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International Labor Standards and Their Harmonization

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Abstract This paper studies international labor standards (LS) in a North-South framework. We consider three regimes of LS: free choices, a policy game between two governments, and international harmonization. In the absence of trade restrictions, the North has a higher LS due to better technology. An import tariff reduces the Southern LS, contrary to conventional wisdom, since the tariff reduces the Southern output which lowers the Southern LS because LS is costly to obtain and contributes to final production. Under the policy game, the North produces a higher LS than under free choices of LS, arising out of the Northern government's welfare maximization behavior, which requires the North to expand output and increase LS. International harmonization under a uniform, minimum LS binding for both countries lowers Northern profits and welfare. A more efficient alternative is technology transfer at a positive reimbursement. It is shown that both countries can obtain higher profits and welfare without intervention by governments or international organizations.

Keywords: Labor Standards, International Harmonization, Technology Transfer, Oligopoly, Policy Game, Trade Restrictions

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1. Introduction

The issue of labor standards (LS) has generated heated debates recently. An example is during the WTO meeting of finance ministers in November 1999, thousands of demonstrators succeeded in bringing their talks to a halt. Such groups demand the WTO address international LS along with trade issues, and claim that market access in the North should be conditioned on raising LS in the South, to prevent a "race to the bottom" in wages and benefits. They ask that since the WTO already addresses issues such as the protection of intellectual property rights that fall outside of a strict definition of trade and investment, why it cannot also act to protect the interests of workers by setting LS. Some even advocate a “social clause” that trade sanctions be imposed in response to violations of LS.

This point of view presumes that workers benefit from LS protection. However, it has not been analyzed formally in economic theory. Some economists argue that LS adds to consumer utility (Rodrik, 1996), or national welfare (Brown, Deardorff and Stern (1995), Srinivasan (1995)). However, in these analyses, workers and firms do not benefit directly from a higher LS. On the other hand, firms must bear the cost of producing it. Thus it is no wonder that firms have no incentives to improve LS.

In our view, while it is costly to maintain a certain level of LS, a higher LS also improves labor productivity. Thus, weak labor standards, like low wages, are likely to be a consequence of low productivity and poverty, not an independent source of international comparative advantage. Specifically, we consider LS to exhibit in three forms. One is work safety, ventilation, clean and comfortable work environment, etc., which is not embodied in the worker physically; the second is health improvement, which is embodied in the worker;

the third is a reduction of child labor (i.e., replacement with adult labor) or an increase in the minimum wage, which can raise productivity indirectly. In addition, the home government's utility can increase if foreign LS (or human rights) rises. These features of LS distinguish themselves from human capital or R&D investments.

If one agrees that LS contributes to productivity, then it is not hard to see that even in poor countries, maintaining a certain level of LS is beneficial to the workers, the firms and national welfare there. This paper models the ideas above, in a North-South two-firm framework, with consumption only in the more developed North which has a superior technology of LS production. The Northern government also imposes a tariff against imports, hoping to raise foreign LS. Firms compete à la Cournot, choosing how much to invest in LS and how much final output to produce.

We consider three regimes: free choices of LS, a policy game between two governments, and international harmonization of LS. In the absence of trade restrictions, the North has a higher LS due to better technology. An import tariff reduces the Southern LS, contrary to conventional wisdom, since the tariff reduces the Southern output which lowers the Southern LS because LS is costly to obtain and contributes to final production. Exactly the opposite arises in the North.

Under the policy game between governments, the North produces a higher LS than under free choices of LS, because the government maximizes national welfare including consumer surplus, which requires the North to expand output and increase LS. As a consequence, the South's market share is squeezed out and its LS forced to fall.

Under international harmonization, a world welfare maximizing uniform LS does not exist, because the North voluntarily chooses a higher one due to its better technology. On the other hand, a common, minimum LS binding for both countries does exist, but it will lower the profits and welfare of the North. A more efficient alternative is technology transfer at a positive reimbursement. It is shown that the world welfare maximizing equilibrium can be restored, without any actions from the governments or international organizations.

In the existing literature, Bhagwati (1995) and Basu (1999) believe that the recent surge in the demands for LS stems overwhelmingly from lobbies whose true agenda is protectionism. Srinivasan (1995) and Brown, Deardorff and Stern (1996) and Brown (2001) demonstrate that the diversity of LS between nations reflect differences in factor endowments and levels of income. Martin and Maskus (2001) show that a failure to establish and enforce LS may reduce an economy's efficiency and interferes with its comparative advantage. Bagwell and Staiger (2001) argue that efficiency can be achieved without negotiating over LS. In contrast, some other economists such as Rodrik (1996) and Elliot (2000) embrace linking LS to trade and FDI. Different from these papers which are mostly in general equilibrium with perfect competition, we analyze the problem under oligopoly, explicitly incorporating LS that contributes to production.

The remainder of the paper is organized as follows. Section 2 sets up the basic model. Section 3 examines the regime of free choices of LS. Section 4 looks into the policy game between governments. Section 5 introduces international harmonization. Section 6 considers different LS allowed for the two countries under world welfare maximization. Section 7 investigates technology transfer. Section 8 provides some discussion on efficiency, equity and human rights. And section 9 concludes.

2. Basic Model Setup

Consider two firms producing an identical product in two different countries the North and the South. The unit cost of production is a function of LS, $c(\theta_i)$, where θ_i represents the LS in country i, ($i = N, S$), with $c' < 0$, $c'' > 0$. That is, an increase in LS reduces the unit cost of final production of the consumption good.

LS θ_i is in turn produced using final output,

$$\theta_i = y_i / \alpha_i, \qquad (1)$$

where α_i represents the technology of producing LS in country i, ($i = N, S$), with $\alpha_N < \alpha_S$; that is, α_i is the output required to produce one unit of LS. It follows that y_i is the total output foregone for LS production of θ_i. There is no market for LS hence each firm must produce it by itself. In other words, final output can be divided into two parts. One part is sold in the market for profits, and the other part is not sold, but used internally to upgrade LS to reduce the unit cost of production. This assumption can be justified on the grounds that LS became an international issue only in the past 20 years also. Since then, firms must devote resource (outputs) to upgrade LS.[1]

This setup includes two sides of LS: to upgrade LS, some final output must be foregone; and also, a higher LS reduces the unit cost of final production. Thus, lowering LS may save some final output for sales, which is why firms prefer a lower LS. However, it also increases the unit cost. These two effects work against each other. The way LS contributes to

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[1] Alternatively we could assume that y_i is also sold in the market, and the firm uses revenue $p(\cdot)y_i$ instead to upgrade LS. This complicates the analysis because $p(\cdot)$ also depends on y_i, even though our analysis itself remains qualitatively the same.

productivity is similar to R&D or human capital investment. But we focus on international harmonization of LS, and its impact on national and world welfare. In addition, the home government's utility can increase if foreign LS (or human rights) rises.

We assume that final outputs are only sold in the North, and the Northern government imposes a tariff on imports. Then the profit functions of both firms can be written as

$$\pi_i(Y_N, Y_S, \theta_i, \alpha_i, t_j) = pY_i - c(\theta_i)(Y_i + \alpha_i\theta_i) - t_j Y_i, \quad t_S = 0, \tag{2}$$

where $p = p(Y_N + Y_S)$ is the inverse demand, with $p' < 0$, and t_j is an import tariff imposed by country $j \neq i$. Final production by firm i is $Y_i + y_i$, of which y_i $(= \alpha_i\theta_i)$ is foregone for LS production and only Y_i is sold at the market. [2]

We start with an initial state in which the Northern government imposes an import tariff *t* (though we do not solve for the optimal tariff). We then consider three regimes separately: free choices of LS, a policy game of LS between governments, and international harmonization of LS. In each regime, we analyze a two-stage game. In stage one, given the tariff in the initial state, LS is chosen, either freely by firms simultaneously, or by governments simultaneously, or internationally harmonized by an international organization such as the International Labor Organization (ILO). The assumption that *t* is imposed prior to the determination of LS reflects our wish to examine the impact of a Northern tariff on Southern LS, as suggested in the so-called "social clause." Then in stage two, the firms

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[2] An alternative is to let the firm sell y_i in the market and use the revenue to upgrade LS. This complicates the algebra since the effects of y_i on *p* must be considered, but without changing anything essential.

compete à la Cournot -- choosing outputs simultaneously. To ensure consistency, we solve the game by backward induction.

In all three regimes, the second stage is Cournot competition in output. The first order conditions (FOCs) for the Northern and Southern firms are respectively:

$$p + Y_N p' - c(\theta_N) = 0, \tag{3a}$$

$$p + Y_S p' - c(\theta_S) - t_N = 0. \tag{3b}$$

Equations (3a) and (3b) determine the equilibrium output of firm i, $Y_i \equiv Y_i(\theta_N, \theta_S; t_N)$. Total differentiation of them yields

$$\begin{pmatrix} 2p' + Y_N p'' & p' + Y_N p'' \\ p' + Y_S p'' & 2p' + Y_S p'' \end{pmatrix} \begin{pmatrix} dY_N \\ dY_S \end{pmatrix} = \begin{pmatrix} c_N^{'} \\ 0 \end{pmatrix} d\theta_N + \begin{pmatrix} 0 \\ c_S^{'} \end{pmatrix} d\theta_s + \begin{pmatrix} 0 \\ 1 \end{pmatrix} dt$$

where $\Delta = \begin{pmatrix} 2p' + Y_N p'' & p' + Y_N p'' \\ p' + Y_S p'' & 2p' + Y_S p'' \end{pmatrix} = 3(p')^2 + (Y_N + Y_s) p' p'' > 0$. From the above we obtain the following comparative static results, for $i, j = N, S, \;\; i \neq j$.

$$\frac{\partial Y_i(\theta_N, \theta_S; t_N; \alpha_N, \alpha_S)}{\partial \theta_i} = \frac{c_i^{'}}{\Delta}(2p' + Y_j p'') > 0, \tag{4a}$$

$$\frac{\partial Y_j(\theta_N, \theta_S; t_N; \alpha_N, \alpha_S)}{\partial \theta_i} = -\frac{c_i^{'}}{\Delta}(p' + Y_j p'') < 0, \tag{4b}$$

$$\frac{\partial Y_N(\theta_N,\theta_S;t_N;\alpha_N,\alpha_S)}{\partial t_N} = -\frac{p' + Y_N p''}{\Delta} > 0, \quad (4c)$$

$$\frac{\partial Y_S(\theta_N,\theta_S;t_N;\alpha_N,\alpha_S)}{\partial t_N} = \frac{2p' + Y_N p''}{\Delta} < 0. \quad (4d)$$

Condition (4a) implies that in order to increase the output sold at the market Y_i, the firm must reduce its unit cost of production by producing more LS θ_i, which in turn consumes more final output y_i. Condition (4b) states that an increase in y_i reduces the rival firm's final output Y_j. Conditions (4c) and (4d) are as expected, stating that an increase in the import tariff raises the Northern output but reduces the Southern one.

So far we have solved for the final output of firm i, which can be written as a function of LS in both countries and the import tariff, i.e., $Y_i \equiv Y_i(\theta_N,\theta_S;t_N,\alpha_N,\alpha_S)$. We now move on backwards to stage one, in which there are three different regimes.

3. Free Choice of Labor Standards

In this section we examine the regime in which firms can decide LS by themselves. Subsequent sections will deal with regimes of LS determined by governments or international organizations.

Define the second-stage profit functions by substituting $Y_i \equiv Y_i(\theta_N,\theta_S;t_N,\alpha_N,\alpha_S) = Y_i(\bullet)$ into (2),

$$\tilde{\pi}_i(\theta_N,\theta_S,t_N,\alpha_i) = p(\bullet)Y_i(\bullet) - c(\theta_i)(Y_i(\bullet)+\alpha_i\theta_i) - t_j Y_i(\bullet), \quad (5)$$

where $p(\bullet) = p(Y_N(\bullet) + Y_S(\bullet))$. Under free choice of LS, each firm chooses its own LS θ_i to maximize profits. Using the envelope theorem, the first order conditions can be obtained as:

$$\frac{\partial \tilde{\pi}_N}{\partial \theta_N} = \frac{\partial \pi_N}{\partial Y_S}\frac{dY_S}{d\theta_N} - \alpha_N c(\theta_N) - c'(\theta_N)(Y_N + \alpha_N \theta_N) = 0, \tag{6a}$$

$$\frac{\partial \tilde{\pi}_S}{\partial \theta_S} = \frac{\partial \pi_S}{\partial Y_N}\frac{dY_N}{d\theta_S} - \alpha_s c(\theta_S) - c'(\theta_S)(Y_S + \alpha_s \theta_S) = 0, \tag{6b}$$

where $\frac{\partial \pi_j}{\partial Y_i} = Y_j p'$.

The first terms in (6a) and (6b) capture the strategic effects of LS: raising own LS reduces the rival's output, which in turn benefits the firm itself. The strategic effect induces firms to invest more on LS. The second terms indicate the cost of producing LS, and the third terms represent the effect that increasing LS reduces the unit cost of final production. The sum of the second and third terms is negative, implying that it is costly to upgrade LS, even though a higher LS reduces the marginal cost of production.

Next, we investigate the properties of the Nash equilibrium determined by (6a) and (6b). Due to the two-stage game structure of the model, further comparisons involve the differentiation of *p"*, resulting in *p"'*, which is hard to interpret as far as economic intuition is concerned. We therefore assume $p'' = 0$ so that the demand curve becomes linear. Then conditions (6a) and (6b) can be simplified to

$$A_N(\theta_N, \theta_S; t_N; \alpha_N) \equiv -(\frac{4}{3}Y_N + \alpha_N \theta_N)c'(\theta_N) - \alpha_N c(\theta_N) = 0, \tag{6a'}$$

$$A_S(\theta_N, \theta_S; t_N; \alpha_S) \equiv -(\frac{4}{3}Y_S + \alpha_S \theta_S)c'(\theta_S) - \alpha_S c(\theta_S) = 0 . \tag{6b'}$$

They yield the best response functions

$$\theta_N = \theta_N(\theta_S; t_N; \alpha_N) , \tag{6a''}$$

$$\theta_S = \theta_S(\theta_N; t_N; \alpha_S) , \tag{6b''}$$

which determine the Nash equilibrium levels of LS . These functions can be plotted as in Figure 1, in which θ_S and θ_N are on the horizontal and vertical axes respectively. Calculations in Appendix 1 give the slopes of the best response functions as

$$\left.\frac{d\theta_N}{d\theta_S}\right|_N = -\frac{\partial A_N / \partial \theta_S}{\partial A_N / \partial \theta_N} , \tag{7a}$$

$$\left.\frac{d\theta_N}{d\theta_S}\right|_S = -\frac{\partial A_S / \partial \theta_S}{\partial A_S / \partial \theta_N} . \tag{7b}$$

Invoking the second order condition, we find that

$$0 \ > \ \left.\frac{d\theta_N}{d\theta_S}\right|_{\mathrm{N}} \ > \ \left.\frac{d\theta_N}{d\theta_S}\right|_{\mathrm{S}} . \tag{8}$$

Thus, both best response functions in LS space are negatively sloped, but (6a”) is flatter. Their intersection is at point H, where $\alpha_S = \alpha_N$. If we fix α_N at the level of point H, but increase α_S only, then South's reaction curve shifts downward, resulting in a new intersection point F in Figure 1, with a lower LS in the South and a higher one in the North. Therefore we have

Lemma 1: *In the free trade equilibrium,* $\theta_N > \theta_S$*, given* $\alpha_S > \alpha_N$.

Lemma 1 implies that the difference in Northern and Southern labor standards reflects their technology difference in upgrading LS.

Next, total differentiation of (6a) and (6b) we also derive respectively the full impacts of the Northern tariff (see Appendix 1 for details).

$$D\frac{d\theta_N}{dt_N} = -\{\frac{\partial A_N}{\partial t_N}\frac{\partial A_S}{\partial \theta_S} - \frac{\partial A_S}{\partial t_N}\frac{\partial A_N}{\partial \theta_S}\} > 0, \qquad (9a)$$

$$D\frac{d\theta_S}{dt_N} = -\{\frac{\partial A_S}{\partial t_N}\frac{\partial A_N}{\partial \theta_N} - \frac{\partial A_N}{\partial t_N}\frac{\partial A_S}{\partial \theta_N}\} < 0. \qquad (9b)$$

That is,

Proposition 1: *An increase in the Northern tariff raises (reduces) the Northern (Southern) LS.*

Proposition 1 runs counter to the expectations of those who advocate imposing trade restrictions against countries observing lower LS. They hoped to use trade restrictions to force Southern countries to adopt a higher LS. However, Proposition 1 says that the opposite may arise. The intuition is, an increase in Northern tariff reduces South's output for sales, while increasing that of the Northern firm. To produce a larger output, the North must use more output to upgrade its LS to reduce the unit cost. On the other hand, the opposite arises in the South. That is, since LS is costly to obtain, and the Northern import tariff reduces the South's exports, the Southern firm is forced to produce a lower LS. These are confirmed in the calculations in Appendix 1 and also in Figure 1. An increase in the tariff under free choices of LS shifts up the Northern best response curve, but does the opposite to the Southern one, moving their intersection to the northwest (not drawn).

Proposition 1 can also shed light on human rights concerns in the sense that the Northern consumers and government care about Southern LS, as claimed by Northern humanitarian groups, labor unions and NGOs. Suppose Southern LS enters positively the utility function of Northern consumers given in (10a), such that the North is better off with a higher Southern LS. Then by Proposition 1, an increase in the import tariff reduces Southern LS, which in turn lowers Northern welfare. Therefore, it is better not to impose the tariff to force the South to adopt a higher LS.

4. A Policy Game of Labor Standards

In this section, we investigate the case in which the governments in the two countries play a policy game, choosing own LS to maximize national welfare, which is the difference with the previous section. The LS chosen by the governments may be different from those chosen by the firms. We compare them and analyze the impacts on profits and welfare.

The game still has three stages. Everything stays the same as in the previous section except that in stage two, here the governments choose LS simultaneously to maximize own national welfare. Then in stage three, when firms compete à la Cournot -- choosing outputs simultaneously, conditions (4a) to (4e) still hold valid.

Country N's objective function includes profits, consumer surplus and tariff revenue. Let us define consumer surplus as $\phi(\theta_N, \theta_S, t_N) \equiv u(Y_N(\bullet) + Y_S(\bullet)) - (Y_N(\bullet) + Y_S(\bullet))p(\bullet)$ where $u(\cdot)$ is the consumer utility, and $u'(\cdot) = p$. Then, the Northern welfare is given by

$$\psi_N(\theta_N, \theta_S, t_N, \alpha_N) = \tilde{\pi}_N(\theta_N, \theta_S, t_N, \alpha_N) + \phi(\theta_N, \theta_S, t_N) + t_N Y_S(\theta_N, \theta_S, t_N). \qquad (10a)$$

The Southern welfare consists of profits only because all outputs are exported,

$$\psi_S(\theta_N, \theta_S, t_N, \alpha_S) = \tilde{\pi}_S(\theta_N, \theta_S, t_N, \alpha_S). \qquad (10b)$$

In stage two, the governments choose θ_N and θ_S simultaneously to maximize (10a) and (10b) respectively, resulting in the following FOCs,

$$\frac{\partial \psi_N(\theta_N, \theta_S; t_N; \alpha_N)}{\partial \theta_N} = \frac{\partial \tilde{\pi}_N}{\partial \theta_N} + \frac{\partial \phi}{\partial \theta_N} + t_N \frac{\partial Y_S}{\partial \theta_N} = 0, \qquad (11a)$$

$$\frac{\partial \psi_S(\theta_N, \theta_S; t_N; \alpha_S)}{\partial \theta_S} = \frac{\partial \tilde{\pi}_S}{\partial \theta_S} = 0, \qquad (11b)$$

where

$$\frac{\partial \phi}{\partial \theta_N} = -(Y_N + Y_S)p'(\frac{\partial Y_N}{\partial \theta_N} + \frac{\partial Y_S}{\partial \theta_N}) = -((Y_N + Y_S)(p')^2 c_N^{'} / \Delta > 0. \qquad (12)$$

That is, since an increase in LS reduces the marginal cost of production, it leads to higher outputs and higher consumer surplus. Invoking $p''=0$ and (4a) to (4e), the above can be simplified to

$$A_N(\theta_N,\theta_S;t;\alpha_N)+\frac{1}{3}\{-(Y_N+Y_S)c_N^{'}-\frac{t_N}{p'}c_N^{'}\}=0\,, \tag{11a'}$$

$$A_S(\theta_N,\theta_S;t;\alpha_S)=0\,. \tag{11b'}$$

Comparing (11b') and (6b'), one sees that in the South, the government's best response function is identical to that of the firm. This arises because there is no consumption in the South and national welfare is equivalent to firm profit.

Compared with (6a'), condition (11a') has two more terms in curled braces: the first one is positive, stemming from the effect of LS on consumer surplus; while the second one is negative, arising from the effect on the tariff revenue. In the absence of the import tariff, the Northern government *always* chooses a higher LS than the Northern firm. In Figure 1, the equilibrium under the policy game is at point *G*, where the Northern best response curve lies above that under free trade. Hence we can establish

Proposition 2: *In the absence of the import tariff, the equilibrium of a policy game between the two governments involves in a higher (lower) LS in the North (South) than under free choices of LS.*

One might be surprised that the Southern government would choose a lower LS than the Southern firm. However, this result stems from our assumption that consumption occurs in the North only. By condition (12), a higher LS raises the Northern welfare. When maximizing national welfare that includes consumer surplus, the Northern government chooses a higher LS than the Northern firm, shifting the Northern government's best response curve to the right of the Northern firm's. While in the South, the best response curves are identical for the government and the firm. Thus, the two governments' best response curves cross at point G in Figure 1. That is, as a result of oligopolistic interactions, the North expands its output which requires a higher LS. This in turn eats into the market share of the South, forcing it to lower its LS, since LS is costly to produce. It follows that the LS gap between the two countries increases. The implication is, government intervention in the form of a policy game cannot narrow the LS gap.

Using (11a'), it can be shown that under a positive import tariff,

$$(Y_N + Y_S) + \frac{t_N}{p'} \;>\; (=,<)\; 0 \quad \text{if} \quad t_N \;<\; (=,>)\; -\frac{1}{\varepsilon P}, \tag{13}$$

where $\varepsilon = (Y_N + Y_S)p'/p$. In Figure 1, the tariff shifts the Northern best response curve downward, but does not change the Southern best response curve.

To see the intuition, note that the terms $(Y_N + Y_S)$ and t_N / p' respectively reflect the effects on consumer surplus and tariff revenue when the Northern government maximizes national welfare. If the government chooses a higher LS, it can increase domestic output and hence consumer surplus. However, this would lower imports, reducing the tariff revenue. Condition (13) shows that if the import tariff is sufficiently low (high), the former effect dominates (is dominated), resulting in a higher (lower) LS chosen by the Northern government than by the Northern firm.

5. International Harmonization

In this section, we examine the issue of LS harmonization. Suppose an official international organization, say the International Labor Organization (ILO), sets a *single* guideline standard, by which all countries are encouraged to abide. We shall consider two separate principles by which the ILO sets the uniform standard. One is that it maximizes the total world welfare, and the other is that the harmonized uniform LS must not lie below each country's original best response curve under free choices of LS. We investigate these two cases sequentially.

5.1 Harmonization and World Welfare Maximization

In this case, the ILO maximizes an objective function which is the sum of (10a) and (10b) with $\theta_N = \theta_S \equiv \theta_w$,

$$W(\theta_w, \theta_w, t_N, \alpha_N, \alpha_S) = \psi_N(\theta_w, \theta_w, t_N, \alpha_N) + \psi_S(\theta_w, \theta_w, t_N, \alpha_S). \tag{14}$$

The first order condition to maximize (14) with respect to θ_w is

$$\frac{\partial W}{\partial \theta_w} = \frac{\partial W}{\partial \theta_N} + \frac{\partial W}{\partial \theta_S} = A_N + A_S + (\frac{\partial \phi}{\partial \theta_N} + \frac{\partial \tilde{\pi}_S}{\partial \theta_N}) + (\frac{\partial \phi}{\partial \theta_S} + \frac{\partial \tilde{\pi}_N}{\partial \theta_S}) = 0, \tag{15}$$

where $(\frac{\partial \phi}{\partial \theta_N} + \frac{\partial \tilde{\pi}_S}{\partial \theta_N}) + (\frac{\partial \phi}{\partial \theta_S} + \frac{\partial \tilde{\pi}_N}{\partial \theta_S}) = \frac{(Y_N + Y_S)(c'_S - c'_N)}{3} = 0$, since $c'_S - c'_N = c'(\theta_w) - c'(\theta_w) = 0$. Equation (15) can then be simplified as

$$A_N(\theta_w, \theta_w; t_N; \alpha_N) + A_S(\theta_w, \theta_w; t_N; \alpha_S) = 0, \qquad (15')$$

which leads to,

Proposition 3: *The world welfare maximizing LS,* $\theta_N = \theta_S \equiv \theta_w$, *lies on the segment between points* H *and* J *in Figure 2(a).*

Proof: In Figure 2(a), curves R_N and R_S are the best response curves of firms N and S, respectively. We have $A_N + A_S < 0$ at point *H* since $A_N = 0$ and $A_S < 0$; and $A_N + A_S > 0$ at point *J* since $A_N > 0$ and $A_S = 0$. Because $A_N(\theta_w, \theta_w; t_N; \alpha_N) + A_S(\theta_w, \theta_w; t_N; \alpha_S)$ is continuous in θ_w, there exists a point I on the 45 degree line between points H and J such that $A_N(\theta_S^I, \theta_S^I; t_N; \alpha_N) + A_S(\theta_S^I, \theta_S^I; t_N; \alpha_S) = 0$. Thus, $\theta_w = \theta_S^I = \theta_N^I$ is the optimal point that maximizes world welfare. ■

Proposition 3 implies that if an international organization such as the ILO imposes a common LS to maximize world welfare, then the initially freely chosen Southern LS must be raised and the Northern one must be reduced. In other words, it is binding only for the South, *not* for the North. The North will choose a higher LS instead. Therefore, a uniform, world-welfare maximizing LS does *not* exist.

To be more specific, as long as the abided by LS is lower than θ_S^H in Figure 2(a), firm N will voluntarily choose a LS on its best response curve R_N, while the abided by LS is binding for firm S only. Then, the combination of the realized LS is located on R_N above the 45 degree line, with the Northern LS higher than the Southern one.

The world welfare is increasing if the realized LS moves from H to F. When the combination of LS is on the Northern best response curve R_N, the world welfare is defined as

$$W(\theta_N(\bullet),\theta_S,t_N,\alpha_N,\alpha_S)=\psi_N(\theta_N(\bullet),\theta_S,t_N,\alpha_N)+\psi_S(\theta_N(\bullet),\theta_S,t_N,\alpha_S), \tag{16}$$

where $\theta_N(\bullet)=\theta_N(\theta_S;t_N;\alpha_N)$ is given by (6a''). Then, we derive

$$\frac{dW}{d\theta_S}=(\frac{\partial\phi}{\partial\theta_N}+\frac{\partial\tilde{\pi}_S}{\partial\theta_N})\frac{\partial\theta_N}{\partial\theta_S}+(A_S+\frac{\partial\phi}{\partial\theta_S}+\frac{\partial\tilde{\pi}_N}{\partial\theta_S}). \tag{17}$$

As we have $\partial\theta_N/\partial\theta_S<0$, $\partial\phi/\partial\theta_N+\partial\tilde{\pi}_S/\partial\theta_N=(Y_S-Y_N)c'_N/3>0$,

$\partial\phi/\partial\theta_S+\partial\tilde{\pi}_N/\partial\theta_S=(Y_N-Y_S)c'_S/3<0$, and $A_s<0$ on the segment HF, we obtain $dW/d\theta_S<0$. Then the world welfare increases as θ_S decreases on segment HF, and it reaches the maximum at point F.

5.2 The Uniform, Binding Minimum LS

Next, we consider the uniform minimum LS that must be binding for both countries. By the principle that the minimum LS must not lie below the original best response curves of either country under free choices of LS, it must be in the area on and above both curves R_N and R_S, i.e. above KFHL in Figure 2(a). Since it is a uniform LS common to both countries, we thus can determine it at point H. This gives rise to

Proposition 4: *Under the uniform, minimum LS that is binding for both countries, world welfare is not maximized.*

This Proposition implies that it is not efficient to enforce a common LS to both countries, given that they possess different technologies of producing LS.

In Figure 2(a), using iso-profit curves, it is straightforward to show that the North obtains a higher profit and welfare at point F than at point H, since its iso-profit curve is concave to the northwest. However, that of the South is ambiguous. As shown in Figure 2(a), depending on the shape of its iso-profit curve, the South's profit and welfare may be higher at point H than at F, or the opposite may arise. If the former case is obtained, then the South benefits from the binding minimum LS.

6. Pareto Efficient and First-Best Labor Standards

6.1 Pareto Efficiency

We first look into Pareto efficiency, when both countries can choose their LS independently. At the pareto efficient locus of LS, the iso-welfare curves of the two countries must be tangent to each other. The slopes of the iso-welfare curves can be obtained by totally differentiating (10a) and (10b) respectively. Equating them to give,

$$\left.\frac{d\theta_N}{d\theta_S}\right|_{\mathrm{N}} \equiv -\frac{A_N}{A_N^S} \quad = \quad \left.\frac{d\theta_N}{d\theta_S}\right|_{\mathrm{S}} \equiv -\frac{\partial \tilde{\pi}_S}{\partial \theta_N} / A_S\,, \tag{18}$$

where $A_N^S \equiv \frac{\partial \tilde{\pi}_N}{\partial \theta_S} + \frac{\partial \phi}{\partial \theta_S} + t_N \frac{\partial Y_S}{\partial \theta_S} = \frac{1}{3}(Y_N - Y_S)c_S^{'} + \frac{2}{3} t_N c_S^{'} p'$ when $p'' = 0$. Under free trade, $t_N = 0$, then condition (18) becomes

$$A_N A_S\big|_{pareto} = \frac{\partial \tilde{\pi}_S}{\partial \theta_N} A_N^S \ = \frac{2 Y_S c_N^{'}}{(Y_N - Y_S) c_S^{'}} > 0\,. \tag{18'}$$

Does this imply that the Pareto efficient locus lies to the left of both best response curves, requiring lower LS for both countries?? This is very bad for equity!!

6.2 First-Best

In this subsection, we allow the ILO to set different LS for each country, to maximize the world total welfare, rather than each's national welfare—Pareto efficiency. We still assume a three-stage game, and treat the import tariff as given. Then the game is identical to the previous sections except in stage two, it is the ILO which determines the LS. As such, equations (4a) to (4e) should all remain valid.

The world welfare can be written as

$$W(\theta_N,\theta_S,t_N,\alpha_N,\alpha_S)=\psi_N(\theta_N,\theta_S,t_N,\alpha_N)+\psi_S(\theta_N,\theta_S,t_N,\alpha_S), \tag{19}$$

where $\psi_N(\theta_N,\theta_S,t_N,\alpha_N)$ and $\psi_S(\theta_N,\theta_S,t_N,\alpha_S)$ are defined by (10a) and (10b), respectively.

The ILO sets possibly two different LS for the two countries. This first order conditions to maximize (19) are

$$\frac{\partial W}{\partial \theta_N}=\frac{\partial \psi_N}{\partial \theta_N}+\frac{\partial \psi_S}{\partial \theta_N}=A_N+\frac{\partial \phi}{\partial \theta_N}+\frac{\partial \tilde{\pi}_S}{\partial \theta_N}=0, \tag{20a}$$

$$\frac{\partial W}{\partial \theta_S}=\frac{\partial \psi_S}{\partial \theta_S}+\frac{\partial \psi_N}{\partial \theta_S}=A_S+\frac{\partial \phi}{\partial \theta_S}+\frac{\partial \tilde{\pi}_N}{\partial \theta_S}=0, \tag{20b}$$

where $\partial\phi/\partial\theta_i = -(Y_N + Y_S)c_i'/3 > 0$ and $\partial\tilde{\pi}_j/\partial\theta_i = 2Y_j c_i'/3 < 0$ when $p'' = 0$. Rearranging we obtain

$$A_N A_S\big|_{1st\ best} = \left(\frac{\partial\tilde{\pi}_S}{\partial\theta_N} + \frac{\partial\phi}{\partial\theta_N}\right)A_N^S. \qquad (21)$$

Comparing this with (18') to give

$$A_N A_S\big|_{Pareto} - A_N A_S\big|_{1st\ best} = -\frac{\partial\phi}{\partial\theta_N}A_N^S > 0. \qquad (22)$$

Does this tell us anything about the position of the best response curves under 1st best and Pareto efficiency?

Let us now compare the first best LS with the freely chosen LS. Under the freely chosen LS, we have $A_N = 0$ and $A_S = 0$ on the best response curves of firms N and S respectively. Notice that at the equilibrium point F, $\theta_N > \theta_S$. And by condition (4a), $Y_N > Y_S$. Substituting these into (20a) and (20b), we must have $\partial W/\partial\theta_N = (Y_S - Y_N)c_N'/3 > 0$ on the best response curve of firm N, and $\partial W/\partial\theta_S = (Y_N - Y_S)c_S'/3 < 0$ on that of firm S. These imply that the first best LS must lie above curve R_N and below curve R_S in Figure 1.

Next we compare the first best LS with that under the policy game. Under the latter, $\partial\psi_N/\partial\theta_N = A_N + \partial\phi/\partial\theta_N = 0$ and $\partial\psi_S/\partial\theta_S = A_S = 0$, as given in (11a') and (11b'). Then we have $\partial W/\partial\theta_N = 2Y_S c_N'/3 < 0$ and $\partial W/\partial\theta_S = (Y_N - Y_S)c_S'/3 < 0$. These imply that the first best LS must lie below both curves R_S and R_N^G.

Combining the two comparisons above, one sees that the first best LS must lie below curve R_S , and between curves R_N and R_N^G , e.g., as at point O in Figure 1. Summarizing these results, we can state,

Proposition 5: *(i). In the South, the first best LS is lower than the one in the regime of free choices of LS; (ii). In the North, it lies in the area between curves* R_N *and* R_N^G *, but to the left of* R_S*. Thus, the first best combination of LS must lie in the area* ABFG *in Figure 1.*

By Proposition 5, suppose we start from point G, then lowering the LS slightly increases the welfare for both countries. This result seems surprising. It is derived purely based on efficiency considerations, without any value judgment. If one introduces Southern LS into either country's welfare function (due to human rights concerns), then the first-best policy and harmonization would call for a higher LS in the South, and Proposition 5 must be revised.

7. Technology Transfer

The previous section has shown that (i) the internationally harmonized, binding minimum LS may lower Northern profits and welfare; (ii) under the first best LS, the Southern LS is too low. In this section, we consider an alternative policy, namely LS technology transfer. If the Northern superior technology of producing LS is transferred to the South, can we improve national and world welfare?

Suppose Northern technology is transferred to the South such that the actual Southern technology becomes

$$\hat{\theta}_S = \hat{y}_S / \hat{\alpha}_S , \tag{23}$$

where $\hat{\alpha}_S = (1-\delta)\alpha_S + \delta\alpha_N$ is the new unit cost of producing LS for the Southern firm. Thus, $\delta \in [0,1]$ indicates the amount of technology transferred from the North, with the lower and upper bounds representing zero or 100 percent technology transfer. We also assume that for each unit of LS produced using the new technology, the Southern firm must pay a unit cost of $e \geq 0$ to the Northern firm. Then the Northern and Southern profit functions become respectively

$$\pi_N(Y_N, Y_S, \theta_N, \alpha_N, t_N) = pY_N - c(\theta_N)(Y_N + \alpha_N\theta_N) - t_N Y_S + e\hat{\theta}_S , \tag{24a}$$

$$\pi_S(Y_N, Y_S, \hat{\theta}_S, \hat{\alpha}_S, \alpha_N, t_N) = pY_S - c(\hat{\theta}_S)(Y_S + \hat{\alpha}_S\hat{\theta}_S) - t_N Y_S - e\hat{\theta}_S . \tag{24b}$$

We examine only the case of free choices of LS. In the final stage, the two firms play a Cournot output game. The FOCs (3a) and (3b) and the comparative statics results (4a)~(4e) still apply. Thus we can rewrite the outputs as functions of LS,

$Y_i \equiv Y_i(\theta_N, \hat{\theta}_S, t_N, \alpha_N, \alpha_S) = Y_i(\bullet)$.

In the second stage, each firm chooses its own LS to maximize profits. Using the envelope theorem, the FOCs can be obtained as:

$$A_N(\theta_N, \hat{\theta}_S; t_N; \alpha_N) \equiv -(\frac{4}{3}Y_N + \alpha_N\theta_N)c'(\theta_N) - \alpha_N c(\theta_N) = 0 , \tag{25a}$$

$$\widehat{A}_S(\theta_N, \widehat{\theta}_S; t_N; \widehat{\alpha}_S) \equiv -(\frac{4}{3}\widehat{Y}_S + \widehat{\alpha}_S\widehat{\theta}_S)c'(\widehat{\theta}_S) - \widehat{\alpha}_S c(\widehat{\theta}_S) - e = 0\,. \tag{25b}$$

In terms of functional forms, these FOCs differ from (6a') and (6b') only in (25b), where the unit cost of technology transfer *e* enters negatively. They yield the best response functions

$$\theta_N = \theta_N(\widehat{\theta}_S; e, \delta; \alpha_N, t_N)\,, \tag{25a'}$$

$$\widehat{\theta}_S = \widehat{\theta}_S(\theta_N; e; \delta; \alpha_S, \alpha_N, t_N)\,, \tag{25b'}$$

which determine the Nash equilibrium levels of LS . In Figure 1, the Northern firm's best response curve can still be represented by R_N, but that of the Southern firm becomes $\widehat{R}_S$, which lies to the right of the original one R_S without technology transfer. The distance between $\widehat{R}_S$ and R_S depends on the parameters *e* and δ, the former of which reduces it while the latter raises it. These can be confirmed by totally differentiating (25a) and (25b), yielding:

$$T\frac{d\theta_S}{de} = -\{\frac{\partial\widehat{A}_S}{\partial e}\frac{\partial A_N}{\partial\theta_N} - \frac{\partial A_N}{\partial e}\frac{\partial\widehat{A}_S}{\partial\theta_N}\} < 0\,, \tag{26a}$$

$$T\frac{d\theta_S}{d\delta} = -\{\frac{\partial\widehat{A}_S}{\partial\delta}\frac{\partial A_N}{\partial\theta_N} - \frac{\partial A_N}{\partial\delta}\frac{\partial\widehat{A}_S}{\partial\theta_N}\} > 0\,, \tag{26a}$$

where $T = \begin{pmatrix} \frac{\partial A_N}{\partial \theta_N} & \frac{\partial A_N}{\partial \widehat{\theta}_S} \\ \frac{\partial \widehat{A}_S}{\partial \theta_N} & \frac{\partial \widehat{A}_S}{\partial \widehat{\theta}_S} \end{pmatrix} > 0$, $\frac{\partial A_N}{\partial e} = \frac{\partial A_N}{\partial \delta} = 0$, and $\frac{\partial \widehat{A}_S}{\partial e} < 0$, $\frac{\partial \widehat{A}_S}{\partial \delta} > 0$.

In particular, we can find a combination of the parameters of e and δ, which gives rise to an $\widehat{R}_S$ passing through point T in Figure 1. And point T must lie on the segment between points F and H on curve R_N. The appeal is that at point T, the Southern LS is higher and the Northern one lower than at point F, which both firms choose voluntarily without any action by governments or international organizations. Recall that this is what the ILO tried to achieve through international harmonization earlier. In addition, compared with point H, the Northern profits and welfare are higher at T. Therefore we can state:

Proposition 6: *Under technology transfer from the North to the South, the Southern firm voluntarily raises its LS, and the Northern profits and welfare are higher.*

Note that the technology transfer equilibrium is more efficient than at H, because the South uses better technology. It follows that the world total welfare is also higher. In addition, since the Southern firm must pay a positive unit cost of technology transfer, in equilibrium, we always have $\theta_N > \widehat{\theta}_S$ under free choices of LS.

8. Efficiency, Equity and Human Rights

So far we have shown that point F in figure 1 is the equilibrium under free choices of LS, at which $\theta_N > \theta_S$, stemming from that assumption of $\alpha_N < \alpha_S$. The equilibrium of a policy game requires an even higher LS for the North and a lower one for the South. These results are derived under efficiency considerations.

However, equity requires that both countries adopt a more or less equal LS. Point H is completely equitable, but not efficient. A more efficient solution is technology transfer, resulting in equilibrium point T, which is more equitable than points F and G.

Incorporating human rights may narrow the LS gap between the two countries. Suppose Southern LS θ_S enters Northern welfare ψ_N directly such that $\frac{\partial \psi_N}{\partial \theta_S} > 0$, as claimed by human rights groups. Note that Northern LS does not enter directly because LS in developed countries has reached a certain threshold level, enabling the government not to worry about it. Then since the best response curves of LS are negatively sloped, national welfare maximization requires the North to adopt a lower LS than when θ_S does not enter ψ_N directly. Due to oligopolistic interactions, Southern LS will be increased, thus narrowing the LS gap between the two countries. In addition, as explained at the end of section 3, since an increase in the import tariff reduces Southern LS, which in turn lowers Northern welfare. Then, it is better not to impose the tariff to force the South to adopt a higher LS, contrary to the claims of human rights groups.

9. Concluding Remarks

Everyone agrees that improving living standards in the South is desirable. The question is how to achieve this. Our model shows that the South adopts a lower LS because its technology is inferior, rendering it to have lower labor productivity. Thus, the Northern LS is not feasible for the South. Attempting to mandate certain labor market processes, such as the setting of minimum LS, under conditions where they are inappropriate may not improve labor market outcomes.

The paper also demonstrates that trade restrictions do not work either. Loss of access to markets in the North hampers the growth prospects of the South and thereby retards the upgrading of its LS. Trade sanctions are thus likely to be counterproductive as a means of encouraging improvements in such standards.

The South may have objections to international harmonization of LS, since its welfare might be lowered. Adequate technology transfer could restore the harmonization equilibrium, in which every party including the North is better off.

Appendix 1 Comparative Statics under Free Choices of LS

Total differentiation of (6a') and (6b') yields

$$\begin{pmatrix} \frac{\partial A_N}{\partial \theta_N} & \frac{\partial A_N}{\partial \theta_S} \\ \frac{\partial A_S}{\partial \theta_N} & \frac{\partial A_S}{\partial \theta_S} \end{pmatrix} \begin{pmatrix} d\theta_N \\ d\theta_S \end{pmatrix} = -\begin{pmatrix} \frac{\partial A_N}{\partial t} \\ \frac{\partial A_S}{\partial t} \end{pmatrix} dt - \begin{pmatrix} \frac{\partial A_N}{\partial \alpha_N} \\ \frac{\partial A_S}{\partial \alpha_N} \end{pmatrix} d\alpha_N - \begin{pmatrix} \frac{\partial A_N}{\partial \alpha_S} \\ \frac{\partial A_S}{\partial \alpha_S} \end{pmatrix} d\alpha_s$$

where $\forall \ i, j = N, S, \ \ i \neq j$,

$$\frac{\partial A_i}{\partial \theta_i} = -(2\alpha_i + \frac{8c_i^{'}}{9p'})c_i^{'} - (\alpha_i\theta_i + \frac{4}{3}Y_i)c_i^{''} < 0,$$

This is the second order condition for profit maximization, which is negatively signed as long as $c_i^{''}$ is sufficiently positive, a condition commonly assumed in two-stage games. We also have

$$\frac{\partial A_i}{\partial \theta_j} = \frac{4}{9p'}c_i^{'}c_j^{'} < 0,$$

$$\frac{\partial A_N}{\partial t} = \frac{4}{9p'}c_N^{'} > 0,$$

$$\frac{\partial A_S}{\partial t} = -\frac{8}{9p'}c_S^{'} < 0,$$

$$\frac{\partial A_i}{\partial \alpha_i} = -c(\theta_i) - \theta_i c_i^{'} + \frac{8}{9p'}\alpha_i^{-2} y_i (c_i^{'})^2,$$

$$\frac{\partial A_j}{\partial \alpha_i} = -\frac{8}{9p'}\alpha_i^{-2} y_i c_i^{'} c_j^{'} > 0.$$

For stability reasons, we require that $D = \begin{pmatrix} \frac{\partial A_N}{\partial \theta_N} & \frac{\partial A_N}{\partial \theta_S} \\ \frac{\partial A_S}{\partial \theta_N} & \frac{\partial A_S}{\partial \theta_S} \end{pmatrix} > 0$, which is expanded as

$$D = \{2\alpha_N c_N^{'} + \frac{8}{9p'}(c_N^{'})^2 + (\alpha_N \theta_N + \frac{4}{3}Y_N)c_N^{''}\}\{2\alpha_S c_S^{'} + \frac{8}{9p'}(c_S^{'})^2 + (\alpha_S \theta_S + \frac{4}{3}Y_S)c_S^{''}\} - \{\frac{4}{9p'}c_N^{'}c_S^{'}\}^2$$

$$= \{2\alpha_N c_N^{'} + (\alpha_N \theta_N + \frac{4}{3}Y_N)c_N^{''}\}\{2\alpha_S c_S^{'} + (\alpha_S \theta_S + \frac{4}{3}Y_S)c_S^{''}\} + \frac{16}{27(p')^2}(c_N^{'}c_S^{'})^2$$

$$+ \frac{8}{9p'}(c_N^{'})^2\{2\alpha_S c_S^{'} + (\alpha_S \theta_S + \frac{4}{3}Y_S)c_S^{''}\} + \frac{8}{9p'}(c_S^{'})^2\{2\alpha_N c_N^{'} + (\alpha_N \theta_N + \frac{4}{3}Y_N)c_N^{''}\}$$

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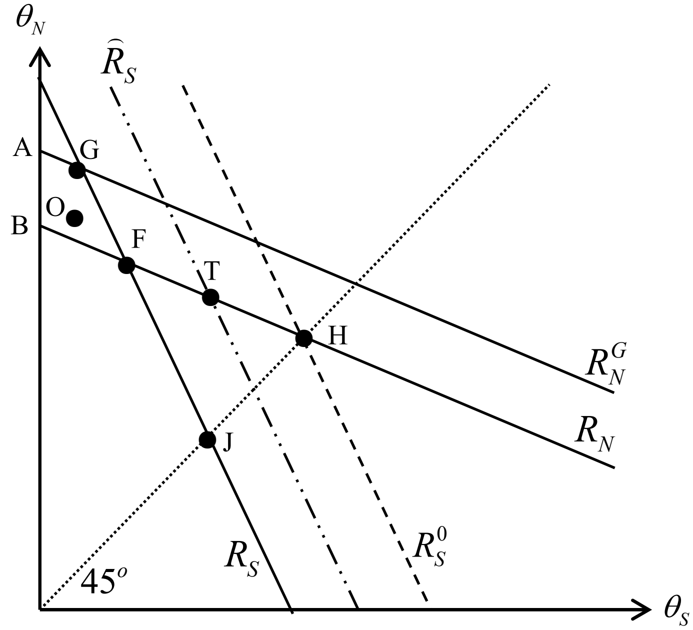
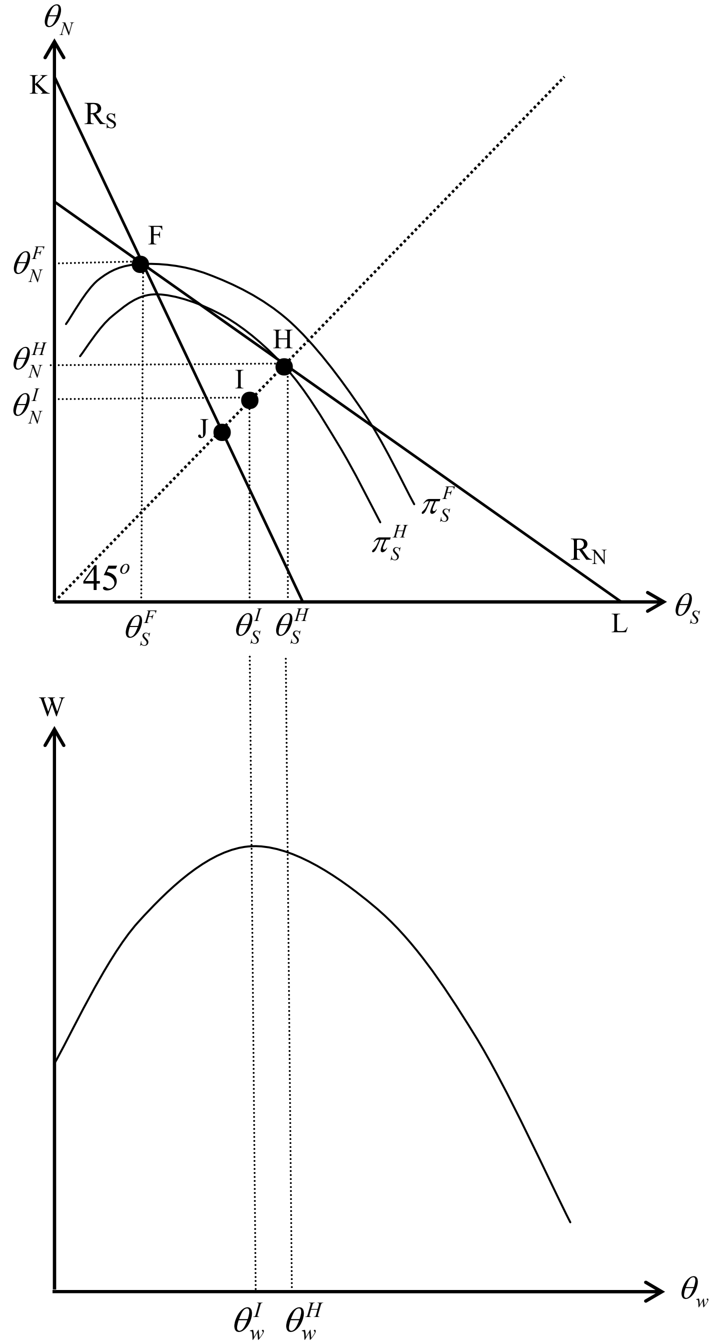


Figure 1

(a)

(b)


θ_N
K
R_S
F
θ_N^F
H
θ_N^H
I
θ_N^I
J
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45^o
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θ_S^H
L
θ_S
W
θ_w^I
θ_w^H
θ_w

Figure 2