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Public policy, footloose capital, and union influence

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Abstract

This document sets up a unionized general oligopolistic equilibrium model of countries, where capital is footloose and governments maximize utilitarian welfare. When capital owners have weak influence on public policy, there is unemployment and the governments compete for jobs, causing a distortion with suboptimal wages. Then globalization—as characterized by a decrease in impediments to international investment—increases the wage elasticity of capital flight, decreasing wages and increasing employment. This benefits the capital owners and the unemployed workers getting a job, but harms the other workers. International coordination of public policy alleviates these consequences of globalization.

JEL CLASSIFICATION

C78; F16; F68; J51

1 | INTRODUCTION

The labor share of income has significantly decreased in the large majority of countries since the early 1980s (Karabarbounis & Neiman, 2014). Moreover, unionization has declined in most of the OECD countries since the 1980s (Nickell, Nunziata, & Ochel, 2005, pp. 6–7). This document provides the following explanation for this development. Because globalization helps the firms to minimize their unit costs by changing their international location, local governments must compete for jobs by lowering labor costs in their jurisdiction, either by labor subsidies or by labor market deregulation.

Because the distribution of income between workers and capital owners plays a crucial role in trade policy, this document takes Neary's (2016) *general oligopolistic equilibrium model (GOLE)* with *footloose capital* as a starting point. The model of a monopoly union is added to explain the existence of involuntary unemployment.[1] Trade policy is introduced as an incorporated part of public policy into a set-up where the government maximizes a utilitarian social welfare function. Then, *globalization* can be characterized by a decrease in the level of the *impediments to international investment* (i.e., cross-border transaction costs). Because the governments of the countries are strategically interlinked, their degree of cooperation is examined by Dixit's (1986) consistent conjecture model.

When union bargaining power or unemployment allowances are introduced into models of international trade, they are commonly taken as exogenous.[2] Because the government can influence union wages and unemployment benefits by taxes and transfers, these can be considered as outcomes of political economy (cf. Blanchard & Giavazzi, 2003). Where wages and profits are earned by different households and there is collective bargaining on wages, an equilibrium with involuntary unemployment is an option for a government that maximizes a utilitarian social welfare function. If workers have enough influence on that government (i.e., a higher weight in the social welfare function), then the equilibrium wage exceeds the market-clearing level, causing involuntary unemployment. In this equilibrium with unemployment, weakening the impediments to international investment decreases wages, hampering social welfare.

Because it is difficult to distinguish between structural and distributional effects of international trade in theoretical studies, the former are in the literature commonly examined by models of two symmetric countries.[3] This study assumes symmetry as well, but there can be any number of countries.

The remainder of this document is organized as follows. Section 2 defines the general equilibrium by an extensive form game where the households, firms, unions, investors, and governments act as players. Section 3 considers the behavior of the households. Section 4 focuses on the working of international product markets. Section 5 constructs the set-up for public policy with labor unions and footloose capital and Section 6 considers the strategic dependence of the governments. Finally, Section 7 summarizes the results.

2 | THE SET-UP

Let there be $1+k$ identical and perfectly integrated countries. Each country has the same "continuum" $z \in [0, 1]$ of identical industries and each industry $z \in [0, 1]$ produces a different traded good with label z. In every country, the mass of the workers is 1 and the initial mass of capital is m. Each worker supplies one unit of labor, being either employed or unemployed, while the capital owners earn all profits. It is assumed, for tractability, that the governments spend an exogenous amount g of every good $z \in [0, 1]$.

In line with the footloose capital model,[4] industries $z \in [0, 1]$ 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. The economic structure is first specified for one "domestic" country and then extended for the other k "foreign" countries by denoting the corresponding foreign variables by superscript (*). Thus, in each industry $z \in [0, 1]$, there is an endogenous number $n(z)$ of domestic oligopolists and an endogenous number $n^*(z)$ of oligopolists in each of the k foreign countries. Given that each of the $1+k$ countries has the initial amount m of capital, the equilibrium of the international capital market is

$$\int_0^1 [n(z)+kn^*(z)]dz=(1+k)m. \tag{1}$$

In the GOLE model with footloose capital, the workers are identical, their labor time is fixed and labor is the only variable input in production. Because a government can use four instruments—taxes on wages and profits and transfers to the employed and unemployed workers—it can independently control the employers' wage and a worker's real disposable income (cf. Palokangas, 1987, 2000). The governments of the countries are strategically interdependent through the goods and capital markets.

The general equilibrium of the model is established as an *extensive form game* with the households, firms, labor unions, capital owners, and governments as players. The stages of the game are the following: (i) The governments determine taxes and transfers in their countries. (ii) The labor unions set the wages, given capital; and the capital owners invest where they generate the highest return, given the wages. (iii) The oligopolistic firms produce their output from labor and capital. (iv) The households consume the products of the firms. This game is solved by backward induction: stage (iv) in Section 3; (iii) in Section 4; (ii) in Section 5; and (i) in Section 6.

3 | HOUSEHOLDS

The households in all the $1+k$ countries form the set H. In line with Neary (2016), it is assumed that household $h \in H$ derives its utility u_h from its consumption $c_h(z)$ of goods $z \in [0, 1]$ by the quadratic function

$$u_h \doteq \int_0^1 \left[ac_h(z) - \frac{b}{2}c_h(z)^2\right] dz, \quad a > 0, \quad b > 0, \tag{2}$$

where a and b are constants. The budget of household h is

$$I_h = \int_0^1 p(z)c_h(z)dz, \tag{3}$$

where $p(z)$ is the price for oligopolistic good $z \in [0, 1]$ and I_h the income of household h. Household h maximizes its utility (2) by its consumption $c_h(z)$ of all goods $z \in [0, 1]$ subject to its budget constraint (3). This yields

$$\lambda_h p(z) = a - bc_h(z) \quad \text{for } z \in [0, 1], \tag{4}$$

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

Following Neary (2016), the numeraire of the model is chosen as follows:

$$\lambda \doteq \int_{h \in H} \lambda_h dh = 1. \tag{5}$$

Then, aggregate income and aggregate consumption are defined by $I \doteq \int_{h\in H} I_h dh$ and $c(z) \doteq \int_{h\in H} c_h(z)dh$. Noting this and (5), and summing (3) and (4) over all households $h \in H$ yield

$$I = \int_0^1 p(z)c(z)dz, \quad p(z) = a - bc(z), \quad p \doteq \int_0^1 p(z)dz. \tag{6}$$

The *indirect utility function* of household $h \in H$ is[5]

$$u_h = \frac{1}{2b}\left[a^2 - \frac{1}{\sigma(ap - bI_h)^2}\right] \quad \text{with} \quad \sigma \doteq \int_0^1 p(z)^2 di, \tag{7}$$

where σ is the *(uncentered) variance of prices* $p(z)$, $z \in [0, 1]$.[6]

4 | PRODUCT MARKETS

Because one unit of each good is produced from one unit of labor, then the sum of private consumption $\int_0^1 c(z)dz$ and the governments' spending $(1+k)g$ is equal to aggregate employment $\int_0^1 [l(z)+kl^*(z)]dz$:

$$\int_0^1 c(z)dz + (1+k)g = \int_0^1 [l(z) + kl^*(z)]dz, \tag{8}$$

where $c(z)$ is the consumption of good $z \in [0, 1]$, $l(z)$ domestic employment and $l^*(z)$ employment in a foreign country.

Because industries $z \in [0, 1]$ are identical, then, in equilibrium, it holds true that $c(z) = c$, $p(z) = p$, $n(z) = n$, $n^*(z) = n^*$, $l(z) = l \leq 1$ and $l^*(z) = l^* \leq 1$ for $z \in [0, 1]$. Consequently, the equilibrium of the international capital market, (1), the price level p [cf. (6)], the variance of prices, σ [cf. (7)], aggregate employment (8), and the utility function (7) become

$$n + kn^* = (1+k)m \quad \text{with} \; \frac{dn^*}{dn} = -\frac{1}{k}, \tag{9}$$

$$p = a - bc, \quad \sigma = p^2, \quad c + (1+k)g = l + kl^*, \tag{10}$$

$$u_h = U\left(\frac{I_h}{p}\right) \doteq \frac{1}{2b}\left[a^2 - \left(a - b\frac{I_h}{p}\right)^2\right], \quad U' = a - b\frac{I_h}{p}, \quad U'' = -b. \tag{11}$$

Domestic employment l, the price level p, and a domestic and foreign firm's profit, π and π^*, depend on the domestic and foreign wage, w and w^*, and the domestic supply of capital, n, as follows:[7]

$$l = \varphi(w, w^*, n)n \leq 1, \quad \frac{\partial \varphi}{\partial n}\Big|_{w^*=w} = 0, \quad \frac{\partial \varphi}{\partial w^*} > 0, \quad \frac{\partial \varphi}{\partial w} < -\frac{\partial \varphi}{\partial w^*} < 0, \tag{12}$$

$$p(w, w^*, n) = (p - w)\varphi > w, \quad \frac{\partial p}{\partial n}\Big|_{w^*=w} = 0, \quad \frac{\partial p}{\partial w} > 0, \quad 0 < \frac{\partial p}{\partial w^*} < 1 - \frac{\partial p}{\partial w}, \tag{13}$$

$$\pi(w, w^*, n), \quad \frac{\partial \pi}{\partial w} < 0, \quad \frac{\partial \pi}{\partial w} + \frac{\partial \pi}{\partial w^*} < 0, \quad n\pi = (p - w)l, \tag{14}$$

$$\begin{aligned} &\pi^*(w, w^*, n), \quad \frac{\partial \pi^*}{\partial w} > 0, \quad \frac{\partial \pi^*}{\partial w^*} < 0, \quad \frac{\partial \pi}{\partial n} = \frac{\partial \pi^*}{\partial n} = 0, \\ &\pi^*_{w^*=w}| = \pi|_{w^*=w}, \quad \left(\frac{\partial \pi}{\partial w} + k\frac{\partial \pi^*}{\partial w}\right)_{w^*=w} < 0, \end{aligned} \tag{15}$$

where φ is a single domestic firm's labor input. These results can be explained as follows. An increase in the domestic wage w or a decrease in the foreign wage w^* decreases domestic employment l and domestic profit π, but increaes foreign employment l^* and foreign profit π^*. With uniform wages in the countries, $w^* = w$, domestic employment l is proportional to, but the price p and profits (π, π^*) are independent of the domestic supply of capital, n.

5 | SET-UP FOR PUBLIC POLICY

5.1 | Employment and the rate of return paid to capital

Because the international capital markets are integrated, one can consider the representative portfolio holder that owns shares of firms in all countries. Because the countries are identical, each of them has the same amount m of capital in equilibrium. It is assumed that if the portfolio holder attempts to change this status quo by transferring a proportion $1-\frac{n}{m}$ of capital m away from the domestic country, or a proportion $1-\frac{n^*}{m}$ of capital m away from any of the k foreign countries, then it faces convex adjustment costs $\frac{1}{2\delta}\left(1-\frac{n}{m}\right)^2$ and $\frac{1}{2\delta}\left(1-\frac{n^*}{m}\right)^2$, where constant $\delta > 0$ measures *impediments to international investment*: an increase of δ makes capital transfers easier.

The portfolio holder earns the rate of return $\frac{n}{m}\pi-\frac{1}{2\delta}\left(1-\frac{n}{m}\right)^2$ for capital in the domestic country and $\frac{n^*}{m}\pi^*-\frac{1}{2\delta}\left(1-\frac{n^*}{m}\right)^2$ for capital in everyone of the k foreign countries, where π is a domestic firm's and π^* a foreign firm's profit. Summing these throughout the 1+k countries and dividing the outcome by the price level p yield the real rate of return for the whole portfolio:

$$r=\frac{1}{p}\left\{\frac{n}{m}\pi-\frac{1}{2\delta}\left(1-\frac{n}{m}\right)^2+k\left[\frac{n^*}{m}\pi^*-\frac{1}{2\delta}\left(1-\frac{n^*}{m}\right)^2\right]\right\}. \tag{16}$$

The portfolio holder maximizes its real rate of return (16) by the ratio $\frac{n}{m}$ subject to the transformation curve (9), given the price level p and the profits (π, π^*). This yields the domestic supply of capital:[8]

$$n=[1+\alpha(\pi-\pi^*)]m \quad \text{with} \quad \alpha \doteq \frac{\delta k}{1+k}=\frac{\delta}{1/k+1}. \tag{17}$$

The parameter α measures the *degree of globalization*: it is the greater, the less there are impediments to international investment (i.e., the bigger δ).

Inserting the profit functions (14) and (15) into (12), (16), and (17) yields the domestic supply of capital, n, domestic employment l, and the domestic rate of return paid to capital, r, as functions of the domestic wage w, the foreign wage w^*, and the parameter α as follows:[9]

$$\begin{aligned}&n(w,w^*,\alpha), \quad n|_{w^*=w}=m, \quad \left.\frac{\partial n}{\partial w}\right|_{w^*=w}=-\left.\frac{\partial n}{\partial w^*}\right|_{w^*=w}<0, \quad \left.\frac{\partial n}{\partial \alpha}\right|_{w^*=w}=0,\\ &\left.\frac{\partial^2 n}{\partial w \partial \alpha}\right|_{w^*=w}=-\left.\frac{\partial^2 n}{\partial w^* \partial \alpha}\right|_{w^*=w}<0,\end{aligned} \tag{18}$$

$$l(w,w^*,\alpha)\leq 1,\quad -\frac{\partial l}{\partial w}\Big|_{w^*=w}=\frac{\partial l}{\partial w^*}\Big|_{w^*=w}>\frac{l}{n}\frac{\partial n}{\partial w^*}\Big|_{w^*=w}>0,\quad \frac{\partial l}{\partial \alpha}\Big|_{w^*=w}=0,$$
$$\frac{\partial^2 l}{\partial w\partial\alpha}\Big|_{w^*=w}=\frac{l}{n}\frac{\partial^2 n}{\partial w\partial\alpha}\Big|_{w^*=w},\quad \frac{\partial^2 l}{\partial w^*\partial\alpha}\Big|_{w^*=w}=\frac{l}{n}\frac{\partial^2 n}{\partial w^*\partial\alpha}\Big|_{w^*=w},\tag{19}$$

$$r(w,w^*,\alpha),\quad \frac{\partial r}{\partial w}<0,\quad \frac{\partial r}{\partial w^*}<0,\quad \frac{\partial r}{\partial\alpha}\Big|_{w^*=w}=0,\quad \frac{w}{p}l=l-rn,$$
$$\frac{\partial^2 r}{\partial w\partial\alpha}\Big|_{w^*=w}=\frac{\partial^2 r}{\partial w^*\partial\alpha}\Big|_{w^*=w}=0.\tag{20}$$

Results (18)–(20) can be explained as follows. An increase in the domestic wage w or a decrease in the foreign wage w^* lowers domestic competitiveness, decreasing domestic employment l, and the domestic supply of capital, n. If the wages are uniform in all countries, $w^* = w$, then globalization (i.e., an increase of α) does not affect relative competitiveness, but makes capital flight out of the country (i.e., a decrease in the domestic supply of capital, n) more elastic with respect to an increase in the domestic wage w:

$$\frac{\partial}{\partial\alpha}\left|\frac{\partial\ln n}{\partial\ln w}\right|_{w^*=w}=\left|\frac{w}{n}\frac{\partial n}{\partial w}\right|_{w^*=w}=\left|\frac{w}{n}\frac{\partial^2 n}{\partial w\partial\alpha}\right|=-\frac{w}{n}\frac{\partial^2 n}{\partial w\partial\alpha}>0.$$

5.2 | Taxation

Because a 100% tax on (pure) profits is incentive incompatible,[10], let there be a uniform international tax $\tau \in [0,1)$ on profits. Because the competition of the governments for tax revenue by it would yield $\tau = 0$ in equilibrium, any increase in τ is possible only by the common agreement of the countries.

In the domestic country, l is the mass of employed and $1-l$ that of unemployed workers. The representative domestic capital owner earns the real rate of return r paid to domestic capital m. The government sets the tax x on wages wl and pays the lump-sum transfer in real terms, T, to each employed worker. Then, an employed worker and the representative capital owner earn real income v and s, correspondingly, as follows:

$$v=(1-x)w/p+T,\quad s=(1-\tau)rm,\tag{21}$$

where w/p is the real wage and τ the international profit tax. Because the government spends the fixed real amount g for administration and provides real allowances q to each unemployed worker, its budget in real terms is

$$xwl/p+\tau rm=g+Tl+(1-l)q.\tag{22}$$

5.3 | Wage settlement

In an industry, the *labor union* sets the wage w to maximize *union rent* $(v-q)l$, subject to the labor demand function (12) and taxation (21), given the foreign wage w^*, the price level p, the domestic supply of capital, n, the tax x, the transfer T, and real unemployment allowances q:

$$w = \arg\max_w [(v-q)l] = \arg\max_w \{[(1-x)w/p+T-q]\varphi n\} = \arg\max_w \Omega$$

$$\text{with} \quad \Omega = \ln[(1-x)w/p+T-q] + \ln\varphi(w,w^*,n),$$

$$\frac{\partial\Omega}{\partial w} = \underbrace{\frac{1-x}{(1-x)w+T-pq}}_{+} + \underbrace{\frac{1}{\varphi}}_{+}\underbrace{\frac{\partial\varphi}{\partial w}}_{-} = 0, \quad \frac{\partial^2\Omega}{\partial w\partial x} < 0, \quad \frac{\partial^2\Omega}{\partial w\partial T} < 0. \tag{23}$$

Differentiating first-order condition $\frac{\partial\Omega}{\partial w} = 0$ totally, and noting (23) and the second-order condition $\frac{\partial^2\Omega}{\partial w^2} < 0$, one obtains the wage function

$$w = \widetilde{w}(w^*,p,n,x,T,q), \quad \frac{\partial\widetilde{w}}{\partial x} = -\frac{\partial^2\Omega}{\partial w\partial x}\Big/\frac{\partial^2\Omega}{\partial w^2} < 0, \quad \frac{\partial\widetilde{w}}{\partial T} < 0. \tag{24}$$

5.4 | Public policy

Because the government controls the wage w and an employed worker's real income v simultaneously by the wage tax x and the transfer T through the union wage function (24) and $v=(1-x)w/p+T$ [cf. (21)], the wage w, a worker's real income v and unemployment allowances q can be considered the government's policy instruments for the remainder of this study. The domestic government maximizes *utilitarian social welfare*, which is here specified as the weighed sum of the domestic households' utilities [cf. (11)]:

$$\begin{aligned} V(q,v,s,w,w^*,\tau,\mu,\alpha) &\doteq lU(v) + \epsilon(1-l)U(q) + \mu U(s) \\ &= l(w,w^*,\alpha)[U(v) - \epsilon U(q)] + \epsilon U(q) + \mu U((1-\tau)mr(w,w^*,\alpha)), \end{aligned} \tag{25}$$

where l is employment, $1-l$ unemployment, $U(v)$, $U(q)$ and $U(s)$ are an employed worker's, an unemployed worker's, and the representative capital owner's utilities [cf. (11)], respectively, and constants $0 < \varepsilon \leq 1$ and $\mu > 0$ characterize the unemployed workers' and the capital owners' relative political influence on the government, respectively. It is assumed that the unemployed workers have no more influence on the government than the employed workers, $\varepsilon \leq 1$. This leads to involuntary unemployment: each unemployed worker has every incentive to take a job, $v > q$ [cf. (43)].

To simplify the analysis, the exogenous public spending g is assumed to be so large that an employed worker becomes a net taxpayer, that is, its real disposable income v is smaller than its pre-tax real wage $\frac{w}{p}$:

$$v < w/p. \tag{26}$$

Noting employment (12), taxation (21), the domestic supply of capital, (18), and the rate of return paid to capital, (20), the domestic government's budget constraint (22) can be transformed into the following form:

$$\begin{aligned} 0 = R(q,v,s,w,w^*,\tau,\alpha) &\doteq \frac{w}{p}l + \tau mr - g - vl - (1-l)q \\ &= (1+q-v)l(w,w^*,\alpha) + [\tau m - n(w,w^*,\alpha)]r(w,w^*,\alpha) - g - q. \end{aligned} \tag{27}$$

6 | THE GOVERNMENTS

6.1 | Strategic interdependence

Because the governments of the 1+k identical countries determine the wages in their own countries by the same strategy, in equilibrium, the countries will have the same equilibrium wage $w^* = w$. Consequently, public policy can be examined in the vicinity of $w^* = w$.

The government's strategic behavior is examined by the consistent conjecture model of Dixit (1986) as follows. When the domestic government determines the domestic wage w, it anticipates that the foreign governments choose the foreign wage w^* according to the *conjectural variation relation*

$$w^*(w,\beta), \quad \frac{\partial w^*}{\partial w} = \beta\psi(w,w^*) > 0, \quad \psi(w,w) = 1, \quad \beta \in (0,1], \tag{28}$$

where the function $\psi(w, w^*)$ is homogeneous of degree zero with respect to the wages (w, w^*) and β is the *expectations parameter*. Each of the k foreign governments have expectations that are identical with (28).

The function (28) can be explained as follows. When all governments increase their wages in the same proportion, then the anticipated elasticity of the foreign wage w^* with respect to the domestic wage w, $\frac{w}{w^*}\frac{\partial w^*}{\partial w}$, remains constant β. Thus, parameter β measures the governments' cooperation: if $\beta = 0$, the governments behave in Cournot manner, taking each other's wages as given; $\beta = 1$, they cooperate as if there were a common international government; and if $0 < \beta < 1$, they expect the others to respond partially to their wage policy. Because full cooperation $\beta = 1$ eliminates the externality from the model, it leads to Pareto optimum. Consequently, incomplete cooperation $\beta < 1$ leads to a distortion with suboptimal wages.

6.2 | Optimal policy

The domestic government maximizes its utility (25) by real unemployment allowances q, an employed worker's real income v and the wage w subject to its budget constraint (27), its expectations on the other governments' behavior, (28), and the full-employment constraint $l(w, w^*, \alpha) \leq 1$ [cf. (19)], given the international profit tax τ and the parameters of globalization α and strategic dependence β. Ignoring the constraint $l(w, w^*, \alpha) \leq 1$ for a while, one obtains the Lagrangean of this maximization as follows:

$$\begin{aligned} &L(\theta,q,v,w,\tau,\mu,\alpha,\beta) \\ &\doteq V\,(q,v,w,w^*(w,\beta),\tau,\mu,\alpha) + \theta R\,(q,v,w,w^*(w,\beta),\tau,\alpha)\,, \end{aligned} \tag{29}$$

where the Lagrangean multiplier θ can be interpreted as the marginal utility of tax revenue. Because an increase in the international profit tax τ is possible only if it is a Pareto improvement, it cannot hurt any country:

$$\frac{\partial L}{\partial \tau} \geq 0. \tag{30}$$

Maximizing the Lagrangean (29) by controls (θ, v, q, w), given the international profit tax τ, and noting (19) yield the functions (cf. the Appendix)

$$w(\mu,\alpha,\beta,\tau),\quad v(\mu,\alpha,\beta,\tau),\quad q(\mu,\alpha,\beta,\tau),\quad s(\mu,\alpha,\beta,\tau),\quad l=\widetilde{l}(\mu,\alpha,\beta,\tau),$$
$$\frac{\partial w}{\partial\mu}<0,\quad \frac{\partial v}{\partial\mu}<0,\quad \frac{\partial q}{\partial\mu}<0,\quad \frac{\partial s}{\partial\mu}>0,\quad \frac{\partial\widetilde{l}}{\partial\mu}>0,\quad \lim_{\mu\to 0}\widetilde{l}<1, \tag{31}$$

$$\frac{\partial w}{\partial\alpha}\Big|_{l<1}<0,\quad \frac{\partial v}{\partial\alpha}\Big|_{l<1}<0,\quad \frac{\partial q}{\partial\alpha}\Big|_{l<1}<0,\quad \frac{\partial s}{\partial\alpha}\Big|_{l<1}>0,\quad \frac{\partial\widetilde{l}}{\partial\alpha}\Big|_{l<1}>0, \tag{32}$$

$$\frac{\partial w}{\partial\beta}\Big|_{l<1}>0,\quad \frac{\partial v}{\partial\beta}\Big|_{l<1}>0,\quad \frac{\partial q}{\partial\beta}\Big|_{l<1}<0,\quad \frac{\partial s}{\partial\beta}\Big|_{l<1}<0,\quad \frac{\partial\widetilde{l}}{\partial\beta}\Big|_{l<1}<0, \tag{33}$$

$$\frac{\partial w}{\partial\tau}\Big|_{l<1}>0,\quad \frac{\partial v}{\partial\tau}\Big|_{l<1}=\epsilon\frac{\partial q}{\partial\tau}\Big|_{l<1},\quad \frac{\partial s}{\partial\tau}\Big|_{l<1}<0,\quad \frac{\partial\widetilde{l}}{\partial\tau}\Big|_{l<1}<0. \tag{34}$$

6.3 | Capital owners' influence

Because a household's utility (11) is an increasing function of its real income, the welfare of an unemployed worker, an employed worker and the representative capital owner can be represented by their real income q, v and s, respectively. Noting (31) and the full-employment constraint $l(w,w^*,\alpha)\le 1$, one obtains $\lim_{\mu\to\infty} l=1$ and the following result:

Proposition 1 *If the capital owners' relative influence is strong enough,* $\mu\to\infty$*, then the government adjusts the wage* w *to maintain full employment,* $\lim_{\mu\to\infty} l=1$*. Otherwise, the government is content with involuntary unemployment* $l<1$*, but uses the wage* w *as a new instrument to influence income distribution between the workers and the capital owners. In that case, a further decrease in the capital owners' relative influence* μ *encourages the government to transfer income from capital owners to workers by shifting tax burden from wages on to profits. This increases the wage* w*, decreases employment l and harms the capital owners and those employed workers who lose their jobs, but benefits the other workers.*

This can be explained as follows. If the capital owners' relative weight μ in social welfare (25) is low enough, then the joint welfare benefit of the workers who can keep their jobs or who are already unemployed, outweighs the joint welfare loss of the capital owners and the workers who lose their jobs.

6.4 | Effects of globalization

Noting (32), one obtains the following result:

Proposition 2 *Globalization (i.e., an increase in* α*) decreases both an employed and an unemployed worker's disposable income,* v *and* q*, and the wage* w*, but increases employment l and a capital owner's disposable income* s*. This benefits the capital owners and the unemployed workers who succeed in getting a job, but harms the other workers.*

If the governments cannot fully cooperate, they compete for jobs by decreasing the wages. This increases employment and profits, but diminishes tax revenue, which compels the government to tax the employed workers more heavily and to reduce unemployment allowances. Globalization increases the wage elasticity of capital flights, strengthening this wage competition.

6.5 | International cooperation

Noting (33) and (34), one obtains the following result:

Proposition 3 *International cooperation in wage policy (i.e., an increase in* β*) or in profit taxation (i.e., an increase of* τ*) increases the workers' real income,* v *and* q*, and the wage* w*, but decreases employment* l *and a capital owner's disposable income* s*. This harms the capital owners and the employed workers who happen to lose their jobs, but benefits the other workers.*

A higher profit tax yields more tax revenue. Cooperation in labor market policy moderates competition for jobs, which increases wages, decreasing employment, but bringing in more tax revenue. In both cases, the governments can ease the workers' taxation and raise unemployment allowances.

7 | CONCLUSIONS

This document considers the effects of globalization on wages, employment, and individual welfare in a common market of integrated countries with footloose capital, union-wage settlement, and governments that maximize utilitarian social welfare. Each government can simultaneously control the producer's wage (= unit labor cost) and both an employed and an unemployed worker's real income by taxation. Moreover, the governments are strategically interlinked through the commodity markets and the cross-border transfer of capital. The results are the following.

If the capital owners have strong enough relative influence on public policy, then it is in the government's interests to establish full employment. If the capital owners' relative influence is low enough, then the government is interested in transferring income from capital owners to workers, by increasing wages above the full-employment level with the help of union power, and it accepts unemployment for that purpose. In this case, the increase of wages improves the welfare of the employed workers so much that it outweighs the joint welfare losses of the capital owners and the workers that lose their jobs. In the presence of unemployment, a decrease in the capital owners' relative influence on policy encourages the government to shift tax burden from wages on to profits and to increase unemployment allowances. This decreases employment and harms the capital owners and the workers who lose their jobs, but benefits the other workers.

If the governments of all countries could fully cooperate, then there would be the Pareto optimum in which the utilitarian welfare is maximized in every country. Consequently, every measure that increases the governments' cooperation is a Pareto improvement. With missing or incomplete cooperation in public policy, globalization—that is, a decrease in the impediments to international investment—makes capital flight out of a country more elastic to the increase of wages in that country. Then, the governments have to compete for jobs by lowering labor costs, which causes a distortion with suboptimal wages. This boosts employment and benefits the capital owners and the unemployed workers who get a job, but harms the other workers.

If the governments cannot cooperate, then the level of capital taxation remains suboptimal as well. In that situation, an international agreement on raising that tax toward the Pareto optimum level increases tax revenue in every country, allowing the governments to ease the employed workers' taxation and to improve unemployment allowances. This hampers employment and harms the capital owners and the employed workers who lose their jobs, but benefit the other workers.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in the supplementary material of this article.

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ENDNOTES

[1] Blanchard and Giavazzi (2003) as well as Bental and Demougin (2010) introduce extended Nash bargaining between the workers and the firm owners to obtain union relative bargaining power as an additional policy instrument. In this document, it is enough to assume a monopoly union, because even then then the government can by taxes independently control the employer's wage and an employed worker's income.

[2] Cf., Naylor (1998, 1999), Kreickemeier and Nelson (2006), Bastos and Kreickemeier (2009), Boulhol (2009) and Egger and Etzel (2012, 2014).

[3] Naylor (1998), Eckel and Eggel (2017) and Kreickemeier and Meland (2013) consider two equal and perfectly identical countries, Aloi, Leite-Monteiro, and Lloyd-Braga (2009) two equal countries that are identical except for union bargaining power, and Egger and Etzel (2014) two equal countries that are identical except for the degree of centralization in wage settlement.

[4] Cf., Martin and Rogers (1995), Munch (2003), Baldwin, Forslid, Martin, Ottaviano, and Robert-Nicoud 2003, ch. 3, Boulhol (2009) and Egger and Etzel (2014).

[5] This is derived in the file "Supplementary Material for the Readers" online.

[6] Neary (2016, p. 674) advices to replace the indirect utility function (7) by the "Frisch indirect utility function" $-\sigma\lambda_h^2$, because the latter is an increasing transformation of the former, utility maximization leads to the same optimum in both cases. In this study, however, it is more convenient to present a household's utility as a function of real income, (11), so that the price level p is eliminated from the government's utility function (25).

[7] This is proven in the file "Supplementary Material for the Readers" online.

[8] This is derived in the file "Supplementary Material for the Readers" online.

[9] This is proven in the file "Supplementary Material for the Readers" online.

[10] Cf., Atkinson and Stiglitz 1980, pp. 347–348 and 356–358.

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SUPPORTING INFORMATION

Additional Supporting Information may be found online in the Supporting Information section.

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APPENDIX A

RESULTS (31)–(33)

This Appendix is more extensively presented online in the file "Supplementary Material for the Readers."

A1 | Optimization

Maximizing (29) by controls (θ, v, q, w), yields the first-order conditions

$$\frac{\partial L}{\partial \theta} = R(q, v, s, w, w^*(w,\beta), \tau, \alpha) = 0, \tag{A1}$$

$$\frac{\partial L}{\partial q} = [1 - l(w, w^*(w, \beta))][\epsilon U'(q) - \theta] = 0 \quad \Leftrightarrow \quad \theta = \epsilon U'(q), \tag{A2}$$

$$\frac{\partial L}{\partial v} = l(w, w^*(w, \beta))[U'(v) - \theta] = 0 \quad \Leftrightarrow \quad \theta = U'(v) > 0, \tag{A3}$$

$$\begin{aligned} \frac{\partial L}{\partial w} &= V_w + \theta R_w = [U(v) - \epsilon U(q) + \theta(1 + q - v)]l_w - \theta r n_w \\ &\quad + [(1-\tau)m\mu U'(s) + \theta(\tau m - n)]r_w = 0, \end{aligned} \tag{A4}$$

where [cf. (18)–(20) and (28)]

$$\begin{aligned} &V_w \doteq \frac{\partial V}{\partial w} + \frac{\partial V}{\partial w^*}\frac{\partial w^*}{\partial w}, \quad R_w \doteq \frac{\partial R}{\partial w} + \frac{\partial R}{\partial w^*}\frac{\partial w^*}{\partial w}, \quad l_w \doteq \frac{\partial l}{\partial w} + \frac{\partial l}{\partial w^*}\frac{\partial w^*}{\partial w}, \\ &l_w|_{w^*=w} = \Big(\frac{\partial l}{\partial w} + \underbrace{\frac{\partial l}{\partial w^*}}_{+}\underbrace{\beta}_{\le 1}\Big)_{w^*=w} = \Big(\underbrace{\frac{\partial l}{\partial w} + \frac{\partial l}{\partial w^*}}_{-}\Big)_{w^*=w} < 0, \\ &n_w \doteq \frac{\partial n}{\partial w} + \frac{\partial n}{\partial w^*}\frac{\partial w^*}{\partial w}, \quad n_w|_{w^*=w} = \Big(\frac{\partial n}{\partial w} + \frac{\partial n}{\partial w^*}\beta\Big)_{w^*=w} = (\underbrace{1-\beta}_{+})\underbrace{\frac{\partial n}{\partial w}}_{-} < 0, \\ &r_w \doteq \underbrace{\frac{\partial r}{\partial w}}_{-} + \underbrace{\frac{\partial r}{\partial w^*}}_{-}\underbrace{\frac{\partial w^*}{\partial w}}_{+} < 0. \end{aligned} \tag{A5}$$

The second-order conditions are [cf. (11)]

$$Z \doteq -\underbrace{(1-l)^2 l}_{+}\underbrace{U''(v)}_{-} - \underbrace{l^2(1-l)\epsilon}_{+}\underbrace{U''(q)}_{-} > 0, \tag{A6}$$

$$J \doteq \underbrace{Z}_{+}\frac{\partial^2 L}{\partial w^2} + \underbrace{R_w^2}_{+}[\underbrace{(1-l)\epsilon}_{+}\underbrace{U''(q)}_{-} + \underbrace{l}_{+}\underbrace{U''(v)}_{-}] < 0. \tag{A7}$$

The condition for the profit tax, (30), can be written as follows:

$$\frac{\partial L}{\partial \tau} = mr(w,w^*,\alpha)[\theta - \mu U'(s)] \ge 0 \quad \Leftrightarrow \quad \theta \ge \mu U'(s). \tag{A8}$$

A2 | Intermediate results

From (11), (A2) and (A3) it follows that a worker earns as employed more than as unemployed:

$$
\begin{aligned}
&a-bv=U'(v)=\theta=\epsilon U'(q)=\epsilon(a-bq)>0 \Leftrightarrow a/b>q,\\
&v=(\underbrace{1-\epsilon}_{+})\underbrace{a/b}_{>q}+\epsilon q>(1-\epsilon+\epsilon)q=q, \quad U(v)>U(q)>\epsilon U(q).
\end{aligned}
\tag{A9}
$$

By (11), (18)–(20), (27), (28), (A4)–(A7) and (A9), it holds true that

$$
\begin{aligned}
&\frac{\partial R}{\partial \tau}\overset{(27)}{=}mr, \quad \frac{\partial R}{\partial \alpha}\Big|_{w^*=w}\overset{(27)}{=}\Big[(1+q-v)\underbrace{\frac{\partial l}{\partial \alpha}}_{=0,\,(19)}+(\tau m-n)\underbrace{\frac{\partial r}{\partial \alpha}}_{=0,\,(20)}\Big]_{w^*=w}=0,\\
&r_{w\alpha}\doteq\Big(\underbrace{\frac{\partial^2 r}{\partial w\partial \alpha}}_{=0,\,(20)}+\underbrace{\frac{\partial r^2}{\partial w^*\partial \alpha}}_{=0,\,(20)}\frac{\partial w^*}{\partial w}\Big)_{w^*=w}=0,
\end{aligned}
\tag{A10}
$$

$$
n_{w\alpha}|_{w^*=w}\doteq\Big(\frac{\partial^2 n}{\partial w\partial \alpha}+\underbrace{\frac{\partial n^2}{\partial w^*\partial \alpha}}_{=-\frac{\partial^2 n}{\partial w\partial \alpha},\,(18)}\underbrace{\frac{\partial w^*}{\partial w}}_{=\beta,\,(28)}\Big)_{w^*=w}=(\underbrace{1-\beta}_{+})\underbrace{\frac{\partial^2 n}{\partial w\partial \alpha}}_{-,\,(18)}<0,
\tag{A11}
$$

$$
\begin{aligned}
l_{w\alpha}|_{w^*=w}&\doteq\Big(\frac{\partial^2 l}{\partial w\partial \alpha}+\frac{\partial^2 l}{\partial w^*\partial \alpha}\frac{\partial w^*}{\partial w}\Big)_{w^*=w}\\
&\overset{(19)}{=}\frac{l}{n}\Big(\frac{\partial^2 n}{\partial w\partial \alpha}+\frac{\partial^2 n}{\partial w^*\partial \alpha}\frac{\partial w^*}{\partial w}\Big)_{w^*=w}=\frac{l}{n}n_{w\alpha}|_{w^*=w}<0,
\end{aligned}
\tag{A12}
$$

$$
\begin{aligned}
&V_w|_{w^*=w}=[\underbrace{U(v)-\epsilon U(q)}_{+,\,(A9)}]\underbrace{l_w|_{w^*=w}}_{-}+(\underbrace{1-\tau}_{\le 0})\underbrace{\mu m U'(s)}_{+}\underbrace{r_w|_{w^*=w}}_{-}<0,\\
&R_w|_{w^*=w}\overset{(A4)}{=}-\underbrace{V_w|_{w^*=w}}_{-}/\underbrace{\theta}_{+,\,(A3)}>0,
\end{aligned}
\tag{A13}
$$

$$
\frac{\partial^2 L}{\partial w\partial \mu}\overset{(A4)}{=}(\underbrace{1-\tau}_{+})m\underbrace{U'(s)}_{+,\,(11)}\underbrace{r_w|_{w^*=w}}_{-}<0,
\tag{A14}
$$

$$\left.\frac{\partial^2 L}{\partial w \partial \tau}\right|_{w^*=w} \overset{(A4)}{=} r_w \frac{\partial}{\partial \tau}[(1-\tau)m\mu U'(s)+\theta(\tau m-n)]$$
$$= r_w \frac{\partial}{\partial \tau}\Big[(1-\tau)m\mu U''(s) \underbrace{\frac{\partial s}{\partial \tau}}_{=-mr,\,(21)} - m\mu U'(s)+\theta m\Big] \tag{A15}$$
$$= m \underbrace{r_w}_{-,\,(A5)} [\underbrace{\theta-\mu U'(s)}_{\geq 0,\,(A8)} - (\underbrace{1-\tau}_{+}) \underbrace{\mu m r}_{+} \underbrace{U''(s)}_{-,\,(11)}] < 0,$$

$$\left.\frac{\partial^2 L}{\partial w \partial \alpha}\right|_{w^*=w} \overset{(A4)}{=} [U(v)-\epsilon U(q)+\theta(1+q-v)] \underbrace{l_{w\alpha}|_{w^*=w}}_{=\frac{l}{n} n_{w\alpha}|_{w^*=w},\,(A12)}$$
$$-\theta r n_{w\alpha}|_{w^*=w} + [(1-\tau)m\mu U'(s)+\theta(\tau m-n)] \underbrace{r_{w\alpha}|_{w^*=w}}_{=0,\,(A11)}$$
$$= \Big\{[\underbrace{U(v)-\epsilon U(q)}_{+,\,(A9)} + \theta(1+\underbrace{q}_{+}-v)]\frac{l}{n} - \theta r\Big\} \underbrace{n_{w\alpha}|_{w^*=w}}_{-,\,(A11)} \tag{A16}$$
$$< (\underbrace{l-rn}_{=\frac{w}{p}l,\,(20)} - vl)\frac{\theta}{n} n_{w\alpha}|_{w^*=w} = \Big(\underbrace{\frac{w}{p}-v}_{+,\,(26)}\Big) \underbrace{l\frac{\theta}{n}}_{+} \underbrace{n_{w\alpha}|_{w^*=w}}_{-,\,(A11)} < 0,$$

$$\left.\frac{\partial^2 L}{\partial w \partial \beta}\right|_{w^*=w} \overset{(A4)}{=} \Big\{[\underbrace{U(v)-\epsilon U(q)}_{+,\,(A9)} + \theta(1+\underbrace{q}_{+}-v)] \underbrace{\frac{\partial l}{\partial w^*}}_{+,\,(19)} - \theta r \frac{\partial n}{\partial w^*}$$
$$+ [(1-\tau)m\mu U'(s)+\theta(\tau m-n)]\frac{\partial r}{\partial w^*}\Big\}\frac{\partial w^*}{\partial \beta}$$
$$> \Big[(1-v) \underbrace{\frac{\partial l}{\partial w^*}}_{>\frac{l}{n}\frac{\partial n}{\partial w^*},\,(19)} - r\frac{\partial n}{\partial w^*}\Big]\theta + [(1-\tau)m\mu U'(s)+\theta(\tau m-n)]\frac{\partial r}{\partial w^*} \tag{A17}$$
$$> \Big[(1-v)\frac{l}{n} - r\Big]\theta\frac{\partial n}{\partial w^*} + [(1-\tau)m\mu U'(s)+\theta(\tau m-n)]\frac{\partial r}{\partial w^*}$$
$$= \Big(\underbrace{\frac{w}{p}-v}_{+,\,(26)}\Big) \underbrace{\frac{l}{n}\theta}_{+} \underbrace{\frac{\partial n}{\partial w^*}}_{+} + [\underbrace{(1-\tau)m}_{+} \underbrace{\mu U'(s)}_{\leq \theta,\,(A8)} + \theta(\tau m-n)] \underbrace{\frac{\partial r}{\partial w^*}}_{-}$$
$$> [(1-\tau)m\theta+\theta(\tau m-n)]\frac{\partial r}{\partial w^*} = (\underbrace{m-n}_{=0,\,(18)})\frac{\partial r}{\partial w^*} = 0.$$

A3 | Comparative statics

The first-order conditions (A1)–(A4) define the wage w, unemployment allowances q and a worker real income v as functions of the parameters (μ, α, β, t). Differentiating them in the vicinity of the equilibrium with $w^* = w$, and noting (A11), (A6), (A7) and (A13)–(A17), this yields

$$\frac{\partial q}{\partial \mu} = \underbrace{(1-l)l}_{+} \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \mu}}_{-} \underbrace{U''(v)}_{-} \underbrace{R_w}_{+} < 0,$$

$$\frac{\partial v}{\partial \mu} = \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \mu}}_{-} \underbrace{R_w}_{+} \underbrace{(1-l)l\epsilon}_{+} \underbrace{U''(q)}_{-} < 0, \quad \frac{\partial w}{\partial \mu} = -\underbrace{\frac{1}{J}}_{-} \underbrace{Z}_{+} \underbrace{\frac{\partial^2 L}{\partial w \partial \mu}}_{-} < 0,$$

$$\frac{\partial q}{\partial \alpha} = \underbrace{(1-l)l}_{+} \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \alpha}}_{-} \underbrace{U''(v)}_{-} \underbrace{R_w}_{+} < 0,$$

$$\frac{\partial v}{\partial \alpha} = \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \alpha}}_{-} \underbrace{R_w}_{+} \underbrace{(1-l)l\epsilon}_{+} \underbrace{U''(q)}_{-} < 0, \quad \frac{\partial w}{\partial \alpha} = -\underbrace{\frac{1}{J}}_{-} \underbrace{Z}_{+} \underbrace{\frac{\partial^2 L}{\partial w \partial \alpha}}_{-} < 0,$$

$$\frac{\partial q}{\partial \beta} = \underbrace{(1-l)l}_{+} \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \beta}}_{+} \underbrace{U''(v)}_{-} \underbrace{R_w}_{+} > 0,$$

$$\frac{\partial v}{\partial \beta} = \underbrace{\frac{1}{J}}_{-} \underbrace{\frac{\partial^2 L}{\partial w \partial \beta}}_{+} \underbrace{R_w}_{+} \underbrace{(1-l)l\epsilon}_{+} \underbrace{U''(q)}_{-} > 0, \quad \frac{\partial w}{\partial \beta} = -\underbrace{\frac{1}{J}}_{-} \underbrace{Z}_{+} \underbrace{\frac{\partial^2 L}{\partial w \partial \beta}}_{+} > 0,$$

$$\frac{\partial w}{\partial \tau} = -\underbrace{\frac{1}{J}}_{-} \underbrace{(1-l)l}_{+} \Big\{ [(\underbrace{l-1}_{-}) \underbrace{U''(v)}_{-} - l\epsilon \underbrace{U''(q)}_{-}] \underbrace{\frac{\partial^2 L}{\partial w \partial \tau}}_{-}$$
$$- \underbrace{rm\epsilon}_{+} \underbrace{U''(q)U''(v)}_{+} \underbrace{R_w}_{+} \Big\} > 0.$$

By these and (A5), in the vicinity of the equilibrium $w^* = w$, l and s can be defined as functions of the parameters (μ, α, β, t) as follows:

$$l = \tilde{l}(\mu,\alpha,\beta,\tau), \quad \frac{\partial \tilde{l}}{\partial \mu} = \underbrace{l_w}_{-} \underbrace{\frac{\partial w}{\partial \mu}}_{-} > 0, \quad \frac{\partial \tilde{l}}{\partial \alpha} = \underbrace{l_w}_{-} \underbrace{\frac{\partial w}{\partial \alpha}}_{-} > 0,$$

$$\frac{\partial \tilde{l}}{\partial \beta} = \underbrace{l_w}_{-} \underbrace{\frac{\partial w}{\partial \beta}}_{+} < 0, \quad \frac{\partial \tilde{l}}{\partial \tau} = \underbrace{l_w}_{-} \underbrace{\frac{\partial w}{\partial \tau}}_{+} < 0, \quad s(\mu,\alpha,\beta,\tau),$$

$$\frac{ds}{d\mu} = \underbrace{(1-\tau)m}_{+} \underbrace{r_w}_{-} \underbrace{\frac{\partial w}{\partial \mu}}_{-} > 0, \quad \frac{\partial s}{\partial \alpha} = \underbrace{(1-\tau)m}_{+} \underbrace{r_w}_{-} \underbrace{\frac{\partial w}{\partial \alpha}}_{-} > 0,$$

$$\frac{\partial s}{\partial \beta} = \underbrace{(1-\tau)m}_{+} \underbrace{r_w}_{-} \underbrace{\frac{\partial w}{\partial \beta}}_{+} < 0, \quad \frac{\partial s}{\partial \tau} = \underbrace{(1-\tau)m}_{+} \underbrace{r_w}_{-} \underbrace{\frac{\partial w}{\partial \tau}}_{+} < 0.$$