Discussion Paper Series No.240

Labor-Management Bargaining, Labor Standards and International Rivalry

Jung HUR College of Economics, Sogan University
Laixun ZHAO Kobe University

April 2009

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Jung Hur* Laixun Zhao**

Abstract

Using the labor union's bargaining power as an indication of government policy on labor standards issues, we analyze the competition between a domestic (North) firm and a foreign (South) firm, and their relationship with optimal labor standards (LS). First, we show that the optimal level of LS is higher when labor unions are employment-oriented than when they are not. Second, it is higher under free trade than under the optimal tariff system if labor unions are employment-oriented. Third, 'a race to the bottom' of LS occurs in the case of wage-oriented unions. Fourth, the North's imposing a tariff to force the Southern government to raise its LS is effective only if the Southern union is wage-oriented. In order to raise Southern LS, both countries may need some deeper form of economic integration, if the North does not want to abandon its free trade system.

Key Words: Labor Standards, Race to the Bottom, Tariff, Economic Integration, Labor Union

JEL Classification: F10, F16, J50, J80, L13

* College of Economics, Sogan University, Seoul, Korea; Email: ecsjhur@sogang.ac.kr.

** **(Corresponding author)** Research Institute for Economics & Business, Kobe University, Kobe 567-8501, Japan; Email: zhao@rieb.kobe-u.ac.jp.

Acknowledgement: We are grateful to anonymous referees and participants at 2007 APTS annual meetings in Shanghai for very helpful comments. The usual disclaimer applies.

1. Introduction

The issue of Labor standards (LS) has been one of the focal points in meetings of the World Trade Organization (WTO) in recent years. For instance, the U.S. and France discussed LS and proposed a "social clause"[1] at WTO meetings in Singapore in 1996 and Seattle in 1999; The European Union also brought such issues to the WTO's Doha conference in 2001. Labor unions and humanitarian organizations argue that without international agreements, 'a race to the bottom' of LS could arise. This movement has met strong opposition from developing countries, who argue that a higher LS may increase labor costs and thus reduce their competitiveness.

In the existing theoretical literature, LS has been treated broadly as a source of externality in a general equilibrium framework, such that it is assumed to directly increase consumer utility or national welfare.[2] Brown et al. (1996) investigate the welfare effect of LS under free trade. Srinivasan (1996) considers whether different LS levels among countries change their incentives for free trade. Bagwell and Staiger (1998, 2001a, 2001b) analyze the interaction between negotiations over trade policy and LS. In particular, they show that a positive tariff and a lower LS are policy substitutes. They emphasize the role of international negotiation on trade and LS policies in order to avoid a race to the bottom of LS. Unlike them, Chau and Kanbur (2006) investigate how Northern tariffs affect the incentives of Southern exporting countries to raise LS without international cooperation. They show that whether a race to the bottom of LS arises or not depends on the Northern demand curve, the size of big exporters relative to each other, and the relative size of the competitive fringe of small exporters.

In these analyses, however, neither workers nor firms are explicitly modeled, and thus it is hard to see how they are affected by LS and how governments view LS policies regarding their effects on firm profits, worker utility and consumer welfare. In the present paper, we wish to model these explicitly. We examine the endogenous choice of LS in a model of international duopoly, in which a domestic firm competes against a foreign exporting firm.

In particular, we introduce two different elements. First, we analyze LS in the context of labor-management negotiations, highlighting how LS affects worker utility and firm profits. We treat the bargaining power of labor unions as a government policy variable on LS, emphasizing the role of governments. This treatment is based on some stylized facts and empirical studies. One of the four

[1] The 'social clause' would permit restrictions to be imposed on imports from countries not complying with an agreed level of minimum LS.

[2] As a more specific type of LS, the implication of child-labor practices in developing countries for international trade has drawn quite some attention. For instance, see Basu (1999).

Core Labor Standards proposed by the International Labor Organization (ILO) is 'freedom of association and the effective recognition of the rights to collective bargaining',[3] which basically represents how strong the union is vs. the firm. According to studies by Moene and Wallerstein (2003), Sweden and Norway have experienced almost full employment after World War II. They attribute this extraordinary phenomenon to the union's strong bargaining power, which is seen as a symbol of high LS in Scandinavia.

Second, our model allows the labor union to have a biased preference toward either wages or employment, as in Pemberton (1988), Mezzetti and Dinopoulos (1991), Zhao (2001) and López and Nalyor (2004). [4] This consideration allows us to examine different firm performances arising out of the union's preference, how it affects the government's optimal choice of LS, and more importantly the issue of a race to the bottom of the LS in the context of union preferences over wages and employment. Certainly this treatment also has empirical support. In an interesting survey of British trade unions, Clark and Oswald (1993) find that union preferences are more heavily weighted toward employment than would be implied by the so-called rent-maximization behavior (i.e., maximizing the sum of union members' rents), even though union leaders care more about wages than employment. Further, it is argued that unions tend to be employment-oriented during recession, when securing jobs is a priority. In contrast, during business boom, they tend to be wage-oriented and have stronger demands for wage hikes. In addition, in a rich country, unions might be concerned more about increasing the size of union membership than wages, while union workers in poor countries might be more interested in the wage level, given that many non-union workers are earning near subsistence-level wages. Thus, in the present model we assume the union and the firm negotiate over two issues, wages and employment, and the negotiated equilibrium would depend on the union's preference.

Regarding the optimal choices of LS under free trade versus optimal tariff systems and their impacts on firms, unions and consumers, we find that, firstly, an increase in LS can raise the domestic firm's profit and reduce that of the foreign firm if labor unions are sufficiently

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[3] The other three are (i) the elimination of all forms of forced or compulsory labor; (ii) the effective abolition of child labor; and (iii) the elimination of discrimination in respect of employment occupation. See International Labour Office (1999).

[4] They analyze how the domestic labor union's exogenous bargaining power affects the formation of tariffs, trade volume, union utility, national welfare and foreign direct investment. In contrast, we take into account both domestic and foreign labor unions and endogeneize their respective bargaining powers. We explicitly allow the domestic labor union's bargaining power to affect the foreign negotiated wage, output and profits. This enables us to further investigate the interactions between the two countries' choice of optimal LS. Consequently, the Southern government's choice of LS affects the choice of the Northern government and vice versa.

employment-oriented. This arises because employment-oriented unions are willing to sacrifice some wage demands for higher employment. An increase in LS via a rise in union bargaining power raises the domestic firm's output and reduces that of the foreign firm. The opposite is true, if labor unions are sufficiently wage-oriented.

Secondly, the optimal level of LS is higher when labor unions are employment-oriented than when they are wage-oriented. In our model of duopoly, firms produce "too little" output. Hence, governments have incentives to set higher LS if this raises output, which happens if unions are employment-oriented. In addition, the government is willing to grant higher LS/bargaining power to more employment-oriented unions.

Thirdly, the optimal level of LS is lower under free trade than under the optimal tariff system if unions are wage-oriented. If unions are employment oriented, the opposite is true. Free trade is not an optimal policy for an importing country under oligopoly. In fact, the importing country's government has an incentive to lower LS if it increases the firms' output, which is the case of wage-oriented unions. In contrast, it will choose to raise LS to increase output in the case of employment-oriented unions.

In addition to the above results, we believe that a contribution to the literature is our findings on the race to the bottom of LS. First, we show that we may observe 'a race to the bottom' of LS only in the case of wage-oriented labor unions. Lowering the LS in a country decreases the negotiated wage rate, and with wage-oriented unions, it also strategically reduces the rival's profits by taking some of the rival's market share away. As an optimal response, the other country may also reduce its LS. Second, the importing country's imposing a tariff to force the other country to raise its LS is effective only if the union in the latter country is wage-oriented. Alternatively, in order to raise the latter's LS, both countries may need a deeper form of economic integration (i.e., joint welfare maximization) if the importing country's government does not want to give up its free trade system.

2. The Basic Model Setup

Consider two countries, the North (N) and the South (S), each having one firm, i.e., respectively N and S. Both firms produce an identical product which is sold in country N only,[5] under the following inverse demand function, $p = p(q_N + q_S)$, with $p' < 0$, where q_i denotes the output of firm *i*, for $i = N,\ S$. The Northern government imposes a tariff t on imports from the South.

[5] Since LS issues arise out of North's claims that low Southern LS helps to improve South's competitiveness in the North, we ignore what might be going on in the S market, though it should be straightforward to introduce a segmented S market.

Firms: Labor is the only input required to produce the outputs in a one-to-one ratio by a proper choice of units. Given a wage rate of w_i, firm *i*'s profits can be written respectively as:

$$\pi_N = (p - w_N) q_N, \qquad \pi_S = (p - w_S) q_S - t q_S . \tag{1}$$

Labor markets: In both countries, workers are organized into unions. The union utility in each country can be represented by this simple function:

$$u_i = w_i^{\beta} q_i , \tag{2}$$

where $\beta > 0$ is a parameter for union bias toward wages (See Pemberton (1988), Mezzetti and Dinopoulos (1991), and López and Nalyor (2004) for a similar definition). That is, if $\beta > 1$, then the union is said to be wage-oriented (more interested in wages than employment); if $\beta < 1$, then the union is said to be employment-oriented (less interested in wages than employment); and finally if $\beta = 1$, then the union is said to be neutral.

Wages and employment are negotiated between the union and the firm in each country. We adopt Nash bargaining to determine the negotiation equilibrium:

$$G_i(w_i, q_i) = (u_i)^{\theta_i} (\pi_i)^{1-\theta_i} , \tag{3}$$

where θ_i is the bargaining power of the union in country *i*. For reasons discussed in the introduction, we use θ_i to represent the LS in country *i* and assume that it is determined endogenously by country *i*'s government.

Governments: We assume that the N and S governments care about each country's respective social welfare including the labor union's utility as follows: [6]

$$\Phi_N = \pi_N + u_N(w_N, q_N) + v(q_N + q_S) - (q_N + q_S) p + t q_S , \tag{4a}$$

$$\Phi_S = \pi_S + u_S(w_S, q_S), \tag{4b}$$

where in the North, it is the sum of firm profits, union utility, consumer surplus and tariff revenue. The term $v(q_N + q_S)$ is the utility of consuming $q_N + q_S$, with $v'(\cdot) = p$, and the consumer surplus is the utility level minus the expenditure, i.e., $v(q_N + q_S) - (q_N + q_S) p$. In the South, since there is no consumption, national welfare is the firm profits plus union utility.

[6] As a referee pointed out, the government objective function could be applied in general equilibrium because labor is the only factor and the income earned by the union has already been picked up in the consumer surplus. However, in order to highlight the impacts of LS on firm profits, labor-management relations and their interactions with those of the rival country, we rely on the current partial equilibrium model. López and Nalyor (2004) also use the same social welfare function in a partial equilibrium setting to see the effects of unions on firm's profit and social welfare.

Game structure: The game has two stages. In the first stage, each government determines its LS simultaneously, and the Northern government also determines the import tariff imposed on Southern imports; and in the second stage, the labor union and the firm negotiate to determine wages and employment in each country simultaneously. To ensure consistency, the game is solved by backward induction.

Equilibrium Solutions: The FOCs (first order conditions) in the second stage are as follows, for $i = N, S$, $i \neq j$,

$$\frac{1}{G_i}\frac{\partial G_i(w_i,\ q_i)}{\partial w_i} = \frac{\beta\theta_i}{w_i} - \left(\frac{1-\theta_i}{\pi_i}\right)\ (q_i) = 0\,, \tag{5a}$$

$$\frac{1}{G_i}\frac{\partial G_i(w_i,\ q_i)}{\partial q_i} = \frac{\theta_i}{q_i} + \left(\frac{1-\theta_i}{\pi_i}\right)\ \left(\frac{\partial \pi_i}{\partial q_i}\right) = 0, \tag{5b}$$

where $\partial\pi_i / \partial q_i = p'q_i + p - w_i - t < 0$ with $t = 0$ if $i = N$ and $t > 0$ otherwise. Using (5a), one sees that (5b) implies $w_N / \beta + p'q_N + p - w_N = 0$ for N and $w_S / \beta + p'q_S + p - w_S - t = 0$ for S. Without the union, the firm could have maximized its profits by setting $\partial\pi_i / \partial q_i = 0$. However, in (5b) we have $\partial\pi_i / \partial q_i < 0$, implying that in the bargaining equilibrium each firm produces more than the level that would maximize its profits. This arises because with positive bargaining power, the union can bargain for more employment as well as higher wages.

The four FOCs (two for each country) can be further simplified as, for $i = N, S$,

$$\frac{\partial \tilde{G}_i}{\partial w_i} \equiv \beta\theta_i\pi_i - (1-\theta_i)\,w_i q_i = 0\,, \tag{6a}$$

$$\frac{\partial \tilde{G}_i}{\partial q_i} \equiv \frac{w_i}{\beta} + \frac{\partial \pi_i}{\partial q_i} = 0\,, \tag{6b}$$

where $\frac{\partial \tilde{G}_i}{\partial w_i} \equiv \frac{w_i\pi_i}{G_i}\frac{\partial G_i}{\partial w_i}$ and $\frac{\partial \tilde{G}_i}{\partial q_i} \equiv \frac{\pi_i}{(1-\theta_i)G_i}\frac{\partial G_i}{\partial q_i}$. These FOCs implicitly define the four endogenous variables (w_N, q_N, w_S, q_S) in equilibrium as functions of the three policy variables, (θ_N, θ_S, t), which are taken as given in stage 2. Then we can endogeneize the optimal choices of the policies in stage 1.

3. Comparative Static Analysis

Next we investigate the impact of the three policies imposed by the N and S governments on firms and unions. Detailed derivations are relegated to Appendix A1.

3.1 *Effects on Outputs and Wages*

The impacts of an increase in LS are, for $i, j = N, S;\ i \neq j$,

$$\frac{dw_i}{d\theta_i} > 0, \tag{7a}$$

$$\frac{dq_i}{d\theta_i} \begin{cases} > 0 & if\ \ \beta < 1, \\ < 0 & if\ \ \beta > 1, \end{cases} \tag{7b}$$

$$\frac{dq_j}{d\theta_i} \begin{cases} < 0 & if\ \ \beta < 1, \\ > 0 & if\ \ \beta > 1, \end{cases} \tag{7c}$$

$$\frac{dw_j}{d\theta_i} \begin{cases} < 0 & if\ \ \beta < 1, \\ > 0 & if\ \ \beta > 1. \end{cases} \tag{7d}$$

Expression (7a) says that an increase in LS raises the negotiated wage, as expected, since the increase in LS raises the union's bargaining power. Expression (7b) states that an increase in country *i*'s LS raises (reduces) firm *i*'s output if the union is employment (wage)-oriented. The reason is that an employment (wage)-oriented union demands a higher level of employment (wage) at the expense of a lower wage (less employment). This effect is strengthened if LS rises.

Expressions (7c) and (7d) follow expression (7b), reflecting the effects of an increase in country *i*'s LS on country *j*'s output and wages. Specifically, the sign of (7c) is the exact opposite of (7b), because outputs q_j and q_i are substitutes. These effects further lead to corresponding changes of the negotiated wage in the other country, resulting in (7d).

In addition, the effects of the Northern tariff can be obtained as follows: $dq_N / dt > 0$, $dw_N / dt > 0$, $dq_S / dt < 0$, and $dw_S / dt < 0$, as expected.

The above results are important to warrant a lemma.

Lemma 1: *An increase in country i's LS, (i) raises the negotiated wage in the country, but it raises the output only if the labor union is employment-oriented, and lowers it if the union is wage-oriented; (ii) reduces the output of the competing country if the union is employment-oriented, and raises it if the union is wage-oriented.*

We can draw some interesting implications from Lemma 1. There exists a hypothesis that a higher LS might provide incentives for workers to work harder and thus increase output (see Zhao, 2006, who does not model union biases). Our results suggest that the increase in LS does provide incentives (in the form of a higher negotiated wage), but it leads to higher output only if the union is employment-oriented. If the union is wage-oriented, then an improvement in LS would lower outputs instead, because the union might sacrifice employment/output for a higher wage.

In addition, humanitarian groups, labor unions and politicians in some Northern countries claim that a lower LS in the South enables it to be more competitive and sell more in Northern markets. Thus, if Southern LS were forced up, Northern firms could sell more and Northern workers gain more. Our results in (7c) and (7d) show that this is only true if unions are wage oriented. In this case, a rise in the LS in the South should surrender more markets to the Northern firm. In turn, the Northern union can also gain by bargaining for higher wages and employment.

3.2 *Effects on Firm Profits*

How is firm profitability affected? First, let us check whether a rise in LS in a country raises the firm's production costs ($C_i = w_i q_i$). Differentiation gives, for $i, j = N, S;\ i \neq j$,

$$\frac{dC_i}{d\theta_i} = \frac{dw_i}{d\theta_i} q_i + \frac{dq_i}{d\theta_i} w_i \quad \text{and} \quad \frac{dC_j}{d\theta_i} = \frac{dw_j}{d\theta_i} q_j + \frac{dq_j}{d\theta_i} w_j .$$

In the first equation, while the first term on the RHS (right hand side) is positive since $dw_i / d\theta_i > 0$ as in (7a), the second term is positive if $\beta < 1$ and negative if $\beta > 1$ as in (7b). In the second equation, both terms are positive if $\beta > 1$ and negative if $\beta < 1$. Hence we can summarize the net effect in the following lemma.

Lemma 2: *(i)* $dC_i / d\theta_i > 0$ *for a large domain of* $\beta \in (0, \bar{\beta})$ with $\bar{\beta} \in (1 + \sqrt{3}, \infty)$*; and (ii)* $dC_j / d\theta_i > 0$ *if* $\beta > 1$ and $dC_j / d\theta_i < 0$ *if* $\beta < 1$ (See Appendix A2).

Observe that the above result implies that the bargaining power granted the union works as a costly factor to firm's production activities, which is in line with the conventional wisdom that an increase in LS would raise production costs and lower profits.

However, this conventional wisdom is only partially correct in the present model. Appendix A3 proves the following results:

$$\frac{d\pi_N}{d\theta_N}\begin{cases} >0 & if\ \beta<\beta^*, \\ <0 & if\ \beta>\beta^*, \end{cases} \quad \text{where} \quad \beta^*<1, \tag{8a}$$

$$\frac{d\pi_S}{d\theta_S}\begin{cases} >0 & if\ \beta<\beta^{**}, \\ <0 & if\ \beta>\beta^{**}, \end{cases} \quad \text{where} \quad \beta^{**}<1, \tag{8b}$$

$$\frac{d\pi_j}{d\theta_i}\begin{cases} <0 & if\ \beta<1, \\ >0 & if\ \beta>1, \end{cases} \quad \text{where}\ \ i,j=N,S\ \ \text{and}\ \ i\neq j, \tag{8c}$$

$$\frac{d\pi_N}{dt}>0, \quad \frac{d\pi_S}{dt}<0. \tag{8d}$$

First, (8a) and (8b) say that an increase in LS *raises* firm profits if the labor union is sufficiently employment-oriented, but reduces them otherwise. The first part is against conventional wisdom. Suppose that unions are employment-oriented. The increase in Northern LS raises the union wage and employment by (7a) and (7b), but it also lowers the Southern firm's employment and thus output by (7c). The former two effects work negatively to the Northern firm's profits through costs, while the last effect intensifies competition in the market. If the unions are sufficiently employment-oriented ($\beta<\beta^*$ for the North and $\beta<\beta^{**}$ for the South), the competition effect may outweigh the cost effect and as a result the Northern firm's profit increases.

Next, (8c) shows that an increase in LS in a country *reduces* firm profits in the other country if labor unions are employment-oriented, but it raises them otherwise. With employment-oriented unions, an increase in Southern LS reduces the Northern employment by (7c), which deteriorates the Northern firm's competitiveness in the market. This effect may dominate the beneficial effect on costs (as through (7c) and (7d)), and thus the Northern firm's profit decreases.

Finally, (8d) is as expected, saying that the tariff increases the profit of the Northern firm but reduces that of the Southern one. We summarize these results as:

Proposition 1: *An increase in country i's LS, (i) lowers the profit of this country, unless the union is sufficiently employment oriented, in which case it may raise the profit; (ii) reduces (raises) the profit of the competing country if the union is employment (wage) oriented.*

This proposition implies that when LS is treated as exogenous, regulations to raise the Southern LS may hurt the Northern firm if the Southern union is employment oriented, contrary to the original intensions of Northern labor activists and other Northern interest groups who lobby to force up Southern LS. However, such regulations are effective if the union is wage oriented, because in this case it increases the rival's costs. This result contrasts with that of Mezzetti and Dinopoulos (1991), who only study the case of one domestic union. In their model, an exogenous increase in the (domestic) union's bargaining power has an ambiguous effect on domestic profits when the union is employment oriented. In the present model, we show clearly that the domestic profits increase if unions are sufficiently employment-oriented, and decrease otherwise. The difference arises because our model has both domestic and foreign labor unions. And the LS changes in one country affect actions of the union and firm in the other country strategically.

3.3 *Effects on Union Utility*

Next, we look into the effects of an increase in LS on union utility. For $i, j = N, S;\ i \neq j$,

$$\frac{du_i}{d\theta_i} = \beta \frac{u_i}{w_i}\frac{dw_i}{d\theta_i} + \frac{u_i}{q_i}\frac{dq_i}{d\theta_i} \quad \text{and} \quad \frac{du_j}{d\theta_i} = \beta \frac{u_j}{w_j}\frac{dw_j}{d\theta_i} + \frac{u_j}{q_j}\frac{dq_j}{d\theta_i} \tag{9}$$

In the first equation, the first term on the RHS is positive since $dw_i / d\theta_i > 0$ as in (7a); and the second term is positive if β <1 and negative if β >1 as in (7b). In the second equation, both terms are positive if $\beta > 1$ and negative if $\beta < 1$ as in (7c) and (7d). Here we summarize the net effects in the following lemma.

Lemma 3: *(i)* $du_i / d\theta_i > 0$ *for* $\beta \in (0, \infty)$ *and (ii)* $du_j / d\theta_i > 0$ *if* $\beta > 1$ *and* $du_j / d\theta_i < 0$ *if* $\beta < 1$ *(See Appendix A4 for proof).*

This lemma shows that a higher LS increases the union's utility regardless of its preference toward wages versus employment. Interestingly, it can also increase the foreign labor union's utility if the labor unions are wage-oriented; and decreases it if they are employment-oriented. That is, raising a foreign country's LS does not necessarily increase the union utility in this country. Intuitively, for instance, if the union has high bargaining power in the North and it cares more for wages than employment, then it will push the Northern firm to increase wages and cut output. This will surrender more markets to the Southern firm and in turn increase Southern wages or employment.

And the Northern tariff has the following effects:

$$\frac{du_N}{dt} = \beta \frac{u_N}{w_N} \frac{dw_N}{dt} + \frac{u_N}{q_N} \frac{dq_N}{dt} > 0, \tag{10a}$$

$$\frac{du_S}{dt} = \beta \frac{u_S}{w_S} \frac{dw_S}{dt} + \frac{u_S}{q_S} \frac{dq_S}{dt} < 0, \tag{10b}$$

because dw_N / dt and dq_N / dt are positive and dw_S / dt and dq_S / dt are negative (see section 3.1 and Appendix A1). As expected, a higher tariff protection of the North against the South would effectively increase the Northern union wage, employment and thus utility, regardless of the union's preference toward wages and employment. And exactly the opposite applies to the Southern union.

3.4 *Effects on Consumer Surplus*

Since output is consumed in the North only, its consumer surplus can be expressed as $\varphi(q_N + q_S) \equiv v(q_N + q_S) - (q_N + q_S)p$. Differentiation yields,

$$\frac{d\varphi}{d\theta_N} = -p'(q_N + q_S)\frac{d(q_N + q_S)}{d\theta_N}$$

where $v' = p$ and $d\left(q_N + q_S\right)/d\theta_N = \left(p' q_S / \Delta\right)\left(\beta\pi_N + q_N w_N\right)\left(\theta_S\left(\beta - 1\right) + 1\right)\left(\left(\beta - 1\right)/\beta\right)$, which is positive if β<1 and negative if β>1. Thus, if the unions are employment oriented, an increase in LS raises the total quantities provided by both firms, lowering the market price. As a result, consumers benefit. However, if the unions are biased toward wages, a higher LS reduces their negotiated employments and the total quantities provided in the market as well, increasing the market price and lowering consumer surplus.

4. Optimal LS and Tariffs

In this section we solve for optimal policies in terms of LS and tariffs, by maximizing national welfare consisting of consumer surplus, firm profits, labor union utility and the tariff revenue, wherever applicable.

4.1 *The Northern Government*

By substitution, the North's welfare function in (4a) can be rewritten as: $\Phi_N = v(q_N + q_S) - pq_S - w_N q_N + u_N(w_N, q_N) + tq_S$. Differentiation yields:

$$\frac{\partial \Phi_N}{\partial \theta_N} = \left[\left(p - p' q_S \right) \frac{d(q_N + q_S)}{d\theta_N} - p \frac{dq_S}{d\theta_N} \right] + \left[t \frac{dq_S}{d\theta_N} + \left(\beta w_N^\beta - w_N \right) \frac{q_N}{w_N} \frac{dw_N}{d\theta_N} \right] + \left[\left(w_N^\beta - w_N \right) \frac{dq_N}{d\theta_N} \right]$$

where $v' = p$, $d\left(q_N + q_S\right)/d\theta_N$ is positive if $\beta < 1$ and negative if $\beta > 1$ (see Section 3.4).

If $\beta < 1$, the first square bracket on the RHS is positive and the second one is negative. If $\beta > 1$, then the signs are reversed. And regardless of β, the last bracket is negative. To find out the optimal Northern LS, we solve $\partial \Phi_N / \partial \theta_N = 0$ for θ_N. Let us denote it by θ_N^*.

On the other hand, the welfare-maximizing optimal tariff is given by:

$$\frac{\partial \Phi_N}{\partial t} = \left[\left(p - p' q_S \right) \frac{d(q_N + q_S)}{dt} \right] + \left[t \frac{dq_S}{dt} + q_S - p \frac{dq_S}{dt} \right] + \left[\left(\beta w_N^\beta - w_N \right) \frac{q_N}{w_N} \frac{dw_N}{dt} + \left(w_N^\beta - w_N \right) \frac{dq_N}{dt} \right]$$

where $d(q_N + q_S)/dt = p' q_N q_S \left(\theta_S \left(\beta - 1 \right) + 1 \right) < 0$.

The first bracket is negative. The second one is positive, provided that the tariff is small. And the third one depends on β: It is negative if $\beta < 1$ and positive if $\beta > 1$. However, we can show that the optimal tariff t^* must be positive. The proof is straightforward: Suppose $\partial \Phi_N / \partial t |_{t \le 0} = 0$. Substituting $t = 0$ into the long expression above for $\partial \Phi_N / \partial t$, we obtain $\partial \Phi_N / \partial t |_{t=0} > 0$ because of $t\left(dq_S / dt \right) < 0$, resulting in a contradiction.

4.2 *The Southern Government*

Maximizing (4b) yields:

$$\frac{\partial \Phi_S}{\partial \theta_S} = \left[p' \frac{d(q_N + q_S)}{d\theta_S} q_S + \left(\beta w_S^\beta - w_S \right) \frac{q_S}{w_S} \frac{dw_S}{d\theta_S} \right] + \left[\left(p - t \right) \frac{dq_S}{d\theta_S} \right] + \left[\left(w_S^\beta - w_S \right) \frac{dq_S}{d\theta_S} \right]$$

where $d(q_N + q_S)/d\theta_S = \left(p' q_N / \Delta \right) \left(\beta \pi_S + q_S w_S \right) \left(\theta_N \left(\beta - 1 \right) + 1 \right) \left(\left(\beta - 1 \right) / \beta \right)$ is positive if $\beta < 1$ and negative if $\beta > 1$. If $\beta < 1$, the first bracket on the RHS is negative and the second one is positive; if $\beta > 1$, the first bracket becomes positive and the second becomes negative. Regardless of β, the last bracket is negative. To find out the optimal Southern LS, we may solve $\partial \Phi_S / \partial \theta_S = 0$ for θ_S. We will denote it θ_S^*.

4.3 *Reaction Functions of LS*

We first calculate the reaction function of the Northern government and show that it is positively related to the Northern LS. Total differentiation of the FOCs yields the following two reaction functions,

$$\frac{d\theta_N}{d\theta_S} = -\frac{\partial^2\Phi_N / \partial\theta_N\partial\theta_S}{\partial^2\Phi_N / \partial\theta_N^2} \text{ and } \frac{d\theta_S}{d\theta_N} = -\frac{\partial^2\Phi_S / \partial\theta_S\partial\theta_N}{\partial^2\Phi_S / \partial\theta_S^2}$$

The second order condition for welfare maximization requires that the denominators are negative. Thus the slopes of the reaction functions depend on the numerator. From the FOCs, it is not difficult to verify that $\partial^2\Phi_N / \partial\theta_N\partial\theta_S > 0$ if $\beta < 1$ and $\partial^2\Phi_N / \partial\theta_N\partial\theta_S < 0$ if $\beta > 1$. Consequently, $d\theta_N / d\theta_S > 0$ if $\beta < 1$ and $d\theta_N / d\theta_S < 0$ if $\beta > 1$. Due to similar structures of firms and unions between the two countries, the reaction function of the Southern government should behave in a similar fashion.

Each of the reaction functions given a value of β tells us how a country optimally responds to the change of the other country's choice of LS. Consider a case that the Southern government reduces its LS level for some reason. How does this affect the Northern government's optimal choice of LS? If unions are employment-oriented ($\beta < 1$), lemma 2 says that the lower LS of the South increases the Northern firm's costs. Consequently the Northern government will respond to it by reducing its LS as well. On the other hand if unions are wage-oriented ($\beta > 1$), the Northern firm's costs will fall and hence the Northern government can afford to set a higher LS. The optimal LS levels of both countries are determined where the two reaction curves meet. In the following section, we will analyze the properties of the optimal LS policies.

4.4 *The Analysis*

Proposition 2: *Regardless of the tariff system, the optimal LS in each country is weaker if* $\beta > 1$ *than if* $\beta < 1$. *That is,* $\theta_i^* |_{\beta>1} < \theta_i^* |_{\beta<1}$ (See Appendix A5 for proof).

Figure 1 shows the level of optimal LS which maximizes the welfare function for the cases of wage-oriented and employment-oriented unions. The optimal LS is lower when unions are wage-oriented, because the marginal impact of LS on the objective function is negative with wage-oriented unions when it is evaluated with the optimal LS. Detailed explanations follow.

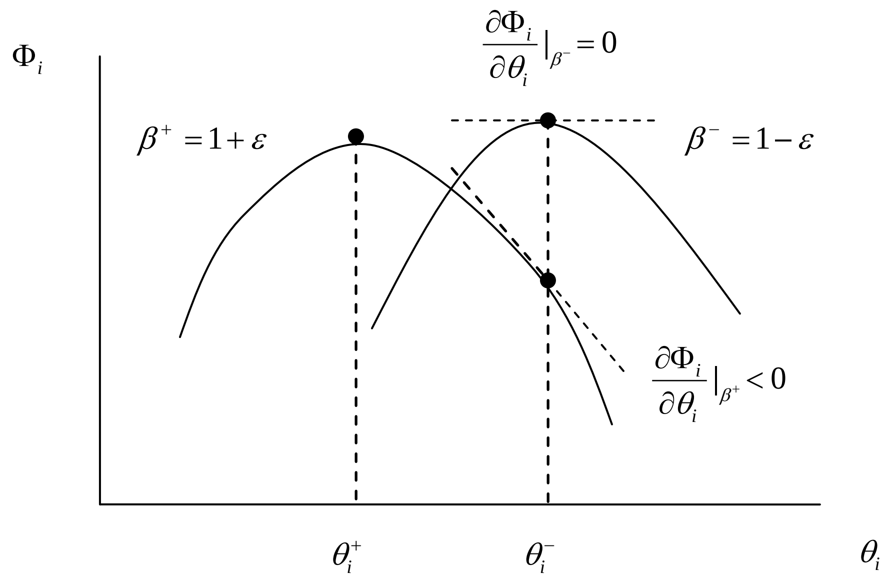

Figure 1: LS - wage vs. employment oriented unions

Wage-oriented unions pursue higher wages at the expense of a lower negotiated employment, raising the firm's costs, and lowering its profitability and consumer output. As a consequence, the government may try to reduce the union's bargaining power by choosing a lower LS. The opposite arises for the case of employment-oriented unions. The intuition is simple. In our model of duopoly, the firms produce "too little" in the market. Consequently, governments have incentives to set higher LS if it raises output, which happens if unions are employment-oriented. And the opposite is true if unions are wage-oriented. This finding is associated with the argument of 'a race to the bottom', which we will further discuss later in Proposition 4.

Next, we investigate how the tariff affects the Northern LS compared with free trade.

Proposition 3: *Each country's LS is lower under the optimal tariff than under free trade if* $\beta < 1$, *and the opposite is true if* $\beta > 1$. *Formally (see Appendix A6 for proof),*

(i) If $\beta < 1$, *then* $\theta_i^* |_{t^*>0} < \theta_i^* |_{t=0}$; *(ii) If* $\beta > 1$, *then* $\theta_i^* |_{t^*>0} > \theta_i^* |_{t=0}$.

Figure 2 shows the welfare and the optimal LS for the cases of wage and employment oriented unions. First, in both cases, we observe that the optimal tariff level is positive, i.e., the welfare level is higher under the optimal tariff system than under zero tariff. Second, the LS is affected by the tariff system; That is, the LS is higher (lower) under free trade than under a positive tariff if unions are employment (wage) oriented. In particular, we show for each case that the marginal impact of LS on the objective function with employment (wage) oriented unions is positive (negative) when it is evaluated at the optimal LS. The intuition for the results is as follows.

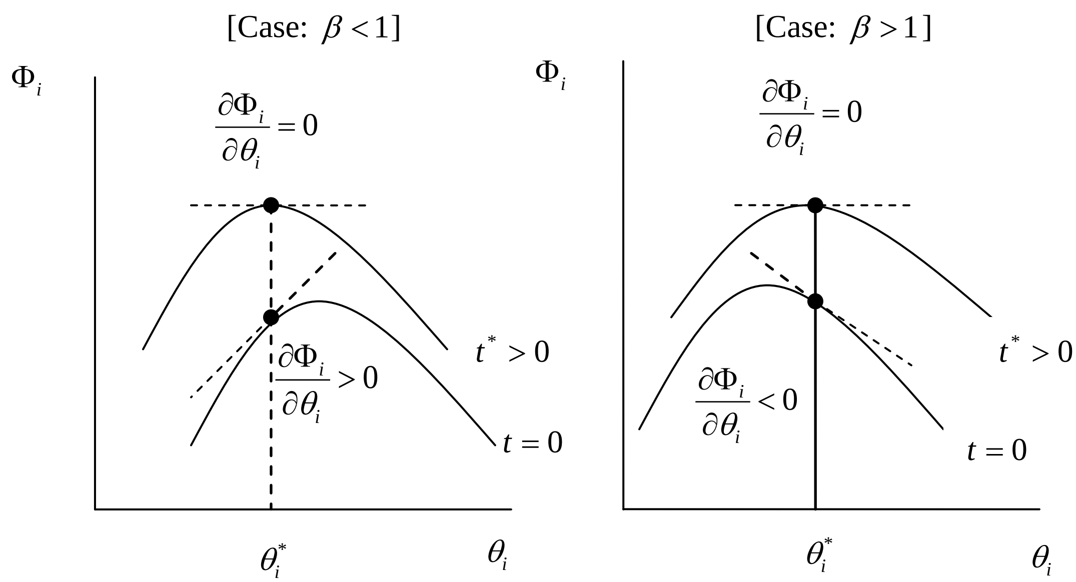

Figure 2: LS - optimal tariff vs. free trade

The positive impact of a small tariff on the importing country's welfare, given that the demand curve is not too convex, is a standard result in trade literature such as Eaton and Grossman (1986). This result helps us to compare the optimal LS under free trade and under the optimal tariff respectively. The optimal level of LS is higher under free trade than under the optimal tariff if unions are employment-oriented, and the opposite is true if unions are wage oriented. The intuition can be explained as follows. Free trade is not an optimal policy for the importing country. Hence, the importing Northern government has an incentive to raise LS if it increases outputs, which is the case of employment-oriented unions, but it will decrease LS to increases the firm's output in the case of wage-oriented unions. And the Southern government would change its LS similarly in order to avoid the negative cost effect from the change of the Northern LS (see Lemma 2).

Proposition 3 implies that imposing a tariff to force the South to raise its LS is only effective if the union is wage-oriented. If the union is employment-oriented, the South would choose a lower LS in response to Northern pressure. Thus, it further implies that trade liberalization in the North may raise Southern LS in the latter case, which is in line with the argument that the best way to raise Southern LS is to keep Northern markets open. In addition, this case confirms the empirical findings of Neumayer and Soysa (2006) that countries that are more open to trade have fewer rights violations than more closed ones.

Next, we examine the issue of 'a race to the bottom' in LS.

Proposition 4: *A race to the bottom of LS arises only under two conditions: each government does not care about union utility, or the union is sufficiently wage-oriented. In other cases, it does not arise* (See Appendix A7 for proof).

This proposition states that 'a race to the bottom' of LS can be observed with sufficiently wage-oriented labor unions or if the governments ignore the unions' welfare. Although the latter case is obvious, the former case is worth noting. The intuition is, lowering the LS in a country decreases the production cost there by reducing the negotiated wage rate, and simultaneously it strategically increases the rival's production costs in the other country by taking some of the rival's market share away. As a response, the other country may also reduce its own LS.

5. **Some Extensions**

In this section we introduce two extensions to the basic model. One is to incorporate asymmetric labor unions in terms of preferences across countries and the other is to look into the effects of economic integration. We analyze how these affect LS choices in the two countries.

5.1 *Asymmetric Labor Unions*

So far, we have treated both labor unions as having identical preferences towards wage versus employment. What if this is not the case? Here we can consider four asymmetric cases: Firstly, the Northern labor union is wage-oriented while the Southern union is employment-oriented, i.e., $\beta_N > 1$ and $\beta_S < 1$. Secondly, the Northern union is employment oriented while Southern union is wage oriented, i.e., $\beta_N < 1$ and $\beta_S > 1$. Thirdly, the union is more wage oriented in country *i* than that in country, j, i.e., $\beta_i > \beta_j > 1$. Lastly, the union is more employment-oriented in country i than that in j, i.e., $\beta_i < \beta_j < 1$. We also examine the first two cases with and without free trade. The results can be summarized as follows.

Proposition 5: *When the labor unions in the two countries have asymmetric preferences over wages and employments, the governments set their optimal LS as follows (see Appendix A8 for Proof).*

(i) $\theta_N^* |_{\beta_N > 1, t=0} < \theta_N^* |_{\beta_N > 1, t>0} < \theta_S^* |_{\beta_S < 1, t>0} < \theta_S^* |_{\beta_S < 1, t=0}$,

(ii) $\theta_S^* |_{\beta_S > 1, t=0} < \theta_S^* |_{\beta_S > 1, t>0} < \theta_N^* |_{\beta_N < 1, t>0} < \theta_N^* |_{\beta_N < 1, t=0}$,

(iii) $\theta_i^* |_{\beta'_i > \beta_j > 1} < \theta_i^* |_{\beta_i = \beta_j > 1}$ *for a given tariff t, and*

(iv) $\theta_i^* |_{\beta_i = \beta_j < 1} < \theta_i^* |_{\beta'_i < \beta_j < 1}$ *for a given tariff t.*

It is quite common to observe that developed countries sustain relatively higher labor standards than developing countries. The above Proposition shows that this may be a reflection of different preferences of their labor unions: The Northern union may be more interested in employment than the Southern one. And in the extreme case that the Northern union is employment oriented while the Southern one is wage oriented, the LS differential between the two countries is the highest under free trade.

5.2 *Economic Integration and Southern LS*

Does regional economic integration increase LS? From Proposition 3, the S government may choose a higher LS under the optimal tariff system than under free trade if labor unions are wage-oriented. Put another way, this implies that the Northern tariff on Southern imports is an effective way to raise Southern LS if labor unions are wage-oriented.

In this section, we further investigate the issue of economic integration. In particular, what we have in mind is the effect of some Southern countries' accessions to the World Trade Organization or to the European Union, where member countries lose their discretionary choice of import tariffs (i.e., internal free trade is mandatory). And they may as well cooperate over non-tariff issues such as LS. Our question is whether such a deeper economic integration increases their LS or not.

To see this formally, we change the game structure as follows. In the first stage, both governments determine their LS cooperatively, and the Northern government abides by the agreed-upon zero tariff; and in the second stage, the labor union and the firm negotiate to determine wages and employment in each country simultaneously.

The second stage of the game can be solved as in earlier sections. Now to find out the optimal LS, both governments maximize their joint welfare choosing the two LS, given a zero-tariff system. They yield the following FOCs:

$$\frac{\partial(\Phi_N + \Phi_S)}{\partial\theta_N} = 0 \quad \text{and} \quad \frac{\partial(\Phi_N + \Phi_S)}{\partial\theta_S} = 0 .$$

Let us denote the Northern optimal LS as θ_N^E and the Southern one as θ_S^E, where the superscript E stands for economic integration. We are now in a position to compare whether θ_i^E is greater or smaller than the optimal LS, θ_i^*, under the full discretionary regime over tariffs and LS in previous sections.

Proposition 6: *After economic integration, if countries cooperate over LS, (i) they tend to choose higher LS than in the absence of economic integration if labor unions are wage-oriented; (ii) If labor unions are employment-oriented, the effect of economic integration on LS is ambiguous* (See Appendix A9 for proof).

The implications of the above proposition are interesting. Suppose that labor unions are wage-oriented. Then the free trade system of the North results in a lower LS in the South as compared to under the optimal tariff, as shown in Proposition 3. And in order for the North to raise Southern LS, it must abandon the free trade regime and impose a positive tariff against Southern imports. However, Proposition 6 says that if both countries cooperate over the LS to maximize their joint welfare under the free trade system, then it is possible for the North to induce the Southern government to choose a higher LS, without giving up the free trade regime.

6. Concluding Remarks

In this paper, with a setting of a Northern firm competing against a Southern exporter in the Northern market, we investigated how governments set LS when labor unions have a biased preference towards either wages or employment. The following main results are noteworthy. First, given any tariff level, governments choose higher LS when labor unions are employment-oriented than when they are wage-oriented. Second, the optimal LS is higher under free trade than under the optimal tariff if labor unions are employment-oriented. Last, ‘a race to the bottom’ of LS may arise if unions are wage-oriented, and it is more so under free trade than under the optimal tariff.

We extended the analysis to two more interesting cases. First, we considered asymmetric preferences of labor unions. We found that the North sets higher LS than the South, when the Northern union is more employment-oriented than the Southern union. Second, we considered the effect of economic integration between the North and the South on their LS decisions. We showed that both countries can cooperatively choose higher LS in order to maximize their joint welfare even if their labor unions are wage-oriented.

Another interesting extension would be to introduce multinational corporations and foreign direct investment, where the Northern firm has a Southern branch and it bargains with the Southern labor union. The Northern multinational firm can use this situation as a threat against the Northern labor union as well as the Southern one, in case either of the negotiations breaks down. The threat of going multinational would reduce the union wage premium regardless of union preferences. However, the Southern labor union has a better position than the Northern one since it deals with two firms, the Southern firm and the Southern branch of the Northern firm. This would positively affect the negotiated wage and employment. The final effect might be ambiguous. We leave it for future studies.

Appendix

A1: Proof for (7a), (7b), (7b) and (7d)

Totally differentiating the FOCs (6a~6b) in the second stage yields (for $i, j = N,\ S$; $i \neq j$):

$$\begin{bmatrix} \frac{\partial^2 \widetilde{G}_N}{\partial w_N^2} & \frac{\partial^2 \widetilde{G}_N}{\partial w_N \partial q_N} & 0 & \beta\theta_N \frac{\partial \pi_N}{\partial q_S} \\ \frac{1-\beta}{\beta} & \frac{\partial^2 \pi_N}{\partial q_N^2} & 0 & \frac{\partial^2 \pi_N}{\partial q_N \partial q_S} \\ 0 & \beta\theta_S \frac{\partial \pi_S}{\partial q_N} & \frac{\partial^2 \widetilde{G}_S}{\partial w_S^2} & \frac{\partial^2 \widetilde{G}_S}{\partial w_S \partial q_S} \\ 0 & \frac{\partial^2 \pi_S}{\partial q_S \partial q_N} & \frac{1-\beta}{\beta} & \frac{\partial^2 \pi_S}{\partial q_S^2} \end{bmatrix} \begin{bmatrix} dw_N \\ dq_N \\ dw_S \\ dq_S \end{bmatrix} = -\begin{bmatrix} \frac{\partial^2 \widetilde{G}_N}{\partial w_N \partial \theta_N} \\ 0 \\ 0 \\ 0 \end{bmatrix} d\theta_N - \begin{bmatrix} 0 \\ 0 \\ \frac{\partial^2 \widetilde{G}_S}{\partial w_S \partial \theta_S} \\ 0 \end{bmatrix} d\theta_S - \begin{bmatrix} 0 \\ 0 \\ \frac{\partial^2 \widetilde{G}_S}{\partial w_S \partial t} \\ \frac{\partial^2 \widetilde{G}_S}{\partial q_S \partial t} \end{bmatrix} dt$$

where $\frac{\partial^2 \widetilde{G}_i}{\partial w_i^2} = \beta\theta_i \frac{\partial \pi_i}{\partial w_i} - (1-\theta_i) q_i = \left[(1-\beta)\theta_i - 1\right] q_i < 0$,

$\frac{\partial^2 \widetilde{G}_i}{\partial w_i \partial q_i} = \beta\theta_i \frac{\partial \pi_i}{\partial q_i} - (1-\theta_i) w_i = -w_i < 0$, $\frac{\partial^2 \widetilde{G}_i}{\partial w_i \partial \theta_i} = \beta\pi_i + w_i q_i > 0$,

$\frac{\partial^2 \widetilde{G}_i}{\partial w_i \partial q_j} = \beta\theta_i \frac{\partial \pi_i}{\partial q_j} = \beta\theta_i p' q_i < 0$, $\frac{\partial^2 \widetilde{G}_i}{\partial q_i \partial w_i} = \frac{1-\beta}{\beta}$, $\frac{\partial^2 \widetilde{G}_i}{\partial q_i^2} = \frac{\partial^2 \pi_i}{\partial q_i^2} = p'' q_i + 2p' < 0$,

$\frac{\partial^2 \widetilde{G}_i}{\partial q_i \partial q_j} = \frac{\partial^2 \pi_i}{\partial q_i \partial q_j} = p'' q_i + p' < 0$, $\frac{\partial^2 \widetilde{G}_S}{\partial w_S \partial t} = -\beta\theta_S q_S < 0$, and $\frac{\partial^2 \widetilde{G}_S}{\partial q_S \partial t} = -1 < 0$.

The determinant of the 4x4 matrix on the LHS can be expanded as:

$$\Delta = \frac{\partial^2 \widetilde{G}_N}{\partial w_N^2} \frac{\partial^2 \widetilde{G}_S}{\partial w_S^2} \left[\frac{\partial^2 \pi_N}{\partial q_N^2} \frac{\partial^2 \pi_S}{\partial q_S^2} - \frac{\partial^2 \pi_N}{\partial q_N \partial q_S} \frac{\partial^2 \pi_S}{\partial q_S \partial q_N} \right] + \left(\frac{1-\beta}{\beta} \right)^2 \left[\beta\theta_N \frac{\partial \pi_N}{\partial q_S} \beta\theta_S \frac{\partial \pi_S}{\partial q_N} - \frac{\partial^2 \widetilde{G}_N}{\partial w_N \partial q_N} \frac{\partial^2 \widetilde{G}_S}{\partial w_S \partial q_S} \right]$$

We have $\beta\theta_i \pi_i = (1-\theta_i) q_i w_i$ for i=N, S from (6a), and $w_N / \beta + p' q_N + p - w_N = 0$ and $w_S / \beta + p' q_S + p - t - w_S = 0$ from (6b). Multiplying $\beta\theta_i$ to the second equations in (6b) and using $\beta\theta_i \pi_i = (1-\theta_i) q_i w_i$, we obtain $\beta\theta_i p' q_i + w_i = 0$. This implies $\beta\theta_i \frac{\partial \pi_i}{\partial q_j} = \frac{\partial^2 \widetilde{G}_i}{\partial w_i \partial q_i}$, making the 2nd bracket on the RHS of Δ zero. Hence, Δ>0 provided that the own effects (the 1st term in 1st bracket) dominate the cross effects (the rest of terms in 1st bracket).

For simplicity we evaluate the comparative static results at $p''=0$. (Our results hold as long as the marginal revenue is decreasing in output, i.e., as long as p'' is not extremely positive.) Then we obtain the results shown in section 3.1 as follows. For $i, j = N, S$ and $i \neq j$;

$$\Delta \frac{dw_i}{d\theta_i} = \left(2\theta_j\left(\beta-1\right)+3\right)\left(p'\right)^2 q_j\left(\beta\pi_i + q_i w_i\right) > 0,$$

$$\Delta \frac{dq_i}{d\theta_i} = \left(\frac{\beta-1}{\beta}\right)\left(\theta_j\left(\beta-1\right)+2\right)p' q_j\left(\beta\pi_i + q_i w_i\right)\begin{cases} >0 & \text{if } \beta<1 \\ <0 & \text{if } \beta>1 \end{cases},$$

$$\Delta \frac{dw_i}{d\theta_j} = \left(\beta-1\right)\theta_i\left(p'\right)^2 q_i\left(\beta\pi_j + q_j w_j\right)\begin{cases} <0 & \text{if } \beta<1 \\ >0 & \text{if } \beta>1 \end{cases},$$

$$\Delta \frac{dq_i}{d\theta_j} = -\left(\frac{\beta-1}{\beta}\right)p' q_i\left(\beta\pi_j + q_j w_j\right)\begin{cases} <0 & \text{if } \beta<1 \\ >0 & \text{if } \beta>1 \end{cases},$$

$$\Delta \frac{dw_N}{dt} = \theta_N\beta\left(p'\right)^2 q_N q_S > 0, \quad \Delta \frac{dq_N}{dt} = -p' q_N q_S > 0,$$

$$\Delta \frac{dq_S}{dt} = \left(\theta_N\left(\beta-1\right)+2\right)p' q_N q_S < 0, \text{ and } \Delta \frac{dw_S}{dt} = -\Delta\beta p'\theta_S \frac{dq_S}{dt} < 0. \qquad \text{QED}$$

A2: Proof for Lemma 2

(i) We only prove the case for the North. That for the South can be done analogously. Detailed calculations yield:

$$dC_N / d\theta_N = \left[\left(2\theta_S(\beta-1)+3\right)-(\beta-1)\theta_N\left(\theta_S(\beta-1)+2\right)\right]q_N q_S\left(p'\right)^2\left(\beta\pi_N + q_N w_N\right)/\Delta.$$

The sign of the expression in square brackets depends on the value of β. First, if β<1, it is positive. Second, if β>1, we set the expression in brackets equal to zero and solve for β, which gives: $\bar{\beta} = (-\theta_N + \theta_S + \theta_N\theta_S + \sqrt{\theta_N^2 + \theta_S^2 + \theta_N\theta_S})/(\theta_N\theta_S)$. Here $\bar{\beta} > 0$ for $\theta_i \in (0,1)$. In particular, $\bar{\beta} \in (1+\sqrt{3}, \infty)$, and $\bar{\beta} = 1+\sqrt{3}$ when $\theta_i = 1$, while $\bar{\beta} = \infty$ when $\theta_i = 0$. Therefore, Lemma 2(i) holds for a large domain of $\beta \in (0, \bar{\beta})$ with $\bar{\beta} \in (1+\sqrt{3}, \infty)$. The proof for Lemma 2(ii) is straightforward from (7c) and (7d). QED

A3: Proof for (8a), (8b), (8c) and (8d)

$$\frac{d\pi_N}{d\theta_N} = \left((\beta\pi_N + q_N w_N) p' q_S / \Delta\beta\right)\left[(\beta-1)(\theta_S(\beta-1)+2)(p-w_N) - p' q_N(\beta(2+\theta_S)+(1+\theta_S))\right].$$

After some calculations, we can verify that $d\pi_N / d\theta_N$ is negative if $\beta > \beta^*$ and positive if $\beta < \beta^*$, where $\beta^* \in (0,1)$ is a critical value of β that gives $d\pi_N / d\theta_N = 0$. The existence proof of the critical value is as follows. Suppose $d\pi_N / d\theta_N = 0$, implying: $(\beta^*-1)(\theta_S(\beta^*-1)+2)(p-w_N) = p' q_N[(\beta^*\theta_S+2)+(1-\theta_S)]$. It is clear that since the RHS is negative, β^* in the LHS must be less than 1 (by definition it is greater than 0). And (8b) can be proved analogously, by replacing β^* with β^{**}, where β^{**} is a critical value of β that yields $d\pi_S / d\theta_S = 0$.

$$\frac{d\pi_N}{d\theta_S} = \frac{\beta-1}{\Delta\beta} q_N(\beta\pi_S + q_S w_S) p'[p' q_N(1-\theta_N) - (p-w_N)].$$

Here, $d\pi_N / d\theta_S < 0$ if $\beta < 1$ and $d\pi_N / d\theta_S > 0$ if $\beta > 1$. We can straightforwardly prove for the case of $d\pi_N / d\theta_S$ in a similar way.

$$\frac{d\pi_N}{dt} = (p' q_N q_S / \Delta)[-(p-w_N) - p' q_N(\theta_N - 1)] > 0.$$

The proof for $d\pi_S / dt < 0$ can be done in a similar way straightforwardly. QED

A4: Proof for Lemma 3

(i) Again we only prove the case for the North. After some calculations, using $dw_N / d\theta_N$, $dq_N / d\theta_N$ and $\beta\theta_N p' q_N = -w_N$ in Appendix A1, we can rearrange (9) as follows.

$$\frac{du_N}{d\theta_N} = \frac{1}{\Delta}(p')^2 (q_N)^2 q_S u_N \beta w_N (\beta\pi_N + q_N w_N)\left[\left(2\theta_S(\beta-1)+3\right) - \frac{\beta-1}{\beta}\theta_N\left(\theta_S(\beta-1)+2\right)\right],$$

which is positive for $\beta \in (0,\infty)$, since the expression in square brackets is positive: $\left((\beta-1)/\beta\right)\theta_N \in (-\infty,1)$ and $\left(2\theta_S(\beta-1)+3\right) > \left(\theta_S(\beta-1)+2\right) > 0$.

(ii) Straightforward from (7c) and (7d). QED

A5: Proof for Proposition 2

We only prove the case for the North. That for the South can be done analogously. Suppose $\beta^{-}=1-\varepsilon$ and $\beta^{+}=1+\varepsilon$, where $\varepsilon>0$ and small. Denote the optimal LS θ_N^{-} that satisfies $\partial\Phi_N/\partial\theta_N=0$ when $\beta^{-}=1-\varepsilon$, and θ_N^{+} that satisfies $\partial\Phi_N/\partial\theta_N=0$ when $\beta^{+}=1+\varepsilon$. Calculations give the following FOC:

$$\frac{\partial\Phi_N}{\partial\theta_N}|_{\beta^{-},\theta_N^{-}}=\left(p'q_S/\Delta\right)\left(\left(1-\varepsilon\right)\pi_N+q_N w_N\right)A=0,$$

where $A=\begin{bmatrix}\left(\dfrac{-\varepsilon}{1-\varepsilon}\right)\left(\left(p-p'q_S\right)\left(1-\varepsilon\theta_S\right)+\left(p-t\right)+\left(w_N^{1-\varepsilon}-w_N\right)\left(2-\varepsilon\theta_S\right)\right)\\ -p'\dfrac{q_N}{w_N}\left(\left(1-\varepsilon\right)w_N^{1-\varepsilon}-w_N\right)\left(3-2\varepsilon\theta_S\right)\end{bmatrix}$.

Now, changing $\beta^{-}=1-\varepsilon$ to $\beta^{+}=1+\varepsilon$ in the above FOC yields:

$$\frac{\partial\Phi_N}{\partial\theta_N}|_{\beta^{+},\theta_N^{-}}=\left(p'q_S/\Delta\right)\left(\left(1+\varepsilon\right)\pi_N+q_N w_N\right)B,$$

where $B=\begin{bmatrix}\left(\dfrac{\varepsilon}{1+\varepsilon}\right)\left(\left(p-p'q_S\right)\left(1+\varepsilon\theta_S\right)+\left(p-t\right)+\left(w_N^{1+\varepsilon}-w_N\right)\left(2+\varepsilon\theta_S\right)\right)\\ -p'\dfrac{q_N}{w_N}\left(\left(1+\varepsilon\right)w_N^{1+\varepsilon}-w_N\right)\left(3+2\varepsilon\theta_S\right)\end{bmatrix}$.

Then, $\partial\Phi_N/\partial\theta_N|_{\beta^{+},\theta_N^{-}}$ is not zero any more since θ_N^{-} is the optimal LS for the case of $\beta^{-}=1-\varepsilon$. To verify the sign, subtracting the former from the latter, we have:

$$\frac{\partial\Phi_N}{\partial\theta_N}|_{\beta^{+},\theta_N^{-}}-\frac{\partial\Phi_N}{\partial\theta_N}|_{\beta^{-},\theta_N^{-}}\ <\ 0. \qquad \text{(A5-1)}$$

To see this, note first that $B>A>0$. And the term in front of *B* in $\partial\Phi_N/\partial\theta_N|_{\beta^{+},\theta_N^{-}}$ is negative and has a larger absolute value than a similar term in front of *A* in $\partial\Phi_N/\partial\theta_N|_{\beta^{-},\theta_N^{-}}$. Thus, (A5-1) is negatively signed. Also, since $\partial\Phi_N/\partial\theta_N|_{\beta^{-},\theta_N^{-}}$ is zero, we must have $\partial\Phi_N/\partial\theta_N|_{\beta^{+},\theta_N^{-}}<0$. This implies that $\theta_N^{+}|_{\beta^{+}}<\theta_N^{-}|_{\beta^{-}}$. Thus in general, we have $\theta_N^{*}|_{\beta>1}<\theta_N^{*}|_{\beta<1}$, which is true under free trade as well. Refer to Figure 1. QED

A6: Proof for Proposition 3

Again it suffices to prove the case for the North only. Under the optimal tariff, t^*, the optimal LS θ_N^* satisfies,

$$\frac{\partial \Phi_N}{\partial \theta_N} = \left(p' q_S / \Delta \right)\left(\beta \pi_N + q_N w_N \right)\left[\begin{array}{l} \left(\frac{\beta - 1}{\beta} \right)\left(\begin{array}{l} \left(p - p' q_S \right)\left(\theta_S \left(\beta - 1 \right) + 1 \right) + \left(p - t^* \right) \\ + \left(w_N^\beta - w_N \right)\left(\theta_S \left(\beta - 1 \right) + 2 \right) \end{array} \right) \\ - p' \frac{q_N}{w_N}\left(\beta w_N^\beta - w_N \right)\left(2\theta_S \left(\beta - 1 \right) + 3 \right) \end{array} \right] = 0 .$$

Now consider a free trade system with t=0. Then from the above expression one can verify that $\partial \Phi_N / \partial \theta_N |_{t=0} > 0$ if $\beta < 1$ and $\partial \Phi_N / \partial \theta_N |_{t=0} < 0$ if $\beta > 1$, which implies the proposition. These are illustrated in Figure 2. QED

A7: Proof for Proposition 4

(i) Let us first prove the case for the South, whose welfare consists of firm profits and union utility, since consumption occurs in the North only. Figure 3 shows that an increase in LS raises firm profits and union utility if the union is sufficiently employment-oriented (i.e. if $\beta < \beta'$ in Figure 3). If the union is wage-oriented ($\beta > 1$), then an increase in LS reduces firm profits, but it still raises union utility. Therefore, the optimal LS can be still positive. It becomes zero only if the union is sufficiently wage oriented, at a point $\beta \geq \beta''$, where $\partial \Phi_S / \partial \theta_S = \partial \pi_S / \partial \theta_S + \partial u_S / \partial \theta_S = 0$ at β''. Also, in the special case that the government does not care about union utility, the union utility does not enter the government's objective function and thus the government chooses zero LS if $\beta > \beta'$ (i.e., $\partial \Phi_S / \partial \theta_S = \partial \pi_S / \partial \theta_S < 0$ if $\beta > \beta'$).

(ii) The proof for the North is more complicated, since Northern welfare includes consumer surplus and tariff revenue. Let us look at the case of near free trade, i.e., $t \approx 0$, then the effect on the tariff revenue disappears. Since an increase in LS raises consumer surplus ($d\varphi / d\theta_N > 0$) if $\beta < 1$, it moves the point for $\partial \Phi_N / \partial \theta_N = 0$ to the right of β'', say a point such as β'''. That is, only if $\beta \geq \beta'''$, then the Northern government would choose a zero level of LS. QED

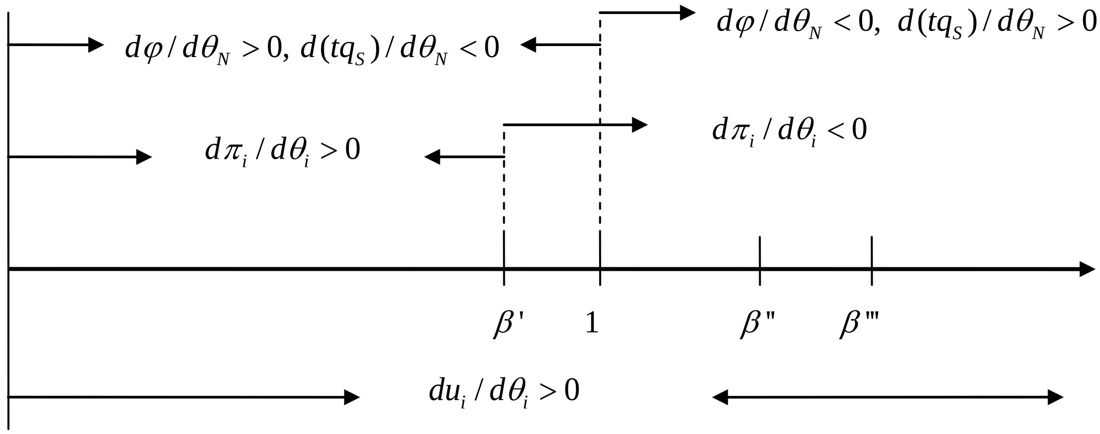

Figure 3: Welfare decomposition

A8: Proof for Proposition 5

Suppose $\beta_N \neq \beta_S$. Then, from Proposition 3, we have $\theta_N^* |_{\beta_N>1,t=0} < \theta_N^* |_{\beta_N>1,t>0}$ and $\theta_N^* |_{\beta_N<1,t>0} < \theta_N^* |_{\beta_N<1,t=0}$; and $\theta_S^* |_{\beta_S<1,t>0} < \theta_S^* |_{\beta_S<1,t=0}$ and $\theta_S^* |_{\beta_S>1,t=0} < \theta_S^* |_{\beta_S>1,t>0}$. In addition, from Proposition 2, we obtain $\theta_N^* |_{\beta_N>1} < \theta_S^* |_{\beta_S<1}$ and $\theta_S^* |_{\beta_S>1} < \theta_N^* |_{\beta_N<1}$ given a level of the tariff. Using all these rankings, we derive (i) and (ii) in Proposition 5.

For (iii) and (iv), it suffices to prove the case for the North only. First, for (iii), suppose that $\beta_N = \beta_S > 1$ and the North chooses a θ_N^* that satisfies the following FOC:

$$\frac{\partial \Phi_N}{\partial \theta_N} = \left(p' q_S / \Delta\right)\left(\beta_N \pi_N + q_N w_N\right)\left[\begin{array}{l}\left(\dfrac{\beta_N - 1}{\beta_N}\right)\left(\begin{array}{l}\left(p - p' q_S\right)\left(\theta_S\left(\beta_S - 1\right) + 1\right) + \left(p - t^*\right) \\ + \left(w_N^{\beta_N} - w_N\right)\left(\theta_S\left(\beta_S - 1\right) + 2\right)\end{array}\right) \\ - p' \dfrac{q_N}{w_N}\left(\beta_N w_N^{\beta_N} - w_N\right)\left(2\theta_S\left(\beta_S - 1\right) + 3\right)\end{array}\right] = 0.$$

Given β_S, if β_N further increases slightly, then $\partial \Phi_N / \partial \theta_N |_{\theta_N^*, \beta'_N} < 0$ from the above FOC. The new optimal level of LS for the North becomes lower. As for (iv), suppose that $\beta_N = \beta_S < 1$ and the North chooses a θ_N^* that satisfies the above FOC. Now, if β_N further decreases slightly, we can similarly verify $\partial \Phi_N / \partial \theta_N |_{\theta_N^*, \beta'_N} > 0$. And the new optimal level of LS for the North becomes higher. QED

A9: Proof for Proposition 6

When plugging the individual optimal LS into the FOCs, the following equalities must hold,

$$\frac{\partial(\Phi_N+\Phi_S)}{\partial\theta_N}\Big|_{\theta_N^*}=\frac{\partial\Phi_N}{\partial\theta_N}\Big|_{\theta_N^*}+\frac{\partial\Phi_S}{\partial\theta_N}\Big|_{\theta_N^*}=0+\frac{\partial\Phi_S}{\partial\theta_N}\Big|_{\theta_N^*},$$

$$\frac{\partial(\Phi_N+\Phi_S)}{\partial\theta_S}\Big|_{\theta_S^*}=\frac{\partial\Phi_N}{\partial\theta_S}\Big|_{\theta_S^*}+\frac{\partial\Phi_S}{\partial\theta_S}\Big|_{\theta_S^*}=\frac{\partial\Phi_N}{\partial\theta_S}\Big|_{\theta_S^*}+0.$$

These equations are not necessarily zero. To see their signs, note first,

$\frac{\partial\Phi_S}{\partial\theta_N}\Big|_{\theta_N^*}=\frac{D+E}{\Delta}$, where

$$D\equiv p'\frac{d(q_N+q_S)}{d\theta_N}q_S+p\frac{dq_S}{d\theta_N}=\frac{1-\beta}{\beta}p'q_S\left(\beta\pi_N+q_Nw_N\right)\left[p+p'q_S\left((1-\beta)\theta_S-1\right)\right],$$

and $E\equiv(\beta w_S^{\beta}-w_S)\frac{q_S}{w_S}\frac{dw_S}{d\theta_N}+(w_S^{\beta}-w_S)\frac{dq_S}{d\theta_N}$.

D is positive if $\beta>1$ and negative if $\beta<1$, while *E* is always positive. Therefore, if $\beta>1$, we have $\partial(\Phi_N+\Phi_S)/\partial\theta_N\,|_{\theta_N^*}=\partial\Phi_S/\partial\theta_N\,|_{\theta_N^*}>0$; that is, the optimal LS under economic integration is greater than without integration. If $\beta<1$, $\partial(\Phi_N+\Phi_S)/\partial\theta_N\,|_{\theta_N^*}=\partial\Phi_S/\partial\theta_N\,|_{\theta_N^*}$ is either positive or negative, depending on the relative size of *D* and *E*.

Second, $\frac{\partial\Phi_N}{\partial\theta_S}\Big|_{\theta_S^*}=\frac{G+K}{\Delta}$, where *G* and *K* can be written similarly as *D* and *E*, with the subscripts *N* and *S* switched. Since the Northern government cares about consumer surplus, *G* shows that an increase in the Southern LS brings ambiguous effects. However, if we assume β is not extremely high or small, the bracket in *G* becomes positive. Then, if $\beta>1$, $\partial(\Phi_N+\Phi_S)/\partial\theta_S\,|_{\theta_S^*}=\partial\Phi_N/\partial\theta_S\,|_{\theta_S^*}>0$, implying that the optimal LS with economic integration is greater than without integration; If $\beta<1$, $\partial(\Phi_N+\Phi_S)/\partial\theta_S\,|_{\theta_S^*}=\partial\Phi_N/\partial\theta_S\,|_{\theta_S^*}$ is either positive or negative, depending on the relative size of *G* and *K*. QED

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