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ABSTRACT

Labor Market Regulation, International Trade and Footloose Capital

I examine the effects of globalization in countries where the employed workers support the unemployed and the governments control wages by regulating the workers' relative bargaining power. I use a general oligopolistic equilibrium model of two integrated countries with two inputs: labor and potentially footloose capital. National competition for jobs by labor market deregulation creates a distortion with suboptimal wages. The mobility of capital aggravates that distortion by increasing the wage elasticity of labor demand, which decreases wages and welfare even further. The delegation of labor market regulation to an international agent eliminates that distortion, increasing wages and aggregate welfare.

JEL Classification: C78, F16, F68, J52

Keywords: international trade, footloose capital, labor market regulation, capital market liberalization

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1. Introduction

Blanchard and Giavazzi (2003) call *labor market regulation* all political or administrative measures that support, and *labor market deregulation* those than weaken the bargaining power of labor unions. This article explores the effects of the integration of capital and labor markets in countries where labor market are regulated and there is an unemployment insurance scheme.

A common tool in modeling international trade is Neary's (2016) *general oligopolistic equilibrium model (GOLE)*, where the utility functions are quadratic and the economy contains a large number ("continuum") of sectors, each containing a small number of firms. Because all income-consumption curves are linear in GOLE, they allow for consistent aggregation over individuals with different incomes. This is in particular proper for our purposes, because it enables the derivation of utility functions for workers, capital owners, national governments and the international policy maker.

Boulhol (2009) incorporates labor market regulation into a model of internationally transferable capital. He shows that because capital mobility re-allocates resources away from the highly-unionized sector, and because the threat of costly relocations encourages labor market deregulation, globalization ultimately reduces labor market rigidities. Aloi et al. (2009) study capital transfer liberalization in a two-country model where the labor markets are non-unionized in one, but unionized in the other country. They show that capital flows from the country with unionized into that with non-unionized labor markets. Consequently, labor income decrease and profits increase in the former, but vice versa in the latter country. Both Boulhol (2009) and Aloi et al. (2009) assume efficient bargaining: the firm owner and the labor union bargain over the wage and employment simultaneously. Consequently, the wage is equal to the reference wage and the rent is divided between the parties according to their relative bargaining power. If efficient bargaining were introduced into GOLE, then relative union bargaining power would affect income distribution only, having no effect on the allocation of resources. That is why this article assumes right-to-manage bargaining: the firm owner and the labor union bargain over the wage subject to the firm's demand for labor. In that case, relative union bargaining power affects both the wage and the level of employment, and consequently the allocation of resources.

Martin and Rogers (1995) and Baldwin et al. (2003) introduce capital as a second factor of production into GOLE as a fixed input, while labor serves as a variable input to production. Egger and Etzel (2014) apply that extended GOLE for two countries, of which one hosts firm-level and the other sector-level labor unions. In contrast, I apply the extended GOLE model for two identical trading countries, where the local governments play Nash by regulating relative union bargaining power.

Palokangas (2015) applies GOLE for the integration of two identical countries performing labor market regulation. He, however, assumes that there is only *one input* called labor, and that the goods markets are only partially integrated: there are competitive, open (but *segmented*) and shielded sectors. He shows that lower trade costs and international labor market regulation promote aggregate welfare, decreasing open-sector relative wages. In contrast in this article, I apply GOLE for the same purpose, but with the assumptions that the goods markets are *fully integrated* and there are *two inputs*: labor and potentially transferable capital.

The remainder of this article is organized as follows. Section 2 presents the structure of the countries and characterizes general equilibrium as an extensive form game where the households, firms, governments and labor and employer lobbies act as players. Section 3 considers the behavior of the households. Sections 4 establishes the equilibrium of the product markets. Section 5 derives the utilities for the groups of households, by which sections 6 and 7 construct the behavior of the investors, the national governments and the international regulator. Section 8 summarizes the results.

2. The economy

To keep the analysis tractable, I consider two identical countries, domestic and foreign. Both countries have a "continuum" $[0,1]$ of workers, each supplying one unit of labor, and a "continuum" of sectors $z \in [0,1]$. Each sector $z \in [0,1]$ produces one unit of a different traded good with label z. The workers earn only wages and the capital owners only profits. A worker's labor time is unity. I construct a simple unemployment insurance scheme by the assumptions that the unemployed workers derive utility from their extra spare time and the employed support the unemployed workers.

Following Martin and Rogers (1995), Baldwin et al. (2003) and Egger and Etzel (2014), I assume that sectors $z \in [0,1]$ use capital as a fixed, but labor as a variable input: each firm employs one worker to produce one unit of output, but needs one unit of capital to start up and to operate itself. Thus, there are endogenous numbers $n(z)$ and $n^*(z)$ of domestic and foreign oligopolists in each sector $z \in [0,1]$, respectively.

Each country has a fixed number K of capital owners, each of which supplies one unit of capital. If capital is *immobile*, then the supply of capital is equal to the number of capital owners in each country:

$$K = \int_0^1 n(z)dz \text{ and } K = \int_0^1 n^*(z)dz \text{ with immobile capital.} \tag{1}$$

If capital is *mobile* (e.g. *footloose*), then cross-border capital transfers involve transaction costs: a marginal transfer of domestic into foreign capital (i.e. a decrease of $\int_0^1 n(z)dz$) creates less and less foreign capital $\int_0^1 n^*(z)dz$, and vice versa. This defines the decreasing and concave function

$$\int_0^1 n^*(z)dz = f\left(\int_0^1 n(z)dz\right),\ f' < 0,\ f'' < 0 \text{ and } K = f(K) \quad \text{with footloose capital,} \tag{2}$$

where $K = f(K)$ results from the assumption that the countries are identical. Profit income is repatriated to the owner's original country of residence.

The government controls the wages either directly by setting minimum wages, or indirectly by regulating the workers' bargaining power. In the latter case, the workers and employers are organized in the *labor union* and the *employer federation*, respectively, to bargain over wages. This can be modeled as an alternating-offers game where both parties maximize their members' utility (cf. Appendix D). The government run labor market policy either nationally or delegate it to the international regulator.

The general equilibrium of the model is established as an *extensive form game* where the households, firms and governments and the international regulator act as players. This game has the following stages:[1]

(i) The governments or the international regulator sets the wages.
(ii) Capital owners invest where they generate the highest return.
(iii) The workers insure themselves against unemployment.
(iv) The firms produce their output from labor and capital.
(v) The households consume the products of the firms.

This game is solved by backward induction: sections 3, 4, 5 and 6 consider stages (v), (iv), (iii) and (ii), respectively, and section 7 stage (i). By this game, I compare the wage and welfare effects of two forms of economic integration: the two countries *(a)* relax international capital movements, or *(b)* delegate their labor market policy to a common international regulator.

3. Households

I extend Neary's (2016) GOLE model as follows: household h derives utility u_h from consumption and spare time according to the quadratic function

$$u_h \doteq \varepsilon_h \int_0^1 \left[a c_h(z) - \frac{b}{2} c_h(z)^2 \right] dz, \quad \varepsilon_h = \begin{cases} 1+g & \text{if } h \text{ unemployed,} \\ 1 & \text{otherwise,} \end{cases} \tag{3}$$

where $c_h(z)$ is its consumption of oligopolistic good $z \in [0,1]$ and $a > 0$, $b > 0$ and $g > 0$ are constants. Thus, with the same income, an unemployed worker has a higher level of welfare than an employed worker.

Household h's budget constraint is

$$I_h = \int_0^1 p(z) c_h(z) dz, \tag{4}$$

where where $p(z)$ is the price for oligopolistic good $z \in [0,1]$ and I_h household h's income. Household h maximizes utility (3) by its consumption, $c_h(z)$ for

[1] If the government controls relative union bargaining power, then it sets relative union bargaining power in stage (i), and the unions and employer federations are agents operating between stages (ii) and (iii) in the extensive form game (cf. Appendix D).

$z \in [0,1]$, subject to its budget constraint (4). This yields

$$\lambda_h p(z) = a - bc_h(z) \text{ for } z \in [0,1], \tag{5}$$

where λ_h is the marginal utility of income for household h.

The representative household of the two countries earns income I, consumes $c(z)$, $z \in [0,1]$, and has the marginal utility of income, λ:

$$I \doteq \int_h I_h dh, \quad c(z) \doteq \int_h c_h(z) dh, \quad \lambda \doteq \int_h \lambda_h dh. \tag{6}$$

Following Neary (2016), I normalize the prices so that the representative household's marginal utility of income is equal to unity [cf. (6)]:

$$\lambda = 1. \tag{7}$$

Summing (4) and (5) over $h \in [0,1]$ and noting (6) and (7) yield the aggregate budget constraint, the *inverse demand functions* and the price index P:

$$I = \int_0^1 p(z)c(z)dz, \quad p(z) = a - bc(z), \quad P \doteq \int_0^1 p(z)dz = a - b\int_0^1 c(z)dz. \tag{8}$$

In Appendix A, I show that household h's utility u_h is a function of its personal income I_h, aggregate income I and the price level P as follows:

$$u_h = \varepsilon_h U(I_h, I, P), \quad \lambda_h = U_1 \doteq \frac{\partial U}{\partial I_h} > 0, \quad U_2 \doteq \frac{\partial U}{\partial I} = -\frac{U_1^2}{2} < 0,$$
$$U_3 \doteq \frac{\partial U}{\partial P} = \frac{a}{b}\left(\frac{U_1}{2} - 1\right)U_1 < 0. \tag{9}$$

Higher personal income I_h promotes a household's welfare. An increase in the price level P hampers a household's welfare u_h. Higher aggregate income I increases the variance of prices, which hampers a household's welfare.

4. Product markets

Let $w(z)$ and $w^*(z)$ be the domestic and foreign wages and $l(z)$ and $l^*(z)$ domestic and foreign employment in sector $z \in [0,1]$, respectively. Because one unit of oligopolistic good $z \in [0,1]$ is produced from one unit of labor, the total demand for output, $c(z)$, is equal to the total demand for labor, $l(z)+l^*(z)$, in sector $z \in [0,1]$. Then, the aggregate demand for labor is

$$L \doteq \int_0^1 [l(z)+l^*(z)]dz = \int_0^1 c(z)dz. \tag{10}$$

In each sector $z \in [0,1]$, an endogenous number $n(z)$ of domestic firms and an endogenous number $n^*(z)$ of foreign firms produce a homogeneous sector-specific output, taking each other's outputs as given. Home firm $j \in \{1,...,n(z)\}$ in sector $z \in [0,1]$ produces its output $l_j(z)$ from $l_j(z)$ units of labor and employs one unit of capital as a fixed input. The foreign firms behave accordingly. Because sectors $z \in [0,1]$ are identical, the countries are identical, and a worker produces one unit of output in any sector, then the price p, domestic employment l, aggregate employment L and aggregate income I are given by [cf. (8) and (10)]

$$w(z)=w,\ w^*(z)=w^*,\ l(z)=l,\ c(z)=l(z)+l^*(z)=L$$

$$\text{and } p(z)=P(L)\doteq a-bL \text{ with } \frac{dP}{dL}=-b \text{ for } z\in[0,1], \tag{11}$$

$$I(L)\doteq \int_0^1 p(z)c(z)dz = P(L)L, \quad \frac{dI}{dL}=P-bL=a-2bL. \tag{12}$$

Because the sectors $z \in [0,1]$ are identical, then, in equilibrium, the constraints for capital transfers, (1) and (2), become

$$n=n^*=K=\text{constant with immobile capital,}$$

$$n^*=f(n),\ f'<0,\ f''<0, \text{ and } K=f(K) \text{ with footloose capital.} \tag{13}$$

Noting this, total employment L, domestic employment l, domestic profit π

and foreign profit π^* are functions of the domestic wage w, the foreign wage w^* and the number of domestic oligopolists, n (cf. Appendix B):

$$l(w, w^*, n), \quad \frac{\partial l}{\partial w^*} > 0, \quad \left.\frac{dl}{dw}\right|_{w^*=w} < 0, \quad \left.\frac{\partial l}{\partial n}\right|_{w^*=w,\, n^*=n} > 0; \tag{14}$$

$$L(w, w^*, n), \quad \frac{\partial L}{\partial w} = \frac{\partial L}{\partial w^*} < 0, \quad \left.\frac{\partial L}{\partial n}\right|_{w^*=w,\, n^*=n} = 0; \tag{15}$$

$$\pi(w, w^*, n), \quad \frac{\partial \pi}{\partial w} < 0, \quad \left.\frac{d\pi}{dw}\right|_{w^*=w} < 0; \tag{16}$$

$$\pi^*(w, w^*, n^*), \quad \left.\frac{d\pi^*}{dw}\right|_{w^*=w} < 0, \quad \left.\frac{\partial^2(\pi + \pi^*)}{\partial w \partial n}\right|_{w^*=w,\, n^*=n} < 0. \tag{17}$$

Results (14), (15) and (16) can be interpreted as follows. The domestic wage w decreases, but the foreign wage w^* increases domestic employment l and domestic profit π, given the number n of domestic firms in a market. Both of these wages decrease aggregate employment L. An increase in the number of domestic oligopolists, n, increases domestic employment l and domestic profits π, but has no effect of aggregate employment L in the neighborhood of the symmetric equilibrium with $w^* = w$ and $n^* = n$. Because the countries are identical, foreign profits (17) are symmetrical with domestic profits (16). The transfer of capital from the foreign to the domestic country (i.e. an increase in n) decreases aggregate profits $\pi + \pi^*$ the more $\big($i.e. the smaller $\frac{\partial(\pi+\pi^*)}{\partial w}\big)$, the higher the domestic wage w is [cf. (17)].

5. Utilities of groups

Because the quadratic preferences (3) allow for consistent aggregation over individuals with different incomes, then, noting (9) and (10), the utilities of groups can be constructed as follows. The *representative domestic capital owner* earns domestic profits $\pi \doteq \int_0^1 \pi(z)dz$ and derives utility

$$V_\Pi \doteq U(\pi, I, P). \tag{18}$$

The *representative international capital owner* in the two countries earns domestic and foreign profits $\pi + \pi^*$ and derives utility [cf. (18)]

$$V_C \doteq V_\Pi + V_\Pi^* = U(\pi + \pi^*, I, P). \tag{19}$$

The domestic unemployment insurance scheme distributes total domestic wages wl between the employed and unemployed workers. Then, the *representative domestic worker*'s utility is (cf. Appendix C)

$$V_W = U\big(h(l)w, I, P\big) \quad \text{with} \quad h' > 0, \tag{20}$$

where $h(l)w$ is the representative domestic worker's income equivalent.

The *representative domestic household* earns the domestic worker's income equivalent $h(l)w$ plus the representative capital owner's income (= domestic profit π) and derives utility [cf. (18) and (20)]

$$\begin{aligned} &V_N \doteq V_\Pi + V_W = U\big(H(w, w^*, n), I, P\big), \quad H(w, w^*, n) \doteq \pi + h(l)w, \\ &\frac{\partial H}{\partial w^*} = \underbrace{\frac{\partial \pi}{\partial w^*}}_{+} + \underbrace{wh'}_{+} \underbrace{\frac{\partial l}{\partial w^*}}_{+} > 0, \quad \left.\frac{\partial H}{\partial n}\right|_{n^*=n} = \underbrace{wh'}_{+} \underbrace{\left.\frac{\partial l}{\partial n}\right|_{n^*=n}}_{+} > 0. \end{aligned} \tag{21}$$

Aggregate welfare V_A is the utility of the representative household that earns domestic income H plus foreign income $H^* = \pi^* + h(l^*)w^*$ [cf. (21)]:

$$V_A = V_N + V_N^* = U(H + H^*, I, P). \tag{22}$$

The representative household's marginal utility of income is [cf. (7) and (22)]

$$U_1(H + H^*, I, P) = U_1(H, I, P) + U_1(H^*, I, P) = \lambda = 1. \tag{23}$$

6. Capital transfers

With mobile capital, a single international capital owner maximizes its welfare (19) by the number of domestic firms, n, subject to the transformation curve (13), given aggregate income I and the price index P [cf. (16) and (17)]:

$$\widetilde{n}(w,w^*) \doteq \arg \max_{n \text{ s.t. } (13)} V_C = \arg\max_n \big[\pi(w,w^*,n) + \pi^*\big(w,w^*,f(n)\big)\big]. \quad (24)$$

Differentiating the first-order condition $\frac{\partial(\pi+\pi^*)}{\partial n} = 0$ of the maximization, and noting (13), (17) and the second-order condition $\frac{\partial^2(\pi+\pi^*)}{\partial n^2} < 0$ of the maximization, one obtains that an increase in the domestic wage w decreases the number $\widetilde{n}$ of domestic firms:

$$\frac{\partial \widetilde{n}}{\partial w}\bigg|_{w^*=w,\,n^*=n=K} = -\underbrace{\frac{\partial^2(\pi+\pi^*)}{\partial w \partial n}}_{-}\bigg/\underbrace{\frac{\partial^2(\pi+\pi^*)}{\partial n^2}}_{-} < 0, \quad \widetilde{n}(w,w) = K,$$

$$\frac{d\widetilde{n}}{dw}\bigg|_{w^*=w} = \frac{\partial \widetilde{n}}{\partial w} + \frac{\partial \widetilde{n}}{\partial w^*} = \frac{dK}{dw} = 0. \quad (25)$$

.

With *immobile capital*, the number of firms in each country is fixed [cf. (1)], $n = n^* = K$. To examine the integration of capital markets, then, noting this and (25), I define the variable

$$\beta = \begin{cases} 0 & \text{with immobile capital } n = K, \\ 1 & \text{with mobile capital } n = \widetilde{n}(w,w^*). \end{cases} \quad (26)$$

Given (24), (25) and (26), the number of domestic firms is the following function of the wages (w,w^*) and the parameter β:

$$n(w,w^*,\beta) \doteq \beta\widetilde{n}(w,w^*) + (1-\beta)K, \quad \frac{dn}{dw}\bigg|_{w^*=w,\,n^*=n=K} = 0, \quad \frac{\partial n}{\partial \beta} = \widetilde{n} - K,$$

$$\frac{\partial^2 n}{\partial w \partial \beta} = \frac{\partial \widetilde{n}}{\partial w} < 0, \quad \frac{\partial n}{\partial \beta}\bigg|_{n^*=n=K} = 0. \quad (27)$$

7. The political economy

I compare the case where the governments delegate their policy to the common international regulator with the case where they act independently, taking the wage in the other country as given. Because the countries are identical, then, in both cases, the wages, the number of firms, national employment and the marginal utility of income are uniform in both countries in equilibrium [cf. (7), (9), (13) and (23)]:

$$\begin{aligned}&w^* = w, \quad n^* = n = K, \quad l^* = l = \frac{L}{2}, \quad H^* = H, \quad U_1(2H, I, P) = 1,\\&U_1(H, I, P) = U_1(H^*, I, P) = \frac{1}{2}.\end{aligned} \tag{28}$$

I denote the equilibrium value with international regulation by subscript I and that with national regulation by subscript N.

7.1. International regulation

In equilibrium (28), aggregate welfare (22) becomes [cf. (11), (12), (15) and (21)]

$$V_A(w) = U\big(2H(w, w, K), I(L(w, w, K)), P(L(w, w, K))\big). \tag{29}$$

The international regulator maximizes aggregate welfare (29) by setting the uniform wage $w^* = w$. This leads to the first-order and second-order conditions [cf. (9), (11), (12), (15), (21) and (28)]

$$\begin{aligned}\frac{dV_A}{dw} &= 2U_1(2H, I, P)\frac{dH}{dw} + U_2(2H, I, P)\frac{dI}{dL}\frac{dL}{dw} + U_3(2H, I, P)\frac{dP}{dL}\frac{dL}{dw}\\&= \underbrace{U_1(2H, I, P)}_{=1}\Big[2\frac{dH}{dw} + \underbrace{\frac{U_2(2H, I, P)}{U_1(2H, I, P)}}_{=-\frac{1}{2}}\frac{dI}{dL}\frac{dL}{dw} + \underbrace{\frac{U_3(2H, I, P)}{U_1(2H, I, P)}}_{=-\frac{a}{2b}}\frac{dP}{dL}\frac{dL}{dw}\Big]\\&= 2\frac{dH}{dw} - \frac{1}{2}\frac{dI}{dL}\frac{dL}{dw} - \frac{a}{2b}\frac{dP}{dL}\frac{dL}{dw} = 2\frac{dH}{dw} - \frac{P - bL}{2}\frac{dL}{dw} + \frac{a}{2}\frac{dL}{dw}\\&= 2\frac{dH}{dw} + (bL + \underbrace{a - P}_{=bL})\frac{1}{2}\frac{dL}{dw} = 2\frac{dH}{dw} + bL\frac{dL}{dw}\end{aligned}$$

$$= 2\left(\frac{\partial H}{\partial w} + \frac{\partial H}{\partial w^*} + \frac{\partial H}{\partial n}\underbrace{\frac{dn}{dw}}_{=0}\right) + bL\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial w^*} + \frac{\partial L}{\partial n}\underbrace{\frac{dn}{dw}}_{=0}\right)$$

$$= 2\left(\frac{\partial H}{\partial w} + \frac{\partial H}{\partial w^*}\right) + bL\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial w^*}\right) = 0, \quad \frac{d^2 V_A}{dw^2} < 0. \tag{30}$$

In the model, international labor market policy leads to Pareto optimum. Because the functions n, $L(w, w^*, n)$, $\frac{\partial L}{\partial w}(w, w^*, n)$, $\frac{\partial L}{\partial w^*}(w, w^*, n)$, $\frac{\partial H}{\partial w}(w, w^*, n)$ and $\frac{\partial H}{\partial w^*}(w, w^*, n)$ are independent of β at the symmetric equilibrium (28) [cf. (15), (21) and (27)], then, the first-order condition $\frac{dV_A}{dw} = 0$ is independent of it, too. Thus, one obtains the result:

Proposition 1. *A switch from national to international regulation establishes Pareto optimum and enhances welfare. With international regulation, capital transfer liberalization (i.e. a change of β) has no effect.*

7.2. National regulation

Noting the price index (11), aggregate income (12), aggregate employment (15) and the number of domestic firms, (27), one can define domestic welfare (21) as a function of the wages and the parameter β:

$$V_N(w, w^*, \beta) \doteq$$
$$U\Big(H\big(w, w^*, n(w, w^*)\big), I\big(w, w^*, n(w, w^*)\big), P\big(L\big(w, w^*, n(w, w^*)\big)\big)\Big). \tag{31}$$

The domestic government maximizes domestic welfare (31) by the domestic wage w subject to given the foreign wage w^*. In equilibrium (28), the first-order and second-order conditions of this are [cf. (9), (11) and (12)]

$$\frac{\partial V_N}{\partial w} = U_1(H, I, P)\left(\frac{\partial H}{\partial w} + \frac{\partial H}{\partial n}\frac{\partial n}{\partial w}\right)$$
$$+ \left[U_2(H, I, P)\frac{dI}{dL} + U_3(H, I, P)\frac{dP}{dL}\right]\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial n}\frac{\partial n}{\partial w}\right)$$

$$
\begin{aligned}
&= \underbrace{U_1(H,I,P)}_{=\frac{1}{2}}\Bigg\{\frac{\partial H}{\partial w} + \frac{\partial H}{\partial n}\frac{\partial n}{\partial w} \\
&\quad + \Bigg[\underbrace{\frac{U_2(H,I,P)}{U_1(H,I,P)}}_{=-\frac{1}{4}}\frac{dI}{dL} + \underbrace{\frac{U_3(H,I,P)}{U_1(H,I,P)}}_{=-\frac{3a}{4b}}\frac{dP}{dL}\Bigg]\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial n}\frac{\partial n}{\partial w}\right)\Bigg\} \\
&= \frac{1}{2}\Bigg\{\frac{\partial H}{\partial w} + \underbrace{\frac{\partial H}{\partial n}}_{=wh'\frac{\partial l}{\partial n}}\frac{\partial n}{\partial w} - \Bigg[\frac{1}{4}\underbrace{\frac{dI}{dL}}_{=P-bL}\frac{\partial L}{\partial w} + \frac{3a}{4b}\underbrace{\frac{dP}{dL}}_{=-b}\Bigg]\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial n}\frac{\partial n}{\partial w}\right)\Bigg\} \\
&= \frac{1}{4}\Bigg\{2\frac{\partial H}{\partial w} + wh'\frac{\partial l}{\partial n}\frac{\partial n}{\partial w} + (a+bL)\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial n}\frac{\partial n}{\partial w}\right)\Bigg\} = 0, \quad \frac{\partial^2 V_N}{\partial w^2} < 0.
\end{aligned}
\tag{32}
$$

From conditions (14), (28) and (32) it follows that

$$
\frac{\partial^2 V_N}{\partial w \partial \beta} = \underbrace{\frac{wh'}{4}}_{+}\underbrace{\frac{\partial^2 l}{\partial w \partial \beta}}_{-} < 0, \quad \frac{\partial w}{\partial \beta}(w^*, \beta) = -\underbrace{\frac{\partial^2 V_N}{\partial w \partial \beta}}_{-}\Bigg/\underbrace{\frac{\partial^2 V_N}{\partial w^2}}_{-} < 0.
$$

Because the foreign government responds $\frac{\partial w^*}{\partial \beta}(w,\beta) < 0$, correspondingly, the equilibrium wage $w^* = w$ decreases. Because the wage $w^* = w$ decreases for all values $\beta \in [0,1]$, then, by the mean value theorem, the result can be generalized for the discrete choice $\beta \in \{0,1\}$ as follows:

Proposition 2. *With national regulation, capital transfer liberalization (i.e. an increase of β from 0 to 1) decreases the wage $w^* = w$.*

The wage elasticity of employment in the domestic country is higher with mobile $\beta = 1$ than with immobile capital $\beta = 0$ [cf. (14)],

$$
\frac{\partial^2 l}{\partial w \partial \beta} < 0, \quad \frac{\partial l}{\partial w}\bigg|_{\beta=0} < \frac{\partial l}{\partial w}\bigg|_{\beta=1} \quad \text{and} \quad -\frac{w}{l}\frac{\partial l}{\partial w}\bigg|_{\beta=0} > -\frac{w}{l}\frac{\partial l}{\partial w}\bigg|_{\beta=1} > 0. \tag{33}
$$

This aggravates the countries' competition for jobs by wages.

7.3. The centralization of labor market policy

To examine the effects of the centralization, I define a variable γ so that $\gamma = 0$ with national and $\gamma = 1$ with international regulation. Noting this and (28), I combine the first-order conditions in (30) and (32):

$$\begin{aligned}
\Gamma(w, w^*, \beta, \gamma) &\doteq \gamma \frac{dV_A}{dw}(w) + 4(1-\gamma)\frac{\partial V_N}{\partial w}(w, w^*, \beta) \\
&= (1-\gamma)\left[2\frac{\partial H}{\partial w} + wh'\frac{\partial l}{\partial n}\frac{\partial n}{\partial w} + (a+bL)\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial n}\frac{\partial n}{\partial w}\right)\right] \\
&\qquad + \gamma\left[2\left(\frac{\partial H}{\partial w} + \frac{\partial H}{\partial w^*}\right) + bL\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial w^*}\right)\right] \\
&= 2\frac{\partial H}{\partial w} + 2\gamma\frac{\partial H}{\partial w^*} + (1-\gamma)wh'\frac{\partial l}{\partial n}\frac{\partial n}{\partial w} + [(1-\gamma)a + bL]\frac{\partial L}{\partial w} \\
&\qquad + \gamma bL\frac{\partial L}{\partial w^*} + (1-\gamma)(a+bL)\frac{\partial L}{\partial n}\frac{\partial n}{\partial w} = 0. \qquad (34)
\end{aligned}$$

In equilibrium (28), given (11), (14), (15), (20), (21) and (27), the function (34) has the property

$$\begin{aligned}
\frac{\partial \Gamma}{\partial \gamma} &= 2\underbrace{\frac{\partial H}{\partial w^*}}_{+} - w\underbrace{h'}_{+}\underbrace{\frac{\partial l}{\partial n}}_{+}\underbrace{\frac{\partial n}{\partial w}}_{-} - a\frac{\partial L}{\partial w} + bL\underbrace{\frac{\partial L}{\partial w^*}}_{=\frac{\partial L}{\partial w}} - (a+bL)\frac{\partial L}{\partial n}\frac{\partial n}{\partial w} \\
&> (\underbrace{bL - a}_{=-P})\frac{\partial L}{\partial w} - (a+bL)\underbrace{\frac{\partial L}{\partial n}}_{=0}\frac{\partial n}{\partial w} = -P\underbrace{\frac{\partial L}{\partial w}}_{-} > 0. \qquad (35)
\end{aligned}$$

From the second-order conditions in (30) and (32) it follows that

$$\frac{\partial \Gamma}{\partial w}(w, \beta, \gamma) \doteq \gamma\frac{d^2 V_A}{dw^2} + 4(1-\gamma)\frac{\partial^2 V_N}{\partial w^2}.$$

Noting this and (35), and differentiating the first-order condition (34) totally, one obtains $\frac{\partial w}{\partial \gamma}(w^*, \beta, \gamma) = -\frac{\partial \Gamma}{\partial \gamma}\big/\frac{\partial \Gamma}{\partial w} > 0$. Because the foreign government responds $\frac{\partial w^*}{\partial \gamma}(w, \beta, \gamma) > 0$, correspondingly, the equilibrium wage $w^* = w$ increases. Because the wage $w^* = w$ increases for all values $\gamma \in [0, 1]$, then, by the mean value theorem, the result can be generalized for the discrete choice $\gamma \in \{0, 1\}$ as follows:

Proposition 3. *The delegation of labor market regulation to the international policy maker (i.e. an increase of γ from 0 to 1) increases the wage $w^* = w$.*

The elimination of inter-country competition over jobs by labor market deregulation encourages the governments to raise the wage in their countries.

7.4. Welfare comparisons

From Propositions 1 and 3 it follows that an increase in the wage $w^* = w$ is welfare enhancing. Because an increase in the uniform wage $w^* = w$ leads simultaneously to a lower capital owner's welfare [cf. (18)], the workers' welfare must increase. I summarize these results as follows:

Proposition 4. *Starting from the initial point of national labor market policy, an increase in the wage $w^* = w$ increases aggregate welfare and the worker's welfare, but decreases the capital owner's welfare.*

Finally, Propositions 2, 3 and 4 have the following corollary:

Proposition 5. *A switch from national to international regulation promotes aggregate welfare and the worker's welfare, but hampers the capital owner's welfare, while capital transfer liberalization does the opposite.*

8. Conclusions

In this paper, I examine the capital market integration of two identical countries where labor markets are regulated, either by binding minimum wages or by controlling the relative bargaining power of labor unions. The regulation is performed either by the local governments or by the common regulator of the countries. To conduct the analysis, I start with Neary's (2016) general oligopolistic equilibrium model (GOLE) with a unit mass of sectors, each containing a small number of firms. In line with Martin and Rogers (1995) and Egger and Etzel (2014), I enrich this framework with capital as a second factor of production. The main results are then as follows.

Assuming exogenous labor union power (e.g. monopoly unions), Alois et al. (2009) and Boulhol (2009) argue that capital transfer liberalization decreases union wages through changing the elasticity of labor demand. This reduces distortions in the labor markets, decreasing the workers welfare but promoting both aggregate and the capital owners' welfare. In this article, I assume that relative union bargaining power is endogenously determined by the government's regulations and the employed workers support the unemployed through an unemployment insurance scheme. Then, the delegation of labor market regulation to an international policy maker leads to Pareto optimum. The national governments' competition for jobs by labor market deregulation causes a distortion with suboptimal wages. Because capital market liberalization increases the wage elasticity of labor demand, it intensifies the competition between the countries. This aggravates the distortion and decreases wages and aggregate welfare ever further. Thus, the prediction is the same in Alois et al. (2009) and Boulhol (2009) as in my model, but with reverse interpretation: capital market liberalization decreases distortions in the former, but increases those in the latter.

While a great deal of caution should be exercised when a highly stylized model of international trade is used to explain the relationship of firms, labor market organizations and national governments, the following judgement nevertheless seems to be justified. So far, the common view has been that the integration of capital markets should precede that of labor market institutions, because the former facilitates the exercise of the latter. This article argues the opposite. Because premature relaxation of international capital transfers can intensify the welfare loss due to the governments' competition over jobs, it might be appropriate first to integrate labor market institutions.

Appendix A. Utility functions (9)

Equations (8) yield $bc(z) = a - p(z)$ and

$$bI = \int_0^1 p(z)bc(z)dz = \int_0^1 p(z)[a - p(z)]dz = aP - \int_0^1 p(z)^2 dz.$$

This defines the uncentred variance of prices as follows:

$$\sigma \doteq \int_0^1 p(z)^2 di = aP - bI. \tag{A.1}$$

On the other hand, transforming (5) into

$$bc_h(z) = a - \lambda_h p(z). \tag{A.2}$$

and plugging (A.1) and (A.2) into (4), one obtains

$$bI_h = \int_0^1 p(z) bc_h(z) dz = \int_0^1 [ap(z) - \lambda_h p(z)^2] dz = aP - \sigma\lambda_h.$$

Solving for the marginal utility of income yields

$$\lambda_h = (aP - bI_h)/\sigma. \tag{A.3}$$

From (6) and (7) it follows that $\lambda_h < \int_0^1 \lambda_\iota d\iota = \lambda = 1$. Plugging this, (A.1), (A.2) and (A.3) into (3) yields (9):

$$\begin{aligned}
\frac{bu_h}{\varepsilon_h} &= \int_0^1 \left[abc_h(z) - \frac{b}{2}c_h(z)^2\right] d = \int_0^1 \left\{a[a - \lambda_h p(z)] - \frac{1}{2}[a - \lambda_h p(z)]^2\right\} di \\
&= \int_0^1 \left\{a[a - \lambda_h p(z)] - \frac{1}{2}\left[a^2 - 2a\lambda_h p(z) + \lambda_h^2 p(z)^2\right]\right\} dz \\
&= \int_0^1 \left\{a^2 - \frac{1}{2}\left[a^2 + \lambda_h^2 p(z)^2\right]\right\} dz = \frac{a^2}{2} - \frac{\lambda_h^2}{2}\int_0^1 p(z)^2 dz \\
&= \frac{a^2}{2} - \frac{\lambda_h^2}{2}\sigma = \frac{a^2}{2} - \frac{(aP - bI_h)^2}{2\sigma} = \frac{a^2}{2} - \frac{1}{2}\frac{(aP - bI_h)^2}{aP - bI} \doteq bU(I_h, I, P) \\
&\text{with } \lambda_h = U_1 \doteq \frac{\partial U}{\partial I_h} \in (0,1), \quad U_2 \doteq \frac{\partial U}{\partial I} = -\frac{1}{2}U_1^2 < 0, \\
&U_3 \doteq \frac{\partial U}{\partial P} = -\frac{a}{b}\left(\frac{\partial U}{\partial I_h} + \frac{\partial U}{\partial I}\right) = \frac{a}{b}U_1\left(\frac{1}{2}U_1 - 1\right) < 0.
\end{aligned}$$

Appendix B. Functions (14), (15), (16) and (17)

Because one unit of output is produced from one unit of labor, employment at home $\ell(z)$ and abroad $\ell^*(z)$ as well as the demand for good, $c(z)$, in sector $z \in [0,1]$ are given by

$$c(z) = \ell(z) + \ell^*(z), \;\; \ell(z) \doteq \sum_{j=1}^{n(z)} l_j(z) \;\text{ and }\; \ell^*(z) \doteq \sum_{j=1}^{n^*(z)} l_j^*(z). \tag{B.1}$$

The profit of domestic firm j in sector $z \in [0,1]$ is

$$\pi_j(z) \doteq [p(z) - w(z)]l_j(z), \tag{B.2}$$

where $p(z)$ is the price and $w(z)$ the wage in sector z. Home profits $\pi(z)$ in sector z are the sum of the profits of the domestic firms, (B.2), in that sector:

$$\pi(z) = \sum_{j=1}^{n} \pi_j(z) = [p(z) - w(z)]\ell(z). \tag{B.3}$$

Home firm j maximizes profit (B.2) by its input $l_j(z)$ subject to total employment (B.1) and the inverse demand (8) for good z, given the wage $w(z)$ and the outputs of the other firms, $\ell^*(z)$ and $l_\xi(z)$ for $\xi \neq j$. The foreign firms behave accordingly. This yields

$$\begin{aligned}\frac{\partial \pi_j(z)}{\partial l_j(z)} &= p(z) - w(z) + l_j(z)\frac{\partial p(z)}{\partial \ell(z)}\frac{\partial \ell(z)}{\partial l_j(z)} = p(z) - w(z) - bl_j(z) \\ &= a - b[\ell(z) + \ell^*(z)] - bl_j(z) - w(z) = 0.\end{aligned}$$

Because foreign firm in sector $z \in [0,1]$ does the same as well, this yields

$$l_j(z) = \frac{a - w(z)}{b} - \ell(z) - \ell^*(z), \;\; l_j^*(z) = \frac{a - w^*(z)}{b} - \ell(z) - \ell^*(z). \tag{B.4}$$

Because all domestic and all foreign firms are identical, respectively, from

(B.1) it follows that

$$\ell(z) = n(z)l_j(z), \quad \ell^*(z) = n^*(z)l_j^*(z). \tag{B.5}$$

Noting this, the conditions (B.4) become

$$\begin{aligned}
&[n(z)+1]l_j(z) + n^*(z)l_j^*(z) = [a - w(z)]/b, \\
&n(z)l_j(z) + [n^*(z)+1]l_j^*(z) = [a - w^*(z)]/b.
\end{aligned} \tag{B.6}$$

Solving for $l_j(z)$ and $l_j^*(z)$ from (B.6) yields the firms' labor inputs

$$l_j(z) = [n(z)+n^*(z)+1]^{-1}\big\{a - [n^*(z)+1]w(z) + n^*(z)w^*(z)\big\}/b \text{ and}$$
$$l_j^*(z) = [n(z)+n^*(z)+1]^{-1}\big\{a - [n(z)+1]w^*(z) + n(z)w(z)\big\}/b.$$

From these equations, (B.1) and (B.5) it follows that

$$\ell(z) = \frac{n(z)/b}{n(z)+n^*(z)+1}\big\{a - [n^*(z)+1]w(z) + n^*(z)w^*(z)\big\}, \tag{B.7}$$

$$\ell^*(z) = \frac{n^*(z)/b}{n(z)+n^*(z)+1}\big\{a - [n(z)+1]w^*(z) + n(z)w(z)\big\}, \tag{B.8}$$

$$\begin{aligned}
L &= \int_0^1 c(z)dz = \int_0^1 [\ell(z)+\ell^*(z)]dz = \int_0^1 [\ell(z)+\ell^*(z)]dz \\
&= \frac{1}{b}\int_0^1 \frac{a[n(z)+n^*(z)] - n(z)w(z) - n^*(z)w^*(z)}{n(z)+n^*(z)+1}di.
\end{aligned} \tag{B.9}$$

Because all sectors $z \in [0,1]$ are identical, then

$$\ell(z) = l,\ \ell^*(z) = l^*,\ w(z) = w,\ w^*(z) = w^* \text{ and } \pi(z) = \pi \text{ for } z \in [0,1]. \tag{B.10}$$

Noting this, (11), (12), (13), (B.1), (B.3) and (B.7)-(B.9), one obtains domestic employment l and aggregate employment $L = l + l^*$ as functions of the wages (w, w^*) and the number of domestic oligopolists, n:

$$\begin{aligned}
&l = \frac{n}{b}\frac{a - (n^* + 1)w + n^* w^*}{n + n^* + 1} = \frac{n}{b}\frac{a - [f(n) + 1]w + f(n)w^*}{n + f(n) + 1} \doteq l(w, w^*, n),\\
&\frac{\partial l}{\partial w}(n) = -\frac{n}{b}\frac{f(n) + 1}{n + f(n) + 1} < 0, \quad \frac{\partial l}{\partial w^*}(n) = \frac{n}{b}\frac{f(n)}{n + f(n) + 1} > 0,\\
&\frac{\partial l}{\partial n}(w)\bigg|_{w_u^* = w,\, n^* = n} = \frac{l}{n} > 0, \quad \frac{dl}{dw}\bigg|_{w^* = w} = -\frac{n/b}{n + f(n) + 1} < 0; \qquad \text{(B.11)}\\
&L = l + l^* = \frac{a(n + n^*) - nw - n^* w^*}{(n + n^* + 1)b} = \frac{a[n + f(n)] - nw - f(n)w^*}{[n + f(n) + 1]b}\\
&\quad \doteq L(w, w^*, n), \quad \frac{\partial L}{\partial w}\bigg|_{w^* = w,\, n^* = n = K} = \frac{\partial L}{\partial w^*}\bigg|_{w^* = w,\, n^* = n = K} = -\frac{K/b}{2K + 1} < 0,\\
&\frac{\partial L}{\partial n}\bigg|_{w^* = w,\, n^* = n = K} = \frac{(a - w)[1 + f'(K)]}{(2K + 1)b} - \frac{[1 + f'(K)]L}{2K + 1} = 0. \qquad \text{(B.12)}
\end{aligned}$$

Because the countries are identical, it holds true that

$$\frac{\partial l^*}{\partial w \partial n^*} = \frac{\partial l}{\partial w^* \partial n}. \qquad \text{(B.13)}$$

Noting (13), (11), (B.3), (B.10), (B.11) and (B.12), one obtains domestic profits π as a function of (w, w^*, n):

$$\begin{aligned}
&\pi(w, w^*, n) \doteq (P - w)l = (a - bL - w)l = [a - bL(w, w^*, n) - w]l(w, w^*, n),\\
&\frac{\partial \pi}{\partial w}\bigg|_{w^* = w, n^* = n = K} = \left(-b\frac{\partial L}{\partial w} - 1\right)l + \underbrace{(P - w)}_{+}\underbrace{\frac{\partial l}{\partial w}}_{-} < \underbrace{\left(\frac{K}{2K + 1} - 1\right)}_{-}l < 0,\\
&\frac{d\pi}{dw}\bigg|_{w^* = w,\, n^* = n = K} = \left[-b\left(\frac{\partial L}{\partial w} + \frac{\partial L}{\partial w^*} + \frac{\partial L}{\partial n}\underbrace{\frac{dn}{dw}}_{=0}\right) - 1\right]l + \underbrace{(P - w)}_{+}\underbrace{\frac{dl}{dw}}_{-}\\
&\qquad < \underbrace{\left(\frac{2K}{2K + 1} - 1\right)}_{-}l < 0,
\end{aligned}$$

$$\pi + \pi^* = (P - w)l + (P - w^*)l^* = P(l + l^*) - wl - w^* l^* = PL - wl - w^* l^*$$

$$= [a - bL(w, w^*, n)]L(w, w^*, n) - wl(w, w^*, n) - w^* l^*(w, w^*, n^*),$$

$$\frac{\partial(\pi + \pi^*)}{\partial n} = (a - 2bL)\frac{\partial \widetilde{L}}{\partial n} - w\frac{\partial l}{\partial n} - w^*\frac{\partial l^*}{\partial n^*}f'(n),$$

$$\left.\frac{\partial^2(\pi + \pi^*)}{\partial w \partial n}\right|_{w^*=w,\, n^*=n=K}$$

$$= (a - 2bL)\underbrace{\frac{\partial^2 L}{\partial w \partial n}}_{=0} - 2b\frac{\partial L}{\partial w}\underbrace{\frac{\partial L}{\partial n}}_{=0} - \underbrace{\frac{\partial l}{\partial n}}_{+} - w\frac{\partial^2 l}{\partial w \partial n} - \underbrace{w^*}_{=w}\frac{\partial^2 l^*}{\partial w \partial n^*}\underbrace{f'(n)}_{=-1}$$

$$< w\left(-\frac{\partial^2 l}{\partial w \partial n} + \frac{\partial^2 l^*}{\partial w \partial n^*}\right) = w\left(-\frac{\partial^2 l}{\partial w \partial n} + \frac{\partial^2 l}{\partial w^* \partial n}\right) = w\frac{\partial}{\partial n}\left(-\frac{\partial l}{\partial w} + \frac{\partial l}{\partial w^*}\right)$$

$$= w\frac{\partial}{\partial n}\left[\frac{n}{b}\frac{f(n) + 1}{n + f(n) + 1} + \frac{n}{b}\frac{f(n)}{n + f(n) + 1}\right] = w\frac{\partial}{\partial n}\left[\frac{n}{b}\frac{2f(n) - 1}{n + f(n) + 1}\right]$$

$$= \frac{w}{b}\left\{\frac{2f(n) - 1 + 2f'(n)n}{n + f(n) + 1} - \frac{n[2f(n) - 1]}{[n + f(n) + 1]^2}\underbrace{[1 + f'(n)]}_{=0}\right\}$$

$$= \frac{w}{b}\frac{2f(n) - 1 + 2f'(n)n}{n + f(n) + 1} = \frac{w}{b}\frac{2n - 1 - 2n}{n + f(n) + 1} = -\frac{w}{b}\frac{1}{n + f(n) + 1} < 0.$$

Appendix C. The representative domestic worker's utility (20)

Let v be the employed's and z the unemployed's disposable income. Because the mass of domestic workers is unity, of which the proportion l is employed and $1 - l$ unemployed, the budget constraint for the unemployment insurance scheme is

$$lv + (1 - l)z = wl. \tag{C.1}$$

According to (9), an employed worker's utility is given by $U(v, I, P)$ and an unemployed worker's utility by $(1 + g)U(z, I, P)$. Because all income-consumption curves are linear with quadratic preferences (3), $(1+g)$ workers earning z derive the same utility as one worker earning $(1 + g)z$: $(1+g)U(z, I, P) = U\big((1+g)z, I, P\big)$. A worker has incentive to supply labor as long as its utility as employed is at least as high as that as unemployed:

$$U(v, I, P) \geq (1 + g)U(z, I, P) = U\big((1 + g)z, I, P\big).$$

This is equivalent to

$$v \geq (1+g)z. \tag{C.2}$$

Because all income-consumption curves are linear with quadratic preferences (3), the sum of all domestic workers' utilities is

$$\begin{aligned} V_W &= lU(v, I, P) + (1-l)(1+g)U(z, I, P) \\ &= lU(v, I, P) + U\big((1-l)(1+g)z, I, P\big) \\ &= U\big(lv + (1-l)(1+g)z, I, P\big). \end{aligned} \tag{C.3}$$

The representative domestic worker maximizes (C.3) by the employed's and unemployed's income, v and z, subject to its budget constraint (C.1) and incentive constraint (C.2), given the wage w, domestic employment l, aggregate income I and the price level P:

$$\begin{aligned} (v, z) &= \arg \max_{(v,z) \text{ s.t. (C.1) and (C.2)}} V_W \\ &= \arg \max_{(v,z) \text{ s.t. (C.1) and (C.2)}} [lv + (1-l)(1+g)z] = \left(h(l)w, \ \frac{h(l)w}{1+g}\right), \end{aligned}$$
where $h(l) \doteq \dfrac{(1+g)l}{1+gl}$ with $h' = \dfrac{1+g}{(1+gl)^2} > 0.$

Then, the representative domestic worker's utility is

$$V_W = \arg \max_{(v,z) \text{ s.t. (C.1) and (C.2)}} U\big(lv + (1-l)(1+g)z, I, P\big) = U\big(h(l)w, I, P\big).$$

Appendix D. Collective bargaining

Bastos and Kreickemeier (2009), Kreickemeier and Meland (2013), and Egger and Etzel (2012, 2014) introduce a simple textbook model of rents-maximizing monopoly unions into the general oligopolistic equilibrium model

(GOLE) of Neary (206). I prefer to derive the utility functions of the labor union and employer federation directly from the households' preferences (3) of the GOLE model. I consider firm-specific wage bargaining, where the number of firms is held constant, for simplicity.

Let the workers and capital owners in a single domestic sector be organized in a labor union and an employer federation, respectively. These attempt to maximize their member's utility (20) and (18), respectively, by the wage w subject to sectorial employment (14) and sectorial profit (16), given the foreign wage w^*, aggregate income I, the price index P and the number of domestic firms, n. When these parties alternate in making offers to each other, they behave as if they jointly set the domestic wage w to maximize a weighed geometric average of their targets called the *Generalized Nash Product*[2] as follows:[3]

$$\begin{aligned}
w &= \arg\max_w [V_W + (1/\delta - 1)V_\Pi] \\
&= \arg\max_w \Big[U\Big(h\big(l(w, w^*, n)\big)w, I, P\Big) + (1/\delta - 1)U\big(\pi(w, w^*, n), I, P\big)\Big] \\
&= \arg\max_w \Big[U\Big(h\big(l(w, w^*, n)\big)w, I, P\Big) + U\big((1/\delta - 1)\pi(w, w^*, n), I, P\big)\Big] \\
&= \arg\max_w U\big(h\big(l(w, w^*, n)\big)w + (1/\delta - 1)\pi(w, w^*, n), I, P\big) \\
&= \arg\max_w \big[h\big(l(w, w^*, n)\big)w + (1/\delta - 1)\pi(w, w^*, n)\big] \doteq \arg\max_w \Omega(w, w^*, n, \delta) \\
\text{with } & \frac{\partial \Omega}{\partial \delta} = -\frac{\pi}{\delta^2} \text{ and } \frac{\partial^2 \Omega}{\partial \delta \partial w} = -\frac{1}{\delta^2}\underbrace{\frac{\partial \pi}{\partial w}}_{-} > 0,
\end{aligned} \tag{D.1}$$

where the the weight $\delta \in (0, 1)$ is relative union bargaining power.

Following Blanchard and Giavazzi (2003), I assume that relative union bargaining power $\delta \in (0, 1)$ depends on labor market regulations (e.g. restrictions in starting a dispute, the intermediation of disputes). The maximization

[2] Cf. Binmore, Rubinstein and Wolinsky 1986.

[3] Because all income-consumption curves are linear with quadratic preferences (3), then, according to Neary (2016), $(1/\delta - 1)$ households earning π derive the same utility as a household earning $(1/\delta - 1)\pi$, and households earning hw and $(1/\delta - 1)\pi$ derive the same utility as a household earning $hw + (1/\delta - 1)\pi$.

in (D.1) yields the first-order condition $\frac{\partial \Omega}{\partial w} = 0$ and second-order condition $\frac{\partial^2 \Omega}{\partial w^2} < 0$. Differentiating $\frac{\partial \Omega}{\partial w} = 0$ and noting $\frac{\partial^2 \Omega}{\partial w^2} < 0$ and (D.1) yield that the wage is an increasing function of relative union bargaining power δ:

$$w = \widetilde{w}(w^*, n, \delta), \quad \frac{\partial \widetilde{w}}{\partial \delta} = -\underbrace{\frac{\partial^2 \Omega}{\partial w \partial \delta}}_{+} \Big/ \underbrace{\frac{\partial^2 \Omega}{\partial w^2}}_{-} > 0.$$

Because the regulator in the end determines union power, then, with some complication, the result $\frac{\partial \widetilde{w}}{\partial \delta} > 0$ would be the same also also in the case of country-wide wage bargaining where the domestic labor union and employer federation take the effect of the domestic wage w on the price index (11), aggregate employment (15) and capital transfers (27) into account.

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References:

Aloi M., Leite-Monteiro M. and Lloyd-Braga T. (2009). Unionized labor markets and globalized capital markets. *Journal of International Economics*, **78**, pp. 149-153.

Baldwin, R., Forslid, R., Martin, P. Ottaviano, G. and Robert-Nicoud, F. (eds.) *Economic Geography and Public Policy.* Princeton: Princeton University Press.

Bastos P. and Kreickemeier U. (2009). Unions, competition and trade in general equilibrium. *Journal of International Economics*, **79**: 238-247.

Binmore K., Rubinstein A. and Wolinsky A. (1986). The Nash bargaining solution in economic modelling. *Rand Journal of Economics*, **17**: 176-188.

Blanchard O. and Giavazzi F. (2003). Macroeconomic effects of regulation and deregulation in goods and labor markets. *Quarterly Journal of Economics* **118**: 879-908.

Boulhol H. (2009) Do capital market and trade liberalization trigger labor market deregulation? *Journal of International Economics* **77**: 223-233.

Dumont M., Rayp G. and Willeme P. (2012). The bargaining position of low-skilled and high-skilled workers in a globalizing world. *Labor Economics*, **19**: 312-319.

Egger H. and Etzel D. (2012). The impact of trade on employment, welfare, and income distribution in unionized general oligopolistic equilibrium. *European Economic Review*, **56**: 1119-1135.

Egger H. and Etzel D. (2014). Union wage-setting and international trade with footloose capital. *Regional Science and Urban Economics*, **48**: 56-67.

Kreickemeier U. and Meland F. (2013). Non-traded goods, globalization and union influence. *Economica*, **80**: 774-792.

Martin P. and Rogers CA. (1995). Industrial Location and Public Infrastructure. *Journal of International Economics*, **39**: 335-351.

Naylor R. (1998). International trade and economic integration when labor markets are generally unionized. *European Economic Review*, **42**: 1251-1267.

Naylor R. (1999). Union Wage Strategies and International Trade. *Economic Journal*, **109**: 102-125.

Neary P. (2016). International Trade in General Oligopolistic Equilibrium. *Review of International Economics*, **24**: 669-698.

Palokangas, T. (2015). The Welfare Effects of Globalization with Labor Market Regulation. IZA Discussion Paper No. 9412.