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83

STRATEGIC TRADE  
POLICY IN A  
TWO-SECTOR  
DUOPOLY MODEL  
WITH AN  
ENDOGENOUS  
UNION STRUCTURE

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**ABSTRACT:** The institutional structure of labour markets is frequently stated to be an important determinant of 'international competitiveness' and the stability of an economy. In this paper we use a two-country, two-sector framework with international duopolies in both sectors to investigate the incentive for firm-specific unions to cooperate with each other either nationally or internationally and to examine the consequences of union cooperation for two separate international duopolies. We show, firstly, that the equilibrium union structure is characterised by the independent unions (the cooperative union) in a given sector, where the inefficient firm in the small (large) country competes with the exports of the efficient firm in the large (small) country. Secondly, production subsidies by smaller country to an efficient export sector are more welfare improving than an equal amount of support to an inefficient import competing sector only when the union of the exporting firm cooperates with the union in the same sector in a larger country.

**Keywords:** Endogenous union structure, strategic trade policy.

**JEL classification:** J51, F12.

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**TIIVISTELMÄ:** Työmarkkinoiden neuvottelujärjestelmän katsotaan usein vaikuttavan talouden toimintakykyyn. Tutkimuksessa tarkastellaan yritysکوhtaisten ammattiliittojen taloudellisia kannustimia muodostaa toimialakohtaisia ja/tai maakohlaisia koalitioita ja tutkitaan eri koalioiden vaikutuksia kahden maan ja kahden toimialan duopoli-kilpailuun. Tutkimuksessa osoitetaan, että ainoastaan ison maan tehottomamman yrityksen ammattiliitolla ja pienen maan tehokkaamman yrityksen ammattiliitolla (kyseiset yritykset kilpailevat keskenään) on taloudellinen kannustin muodostaa yhteinen ammattiliitto. Tämän toimialakohtaisen ammattiliiton vallitessa pienen maan on talouden kokonaishyvinvoinnin kannalta tarkoituksenmukaisempaa tukea tehokkaampaa yritystä kuin tehotonta; muunlaisen ammattiliittorakenteen valitessa tehottomamman yrityksen tukeminen on tarkoituksenmukaisempaa.

**Avainsanat:** Endogeeninen ammattiliittorakenne, stratekinen kauppapolitiikka.

**JEL luokittelu:** J51, F12.

## 1. INTRODUCTION

The institutional structure of labour markets is frequently stated to be an important determinant of 'international competitiveness' and the stability of an economy. Unfortunately, the economics literature has relatively little to say about how labour market institutions affect trade patterns and policy and employment fluctuations resulting from floating exchange rates. In this paper we investigate the incentive for firm-specific unions to cooperate with each other either nationally or internationally and examine the consequences of union cooperation for two separate international duopolies and for strategic trade policy.

The partial equilibrium model contains two countries and two sectors such that each country has one firm in each sector. Initially each firm has its own trade union, which sets its wage rate unilaterally. After the firm-specific wages have been determined, the firms unilaterally set their output (and employment) level, taking their rivals' behaviour as given, i.e. each firm displays Cournot conduct. The small domestic country exports a product in one sector to the large foreign country and imports a product in the other sector from the foreign country. Exporting firms are assumed to be more efficient than their rivals. The demand for goods in each country is assumed to be independent and domestic markets are perfectly segmented from foreign markets. In this framework the exogenous exchange rate affects the behaviour of duopoly pairs and thus the welfare of both countries.

The aim of this paper is threefold. Firstly, we endogenise union structure and demonstrate that one union may have an incentive to cooperate with the other union in the same sector. The efficient exporting firm (the inefficient firm competing with imports) gains (loses) from the unions' country-wide cooperation, whereas they both oppose the unions' sector-wide cooperation. Secondly, we investigate how the exchange rate affects employment under different union structures and find that a country-specific union structure minimises employment fluctuation. Thirdly, we demonstrate that production subsidies by a smaller country to an efficient export

sector are more welfare-improving than an equal amount of support to an inefficient import sector only when the union of the exporting firm cooperates with the union in the same sector in a larger country.

This paper is related to the literature as follows. Firstly, Brander and Spencer (1988) examine the consequences of the unionisation of one firm only for an international duopoly. They draw attention to the positive effects of unionisation on international markets and study the implication of unionisation for international trade policy. Secondly, Driffill and van der Ploeg (1993) investigate the effects of the European single market on trade unions and wage formation. They analyse whether unions have an incentive to cooperate with unions in other countries. They focus on a two-country model of international trade where each country specialises in the production of a homogenous product. They assume perfect competition in the output markets. Thirdly, Horstman and Markkusen (1992) consider the behaviour of two (potentially) horizontal multinational firms in the presence of imperfect competition and analyse the effects of trade policies on an endogenous market structure. Fourthly, Neary (1994) considers the optimality of export subsidies in oligopolistic markets when home and foreign firms have different costs and the social cost of public funds exceeds unity. Neary shows that subsidies are optimal only when the social cost of public funds is very low and, if subsidies are justified, they should be higher the more cost-competitive are domestic firms. Finally, Padilla et al (1994) have developed a game-theoretic version of the right-to-manage model of firm -level bargaining where strategic interactions between firms are explicitly recognised. It is a single country model where the reference wage for one union depends on the wage level in other firms. It is thus easy to understand that unions in competing firms do not have opposing interests in terms of wages as they all benefit from simultaneous wage increases at their respective firms. Therefore, even if bargaining were conducted at an industry level we would expect unions to succeed in coordinating their strategies.

The remainder of the paper is organised as follows. Section 2 describes the model and the section 3 compares the dependence of wage formation on the union structure. In section 4, we consider how the union structure depends on the parameters of the model, while in section 5 the effects of the union structure and the exchange rate on the domestic economy are studied. Section 6 considers the welfare effects of the production subsidies and section 7 consists of concluding remarks.

## 2. THE MODEL

We focus on a two-country, two-firm and two-commodity model where each country has two firms, each producing one commodity. The demand for two goods in home country is assumed to be linear and independent, being given by

$$p_i^h = A_i^h - a_i^h z_i^h, \quad (1)$$

where  $p_i^h$  is the domestic market price and  $z_i^h$  is the domestic consumption of commodity  $i$ , and  $A_i^h$  and  $a_i^h$  are positive parameters. The demand in the foreign country is

$$p_i^f = A_i^f - a_i^f z_i^f, \quad (2)$$

where  $p_i^f$  is the domestic market price and  $z_i^f$  is the domestic consumption of commodity  $i$ , and  $A_i^f$  and  $a_i^f$  are positive parameters. The output markets are assumed (for reason of simplicity) to be perfectly segmented, implying that the domestic and foreign prices may differ.

To introduce trade flows, the domestic (foreign) country is assumed to have a cost-advantage in the production of good 1 (good 2), implying that the domestic country exports good 1 to (imports good 2 from) the foreign country. Thus (assuming homogeneous products in both sectors) domestic and foreign consumption are defined as

$$z_1^h = F_1^h - x_1^h ; \quad z_2^h = F_2^h + x_2^f, \quad (3)$$

$$z_1^f = F_1^f + x_1^h ; \quad z_2^f = F_2^f - x_2^f, \quad (4)$$

where  $F_2^h$  is the domestic production of and  $x_2^f$  is the domestic import of good 2, whereas  $F_1^f$  is the foreign production and  $x_1^h$  is the foreign import of good 1. The total production of domestic firm 1 is thus  $F_1^h = z_1^h + x_1^h$  and that of foreign firm 2 is  $F_2^f = z_2^f + x_2^f$ .

The production structure is as simple as possible: it is assumed that technology exhibits constant returns to scale such that  $F_i^h = L_i^h$  and  $F_i^f = L_i^f$  for both firms, i.e. labour is the only input. The profit functions of the domestic firms are

$$\pi_1^h = p_1^h z_1^h + e p_1^f x_1^h - (w_1^h + \beta^h)(z_1^h + x_1^h), \quad (5)$$

$$\pi_2^h = p_2^h F_2^h - (w_2^h + \alpha^h) F_2^h, \quad (6)$$

where  $\beta^h$  is the production tax on the exportable,  $\alpha^h$  is the total specific production cost of good 2 ( $\alpha^h$  includes the production tax levied on good 2), and  $e$  is the exogenous exchange rate<sup>1</sup> of the domestic and foreign currencies. So  $e p_1^f x_1^h$  is the value of domestic exports denominated in the domestic currency.

The profit functions of the foreign firms are

$$\pi_1^f = p_1^f F_1^f - (w_1^f + \alpha^f) F_1^f, \quad (7)$$

$$\pi_2^f = p_2^f z_2^f + \left(\frac{1}{e}\right) p_2^h x_2^f - (w_2^f + \beta^f)(z_2^f + x_2^f), \quad (8)$$

where  $\beta^f$  is the production tax on the foreign exportable and  $\alpha^f$  is the total specific production cost of foreign good 1 ( $\alpha^f$  includes the production tax levied on good 1). Here  $\left(\frac{1}{e}\right) p_2^h x_2^f$  is the value of foreign exports denominated in the foreign currency.

It is assumed initially that each firm has its own union. Wage determination will obviously depend on the shape of the unions' utility functions. This paper concentrates on interactions between the product markets, and simplifying assumptions are

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<sup>1</sup> If one allows the exchange rate to be endogenous, being determined such that the trade balance is always zero, and if this is known to firms, there is no trade at all at the Cournot-Nash equilibrium when export costs are zero.



needed with these aspects of the model to retain a meaningful level of tractability. It is therefore assumed that the objective function of each union is the maximisation of union rents, i.e. the total wage above the competitive wage level as in De Fraja (1993). The domestic unions' utility are therefore given by

$$u_i^h = (w_i^h - r^h) F_i^h \quad (9)$$

and the foreign unions' utility by

$$u_i^f = (w_i^f - r^f) F_i^f, \quad (10)$$

where  $r^h$  and  $r^f$  are the reference wages in the domestic and foreign country respectively.

### 3. SOLUTION OF THE MODEL UNDER DIFFERENT UNION STRUCTURES

This section considers two international duopoly pairs, where the firms belonging to the same pair produce homogeneous products. It is assumed that the domestic country has a cost advantage in the production of good 1, and the foreign country has a cost advantage in the production of good 2, implying that the domestic (foreign) country exports (imports) good 1 and imports (exports) good 2. Since the output markets are perfectly segmented between the domestic and foreign country, i) the domestic firm producing good 1 is in a monopoly position in the domestic country, but it has a Cournot competitor in the foreign market, ii) the foreign firm producing good 2 is in a monopoly position in the foreign country, but it has a Cournot competitor in the domestic market.

The subgame-perfect equilibrium incorporates two stages of decision. In stage 1, each firm-specific union or coalition of unions simultaneously commit to the wages paid by firms for labour, without knowing the wage-setting processes of the other unions. In stage 2, the outputs of the final products are determined either by the Cournot game or by monopoly pricing. The domestic and foreign countries are

assumed to commit their policies, specific production subsidies, at stage 0, prior to moves by the unions and firms. This type of game appears to be accepted in literature on bargaining in firms operating in imperfectly competitive markets (see for example Brander and Spencer, 1988, and De Fraja, 1993).

Therefore consider firstly the profit maximising firms. They chooses their supplies to domestic and foreign market so as to maximise their profits for given levels of the exchange rate, government policies, wages and rival's supplies as presented in Table 1.

Table 1: Behaviour of firms at optimum.

home firms	foreign firms
1: $z_1^h = \frac{A_1^h - w_1^h - \beta^h}{2a_1^h}$	2: $z_2^f = \frac{A_2^f - w_2^f - \beta^f}{2a_2^f}$
1: $x_1^h = \frac{A_1^f + \alpha^f - (2/e)\beta^h + w_1^f - (2/e)w_1^h}{3a_1^f}$	2: $x_2^f = \frac{A_2^h + \alpha^h - (2e)\beta^f + w_2^h - (2e)w_2^f}{3a_2^h}$
2: $F_2^h = \frac{A_2^h - 2\alpha^h + e\beta^f - 2w_2^h + ew_2^f}{3a_2^h}$	1: $F_1^f = \frac{A_1^f - 2\alpha^f + (1/e)\beta^h - 2w_1^f + (1/e)w_1^h}{3a_1^f}$

Table 1 shows simple monopoly rules for the production of good 1 in the domestic country and for the production of good 2 in the foreign country. Due to Cournot competition the domestic export (production) and the foreign production (export) of good 1 (good 2) are interdependent. The foreign marginal production cost of good 1 increases the domestic export (at a rate of  $\left[1/(3a_1^f)\right]$ ) and decreases the foreign production (at a rate of  $\left[-2/(3a_1^f)\right]$ ). Since the domestic production costs are measured in terms of the domestic currency the exchange rate affects the rates at which the domestic marginal production cost decreases the domestic export and increases the foreign production. The domestic costs have to be converted by the factor  $(1/e)$  into those of the foreign market. The foreign export and the domestic production of good 2 can be interpreted as above.

Next we turn to the behaviour of unions and consider whether firm-specific unions have any incentive to cooperate. We describe the different union structures in the following four subsections. It is extremely hard to obtain an explicit analytical solution to the wage systems following from the first-order conditions of the unions' maximisation. Numerical simulations have therefore been performed in section 4.

### 3.1. Independent firm-specific unions

For given levels of the exchange rate, government policies and the other unions' actions, each independent firm-specific union maximises its own utility by setting its wage level, taking into account the reactions of firms. The first-order conditions are presented in Table 2.

Table 2: Behaviour of independent unions

home unions

$$1: z_1^h + x_1^h + (w_1^h - r^h) \frac{\partial(z_1^h + x_1^h)}{\partial w_1^h} = 0$$

$$2: F_2^h + (w_2^h - r^h) \frac{\partial F_2^h}{\partial w_2^h} = 0$$

foreign unions

$$1: F_1^f + (w_1^f - r^f) \frac{\partial F_1^f}{\partial w_1^f} = 0$$

$$2: z_2^f + x_2^f + (w_2^f - r^f) \frac{\partial(z_2^f + x_2^f)}{\partial w_2^f} = 0$$

Table 2 shows that each union's wage premium satisfies the inverse elasticity rule. For example union 1 in the home country sets  $w_1^h - r^h = -w_1^h/\varepsilon_1^h$  ( $> 0$ ), where  $\varepsilon_1^h$  is the wage elasticity of labour demand. So each union captures a positive wage premium.

### 3.2. Country-specific unions

An integrated country-wide union maximises the sum of its member unions' utility. For given levels of the exchange rate, government policies and the wage of the other country, each country-specific union sets a country-wide wage level, taking into

account the reactions of firms. The first-order conditions of the domestic and foreign country are presented in equations (11) and (12),

$$z_1^h + x_1^h + F_2^h + (w^h - r^h) \frac{\partial(z_1^h + x_1^h + F_2^h)}{\partial w^h} = 0, \quad (11)$$

$$z_2^f + x_2^f + F_1^f + (w^f - r^f) \frac{\partial(z_2^f + x_2^f + F_1^f)}{\partial w^f} = 0, \quad (12)$$

respectively, where  $w^h = w_1^h = w_2^h$  and  $w^f = w_1^f = w_2^f$ .

Both country-specific unions' wage premiums satisfy the inverse elasticity rule, but the relevant elasticity here is the wage elasticity of the total labour demand in the country in question. In the following we will also consider cases where there is a country-wide union in one country and two independent unions in the other country.

### 3.3. Sector-specific unions

An integrated sector-wide union maximises the sum of its member unions' utility. A union sets one sector-specific wage level. It is assumed that this wage level is denominated in the foreign currency, implying that the wage cost of the foreign firm is independent of the exchange rate, whereas the wage cost of the domestic firm fluctuates with the exchange rate. In other words, the domestic firm has to pay wages in the foreign currency, i.e.  $w_1^h = ew_1^f$  and  $w_2^h = ew_2^f$ .

For given levels of the exchange rate, government policies and the wage in the other sector, each sector-specific union sets a sector-specific wage level, taking into account the reactions of firms. The first-order conditions of the sector 1 and sector 2 are presented in equations (13) and (14)

$$e(z_1^h + x_1^h) + F_1^f + (ew_1^f - r^h) \frac{\partial(z_1^h + x_1^h)}{\partial w_1^f} + (w_1^f - r^f) \frac{\partial F_1^f}{\partial w_1^f} = 0, \quad (13)$$

$$eF_2^h + z_2^f + x_2^f + (ew_2^f - r^h) \frac{\partial F_2^h}{\partial w_2^f} + (w_2^f - r^f) \frac{\partial (z_2^f + x_2^f)}{\partial w_2^f} = 0, \quad (14)$$

respectively. The first two terms in each equation measure the direct effect of wages on the unions' utility, whereas the last two terms measure the indirect effects from domestic and foreign labour demand in the sector in question.

### 3.4. One global union

A global union sets one wage level, denominated in the foreign currency. This means that the wage level in the domestic country is  $w^h = ew^f$ , implying that the domestic wage level fluctuates with the exchange rate. As before, an integrated union maximises the sum of its member unions' utility. For given levels of the exchange rate and government policies, a global union sets one country-wide and sector-wide wage level, taking into account the reactions of firms. The first-order condition is presented in equation (15) as

$$e(z_1^h + x_1^h + F_2^h) + (ew^f - r^h) \frac{\partial (z_1^h + x_1^h + F_2^h)}{\partial w^f} + F_1^f + z_2^f + x_2^f + (w^f - r^f) \frac{\partial (F_1^f + z_2^f + x_2^f)}{\partial w^f} = 0. \quad (15)$$

The first and third terms measure the direct effect of the wage on the union's utility, whereas the second and fourth terms measure the indirect effects from labour demand.

## 4. ENDOGENOUS UNION STRUCTURE: NUMERICAL SOLUTION

It is extremely hard to obtain an explicit solution to the system of wages given by the first-order conditions. Numerical simulations have therefore been performed for various values of the parameters, firstly obtaining the Cournot-Nash equilibrium for

the wage levels, and then calculating the values of the other pertinent variables. Table 3 shows the exogenous parameters.

Table 3: Parameter values

	$A_1$	$a_1$	$A_2$	$a_2$	$r$
home	10	0.5	10	0.5	0
foreign	12	0.5	12	0.5	1

We have assumed that the foreign country is larger than the domestic country in the sense that i) consumption is larger in the foreign than in the domestic country in both goods at the same level of output price, i.e. the intercepts of the demand function are larger in the foreign than the domestic country, and ii) the reference wage level is higher in the foreign than in the domestic country.

Eight different union structures are considered in the following. They are termed as follows:

- a: independent unions in both countries and sectors,
- b: cooperative union in home country and independent unions in foreign country ,
- c: independent unions in home country and cooperative union in foreign country,
- d: cooperative unions in both countries,
- e: cooperative union in sector 1 and independent unions in sector 2,
- f: independent union in sector 1 and cooperative union in sector 2,
- g: cooperative unions in both sectors,
- h: one cooperative union.

As the preceding section clearly shows, the exogenous exchange rate affects the firms' and unions' behaviour. It may well be that the unions' incentive to cooperate depends on the level of the exchange rate. We do not, however, consider the dependence of the union structure on the exchange rate in this section. Instead, we calculate the unions' payoffs at one specific value of the exchange rate. We have

used  $e = 0.8$  as the reference value for the exchange rate, since this value implies a near-balance in trade between countries.

Table 4 shows unions' payoffs in the different regimes both with and without the domestic production subsidy to sector 2, competing with the foreign import. It shows clearly that the unions of both the exporting firms have a strong incentive (disincentive) to cooperate with the unions in the same sector (country). The union of the domestic firm competing with the foreign import has a strong incentive to stay independent; all forms of cooperation decrease the union's welfare. The union of the foreign firm competing with the domestic export is in favour of sector-wide cooperation and opposes country-wide cooperation. Without any compensation payments, and when each union's decision depends only on its own free choice, the equilibrium union structure includes the independent unions in sector 2 and the cooperative union in sector 1. However, the union structure, where the unions in both sectors cooperate, maximises the sum of each union's welfare.

Table 4: Dependence of unions' utility on union structure: when  $e = 0.8$

	without subsidies				with subsidies			
	$\beta^h = 0$ $u_1^h$	$\alpha^h = .5$ $u_2^h$	$\beta^f = 0$ $u_1^f$	$\alpha^f = .5$ $u_2^f$	$\beta^h = 0$ $u_1^h$	$\alpha^h = 0$ $u_2^h$	$\beta^f = 0$ $u_1^f$	$\alpha^f = .5$ $u_2^f$
a	41.98	15.22	16.16	44.53	41.98	17.47	16.16	43.73
b	41.76	15.14	15.60	45.75	41.87	17.48	15.83	44.44
c	44.54	14.42	15.99	43.87	44.47	16.65	16.02	43.11
d	44.41	14.08	15.03	45.41	44.42	16.50	15.37	44.16
e	45.82	15.22	16.65	44.53	45.82	17.47	16.65	43.73
f	41.98	13.20	16.16	49.66	41.98	16.64	16.16	47.85
g	45.82	13.20	16.65	49.66	45.82	16.64	16.65	47.85
h	45.83	13.30	16.60	49.52	45.82	16.66	16.59	47.77

The domestic production subsidy to the firm competing with the foreign import does not change the qualitative results of the union structure. It is evident that the domestic subsidy increases the domestic union's utility and decreases the foreign union's

utility. The interesting result is that the domestic subsidy decreases the domestic union's welfare losses and the foreign union's welfare gains from the sector-wide cooperation. The following proposition summarises the results:

*Proposition 1:*

- i) Without any compensation payments, and when each union's decision depends only on its own free choice, the equilibrium union structure includes the independent unions (the cooperative union) in that sector where the inefficient firm competes with the exports of the efficient firm in the small (large) country.
- ii) The domestic production subsidy to the firm competing with the foreign imports decreases the domestic union's welfare losses and the foreign union's welfare gains from the sector-wide cooperation.

The economic forces at work are as follows. Firstly, when the domestic unions cooperate, the wage level of the lower-cost exporting firm decreases and that of the higher-cost firm competing with the foreign export increases, since the country-wide union maximises the sum of both unions' rents. These direct wage changes increase firm 1's demand for labour and decrease firm 2's demand for labour in the home country. Since an increase in the wages of one firm increases its rival's production<sup>2</sup>, foreign exports increase and firm 1's demand for labour decreases in the foreign country. Changes in the outputs affect in turn wage determination in the foreign country, feeding back to the domestic country. This reasoning implies that union 1's utility decreases, whereas union 2's utility increases in the foreign country. The effects on unions in the home country are ambiguous; numerical simulations, however, show that both domestic unions' utility decreases. Therefore, the domestic unions have a disincentive to cooperate. We can argue, in the same way, that the foreign unions do not cooperate either.

Secondly, when the unions in the same sector cooperate, the wage level in that sector increases above the level of the other union structures. The reason is that the

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<sup>2</sup> In the terminology of Bulow et al. (1985), outputs are strategic substitutes.



integrated union internalises the externality due to the sector-specific Cournot competition in the output market. The externality effect is as follows. Assume that the domestic union increases its own wage level unilaterally. This decreases the domestic firm's production but increases foreign firm's production, increasing the foreign union's utility. When sector-specific cooperation occurs the integrated union takes into account the effect that an increase in the wage level in one country boosts the union's utility in the other country, implying that the sector-specific union has an additional incentive to increase its wage level. When the sector-specific wage level increases, both firms' demand for labour decreases, negatively affecting the unions' utility. However, this externality effect guarantees that the sum of the unions' utility increases, implying that at least one union's utility increases. Whether the other union's utility increases (decreases) depends i) positively (negatively) on employment, ii) negatively (positively) on the difference between the wage level and the reference wage, and iii) negatively (positively) on size of the effect of the wage level on employment. The result that the foreign union's utility increases where there is an integrated union in sector 1 and that the domestic union's utility decreases where there is an integrated union in sector 2 thus follows from the fact that the domestic markets are smaller than the foreign markets and that the domestic reference wage is lower than the foreign.

Thirdly, although the domestic production subsidy affects positively the production of the domestic firm competing with the import, the small subsidy studied in Table 4 does not change the qualitative results of the union structure. Finally, since the two sectors are independent, union integration in one sector has no effect on the other sector.

## 5. EFFECTS OF THE UNION STRUCTURE AND THE EXCHANGE RATE ON THE DOMESTIC ECONOMY

In this section we analyse the sensitivity of the domestic economy with regard to the union structure and the exchange rate, by allowing the exchange rate to fluctuate.

We calculate the equilibrium outcomes of this two-stage games under the different union structures when the exchange rate varies between [0.8-1.2].<sup>3</sup> Table 5 details the numerical results.

Table 5: Sensitivity of the domestic economy with regard to the union structure and the exchange rate (TB refers to the trade balance).

	without		subsidies											
	$\beta^h = 0$	$\alpha^h = .5$	$\beta^f = 0$	$\alpha^f = .5$										
	$u_1^h$	$u_2^h$	$\pi_1^h$	$\pi_2^h$	$w_1^h$	$w_2^h$	$L^h$	TB <sup>h</sup>						
a	48.2 (4.7)	16.5 (.95)	28.7 (2.2)	11.0 (.63)	4.53 (.43)	3.51 (.10)	15.3 (.17)	20.8 (11)						
b	47.6 (4.4)	16.1 (.74)	33.2 (3.9)	7.55 (.36)	4.16 (.29)	4.16 (.29)	15.3 (.17)	20.3 (11)						
c	49.5 (3.7)	15.9 (1.1)	29.3 (1.8)	10.6 (.76)	4.59 (.38)	3.45 (.12)	15.4 (.07)	21.4 (10)						
d	49.2 (3.6)	15.2 (.90)	34.9 (3.4)	6.65 (.08)	4.18 (.27)	4.18 (.27)	15.4 (.08)	21.2 (10)						
e	50.1 (3.2)	16.5 (.95)	20.4 (.76)	11.0 (.63)	5.56 (.50)	3.51 (.10)	13.6 (.10)	19.8 (9.2)						
f	48.2 (4.7)	12.5 (.55)	28.7 (2.2)	2.49 (.55)	4.53 (.43)	5.67 (.36)	12.8 (.21)	13.9 (9.8)						
g	50.1 (3.2)	12.5 (.55)	20.4 (.76)	2.49 (.55)	5.60 (.50)	5.67 (.36)	11.2 (.48)	12.9 (7.6)						
h	50.1 (3.2)	12.5 (.64)	20.1 (1.2)	2.55 (.65)	5.64 (.43)	5.64 (.43)	11.1 (.40)	12.7 (7.9)						

Table gives average values; standard errors are in parenthesis.

Let us first consider how the union structure affects the domestic country. Firstly, union 1 prefers sectoral cooperation with the highest wage level, since firm 1 is a monopoly in the domestic country, implying that wage changes affect employment less they would if firm 1 had competitors, and since sectoral cooperation increases the wage level in the rival firm and thus the high wage level does not damage firm 1's competitiveness in the foreign country. Union 2 prefers to be independent, implying, in contrast, a very low wage level. This follows from the fact that i) sectoral integration increases the wage level so much that the negative employment effect outweighs the positive wage effect, that ii) domestic integration increases the foreign exporting firm's competitiveness in the domestic market. Secondly, firm 1 (2) gains

<sup>3</sup> The exchange rate naturally varies all the time during contract periods in the labour market. This analysis shows how definite shifts in the exchange rate affect the labour market. In the following, the exchange rate has the following values: 0.8, 0.9, 1.0, 1.1, 1.2.

(loses) from the domestic unions' cooperation, since the domestic integrated union sets a lower wage for firm 1 and a higher wage for firm 2 than independent unions do. Both firms oppose the sector-wide cooperation of trade unions since the wage level is highest where there is a sectoral union. Thirdly, domestic employment and the domestic trade balance are highest when the foreign country has a country-wide trade union. When the foreign country has one union i) the wage level of the foreign firm competing with the domestic exports increases, boosting domestic exports, and ii) the wage level of the foreign exporting firm decreases, increasing domestic imports. However, since the foreign country has a larger market than the domestic country, the domestic trade balance and employment improve. Proposition 2 summarises the results:

*Proposition 2:*

- i) The efficient exporting firm (the inefficient firm competing with the import) gains (loses) from the domestic unions' cooperation, but both firms oppose the sector-wide cooperation of trade unions.
- ii) Domestic employment and the domestic trade balance are highest when the foreign country has a country-wide trade union.

We turn next to the effects of the exchange rate on the domestic economy. Table 5 shows that an integrated union in one sector minimises the union's utility and the firm's profit fluctuation in that sector, but maximises wage fluctuation. The high wage fluctuation follows from the fact that the sector-wide union sets the wage level in terms of the foreign currency and thus wages in the domestic currency are sensitive to the exchange rate. High wage fluctuation implies, in turn, high employment, production and price fluctuation, diminishing the union's utility and the firm's profit fluctuation. Domestic employment fluctuation is greatest and trade balance fluctuation is smallest when both sectors are integrated. Low trade balance fluctuation follows from high wage fluctuation, implying high production fluctuation and lessening the exchange rate fluctuation.

## 6. WELFARE EFFECTS OF THE PRODUCTION SUBSIDIES

In this section we study how domestic production subsidies affect domestic welfare, employment and the trade balance under the different union structures and compare whether the domestic government should support the exporting firm or the firm competing with the import. In this partial equilibrium framework welfare depends on the domestic consumer surplus, both domestic unions' utility, both domestic firms' profits and the level of the production subsidy. Due to the limitation of our welfare concept, we have reported the changes in employment and the trade balance. In the numerical simulations we have restricted the value of the total support to two units (this is about 10 percent from the wage cost of the firm competing with the import).

Table 6 shows the changes in welfare, employment and the trade balance brought about by the production subsidy. It shows firstly that independent of the union structure and what firm receives the subsidy, the domestic production subsidy increases domestic welfare, employment and the trade balance. This is the Spencer and Brander (1983) result that export (production) subsidies increase welfare when there is Cournot competition between a foreign and a domestic firm. Secondly, domestic production subsidies to an efficient export sector are more welfare-improving than subsidies to an inefficient import sector only where the union of the exporting firm cooperates with the foreign union in the same sector. In the other forms of union structure the domestic government should support the firm competing with the import rather than the exporting firm.<sup>4</sup> Subsidies to the exporting firm boost its wage costs more than subsidies to the firm competing with the import increase the wage costs of that firm in the other union structures, with the exception of sector-wide cooperation in the domestic exporting sector. Since the domestic exporting firm has a monopoly position in the home country, its union can hive off almost the entire support for its members. Sector-wide cooperation prevents this happening, since

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<sup>4</sup> This contradicts Neary's (1994) result that the domestic country should support winners rather than losers.

support for domestic firm weakens the competitiveness of the foreign firm, decreasing the foreign union's wage claim. This, in turn, lowers the wage level in the domestic firm.

Table 6: Welfare effects of production subsidies

	value of domestic subsidy:						two units					
	to export sector			to import sector			to export sector			to import sector		
	W <sup>h</sup>	L <sup>h</sup>	TB <sup>h</sup>	W <sup>h</sup>	L <sup>h</sup>	TB <sup>h</sup>	W <sup>h</sup>	L <sup>h</sup>	TB <sup>h</sup>	W <sup>h</sup>	L <sup>h</sup>	TB <sup>h</sup>
a	1.282	(0.05)	0.210	(0.02)	0.589	(0.08)	1.715	(0.04)	0.260	(0.01)	0.837	(0.06)
b	1.065	(0.01)	0.195	(0.02)	0.461	(0.02)	2.201	(0.03)	0.295	(0.01)	1.119	(0.01)
c	0.926	(0.92)	0.183	(0.06)	0.547	(0.16)	1.659	(0.05)	0.261	(0.01)	0.823	(0.07)
d	1.142	(0.01)	0.193	(0.02)	0.499	(0.02)	2.101	(0.04)	0.301	(0.00)	1.106	(0.08)
e	2.842	(0.05)	0.379	(0.05)	1.767	(0.04)	1.715	(0.04)	0.260	(0.01)	0.837	(0.06)
f	1.283	(0.06)	0.210	(0.02)	0.589	(0.01)	5.953	(0.36)	0.818	(0.03)	4.112	(0.45)
g	2.843	(0.05)	0.379	(0.05)	1.767	(0.04)	5.953	(0.36)	0.817	(0.03)	4.112	(0.45)
h	3.455	(0.10)	0.486	(0.05)	1.927	(0.06)	5.683	(0.38)	0.761	(0.03)	3.810	(0.39)

Thirdly, production subsidies to the exporting firm are most effective (least effective) when there is one global union (each union acts independently). This follows from the fact that when one global union (each union independently) controls wage determination an increase in the production subsidy boosts the average wage level least (most). Fourthly, production subsidies to the firm competing with the import are most effective (least effective) when the union of that firm cooperates with the union of the foreign exporter (each union in the domestic country acts independently but the foreign unions cooperate). This also results from the behaviour of the average wage level. When the sectoral union sets a unilateral wage level an increase in the production subsidy boosts both the domestic and foreign wage levels and thus the domestic firm fully gains from the improved competitiveness. When the foreign country has a country-wide union maximising the sum of both unions' rents in that country, the domestic wage level increases more than the foreign, reducing the domestic firm's competitiveness.

*Proposition 3:* The domestic government should support to an efficient exporting firm only where the union of the exporting firm cooperates with the union in the same sector in a larger country, whereas in all other cases the domestic government should support the firm competing with the import rather than the exporting firm.

## 7. CONCLUSIONS

The institutional structure of labour markets is frequently stated to be an important determinant of 'international competitiveness' and the stability of an economy. In this paper we investigate firm-specific unions' incentive to cooperate with each other either nationally or internationally and examine the consequences of union cooperation for two separate international duopolies.

We show, firstly, that the equilibrium union structure includes the independent unions (the cooperative union) in that sector, where the inefficient firm in the small (large) country competes with the export of the efficient firm in the large (small) country and where each union's decision depends only on its own free choice without any compensation payments. Secondly, the efficient exporting firm (the inefficient firm competing with the import) gains (loses) from the unions' country-wide cooperation, whereas they both oppose the unions' sector-wide cooperation. Thirdly, domestic employment is highest when the foreign country has a country-wide union regardless of whether the domestic country has independent unions or a country-wide union. Fourthly, production subsidies by a smaller country to an efficient export sector are more welfare-improving than an equal level of support to an inefficient import sector only where the union of the exporting firm cooperates with the union in the same sector in a larger country.

There are several areas for further research. Firstly, the assumption of independent demands should be relaxed and a situation where two goods are substitutes should be studied. Secondly, it is a familiar result in the strategic trade policy that optimal policies depend on whether firms display Cournot conduct or Bertrand conduct. But

the effect assumptions about conduct have on the behaviour of unions would be interesting area of research. Finally, analysis has revealed that an individual country's trade policy spills over to another country. This raises a question of what happens under policy coordination.

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