Labor Market Regulation and International Trade with Footloose Capital

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Abstract
This article examines the welfare effects of economic integration in a general partially oligopolistic equilibrium model of two identical countries where the governments determine the non-competitive wages, either directly, or through regulating labor union power. Oligopolists use labor and capital and the national governments can either act independently or delegate their power to a common agent. It is shown that capital market integration decreases the non-competitive wage, wage inequality, and the workers’ aggregate welfare, but increases aggregate welfare and the capitalists’ welfare. A change from national into international regulation does the same, even after implementing capital market integration.

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1. Introduction

Blanchard and Giavazzi (2003) call labor market regulation all political or administrative measures that maintain the bargaining power of labor unions. Labor markets are commonly regulated by a political process in which the workers and employers influence the regulator (i.e. a government or some other authority) that determines either the non-competitive wages directly or through regulating union power in collective bargaining. This article explores the effects of globalization in this setup. It turns out that capital market integration and the international coordination of labor market regulation have opposite effects on welfare.

The traditional way of considering globalization analyzes the impact of trade cost reductions or opening up to trade on bargained wages through the elasticity of labor demand. Huizinga (1993) and Driffill and Vander Ploeg (1995) claim that the integration of markets increases the elasticity of labor demand, decreasing bargained wages. Naylor (1998,1999) indicates the opposite. Bastos and Kreickemeier (2009) as well as Kreickemeier and Meland (2013) combine Neary’s (2015) general oligopolistic equilibrium model (GOLE) with partly unionized labor markets, repeating Naylor’s conclusion. In these articles, however, union power is wholly exogenous (e.g. monopoly unions), while here it is ultimately determined by the policy maker.

There is empirical evidence on declining union power. Unionization has declined in most OECD countries since the 1980s (Nickell et al. 2005, pp. 6-7). In particular, in the years 1975-2000, labor markets have been rapidly deregulated in the US and UK (Acemoglu et al. 2001). Globalization has undermined union bargaining power (cf. Abraham et al. 2009, Dumont at al. 2006, 2012, Boulhol et al. 2011). Protection of regular employment contracts was diminished when globalization was proceeding rapidly (Potrafke 2010). Given this evidence, it is instructive to consider relative union bargaining power as endogenous in a model of international trade.

Using menu auctioning model, Palokangas (2015) examines how the integration of two countries affects non-competitive wages and welfare, when each country has only one input, labor, and three kind of sectors: competitive; oligopolistic and open (but segmented); and oligopolistic and shielded. The result is that a decrease in trade costs and international labor market

1
regulation promote aggregate welfare decreasing open-sector relative wages. This article, in contrast, examines how integration affects welfare, when there are two inputs, labor and capital, and all sectors are fully integrated.

The remainder of this article is organized as follows. Section 2 presents the structure of the two-country economy and characterizes general equilibrium by an extensive form game where households, firms, labor unions, employer federations, regulators and labor and employer lobbies act as players. Section 3 considers the behavior of the households. Sections 4 and 5 establish the equilibrium of the product, labor and capital markets, respectively. Section 6 considers labor market regulation, and section 7 summarizes the results.

2. The economy

To keep the analysis tractable, I examine two identical countries, home and foreign. Both countries have a “continuum” [0, 1] of workers, a fixed number $K$ of capitalists, each of which supplies one unit of capital, a “continuum” of oligopolistic sectors $z \in [0, 1]$, so that each sector $z$ produces a different good with label $z$, and a “continuum” of competitive sectors $i \in [0, g]$, so that in each sector $i$ a large number of firms produces a different good with label $i$ from one unit of labor, with no profits, and $g$ is a constant. The oligopolist firms behave in Cournot manner. The workers earn only wages and the capitalists only profits. A worker’s labor time is unity.

In contrast to the competitive sectors, the oligopolistic sectors use both labor and capital. Following Martin and Rogers (1995) and Egger and Etzel (2012, 2014), I assume that capital is used as a fixed, but labor as a variable input: each oligopolist uses one unit of labor to produce one unit of output, but employs one unit of capital to start up and to operate itself. Thus, there are endogenous numbers $n(z)$ and $n^*(z)$ of home and foreign oligopolists in sector $z$, respectively.

If capital is immobile, then the supply of capital is equal to the number of capitalists in each country,

$$K = \int_0^1 n(z) dz, \quad K^* = \int_0^1 n^*(z) dz. \quad (1)$$
I assume that if capital is mobile (e.g. footloose), then cross-border capital transfers involve transaction costs. Thus, home capital is transformed into foreign capital according to the decreasing and convex function

\[ n^* = f(n), \quad f' < 0, \quad f'' < 0, \quad K = f(K), \]

where the assumption \( K = f(K) \) maintains symmetry between the countries. Profit income is repatriated to the owner’s original country of residence.

I assume that the government can control the non-competitive wages in two alternative ways:

- It sets a minimum wage for the oligopolistic sectors.
- It controls the bargaining power of unions, determining union wages indirectly. In that case, the workers and employers are organized in the labor union and the employer federation, respectively, to bargain over their wages. This can be modeled as an alternating-offers game where both parties maximize their members’ rents (cf. Appendix F).

The households, competitive firms, oligopolists and the government act as agents.\(^1\) Their decisions form an extensive form game that has the following stages:

(i) The government determines the non-competitive wage.
(ii) Capital owners invest where they generate the highest return.
(iii) The firms produce their output from labor and capital.
(iv) The households consume the products of the firms.

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

\(^1\)If the government controls relative union bargaining power, then there are also labor unions and employer federations, operating between stages (ii) and (iii) in the extensive form game (cf. Appendix F).
3. Households

3.1. A single household

I extend Neary’s (2015) model of oligopolistic competition as follows. Household $h$ derives its utility $u_h$ from its consumption $c_h(z)$ of oligopolistic goods $z \in [0, 1]$ and that $m_h(i)$ of the competitive goods $i \in [0, g]$ according to

$$u_h = \int_0^1 \left[ ac_h(z) - \frac{b}{2} c_h(z)^2 \right] dz + \int_0^g \left[ am_h(i) - \frac{b}{2} m_h(i)^2 \right] di,$$

where $g > 0$, $a > 0$ and $b > 0$ are constants. The role of the competitive sector in the model is to employ the remainder of labor force and thereby offer an opportunity wage for the workers. The budget of household $h$ is

$$I_h = \int_0^1 p(z)c_h(z)dz + \int_0^1 q(i)m_h(i)di,$$

where $I_h$ is its income, $p(z)$ the price for oligopolistic good $z \in [0, 1]$ and $q(i)$ that for competitive good $i \in [0, g]$. Household $h$ maximizes its utility (3) by its consumption $c_h(z)$ and $m_h(i)$ subject to its budget (4). This yields

$$\lambda_h p(z) = a - bc_h(z), \quad \lambda_h q(i) = a - bm_h(i),$$

where $\lambda_h$ is the marginal utility of income for household $h$.

3.2. The representative household of the two countries

I consider the representative household of the two countries, whose income $I$, demand for oligopolistic good $z$, $c(z)$, that for the competitive good, $m$, and marginal utility $\lambda$ are determined by

$$I \doteq \int_h I_h dh, \quad c(z) \doteq \int_h c_h(z) dh, \quad m(i) \doteq \int_h m_h(i)dh, \quad \lambda \doteq \int_h \lambda_h dh.$$
Let $l(z)$ be the demand for labor in oligopolistic home sector $z$ and $l^*(z)$ that in the corresponding foreign sector $z$. Because one unit of each good $z \in [0, 1]$ is produced by one unit of labor, the consumption of oligopolistic goods in the two countries, $\int_0^1 c(z)dz$, is equal to aggregate oligopoly employment in those countries, $L$ [cf. (3)]:

$$\int_0^1 c(z)dz = L = \int_0^1 [l(z) + l^*(z)]dz. \quad (7)$$

The aggregate demand for labor in the competitive and oligopolistic sectors is equal to the mass of workers $h \in [0, 1]$ in both countries:

$$\int_0^g m(i)di + L = 2. \quad (8)$$

Following Neary (2015), I normalize the prices so that the representative household’s marginal utility of income, $\lambda$, is equal to unity. Summing (4) and (5) over $h \in [0, 1]$, and noting $\lambda = 1$, (6), (7) and (8), one obtains the aggregate budget constraint, and the inverse demand functions for oligopolistic goods $z \in [0, 1]$ and competitive goods $i \in [0, g]$, respectively:

$$I = \int_0^1 p(z) c(z)dz + \int_0^g q(i) m(i)di, \quad p(z) = a - bc(z), \quad q(i) = a - bm(i). \quad (9)$$

### 3.3. Utilities

In Appendix A, the utility $u_h$ of a single household $h$ is shown to be the following function of personal income $I_h$ and aggregate income $I$:

$$u_h = U(I_h, I), \quad \lambda_h = U_h = \frac{\partial U}{\partial I_h} > 0, \quad U_I = \frac{\partial U}{\partial I} = -\frac{\lambda_h^2}{2} < 0. \quad (10)$$

A household’s welfare $u_h$ increases with its personal income $I_h$, but decreases with aggregate income $I$, because this is associated with higher prices.

Because the quadratic preferences (3) imply that all income-consumption
curves are linear, they allow for consistent aggregation over individuals with different incomes (cf. Neary 2015). Noting (6) and (10), one can then construct aggregate welfare (i.e. the utility of the representative household in the two countries) as follows (cf. Appendix A):

\[ W \doteq \int_h u_h dh = U(I, I) = \frac{1}{2} I + \frac{a^2}{b} - \frac{aP}{2b} = \frac{1}{2} I + \text{constants.} \] (11)

One can aggregate the utilities of other groups as well. The representative home capitalist earns home profits \( \pi \) and derives utility [cf. (10)]

\[ v_\pi \doteq \int_{\text{home capitalist}} u_h dh = U(\pi, I). \] (12)

Because one unit of the competitive good is produced from one unit of labor, the competitive wage is equal to the price for the competitive good, \( q \), and, with the mass \([0, 1]\) of home workers, home labor supply is unity. The representative home worker earns wages \( w_l \) and \( q(1 - l) \) from the oligopolistic and competitive sectors at home, respectively, and derives utility [cf. (10)]

\[ v_w \doteq \int_{\text{home worker}} u_h dh = U(I_w, I), \quad I_w \doteq w_l + (1 - l)q. \] (13)

The representative home household earns home income \( J \) and derives utility

\[ V \doteq \int_{\text{home resident}} u_h dh = U(J, I), \quad J \doteq I_w + \pi. \] (14)

4. Product markets

In oligopolistic sector \( z \in [0, 1] \), an endogenous number \( n(z) \) of home oligopolists 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 \( t_j(z) \) from \( l_j(z) \) units of labor and employs one unit of capital as a fixed input. The foreign firms behave accordingly. Because all sectors \( z \in [0, 1] \) and \( i \in [0, g] \) are
identical, respectively, indices \( z \) and \( i \) can be omitted from the variables. Noting this, (9), (7) and (8), I derive home labor input \( l \), aggregate oligopoly employment \( L \), the oligopoly price \( p \), home profit \( \pi \) and aggregate income \( I \) as

\[
\begin{align*}
l &= n \frac{a - (n^* + 1)w + n^*w^*}{(n + n^* + 1)b}, \quad l + l^* = L = \frac{a(n + n^*) - nw - n^*w^*}{(n + n^* + 1)b}, \quad (15) \\
p &= a - bL, \quad q = a - bm = a - (2 - L)\frac{b}{g}, \quad \pi = \pi = (p - w)l, \\
I(L) &= pL + gqm = aL - bL^2 + a(2 - L) - \frac{b}{g}(2 - L)^2. \quad (16)
\end{align*}
\]

In the system (2), (15) and (16), the number of foreign firms, \( n^* \), home employment \( l \), the oligopoly price \( p \), home profits \( \pi \), aggregate employment \( L \) and aggregate income \( I \) are unknown, while the home non-competitive wage \( w \), the foreign non-competitive wage \( w^* \) and the number \( n \) of home oligopolists known variables. The comparative statics of this system yields (cf. Appendix D):

\[
\begin{align*}
l &= \tilde{l}(w, w^*, n), \quad \frac{\partial \tilde{l}}{\partial w}(n) < 0, \quad \frac{\partial \tilde{l}}{\partial w^*}(n) > 0, \quad \frac{\partial \tilde{l}}{\partial n}(w) > 0; \\
L &= \tilde{L}(w, w^*, n), \quad \frac{\partial \tilde{L}}{\partial n}\bigg|_{n^* = n = K} = 0, \quad \frac{\partial \tilde{L}}{\partial w}(n) = \frac{\partial \tilde{L}}{\partial w^*}(n) < 0, \\
\frac{\partial \tilde{l}}{\partial w}\bigg|_{n^* = n = K} &= (1 + K)\frac{\partial \tilde{L}}{\partial w}\bigg|_{n^* = n = K} < 0, \quad \frac{\partial^2 \tilde{L}}{\partial n \partial w}\bigg|_{n^* = n = K} = 0; \\
\pi(w, w^*, n), \quad \frac{\partial \pi}{\partial w} < 0, \quad \frac{\partial \pi}{\partial w} + \frac{\partial \pi}{\partial w^*} < 0, \quad \frac{\partial \pi}{\partial n}\bigg|_{w^* = w, n^* = n = K} > 0, \\
\frac{\partial^2 \pi}{\partial n^2}\bigg|_{w^* = w, n^* = n = K} = 0, \quad \frac{\partial^2 \pi}{\partial n \partial w}\bigg|_{w^* = w, n^* = n = K} < \min\left[0, \frac{\partial^2 \pi}{\partial n \partial w^*}\bigg|_{w^* = w, n^* = n = K}\right].
\end{align*}
\]

Thus, the home non-competitive wage \( w \) decreases, but the foreign non-competitive wage \( w^* \) increases both home oligopoly employment \( l \) and home profits \( \pi \), given the number \( n \) of home oligopolists. Both of these wages
decrease aggregate oligopoly employment in the two countries, \( L \). An increase in the number of home oligopolists, \( n \), increases home employment \( l \) and total home profits \( \pi \), but has no effect of aggregate employment \( L \), for the change of firms between the countries transfers jobs accordingly. By the symmetry of the countries and (19), the foreign profit function is

\[
\pi^*(w, w^*, n^*), \quad \frac{\partial \pi^*}{\partial w^*} < 0, \quad \frac{\partial \pi^*}{\partial w} + \frac{\partial \pi^*}{\partial w^*} < 0, \quad \frac{\partial \pi^*}{\partial n^*} \bigg|_{w^* = w, n^* = n = K} > 0,
\]

\[
\frac{\partial^2 \pi^*}{\partial n \partial w^*} \bigg|_{w^* = w, n^* = n = K} = \frac{\partial^2 \pi}{\partial n^* \partial w^*} \bigg|_{w^* = w, n^* = n = K} < \min \left[ 0, \frac{\partial^2 \pi}{\partial n^* \partial w} \bigg|_{w^* = w, n^* = n = K} \right],
\]

\[
\frac{\partial^2 \pi^*}{\partial (n^*)^2} \bigg|_{w^* = w, n^* = n = K} = 0.
\]

(20)

5. The movement of capital

With *immobile capital*, the number of firms in each country is fixed [cf. (1)], \( n = K = K^* = n^* \). With *mobile capital*, the representative capitalist maximizes aggregate profits \( \Pi(w, w^*, n) \) [cf. (19) and (20)]

\[
\Pi(w, w^*, n) = \int_0^1 \pi di + \int_0^1 \pi^* di = \pi(w, w^*, n) + \pi^*(w, w^*, n^*)
\]

by the number of home oligopolists, \( n \), given the non-competitive wages \( w \) and \( w^* \), subject to the transformation curve (2). This proves that in the neighborhood of the symmetric equilibrium with \( w^* = w \), the number of home oligopolists decreases with the home and increases with the foreign non-competitive wage (cf. Appendix C):

\[
n = \tilde{n}(w, w^*), \quad \tilde{n}(w, w) = K, \quad \frac{\partial \tilde{n}}{\partial w^*}(w, w) = -\frac{\partial \tilde{n}}{\partial w}(w, w) < 0.
\]

(22)

To examine the integration of capital markets, I define the variable

\[
\beta = \begin{cases} 
0 & \text{with immobile capital } n = K, \\
1 & \text{with mobile capital } n = \tilde{n}(w, w^*). 
\end{cases}
\]

(23)
Given (22) and (23), the number of home oligopolists is the following function of the non-competitive wages and the parameter $\beta$:

$$n(w, w^*, \beta) \equiv \beta \tilde{n}(w, w^*) + (1 - \beta)K, \quad \frac{\partial n}{\partial \beta} = \tilde{n} - K, \quad \frac{\partial^2 n}{\partial w \partial \beta} = \frac{\partial \tilde{n}}{\partial w} < 0,$$

$$\frac{\partial^2 n}{\partial w^* \partial \beta}(w, w) = \frac{\partial \tilde{n}}{\partial w} = -\frac{\partial \tilde{n}}{\partial w} = -\frac{\partial^2 n}{\partial w \partial \beta}(w, w) > 0, \quad \frac{\partial n}{\partial \beta} \bigg|_{n^* = n = K} = 0. \quad (24)$$

Inserting the number of home oligopolists, (24), into (17) and (18), home and aggregate employment are obtained as functions of the non-competitive wages $(w, w^*)$ and the parameter $\beta$ (cf. Appendix E):

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

$$\frac{\partial L}{\partial \beta} \bigg|_{n^* = n = K} = \frac{\partial^2 L}{\partial w \partial \beta} \bigg|_{n^* = n = K} = 0; \quad (25)$$

$$l(w, w^*, \beta), \quad \frac{\partial l}{\partial w^*} > 0, \quad \frac{\partial l}{\partial \beta} \bigg|_{n^* = n = K} = 0, \quad \frac{\partial^2 l}{\partial w \partial \beta} \bigg|_{n^* = n = K = K} < 0, \quad \frac{\partial^2 l}{\partial w^* \partial \beta} \bigg|_{n^* = n = K} < 0, \quad \frac{\partial l}{\partial w} \bigg|_{n^* = n = K} < (1 + K) \frac{\partial L}{\partial w} \bigg|_{n^* = n = K} < 0. \quad (26)$$

Given (16) and (25), the competitive wage (= the price in the competitive sector) can be defined as a function of the non-competitive wages $(w, w^*)$ and the parameter $\beta$:

$$q(w, w^*, \beta) \equiv a + \frac{b}{g} [L(w, w^*, \beta) - 2], \quad \frac{\partial q}{\partial w} < 0, \quad \frac{\partial q}{\partial w^*} < 0,$$

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

6. The political economy

I assume that the home government controls the home non-competitive wage $w$ and the foreign government the foreign non-competitive wage $w^*$ either directly through minimum wages, or indirectly though relative union bargaining power (cf. Appendix F). I compare two cases: one where na-
tional governments run labor market regulation independently, behaving in Cournot manner; and the other where they delegate their power to a common regulator. Because the countries are identical, the wages and the number of firms are the same in equilibrium in both cases: $w^* = w$ and $n^* = n = K$.

6.1. National regulation

The oligopoly price $p$ is higher than the competitive wage $q$. Noting (8), (13), (16), (25) and (26), home income can be defined as a function of home and aggregate oligopoly employment:

$$J(l, L) = \pi + I_w = pl + q(1 - l) = (a - bL)l + \left[a - \frac{b}{g}(2 - L)\right](1 - l),$$

$$\frac{\partial J}{\partial l} = p - q = \frac{b}{g}[1 - (1 + g)L] > 0,$$

$$\frac{\partial J}{\partial L} = b[g - (1 + g)l] > b[g - (1 + g)L] > 0. \quad (28)$$

Consequently, the home household’s utility (14) becomes a function of the non-competitive wages $(w, w^*)$ and the parameter $\beta$ [cf. (26), (25) and (28)]

$$V(w, w^*, \beta) = \Phi(l(w, w^*, \beta) L(w, w^*, \beta)) = U(J(l, L), I(L)) \quad \text{with}$$

$$\frac{\partial V}{\partial w} = \frac{\partial \Phi}{\partial l} \frac{\partial l}{\partial w} + \frac{\partial \Phi}{\partial L} \frac{\partial L}{\partial w} = \frac{\partial U}{\partial J} \frac{\partial J}{\partial l} \frac{\partial l}{\partial w} + \left[\frac{\partial U}{\partial J} \frac{\partial L}{\partial L} + \frac{\partial U}{\partial I} \frac{\partial I}{\partial L}\right] \frac{\partial L}{\partial w}. \quad (29)$$

The home government maximizes home welfare (29) by the home non-competitive wage $w$, taking the foreign non-competitive wage $w^*$ as given. The first-order and second-order conditions of this maximization are

$$\frac{\partial V}{\partial w} = 0, \quad \frac{\partial^2 V}{\partial w^2} < 0. \quad (30)$$
From (11), (26), (29) and (30) it follows that

\[
\frac{dI}{dL} = - \left[ \frac{\partial U}{\partial J} \frac{\partial J}{\partial \ell} \frac{\partial \ell}{\partial w} + \frac{\partial U}{\partial J} \frac{\partial J}{\partial L} \frac{\partial L}{\partial w} \right] \left[ \frac{\partial U}{\partial I} \frac{\partial I}{\partial \ell} \right] > 0,
\]

\[
\frac{dW}{dw} \bigg|_{w^* = w} = \frac{dI}{dL} \bigg|_{w^* = w} + \frac{dL}{dw} \bigg|_{w^* = w} < 0, \quad \frac{\partial^2 V}{\partial w \partial \beta} \bigg|_{n^* = n = K} = \frac{\partial \Phi}{\partial l} \frac{\partial^2 l}{\partial w \partial \beta} \bigg|_{n^* = n = K} < 0.
\]

Differentiating the first-order condition \( \frac{\partial V}{\partial w} = 0 \) with (29) totally and noting (23), (27), (30) and (31), one obtains

\[
\frac{dw}{d\beta} \bigg|_{n^* = n = K} = - \frac{\partial^2 V}{\partial w \partial \beta} \bigg|_{n^* = n = K} \frac{\partial^2 V}{\partial w^2} \bigg|_{n^* = n = K} < 0, \quad \frac{d(w - q)}{d\beta} \bigg|_{n^* = n = K} < 0. \quad (32)
\]

Results (31) and (32) can be written as follows:

**Proposition 1.** With national labor market regulation, capital market integration (i.e. an increase of \( \beta \)) increases aggregate welfare \( W \), but decreases the non-competitive wage \( w^* = w \) wage inequality \( w - q \).

The introduction of footloose capital makes both oligopoly employment and national income more elastic to the non-competitive wage of the country. This compels each government to decrease that wage, increasing aggregate income and welfare.

### 6.2. International regulation

The common regulator of the two countries maximizes the aggregate welfare of the countries, (11). Noting (16) and (25), this is equivalent to

\[
w = \arg \max_w W = \arg \max_w U(I, I) = \arg \max_w I(L(w, w^*, \beta))
\]
and \( L = \arg \max_L I(L) \). Given (16), the first-order and second-order conditions for this are

\[
\frac{dI}{dL} = 2 \frac{b}{g} [2 - (1 + g)L] = 0, \quad \frac{d^2I}{dL^2} = -2 \frac{b}{g} (1 + g) < 0.
\] (33)

Thus, at the social optimum, aggregate oligopoly employment \( L_o \) and national oligopoly employment \( l_o^* = l_o \) are given by

\[
L_o = \frac{2}{1 + g}, \quad l_o^* = l_o = \frac{L_o}{2} = \frac{1}{1 + g}.
\]

Of this, one can make the following conclusion:

**Proposition 2.** With international labor market regulation, capital market integration (i.e. parameter \( \beta \)) has no effect on the wages.

International labor market regulation makes the two identical countries to behave as a single country with uniform wages. In that setting, international capital flows don’t play any role.

Because \( \frac{dI}{dL} > 0 \) holds true for national regulation with footloose capital [cf. (31)], but \( \frac{dI}{dL} = 0 \) for the international regulation [cf. (33)], aggregate oligopoly employment \( L \) is in the former case below the socially optimum level \( L_o \). This means that the non-competitive wage \( w^* = w \) is higher with national than with international regulation [cf. (25)]. This results can be summarized as follows [cf. (11)]:

**Proposition 3.** A change from national regulation with footloose capital into international regulation increases aggregate income \( I \), aggregate welfare \( W \) and oligopoly employment \( l_o^* = l_o = \frac{1}{2} L_o \), but decreases the non-competitive wage \( w^* = w \) and wage inequality \( w - q \).

Because the national governments ignore the effect of their non-competitive wage on the price level through the non-competitive wage of the other country, they set non-competitive wages at a higher and oligopoly employment at a lower level than the international regulator.
Given (10), an increase in the non-competitive wage $w^* = w$ raises the worker’s welfare (12):

$$\frac{dv_w}{dw} = \frac{\partial U}{\partial I} \left. \frac{dI}{dw} \right|_{w^* = w} + \frac{\partial U}{\partial L} \left. \frac{dL}{dw} \right|_{w^* = w} > 0.$$ 

Because aggregate welfare decreases at the same time (cf. proposition 3), the capitalist’s welfare must decrease. I summarize these results together with proposition 1 as follows:

**Proposition 4.** An increase in the non-competitive wage $w^* = w$ increases the worker’s, but decreases the capitalist’s welfare. In the presence of national labor market regulation, capital market integration (i.e. an increase of $\beta$) and a change from national into international regulation decreases the worker’s, but increases the capitalist’s welfare.

7. Conclusions

In this paper, I examine two identical countries where labor markets are regulated: the government either sets the binding minimum wage for the oligopolistic sectors or controls the relative bargaining power of labor unions in those sectors. To conduct the analysis, I start with Neary’s (2009) general oligopolistic equilibrium model(GOLE): there is a unit mass of oligopolistic sectors, each containing a small (endogenous) 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. Furthermore, to have an equilibrium with labor market regulation, I introduce a competitive sector with no rents. I compare two forms of economic integration: removing capital transfer barriers and delegating labor market regulation to a common international agent. The main results are as follows.

With national labor market regulation, capital market integration decreases the non-competitive wage and wage inequality, i.e. the difference between the oligopoly and competitive wages. Consequently, it decreases the workers’, but increases the capitalists’ welfare. The introduction of footloose
capital makes both oligopoly employment and national income more elastic to the non-competitive wage of the country. This compels each government to decrease the non-competitive wage. International labor market regulation makes the two identical countries to behave as a single country with uniform wages. Then, international capital flows don’t play any role.

Because the national governments ignore the effect of their non-competitive wage on the price level through the non-competitive wage of the other country, they set non-competitive wages at a higher and oligopoly employment at a lower level than the international regulator. A change from national into international regulation eliminates this distortion, increasing aggregate welfare, but decreasing the non-competitive wage and wage inequality. Consequently, it decreases the workers’, but increases the capitalists’ welfare.

Appendix A. Utility functions (10) and (11)

Noting (7) and (8), one obtains a constant price index as follows:

\[
P = \int_0^1 p(z)dz + \int_0^g q(i)di = a - b \int_0^1 c(z)dz + ag - b \int_0^g m(i)di
\]

\[
= (1 + g)a - b \left( L + \int_0^g m(i)di \right) = (1 + g)a - 2b. \tag{A.1}
\]

Equations (9) and (A.1) yield \( bc(z) = a - p(z) \), \( bm(i) = a - q(i) \) and

\[
bI = \int_0^1 p(z)bc(z)dz + \int_0^g q(i)bm(i)di
\]

\[
= \int_0^1 p(z)[a - p(z)]dz + \int_0^g q(i)[a - q(i)]di
\]

\[
= aP - \int_0^1 p(z)^2di - \int_0^g q(i)^2di.
\]

This defines the uncentred variance of prices as follows:

\[
\sigma = \int_0^1 p(z)^2di + \int_0^g q(i)^2di = aP - bI. \tag{A.2}
\]
On the other hand, transforming (5) into

\[ bc_h(z) = a - \lambda_h p(z), \quad bm_h(i) = a - \lambda_h q(i), \] (A.3)

and plugging (A.1), (A.2) and (A.3) into (4), one obtains

\[ bI_h = \int_0^1 p(z) bc_h(z) \, dz + \int_0^g q(i) bm_h(i) \, di = \int_0^1 p(z)[a - \lambda_h p(z)] \, dz + \int_0^1 q(i)[a - \lambda_h q(i)] \, di = aP - \sigma \lambda_h. \]

Solving for the marginal utility of income yields

\[ \lambda_h = (aP - bI_h)/\sigma. \] (A.4)

Plugging (A.1), (A.2), (A.3) and (A.4) into (3) yields (10):

\[
\begin{align*}
bu_h &= \int_0^1 \left[ abc_h(z) - \frac{b^2}{2} c_h(z)^2 \right] \, dz + \int_0^g \left[ abm_h(i) - \frac{b^2}{2} m_h(i)^2 \right] \, di \\
&= \int_0^1 \left\{ a[a - \lambda_h p(z)] - \frac{1}{2} [a - \lambda_h p(z)]^2 \right\} \, di \\
&\quad+ \int_0^g \left\{ a[a - \lambda_h q(i)] - \frac{1}{2} [a - \lambda_h q(i)]^2 \right\} \, di \\
&= \int_0^1 \left\{ a[a - \lambda_h p(z)] - \frac{1}{2} [a^2 - 2a\lambda_h p(z) + \lambda_h^2 p(z)^2] \right\} \, dz \\
&\quad+ \int_0^g \left\{ a[a - \lambda_h q(i)] - \frac{1}{2} [a^2 - 2a\lambda_h q(i) + \lambda_h^2 q(i)^2] \right\} \, di \\
&= \int_0^1 \left\{ a^2 - \frac{1}{2} [a^2 + \lambda_h^2 p(z)^2] \right\} \, dz + \int_0^g \left\{ a^2 - \frac{1}{2} [a^2 + \lambda_h^2 q(i)^2] \right\} \, di \\
&= (1 + g) \frac{a^2}{2} - \frac{\lambda_h^2}{2} \left[ \int_0^1 p(z)^2 \, dz + \int_0^g q(i)^2 \, di \right] = (1 + g) \frac{a^2}{2} - \frac{\lambda_h^2}{2} \sigma \\
&= a^2 - \frac{1}{2\sigma} (aP - bI_h)^2 = a^2 - \frac{1}{2} \frac{(aP - bI_h)^2}{aP - bI}.
\end{align*}
\]
with $\lambda_h = U_h = \frac{\partial U}{\partial h} > 0$ and $U_I = \frac{\partial U}{\partial I} = -\frac{\lambda_I^2}{2} < 0$.

Appendix B. Demand functions (15) and (16)

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

$$c(z) = \ell(z) + \ell^*(z), \quad \ell(z) = \sum_{j=1}^{n(z)} l_j(z) \quad \text{and} \quad \ell^*(z) = \sum_{j=1}^{n^*(z)} l^*_j(z). \quad (B.1)$$

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

$$\pi_j(z) = [p(z) - w(z)]l_j(z), \quad (B.2)$$

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 home oligopolists, (B.2), in that sector:

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

Home firm $j$ maximizes profit (B.2) by its input $l_j(z)$ subject to total employment (B.1) and the inverse demand (9) for good $z$, given the wage $w(z)$ and the outputs of the other firms, $\ell^*(z)$ and $l_{\gamma}(z)$ for $\gamma \neq j$. The foreign firms behave accordingly. This yields

$$\frac{\partial \pi_j(z)}{\partial l_j(z)} = p(z) - w(z) + l_j(z) \frac{\partial p(z)}{\partial \ell(z)} \frac{\partial \ell(z)}{\partial l_j(z)} = p(z) - w(z) - bl_j(z)$$

$$= a - b[\ell(z) + \ell^*(z)] - bl_j(z) - w(z) = 0.$$  

Because foreign firm in sector $z \in [0, 1]$ does the same as well, the equilibrium
conditions are

\[ l_j(z) = \frac{[a - w(z)]}{b - \ell(z) - \ell^*(z)}, \quad l^*_j(z) = \frac{[a - w^*(z)]}{b - \ell(z) - \ell^*(z)}. \]  
(B.4)

Because the home and foreign firms are identical, from (B.1) it follows that

\[ \ell(z) = n(z)l_j(z), \quad \ell^*(z) = n^*(z)l^*_j(z). \]  
(B.5)

Noting this, the conditions (B.4) become

\[ [n(z) + 1]l_j(z) + n^*(z)l^*_j(z) = \frac{[a - w(z)]}{b}, \]
\[ n(z)l_j(z) + [n^*(z) + 1]l^*_j(z) = \frac{[a - w^*(z)]}{b}. \]  
(B.6)

Solving for \( l_j(z) \) and \( l^*_j(z) \) from (B.6) yields the oligopolists’ labor inputs

\[ l_j(z) = \frac{[n(z) + n^*(z) + 1]^{-1}\{a - [n^*(z) + 1]w(z) + n^*(z)w^*(z)\}}{b} \]
\[ l^*_j(z) = \frac{[n(z) + n^*(z) + 1]^{-1}\{a - [n(z) + 1]w^*(z) + n(z)w(z)\}}{b}. \]

From these equations, (7), (B.1) and (B.5) it follows that

\[ \ell(z) = \frac{n(z)/b}{n(z) + n^*(z) + 1}\{a - [n^*(z) + 1]w(z) + n^*(z)w^*(z)\}, \]  
(B.7)
\[ \ell^*(z) = \frac{n^*(z)/b}{n(z) + n^*(z) + 1}\{a - [n(z) + 1]w^*(z) + n(z)w(z)\}, \]  
(B.8)
\[ L = \int_0^1 c(z)dz = \int_0^1 [\ell(z) + \ell^*(z)]dz = \int_0^1 [\ell(z) + \ell^*(z)]dz \]
\[ = \frac{1}{b} \int_0^1 a[n(z) + n^*(z)] - n(z)w(z) - n^*(z)w^*(z)\frac{di}{n(z) + n^*(z) + 1}. \]  
(B.9)

Because all sectors \( z \in [0, 1] \) are structurally identical, one obtains \( \ell(z) = l, \)
\( \ell^*(z) = l^*, \ w(z) = w, \ p(z) = p \) and \( \pi(z) = \pi \) for \( z \in [0, 1] \). Then, from (9), (7), (B.1), (B.3) and (B.7)-(B.9), it follows the results (15) and (16).

**Appendix C. The migration of oligopolists (22)**

In the neighborhood of the symmetric equilibrium with \( w^* = w \) and \( n^* = n = K \), the first-order and second-order conditions of this are [cf. (2), (19) and (20)]:

\[
\frac{\partial \Pi}{\partial n} = \frac{\partial \pi}{\partial n}(w, w^*, n) + \frac{\partial \pi^*}{\partial n^*}(w, w^*, n)f'(n) = 0, \quad \frac{\partial^2 \Pi}{\partial n^2} = \frac{\partial \pi^*}{\partial n^*}f'' < 0.
\]

Differentiating the first-order condition and noting (2), (19), (20) and the second-order condition \( \frac{\partial^2 \Pi}{\partial n^2} < 0 \), one obtains home capital as a function of the home and foreign non-competitive wages:

\[
n = \tilde{n}(w, w^*), \quad \tilde{n}(w, w) = K, \quad \frac{\partial \tilde{n}}{\partial w^*}(w, w) = -\frac{\partial \tilde{n}}{\partial w}(w, w),
\]

\[
\frac{\partial \tilde{l}}{\partial w}(n) = -\frac{(n^* + 1)n}{(n + n^* + 1)b} = -\frac{(2K - n + 1)n}{(2K + 1)b} < 0,
\]

\[
\frac{\partial \tilde{l}}{\partial w^*}(n) = \frac{n^* n}{(n + n^* + 1)b} = \frac{(2K - n)n}{(2K + 1)b} > 0,
\]

\[
\frac{\partial \tilde{l}}{\partial n}(w) = \frac{a - w}{(n + n^* + 1)b} = \frac{a - w}{(2K + 1)b} > 0,
\]

**Appendix D. Employment and profit before capital transfers (18)**

The system (2), (15) and (16) of six equations defines the unknown variables \( n^*, l, p, \pi, L \) and \( I \) as functions of the known variables \( w, w^* \) and \( n \). Differentiating this system totally yields the following partial derivatives:

\[
\frac{\partial \Pi}{\partial \ell} = \frac{\partial \pi}{\partial \ell}(w, w^*, n) + \frac{\partial \pi^*}{\partial \ell^*}(w, w^*, n)f'(n) = 0,
\]

\[
\frac{\partial^2 \Pi}{\partial \ell^2} = \frac{\partial \pi^*}{\partial \ell^*}f'' < 0.
\]
\[
\frac{\partial L}{\partial w}(n) = \frac{\partial L}{\partial w^*}(n) = -\frac{n}{(n + n^* + 1)b} = -\frac{n}{(2K + 1)b} \in \left( -\frac{1}{b}, 0 \right),
\]
\[
\left. \frac{\partial L}{\partial n} \right|_{n^* = n} = \frac{w^* - w + (a - w - bL)}{(n + n^* + 1)b} \left[ 1 + f'(n) \right]_{n^* = n} = 0,
\]
\[
\frac{\partial \pi}{\partial w} = -l - \frac{(n^* + 1)n}{(n + n^* + 1)b} \left( p - w \right) < 0,
\]
\[
\frac{\partial \pi}{\partial w^*} = -2l - \frac{n}{(n + n^* + 1)b} \left( p - w \right) < 0,
\]
\[
\frac{\partial \pi}{\partial n} = \frac{1}{b} a - bL - w
\]
\[
\times \left\{ a - \left[ f(n) + 1 \right] w + f(n)w^* - bl + [(w^* - w)n - bl]f'(n) \right\},
\]
\[
\left. \frac{\partial \pi}{\partial n} \right|_{w^* = w, n^* = n} = \frac{1}{b} a - bL - w \left( n + f(n) + 1 \right) > 0,
\]
\[
\frac{\partial^2 \pi}{\partial n \partial w} = -\frac{\partial \pi}{\partial n} \frac{1}{a - bL - w} \left( 1 + b \frac{\partial L}{\partial w} \right)
\]
\[
+ \frac{p - w}{(n + n^* + 1)b} \left\{ -1 - f(n) - nf'(n) - b[1 + f'(n)] \frac{\partial l}{\partial w} \right\},
\]
\[
\frac{\partial^2 \pi}{\partial n \partial w^*} = -\frac{\partial \pi}{\partial n} \frac{1}{a - bL - w} \left( 1 + b \frac{\partial L}{\partial w} \right)
\]
\[
+ \frac{p - w}{(n + n^* + 1)b} \left\{ f(n) + nf'(n) - b[1 + f'(n)] \frac{\partial l}{\partial w^*} \right\},
\]
\[
\left. \frac{\partial^2 \pi}{\partial n \partial w} \right|_{w^* = w, n^* = n} = -\frac{\partial \pi}{\partial n} \frac{1}{a - bL - w} \left( 1 + b \frac{\partial L}{\partial w} \right)
\]
\[
+ \frac{p - w}{(n + n^* + 1)b} \left\{ -1 - f(K) - Kf'(K) - b[1 + f'(K)] \frac{\partial l}{\partial w} \right\},
\]
\[
= -\frac{\partial \pi}{\partial n} \frac{1}{p - w} \left( 1 + b \frac{\partial L}{\partial w} \right) - \frac{p - w}{(n + n^* + 1)b} < 0,
\]
\[
\frac{\partial^2 \pi}{\partial n \partial w^*} \bigg|_{w^* = n^* = n} = \frac{\partial \pi}{\partial n} \bigg|_{w^* = n^* = n} \frac{1}{a - bL - w} \left( 1 + b \frac{\partial L}{\partial w^*} \right) + \frac{p - w}{(n + n^* + 1)b} \left\{ f(K) + Kf'(K) - b[1 + f'(K)] \frac{\partial l}{\partial w^*} \right\} = 0
\]

\[
\frac{\partial^2 \pi}{\partial n \partial w^*} \bigg|_{w^* = n^* = n} - \frac{\partial^2 \pi}{\partial n \partial w^*} \bigg|_{w^* = n^* = n} = \frac{p - w}{(n + n^* + 1)b} < 0.
\]

Appendix E. Employment after capital transfers

Noting (17), (18) and (24), one can define the functions

\[
l = l(w, w^*, \beta) \equiv \tilde{l}(w, w^*, n(w, w^*, \beta)) ,
\]

\[
\frac{\partial l}{\partial w} = \frac{\partial \tilde{l}}{\partial w} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial n}{\partial w} > 0 , \quad \frac{\partial l}{\partial w^*} = \frac{\partial \tilde{l}}{\partial w^*} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial n}{\partial w^*} > 0 ,
\]

\[
\frac{\partial l}{\partial \beta} = \frac{\partial \tilde{l}}{\partial n} \frac{\partial n}{\partial \beta} , \quad \frac{\partial l}{\partial n} \bigg|_{n^* = n = K} = \frac{\partial \tilde{l}}{\partial n} \frac{\partial n}{\partial \beta} = 0 ,
\]

\[
\frac{\partial^2 l}{\partial w \partial \beta} \bigg|_{n^* = n = K} = \frac{\partial^2 \tilde{l}}{\partial w \partial n} \frac{\partial n}{\partial \beta} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial^2 n}{\partial w \partial \beta} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial^2 n}{\partial w \partial \beta} = 0 ,
\]

\[
\frac{\partial^2 l}{\partial w^* \partial \beta} \bigg|_{n^* = n = K} = \frac{\partial^2 \tilde{l}}{\partial w^* \partial n} \frac{\partial n}{\partial \beta} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial^2 n}{\partial w^* \partial \beta} + \frac{\partial \tilde{l}}{\partial n} \frac{\partial^2 n}{\partial w^* \partial \beta} = 0 ,
\]

\[
= - \frac{\partial \tilde{l}}{\partial n} \frac{\partial^2 n}{\partial w \partial \beta} \bigg|_{n^* = n = K} = - \frac{\partial^2 l}{\partial w \partial \beta} \bigg|_{n^* = n = K} < 0 ,
\]

\[
L = L(w, w^*, \beta) \equiv \tilde{L}(w, w^*, n(w, w^*, \beta)) = \tilde{L}(w, \varphi w, n(w, \varphi w, \beta)) ,
\]

\[
\frac{\partial L}{\partial w} \bigg|_{n^* = n} = \frac{\partial \tilde{L}}{\partial w} + \frac{\partial \tilde{L}}{\partial n} \bigg|_{n^* = n} \frac{\partial n}{\partial w} = \frac{\partial \tilde{L}}{\partial w} > 0 ,
\]

20
\[ \frac{\partial L}{\partial \beta} = \frac{\partial \tilde{L}}{\partial n}(w) \frac{\partial n}{\partial \beta} = \frac{\partial \tilde{L}}{\partial n} \bigg|_{n^* = n = K} \frac{\partial n}{\partial \beta}, \frac{\partial L}{\partial \beta} \bigg|_{\beta = 0} = 0, \]

\[ \frac{\partial^2 L}{\partial w \partial \beta} \bigg|_{n^* = n = K} = \frac{\partial^2 \tilde{L}}{\partial w \partial n} \bigg|_{\beta = 0} + \frac{\partial \tilde{L}}{\partial n} \bigg|_{n^* = n = K} \frac{\partial^2 n}{\partial w \partial \beta} = 0. \]

Appendix F. Collective bargaining

Bastos and Kreickemeier (2009), Kreickemeier and Meland (2013), and Egger and Etzel (2012, 2014) introduce a simple textbook model of rent-maximizing monopoly unions into the general oligopolistic equilibrium model (GOLE) of Neary (2009). I prefer to derive the utility functions of the labor union and employer federation directly from the households’ preferences (3) of the GOLE model as follows.

Assume that the workers and firms are organized labor unions and employer federations in each sector, respectively. These attempt to maximize their member’s utility (12) and (13), respectively, given aggregate income \( I \), the competitive wage \( q \), the foreign wage \( w^* \) and the number of firms, \( n \). When these parties alternate in making offers to each other, they behave as if they jointly maximized a weighed geometric average of their targets called the Generalized Nash Product (GNP) by the wage \( w \):

\[
\begin{align*}
  w &= \arg \max_w [v_w + (1/\delta - 1)v_w] \\
  &= \arg \max_w \left[ U\left( (w - q)l(w, w^*, \beta) + q, I \right) + (1/\delta - 1)U\left( \pi(w, w^*, \beta), I \right) \right] \\
  &= \arg \max_w \Theta(w, w^*, q, n, \delta), \quad \text{with} \\
  \Theta(w, w^*, q, n, \delta) &= (w - q)l(w, w^*, \beta) + (1/\delta - 1)\pi(w, w^*, \beta),
\end{align*}
\]

where, by the properties of the quadratic preferences, I constructed a “mimic

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Because the regulator in the end determines union power in the model, the results would be the same if wage bargaining is carried out at the level of a firm.

Cf. Binmore, Rubinstein and Wolinsky 1986, or Palokangas 2000, Ch. 1.
agent” that earns income \((w - q)l + q + (1/\delta - 1)\pi\). Following Blanchard and Giavazzi (2003), I assume that the constant weight \(\delta \in (0, 1)\) of the product (F.1) reflects the relative bargaining power of the labor union, depends on labor market regulations (e.g. restrictions in starting a dispute, the intermediation of disputes).

The maximization (F.1) yields the first-order condition \(\frac{\partial \Theta}{\partial w} = 0\) and second-order condition \(\frac{\partial^2 \Theta}{\partial w^2} < 0\). Differentiating \(\frac{\partial \Theta}{\partial w} = 0\) and noting \(\frac{\partial^2 \Theta}{\partial w^2} < 0\) yield the wage as an increasing function of relative union bargaining power:

\[
w = \tilde{w}(w^*, q, n, \delta), \quad \frac{\partial \tilde{w}}{\partial \delta} = -\frac{\partial^2 \Theta}{\partial w \partial \delta} \frac{\partial^2 \Theta}{\partial w^2} = \frac{\delta - 2}{\pi} \frac{\partial \pi}{\partial w} \frac{\partial \theta}{\partial w^2} > 0. \quad (F.2)
\]

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**References:**


