectors. In contrast, increasing the share of sectors that are open to trade reduces the union wage premium in all sectors. In response, the share of workers

[5] See Neary (2007) for an application to cross-border mergers.

[6] Similar to us, Bastos and Kreickemeier (2009) embed a unionised oligopoly into Neary's GOLE framework. In their model, there is either no trade or trade in all sectors, and hence they cannot analyse the questions that we are interested in. Another recent extension of the GOLE framework to the case of segmented markets is Bastos and Straume (2010), who analyse the case of endogenous product differentiation in the presence of a perfectly competitive labour market.

employed by unionised firms in all sectors increases. Interestingly, the economy-wide effect on employment in unionised firms does not depend on the type of trade liberalisation we consider: at the aggregate level both varieties of freer trade lead to a larger share of the workforce being unionised. While these results are reminiscent of outcomes one could expect to get from solidaristic bargaining, in our model they come about as a natural consequence of globalisation under decentralised wage setting by sector-specific monopoly unions once general equilibrium effects are properly accounted for.

We also analyze the effects of trade liberalisation on aggregate welfare, which can be measured in a consistent way by the utility of a representative consumer. We show that liberalisation in the form of a reduction in marginal trade costs leads to an unambiguous reduction in aggregate welfare. The welfare effects are potentially more benign when considering an increase in the number of open sectors. Here, welfare typically increases if the share of open sectors is already sufficiently large.

The remainder of the paper is structured as follows. Section 2 presents the basic framework. Section 3 demonstrates how the model is solved in partial equilibrium. Section 4 is the core of the paper, where all important general equilibrium results are derived. Section 5 concludes.

2 The model

We consider a world of two countries, Home and Foreign, that are identical in all respects. Due to the assumed symmetry, we can focus on the Home country throughout, in the understanding that the results hold for the Foreign economy by analogy. Variables pertaining to the Foreign economy are denoted by an asterisk (*).

There is a continuum of sectors indexed by $z \in [0, 1]$, each featuring n firms that compete in Cournot fashion. The marginal product of labour is identical in all sectors and normalised to unity. Markets are segmented, as in Brander and Krugman (1983), and if a good is traded, there is a specific per unit tariff τ. Following Neary (2009), we consider a representative consumer in the home country with utility function

$$U = \int_0^1 \left(ax(z) - \frac{1}{2} b[x(z)]^2 \right) dz, \tag{1}$$

where $x(z)$ is consumption of good z.[7] The budget constraint is

$$\int_0^1 p(z)x(z)dz = I.$$

Utility maximisation yields inverse demand for good z as

$$p(z) = \frac{a - bx(z)}{\lambda}, \tag{2}$$

where λ is the marginal utility of income, i.e. the Lagrange multiplier attached to the budget constraint. Substituting for $x(z)$ in the budget constraint gives an expression for the marginal utility of income:

$$\lambda = \frac{a\mu_1 - bI}{\mu_2}, \tag{3}$$

where

$$\mu_1 = \int_0^1 p(z)dz \qquad \text{and} \qquad \mu_2 = \int_0^1 [p(z)]^2 dz$$

are the first and second moment, respectively, of the price distribution.

Since each sector constitutes only a marginal part of the economy as a whole, all firms treat the marginal utility of income parametrically. This implies that perceived inverse demand functions are linear (see eq. (2)), which is convenient for the discussion of oligopoly behaviour, and it is a key part of the GOLE framework.

The indirect utility function is derived by substituting for $x(z)$, and subsequently for λ, in the direct utility function. We eventually get

$$\widetilde{U} = \frac{1}{2b} \left[a^2 - \frac{(a\mu_1 - bI)^2}{\mu_2} \right]. \tag{4}$$

[7] As discussed in Neary (2009), utility function (1) is a special case of the Gorman (1961) polar form. This property allows for consistent aggregation over individuals with different incomes (provided the parameter b is the same for all). The property furthermore facilitates the normative applications of the model, as it rationalises the use of the indirect utility function of the single representative consumer to evaluate aggregate welfare in each country.

We know that $a\mu_1 - bI$ is positive, since the marginal utility of income is positive. Hence, utility is increasing in income and decreasing in the first moment of prices, as can be expected. It is also increasing in the second moment of prices: holding the average of prices constant, a greater variance of prices increases utility.[8]

Sectors are heterogeneous along two dimensions. The first dimension refers to the tradability of goods: A proportion α of sectors produces tradable goods, and we will use the label "open" when referring to these sectors, although trade occurs in equilibrium only if the trade cost τ is sufficiently low. The remaining sectors produce goods that are non-tradable, and we will call those the "shielded" sectors. The second dimension refers to the labour market characteristics: A proportion β of sectors has wages determined by unions, while the remaining sectors have fully flexible wages and no unions. We assume that both sector characteristics are uncorrelated. Lastly, and with no loss of generality, sectors are ordered in such a way that tradable (non-tradable) goods are produced for $z \in [0, \alpha)$ ($[\alpha, 1]$), with unionised wage-setting for lower values of z in each interval. Figure 1 illustrates. Due to the assumed complete symmetry between countries, trade in this model is purely intra-industry.

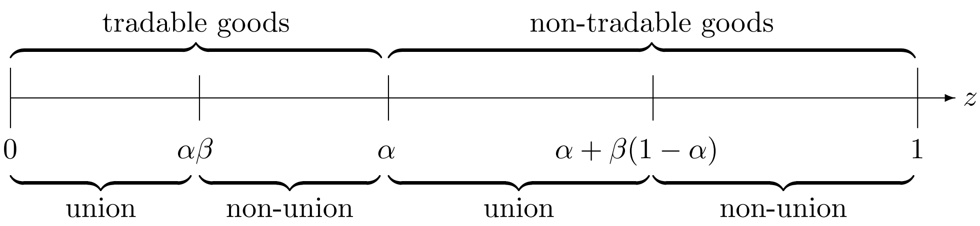

Figure 1: Heterogeneity of sectors

[8] The last result follows from the assumption that preferences are symmetric over goods, combined with the fact that the indirect utility function is quasi-convex, see e.g. Cornes (1992, pp. 38-41). Intuitively, consider the example of starting from a symmetric consumption bundle with identical prices, and then change the prices in any way (necessarily increasing their variance) while leaving nominal income and the average price constant. The original consumption bundle is still affordable, but it is possible (if preferences are not Leontief) to increase utility by substituting away from goods that have become relatively more expensive.

When modeling the labour market we follow Naylor (1998, 1999) and adopt a monopoly union framework. In each of the unionised sectors there is a single union, and its objective is to maximise rents. Firms subsequently choose the level of employment. As in Bastos and Kreickemeier (2009), each union sets the wage $w(z)$ according to

$$w(z) = \arg\max_{w} \left\{\lambda[w(z) - w^c]l(z)\right\}, \tag{5}$$

where $l(z)$ is the total employment in sector z and w^c is the competitive wage. Due to the assumption of a continuum of sectors, unions are small in the economy as a whole, and therefore treat w^c and λ parametrically. If applicable, unions also treat the foreign union wage parametrically, since wage setting occurs simultaneously in all unionised sectors. As usual, the game is solved by backwards induction.

3 Partial Equilibrium

In partial equilibrium, all endogenous variables are determined as a function of the competitive wage w^c and the marginal utility of income λ. We look separately at equilibrium for the shielded and open sectors.

3.1 Shielded sectors

In non-unionised shielded sectors, firm output is given by the standard result for Cournot competition between n identical firms, where the marginal cost is given by the competitive wage:

$$x_i(z) = \frac{l(z)}{n} = \frac{a' - w^c}{b'(n+1)}, \tag{6}$$

with $a' \equiv a/\lambda$ and $b' \equiv b/\lambda$. In unionised shielded sectors, the profit maximising output is given by an equation identical to (6), with the union wage w_n^u replacing w^c:

$$x_i(z) = \frac{a' - w_n^u}{b'(n+1)} \tag{6'}$$

Quantity choices by firms are preceded by union wage-setting. The union wage w_n^u is the solution to

$$\arg\max_{w} \left\{\lambda[w(z) - w^c]n\left(\frac{a' - w(z)}{b'(n+1)}\right)\right\},$$

and straightforward calculations lead to

$$w_n^u = \frac{a' + w^c}{2}. \tag{7}$$

Due to the assumed symmetry between the countries, $w^c = w^{c*}$ and $w_n^u = w_n^{u*}$.

3.2 Open sectors

In the non-unionised open sectors, we have the standard results from the reciprocal dumping model of Brander and Krugman (1983). Exports occur if and only if τ is below a critical level that is implicitly given by the condition that the effective marginal cost of serving the export market, $w^c + \tau$, equals the price in this market in the absence of trade, $(a' + nw^c)/(n+1)$, which is also the marginal revenue of the exporting firm for the first unit sold abroad. For trade costs below this threshold, there is competition between n domestic firms and n foreign firms, where the latter have higher effective (trade-cost inclusive) marginal cost. The profit maximising output levels of Home firms in the domestic and export market, respectively, are given by

$$x_i(z) = \frac{a' - (n+1)w^c + n[w^{c*} + \tau]}{b'(2n+1)} \qquad y_i(z) = \frac{a' - (n+1)[w^c + \tau] + nw^{c*}}{b'(2n+1)},$$

where $x_i(z)$ is output for serving the home market and $y_i(z)$ denotes output sold on the export market. Exploiting the fact that $w^c = w^{c*}$ in equilibrium due to the assumption of identical countries, we get:

$$x_i(z) = \frac{a' - w^c + n\tau}{b'(2n+1)} \qquad y_i(z) = \frac{a' - w^c - (n+1)\tau}{b'(2n+1)} \tag{8}$$

In the unionised sectors, the critical level of tariffs below which trade occurs cannot be determined by simply comparing autarky price and marginal cost, since the marginal cost of serving the export market is partially determined by the union wage, which in turn is a choice variable of the union. We show in the appendix that a critical τ can nevertheless be determined, and that it is strictly lower than the critical level of trade costs in the non-unionised sectors. For the moment, let us assume that the actual trade cost is below this threshold. The equilibrium is then determined in a two stage game, where the firms' output choices in the second stage are given by

$$x_i(z) = \frac{a' - (n+1)w(z) + n[w^*(z) + \tau]}{b'(2n+1)} \qquad y_i(z) = \frac{a' - (n+1)[w(z) + \tau] + nw^*(z)}{b'(2n+1)},$$

with union wages $w(z)$ and $w^*(z)$ determined in the first stage. The rent-maximising wage for the domestic union, for a given foreign union wage $w^*(z)$, is the solution to

$$\arg\max_{w} \left\{ \lambda[w(z) - w^c]n \left(\frac{2[a' - (n+1)w(z) + nw^*(z)] - \tau}{b'(2n+1)} \right) \right\},$$

where the term in round brackets is the profit maximising output $x_i(z)+y_i(z)$ of a domestic exporting firm. Solving for $w(z)$ gives the domestic union's best reply function:

$$w(z) = \frac{2[a' + (n+1)w^c + nw^*(z)] - \tau}{4(n+1)}$$

There is an analogous best reply function for the foreign union, and due to this symmetry, the union wages in the sectors producing tradables are given by

$$w_t^u = w_t^{u*} = \frac{2[a' + (n+1)w^c] - \tau}{2(n+2)}. \tag{9}$$

Using this equality of the domestic and foreign union wage, profit maximising output levels in the domestic and export markets follow in analogy to (8) as:

$$x_i(z) = \frac{a' - w_t^u + n\tau}{b'(2n+1)} \qquad y_i(z) = \frac{a' - w_t^u - (n+1)\tau}{b'(2n+1)} \tag{8'}$$

The difference between union wages in the shielded and open sectors (provided that trade in the latter actually occurs) is given by the difference between (7) and (9):

$$D \equiv w_n^u - w_t^u = \frac{n(a' - w^c) + \tau}{2(n+2)}$$

We know from (6) that $(a' - w^c)$ is positive, and hence union wages are higher in those sectors that are shielded from international competition.

4 General Equilibrium

In general equilibrium, we are free in the choice of a numeraire. Following Neary (2009), it turns out to be particularly convenient to choose marginal utility for this role, which implies that all prices are defined relative to the cost of marginal utility, which is given by λ^{-1}, the inverse of the marginal utility of income. Wages $w/(\lambda^{-1}) = \lambda w$ have the interpretation of *real wages at the margin* (Neary, 2009), and similarly for prices λp. It is instructive to re-write indirect utility function (4) in terms of prices λp. Using (3), we get

$$\widetilde{U} = \frac{1}{2b}(a^2 - \lambda^2 \mu_2), \tag{4'}$$

which shows that utility depends negatively on the second moment of real prices at the margin, λp. This is explained by the fact that the sub-utility for each good is concave, and hence the representative consumer benefits from spreading a *given quantity* of aggregate consumption evenly across the different goods.[9]

While aggregate consumption is of course determined in general equilibrium, in our particular version of the GOLE framework with identical labour input coefficients in all sectors and full employment, the determination is particularly simple: Aggregate output is constant and equal to L, and hence this must be true for aggregate consumption as well. Importantly, it follows that the first moment of prices is constant in our model. This is so since all perceived inverse demand curves (2) are identical and linear, and therefore each price increase must be matched one for one by a price decrease elsewhere in order to keep aggregate demand constant. With a constant average price, (4′) implies that utility is decreasing in the *variance* of real prices at the margin.

In order to economise on notation and terminology, we now simply set $\lambda^{-1} \equiv 1$, and no longer make explicit the distinction between nominal prices on the one hand and real prices at the margin on the other hand, in the understanding that in the remainder of the paper we are always talking about the latter. With the normalisation of λ^{-1}, general equilibrium effects between sectors are only transmitted via the competitive wage w^c. It is determined by the condition that aggregate labour demand of all sectors combined be equal to exogenous labour supply L. This full employment condition in its most general

[9] Note that this does not contradict the earlier observation that a higher variance of nominal prices in (4) increases utility *for a given nominal income*. The distinction reflects the difference between partial and general equilibrium.

form is given by

$$L = n \int_0^1 [x_i(z) + y_i(z)]dz,$$

where $y_i(z)$ is zero for shielded sector firms. We focus throughout on the case where τ is sufficiently low for trade to occur in the open sectors $z \in [0, \alpha)$. Using the partial equilibrium expressions derived above, it is now straightforward to substitute for $x_i(z)$ and $y_i(z)$, noting that with the help of (7) and (9) output in unionised sectors can also be written as a function of the competitive wage. We get

$$w^c = a - \frac{2(n+1)}{K} \left[\left(\frac{(n+2)(2n+1)}{n} \right) bL + \alpha(n+2-\beta)\tau \right], \tag{10}$$

where $K \equiv (2-\beta)(2n^2+5n+2) + \alpha[\beta(2n^2+n-2)+2n+4] > 0$. With the competitive wage thus expressed as a function of model parameters only, it is now possible to find closed-form solutions for all the endogenous variables of the model in general equilibrium.

5 Comparative statics

In our framework with traded non-traded goods it is possible to distinguish between *globalisation at the intensive margin*, modeled as a decrease in trade costs in those sectors already open to trade, and *globalisation at the extensive margin*, modeled as an increase in the proportion of sectors producing tradable goods. We consider both aspects of globalisation in turn.

5.1 The intensive margin of globalisation

Partially differentiating (10) gives

$$\frac{\partial w^c}{\partial \tau} = -\frac{2\alpha(n+1)(n+2-\beta)}{K} < 0, \tag{11}$$

and hence a marginal reduction in trade costs increases the competitive wage. This effect is explained by the fact that trade liberalisation increases the labour demand of firms in open sectors, ceteris paribus: For a constant level of w^c and w_t^u, a reduction in trade costs leads to lower output for the home market due to increased import competition, but to higher output for the export market, since firms become more competitive there. It can be seen in (8) and (8′) that the net effect on labour demand is positive. The increased labour demand from open sectors meets a constant labour supply, resulting in upward pressure on the competitive wage.

Using the definition of K, it follows that $\partial^2 w^c/(\partial\tau\partial\alpha) < 0$, which means that the effect of a change in τ on the competitive wage is stronger the larger the proportion of sectors that produce tradable goods. This is very intuitive: The partial equilibrium effect on labour demand in each sector is independent of α, and with more sectors experiencing trade liberalisation the effect on aggregate labour demand increases.

The effect of trade liberalisation on the union wage in shielded and open sectors, respectively, follows from (7), (9) and (11):

$$\frac{dw_n^u}{d\tau} = \frac{\partial w_n^u}{\partial w^c}\frac{\partial w^c}{\partial \tau} = \left(\frac{1}{2}\right)\frac{\partial w^c}{\partial \tau} < 0 \tag{12}$$

$$\frac{dw_t^u}{d\tau} = \frac{\partial w_t^u}{\partial w^c}\frac{\partial w^c}{\partial \tau} + \frac{\partial w_t^u}{\partial \tau} = \left(\frac{n+1}{n+2}\right)\frac{\partial w^c}{\partial \tau} - \frac{1}{2(n+2)} < 0, \tag{13}$$

and hence lower trade costs mean that unions in both shielded and open sectors set higher wages. The first effect, present in both sectors, results from the general equilibrium increase in the competitive wage just described, which in the absence of any adjustment in the union wage would decrease the union wage premium. With a higher competitive wage the union rent $(w^u - w^c)l$ is no longer maximised for the original wage-employment combination, and it becomes optimal for unions to opt for higher wages. In the open sectors, there is an additional, direct effect known from partial equilibrium models (Naylor 1998, 1999): With higher output due to lower trade cost, the labour demand of unionised firms becomes less elastic, unions can therefore increase wages at a lower cost in terms of employment, and this is therefore what they choose to do.

While a trade cost reduction leads to increased union wages in both shielded and open sectors, the change in the absolute union wage premium is sector specific. We get:

$$\frac{d(w_n^u - w^c)}{d\tau} = -\frac{1}{2}\left(\frac{\partial w^c}{\partial \tau}\right) > 0, \tag{14}$$

$$\frac{d(w_t^u - w^c)}{d\tau} = -\frac{1}{(n+2)}\left(\frac{1}{2} + \frac{\partial w^c}{\partial \tau}\right) < 0, \tag{15}$$

where the inequality sign follows from the fact that $\partial w^c/\partial\tau > -(1/2)$ whenever $\alpha < 1$. Trade liberalisation therefore leads to a decrease of the union wage premium in shielded sectors, while the union wage premium in the open sectors increases. In order to see the economic intuition for this result, consider the counterfactual situation where the unions increase wages in line with the competitive wage, and hence the union wage premium is constant. In the shielded sectors, this wage increase would lead to a decrease in employment, according to ($6'$). In analogy to our earlier argument, with lower employment it is no longer rent maximising for the union to demand the original wage premium, and it accepts a lower premium in return for a smaller decrease in employment. In the open sectors, a constant union wage premium would lead to higher employment due to the Naylor-effect described above. It is therefore optimal for unions to set yet higher wages, thereby sacrificing part of the employment increase that would otherwise have occurred. The results are summarised as follows.

Proposition 1. *A reduction of trade costs in the open sectors leads to a higher competitive wage, and to higher union wages in both shielded and open sectors. The absolute union wage premium falls in shielded sectors and increases in open sectors.*

It is instructive to compare this result to a situation where all sectors are open to international trade, i.e. $\alpha = 1$, which is the scenario considered in Bastos and Kreickemeier (2009). In this case trade liberalisation affects all sectors equally, and hence in general equilibrium all sector-specific employment levels must remain constant. As a consequence rent maximising unions have no incentive to demand a change the wage premium, and therefore the competitive wage and the union wage increase by the same extent.[10]

Comparing (6) to ($6'$) and (8) to ($8'$), respectively, we see that the absolute union wage premium determines the relative employment of unionised and non-unionised firms both within the shielded and within the open sectors. An increase in the union wage premium means that the marginal cost difference between unionised and non-unionised firms in the respective sector increases, and therefore the employment difference between both types

[10]This is confirmed by (11) and (13), which for $\alpha = 1$ give the result $\partial w^c/\partial\tau = \partial w_t^u/\partial\tau = -(1/2)$.

of firms increases as well. Hence it follows from Proposition 1 that in the shielded sectors the relative employment in unionised firms goes up, while in the open sectors it goes down.

In order to gauge the effect of trade liberalisation on the overall share of the workforce employed in unionised firms, one has to aggregate these sector-specific effects, and furthermore take into account that the share of the workforce employed in shielded sectors, L_s/L, changes as trade costs are lowered. Formally, the latter effect can be derived by noting that L_s/L, from eqs. (6), (6′) and (7), is equal to

$$\frac{L_s}{L} = \frac{n(1-\alpha)(2-\beta)(a-w^c)}{2(n+1)bL}.$$

Since the competitive wage increases in the course of trade liberalisation, as shown above in eq. (11), there is a reallocation of workers towards the open sectors when trade costs fall. Taking these general equilibrium effects into account, we are able to show the following:

Proposition 2. *The proportion of workers employed in unionised firms increases as trade costs in open sectors are reduced.*

Proof. See the appendix. □

This result tells us that globalisation need not be – as suggested by views held by the general public – detrimental to union coverage, quite the opposite. In our setting with symmetric countries, in principle this should not come as a surprise: after all, a reduction in trade costs is not only – in the form of import competition – a threat to unionised workers and the firms employing them, but also an opportunity due to the improved competitiveness in export markets. However, as shown earlier, rent maximising unions in the open sectors opt for wage increases, thereby sacrificing increases in the number of employed workers, and the aggregate gain in union coverage is the result of relative wage restraint exercised by unions in the shielded sectors, who are the high-wage earners to begin with. Notably, what could appear to be wage solidarity among unionised workers in the face of globalisation, in our model comes about not because of solidaristic bargaining, but as a natural consequence of trade liberalisation under decentralised wage setting by unions at the sector level once general equilibrium effects are properly accounted for.

We now turn to the welfare analysis of trade liberalisation. Aggregate welfare is measured by the utility of the representative individual, and as argued earlier it only depends on the variance of prices. Since, as we have just shown, the relative output of shielded sectors decreases, relative prices of the non-traded goods increase. Since these are the higher prices to begin with, the variance of prices increases. We therefore get the following result:

Proposition 3. *A reduction in trade costs in open sectors reduces welfare.*

Proof. See the appendix. □

That welfare unambiguously falls as a consequence of a reduction in marginal trade costs stands in marked contrast to the result derived in the tradable-goods-only framework of Bastos and Kreickemeier (2009), who find that trade liberalisation has no effect on welfare. In their case, since trade liberalisation affects all sectors equally and prices stay the same as a consequence, the consumption levels of all goods are unchanged. In our model, with high prices rising and low prices falling, consumption levels across goods become more unequal. Since overall output is constant, this reduces welfare due to the concavity of the utility function.

5.2 The extensive margin of globalisation

Trade cost reductions in sectors already open to trade are only one facet of globalisation. In our framework, which features the co-existence of open and shielded sectors, we can look at a piecemeal increase in the proportion of sectors that are open to trade, which amounts to liberalisation along the extensive margin of globalisation. This case is fundamentally different from liberalisation at the intensive margin considered so far, since all partial equilibrium effects are now eliminated: Both w_n^u and w_t^u are only affected via the change in the competitive wage. In addition, there is of course a direct wage effect in those sectors that change their trade status. We show the following results:

Proposition 4. *Increasing the proportion of sectors open to trade increases the competitive wage as well as the union wage in both open and shielded sectors. The union wage* *premium in all sectors decreases, while the fraction of the workforce employed in unionised firms increases.*

Proof. It is shown in the appendix that $\partial w^c/\partial\alpha > 0$. Using (7) and (9) it follows that

$$\frac{dw^c}{d\alpha} > \frac{dw_t^u}{d\alpha} = \left(\frac{n+1}{n+2}\right)\frac{dw^c}{d\alpha} > \frac{dw_n^u}{d\alpha} = \left(\frac{1}{2}\right)\frac{dw^c}{d\alpha} > 0.$$

Lastly, $\partial(L^u/L)/\partial\alpha > 0$ is shown in the appendix. □

Intuitively, for a given value of w^c, output – and therefore labour demand – increases in those sectors that become open to trade, resulting in upward pressure on the competitive wage. Union wages increase, but union wage *premia* decrease in all sectors, leading to a shift in employment towards unionised firms.[11] Thus, as in the case of globalisation at the intensive margin, globalisation at the extensive margin does not weaken union coverage, quite the opposite.

Welfare effects can again be inferred from changes in the variance of prices. Bastos and Kreickemeier (2009) have shown that welfare is higher with free trade in all sectors than in autarky, which is due to the reallocation of workers towards unionised firms, a decrease in the relative price charged by those firms, and the resulting decrease in the variance of prices. Formally, the result of Bastos and Kreickemeier (2009) is equivalent to

$$\left(p_n^u - p_n^n\right)\big|_{\alpha=0} > \left(p_t^u - p_t^n\right)\big|_{\alpha=1} \tag{16}$$

We cannot use this simple intuition for the analysis of an incremental increase in α considered here since at intermediate levels of α there are now *four* prices to consider, rather than just two at a time as in (16). All four prices increase with higher α due to the increase in wages, and at the same time the weight of the lower prices in the traded goods sectors (we have $p_n^u > p_t^u$ and $p_n^n > p_t^n$) is increased, leaving the average constant. It is clear from Bastos and Kreickemeier (2009) that the welfare effect of marginally increasing α must be

[11] Bastos and Kreickemeier (2009) compare wages and wage premia in autarky to those in a situation with trade in all sectors, which in our current framework would amount to comparing the polar cases $\alpha = 0$ and $\alpha = 1$. The results are as in Proposition 4, as they must be, since we have shown that a change in α has a monotonic effect on wages and wage premia.

positive for at least some ranges of α, since going all the way from autarky to free trade increases welfare. We can in fact show the following:

Proposition 5. *An incremental increase in the proportion of open sectors increases welfare if this proportion is already sufficiently high, but may decrease welfare otherwise.*

Proof. See the appendix. □

Incremental globalisation along the extensive margin is therefore potentially favourable from a welfare point of view, in contrast to globalisation along the intensive margin, and this is definitely the case if the economy is already sufficiently open.

6 Conclusion

In this paper we study the effects of globalisation on labour markets and welfare when some sectors are shielded from international competition. Wage setting monopoly unions are a feature of the labour market in a subset of sectors, and we analyse the differential impact that unionisation has on wages, depending on whether the sectors in question are open to international trade or not. By highlighting the importance of a sector's exposure to international trade for union wages, our setup is reminiscent of the literature on solidaristic bargaining in open economies, but unions in our framework do not coordinate their wage policies across sector boundaries. We consider two forms of globalisation – a reduction in marginal trade cost, and an increase in the number of sectors open to trade – and find that both increase union coverage, and they also lead to a lower union wage premium in shielded sectors. In contrast, the union wage premium in open sectors and aggregate welfare are affected differently by the two types of globalisation. Trade cost reductions in open sectors always lead to higher union wage premia and to lower aggregate welfare, while an increased number of open sectors lowers the union wage premium, and it will definitely increase welfare if the degree of openness is already sufficiently high.

Appendix

Threshold level of trade costs

For two-way trade to be an equilibrium in all sectors, we check here that unions in one country (home) will not want to deviate from an exporting strategy and choose a discretely higher wage, inducing the firms to stop exporting (see also Naylor, 1998, 1999, Lommerud, Meland and Sørgard, 2003 and Bastos and Kreickemeier, 2009). For simplicity, we set $\lambda = 1$. Also, the z-notation is dropped.

The rents of the union (R) if it follows the export strategy is readily found:

$$R_t^u = \frac{1}{2}\left(2(a - w^c) - \tau\right)^2 n \frac{n+1}{(n+2)^2 b\,(2n+1)},$$

which is decreasing in τ (also when taking equilibrium effects through w^c into account). Thus as trade costs increase, the utility of the union falls.

Alternatively, the union could choose a higher wage inducing only imports, and optimally set, this wage would be

$$\begin{aligned} w_{dev} &= \arg\max_w (w - w^c) n \left(\frac{a - (n+1)w + n(w^* + \tau)}{b\,(2n+1)} \right) \\ &= \frac{1}{2}\frac{a + n(w^* + \tau) + (n+1)w^c}{(n+1)}, \end{aligned}$$

where w^* is the wage of the foreign union. Given that the union in the foreign country chooses the equilibrium wage $w^* = \frac{2a+2w^c(n+1)-\tau}{2(n+2)}$, union utility in the case of deviation is

$$R_{dev} = \frac{n}{16}\frac{\left(4(n+1)(a - w^c) + \tau n(3+2n)\right)^2}{(n+2)^2 (2n+1)\, b\,(n+1)},$$

which is increasing in τ (again, also when taking equilibrium effects into account). Thus the incentive to deviate is higher for higher trade costs, because then both the deviation utility increases and the non-deviation utility becomes lower. The union is indifferent between deviating and not when $R_t^u = R_{dev}$, or for

$$\tau = \tau^* = \frac{8\left(\sqrt{2} - 1\right) bL\,(n+1)^2}{nK_2},$$

where $K_2 \equiv \left(4\alpha + 3n + 2n^2\right)(2 - \beta) + n\alpha(6 + \beta(2n-1)) + 2\sqrt{2}\,(1-\alpha)(2-\beta)(n+1) > 0$. For $\tau < \tau^*$, the union will not want to deviate, and we can conclude that there will exist an equilibrium in the wage setting game where there is two-way trade in the unionised sectors.

For the non-union open sector, there will be trade if

$$y = n\frac{a - (w^c + t(n+1))}{(2n+1)\,b} > 0.$$

Solving for τ, this gives us

$$\tau < \tau^{**} = \frac{2}{n}\frac{(n+2)\,bL}{(2-\beta)(2+n) + \alpha\beta n}. \tag{17}$$

This is a less strict condition than the above restriction calculated for the unionised open sector, so $\tau < \tau^*$ is sufficient for two way trade to occur in both unionised and non-unionised sectors. We will thus assume that $\tau < \tau^*$. However, wherever it suffices to use $\tau < \tau^{**}$ in a proof and it simplifies the expressions, we will use that instead.

Proof of Proposition 2

The fraction of the labour force that is employed in unionised firms is given by

$$\frac{L^u}{L} = n\frac{\alpha\beta\,(n+1)\,\frac{2a-(2w^c+\tau)}{(n+2)b(2n+1)} + (1-\alpha)\beta\frac{a-w^c}{2b(n+1)}}{L},$$

which, after substituting the general equilibrium value of w^c, can be rewritten as

$$\frac{L^u}{L} = \beta\frac{\big(2(n^2+1)(1+\alpha) + n(5+3\alpha)\big)\,bL - \alpha(1-\alpha)(1-\beta)n^2\tau}{KbL},$$

where $K > 0$ is defined in Section 4. It is now immediate that $\frac{\partial(L^u/L)}{\partial\tau} \leq 0$, where the inequality is strict if $0 < \alpha < 1$ and $\beta < 1$.

Proof of Proposition 3

The second moment of prices is given by

$$\mu_2 = \alpha\big[\beta(p_t^u)^2 + (1-\beta)(p_t^n)^2\big] + (1-\alpha)\big[\beta(p_n^u)^2 + (1-\beta)(p_n^n)^2\big],$$

and this can be written as

$$\begin{aligned}\mu_2 =& a(a-2bL) + \frac{(1-\alpha)(4-3\beta)}{K^2}\big[\,(n+2)\,(2n+1)\,bL + \alpha\,(n+2-\beta)\,n\tau\big]^2\\ &+\alpha\frac{(n+2)^2-(2n+3)\beta}{K^2}\big[4(n+1)bL - (1-\alpha)\,(2-\beta)\,n\tau\big]^2.\end{aligned} \tag{18}$$

Since $\frac{\partial^2 \mu_2}{\partial \tau^2} > 0$, $\frac{\partial \mu_2}{\partial \tau} \leq \frac{\partial \mu_2}{\partial \tau}|_{\tau=\tau^{**}}$, where

$$\left.\frac{\partial \mu_2}{\partial \tau}\right|_{\tau=\tau^{**}} = -\frac{2\alpha(1-\alpha)\beta n^2 (\beta+n)\, bL}{[(n+2)(2-\beta)+\alpha\beta n]\, K} \leq 0.$$

Thus $\frac{\partial \mu_2}{\partial \tau} \leq 0$, where the inequality is strict unless $\alpha = 0$ or $\alpha = 1$.

Proof of Proposition 4

Partially differentiating w^c with respect to α leads to:

$$\frac{\partial w^c}{\partial \alpha} = 2(n+1)(n+2)(2n+1)\,\frac{\left(2\beta n^2 + 4 - 2\beta + \beta n + 2n\right) bL - (2-\beta)(n+2-\beta)\, n\tau}{nK^2}$$

Since $\partial^2 w^c / \partial\alpha\partial\tau < 0$,

$$\frac{\partial w^c}{\partial \alpha} \geq \left.\frac{\partial w^c}{\partial \alpha}\right|_{\tau=\tau^{**}} = \frac{2\beta bL\,(2n+1)(n+2)(n+1)}{K\,(\alpha\beta n + (2-\beta)(n+2))} > 0.$$

For the fraction of workers in the unionised sectors, we have

$$\frac{\partial (L^u/L)}{\partial \alpha} = \beta n (1-\beta)(2+n)(2n+1)\,\frac{\tau n \left[\frac{\alpha K}{(2+n)(2n+1)} - (1-\alpha)(2-\beta)\right] + 4(n+1)\, bL}{bLK^2}.$$

For $\tau = 0$, $\partial (L^u/L)/\partial \alpha > 0$. Thus an increase in the number of open sectors also leads to higher total employment in unionised firms. This can only change with higher τ if $\frac{\alpha K}{(2+n)(2n+1)} - (1-\alpha)(2-\beta) < 0$, which happens for low α. Assuming $\frac{\alpha K}{(2+n)(2n+1)} - (1-\alpha)(2-\beta) < 0$, and using the fact that $\frac{\partial^2 (L^u/L)}{\partial\alpha\partial\tau}$ is then negative,

$$\frac{\partial (L^u/L)}{\partial \alpha} \geq \left.\frac{\partial (L^u/L)}{\partial \alpha}\right|_{\tau=\tau^{**}}$$

$$= \frac{2(n+2)(1+\alpha+2n)\,\beta n (1-\beta)}{K((2-\beta)(n+2)+n\alpha\beta)} \geq 0.$$

Thus, $\partial (L^u/L)/\partial \alpha \geq 0$, and it is exactly equal to zero only if $\beta = 0$ or $\beta = 1$.

Proof of Proposition 5

Evaluating (18) for $\alpha = 1$, we can show that

$$\left.\frac{\partial^3 \mu_2}{\partial\alpha\partial\tau^2}\right|_{\alpha=1} = -\frac{1}{8}(4-3\beta)\,\frac{n^2}{(n+1)^2} < 0.$$

Thus $\left.\frac{\partial^2\mu_2}{\partial\alpha\partial\tau}\right|_{\alpha=1}$ must be decreasing in τ, implying

$$\left.\frac{\partial^2\mu_2}{\partial\alpha\partial\tau}\right|_{\alpha=1} \geq \left.\frac{\partial^2\mu_2}{\partial\alpha\partial\tau}\right|_{\alpha=1,\tau=\tau^{**}} = \frac{1}{4}n^2Lb\beta\frac{n+\beta}{(n+2-\beta)^2(n+1)} > 0.$$

In analogy to the previous argument, this implies that $\left.\frac{\partial\mu_2}{\partial\alpha}\right|_{\alpha=1}$ is increasing in τ. Thus

$$\left.\frac{\partial\mu_2}{\partial\alpha}\right|_{\alpha=1} \leq \left.\frac{\partial\mu_2}{\partial\alpha}\right|_{\alpha=1,\tau=\tau^{**}} = -\frac{1}{4}b^2L^2\beta n\frac{n^2+n(6-5\beta)+8(1-\beta)}{(n+2-\beta)^3} < 0.$$

By continuity, there is also a range of $\alpha \leq 1$ near $\alpha = 1$ where $\frac{\partial\mu_2}{\partial\alpha} < 0$.

To illustrate that both $\frac{\partial\mu_2}{\partial\alpha} > 0$ and $\frac{\partial\mu_2}{\partial\alpha} < 0$ can happen for lower levels of α, let for instance $\tau = 0$ and $n = 2$. Evaluating $\frac{\partial\mu_2}{\partial\alpha}$ at $\alpha = 0$ yields

$$\left.\frac{\partial\mu_2}{\partial\alpha}\right|_{\alpha=0,\tau=0,n=2} = \frac{8}{25}b^2L^2(1-3\beta)\frac{1-2\beta}{(2-\beta)^3},$$

which is negative for $\beta \in (\frac{1}{3}, \frac{1}{2})$ and positive otherwise. (It is also easy to show that for $\beta = 1$ and $\beta = 0$, $\frac{\partial\mu_2}{\partial\alpha}|_{\alpha=0}$ is always positive.)

References

[1] Bastos, P., Kreickemeier, U., 2009. Unions, competition and international trade in general equilibrium. Journal of International Economics 79, 238–247.

[2] Bastos, P., Kreickemeier, U., Wright, P., 2009. Oligopoly, open shop unions and trade liberalization. International Journal of Industrial Organization 27, 679–686.

[3] Bastos, P., Straume, O.R., 2010. Globalization, Product Differentiation and Wage Inequality. IDB Working Paper 184.

[4] Bettendorf, L., Dewachter, H., 2007. Ageing and the relative price of nontradables. Tinbergen Institute Discussion Paper 07-064/2.

[5] Brander, J., Spencer, B., 1988. Unionised Oligopoly and International Trade Policy. Journal of International Economics 24, 217–234.

[6] Brander, J., Krugman, P.R., 1983. A 'Reciprocal Dumping' Model of International Trade. Journal of International Economics 15, 313–321.

[7] Corden, W.M., Neary, J.P., 1982. Booming Sector and De-industrialisation in a Small Open Economy, Economic Journal 92, 825–848.

[8] Cornes, R., 1992. Duality and Modern Economics. Cambridge University Press.

[9] De Gregorio, J., Giovannini, A., Wolf, H., 1994. International evidence on tradables and nontradables inflation. European Economic Review 38, 1225–1244.

[10] Falvey, R., Kreickemeier, U., 2005. Globalisation and Factor Returns in Competitive Markets. Journal of International Economics 66, 233–248.

[11] Gorman, W., 1961. On a Class of Preference Fields. Metroeconomica 13, 53–56.

[12] Holden, S., 2003. Wage-setting under Different Monetary Regimes, Economica 70, 251–266.

[13] Huizinga, H., 1993. International Market Integration and Union Wage Bargaining. Scandinavian Journal of Economics 95, 249–255.

[14] Lommerud, K.E., Meland, F., Sørgard, L., 2003. Unionised Oligopoly, Trade Liberalisation and Location Choice. Economic Journal 113, 782–800.

[15] Lommerud, K.E., Meland, F., Straume, O.R., 2006. Globalisation and Union Opposition to Technological Change. Journal of International Economics 68, 1–23.

[16] Lommerud, K.E., Straume, O.R., Sørgard, L., 2006. National versus International Mergers in Unionised Oligopoly. RAND Journal of Economics 37, 212–233.

[17] Meland, F., 2006. A Union-Bashing Model of Inflation Targeting. Scandinavian Journal of Economics 108, 419–432.

[18] Mezzetti, C., Dinopoulos, E., 1991. Domestic Unionization and Import Competition. Journal of International Economics 31, 79–100.

[19] Moene, K.O., Wallerstein, M., 1995. How Social Democracy Worked. Politics and Society 23, 185–211.

[20] Munch, J.R., Skaksen, J.R., 2002. Product Market Integration and Wages in unionised Countries. Scandinavian Journal of Economics 104, 289–299.

[21] Naylor, R., 1998. International Trade and Economic Integration When Labour Markets are Generally Unionised. European Economic Review 42, 1251–1267.

[22] Naylor, R., 1999. Union Wage Strategies and International Trade. Economic Journal 109, 102–125.

[23] Neary, J.P., 1988. Determinants of the Equilibrium Real Exchange Rate. American Economic Review 78, 210–215.

[24] Neary, J.P., 2007. Cross Border Mergers as Instruments of Comparative Advantage. Review of Economic Studies 74, 1229–1257.

[25] Neary, J.P., 2009. International Trade in General Oligopolistic Equilibrium. University of Oxford, Mimeo.

[26] Rasmussen, B.S., 1992. Union Cooperation and Nontraded Goods in General Equilibrium. Scandinavian Journal of Economics 94, 561–579.

[27] Sørensen, J.R., 1993. Integration of Product Markets when Labour Markets are unionised. Recherches Economiques de Louvain 59, 485–502.

[28] Straume, O.R., 2003. International Mergers and Trade Liberalisation: Implications for Unionised Labour. International Journal of Industrial Organization 21, 717–735.

[29] Vartiainen, J., 2002. Relative Prices in Monetary Union and Floating. Scandinavian Journal of Economics 104, 277–287.