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competition and offshoring**

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The winner gives it all: Unions, tax competition and offshoring*

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Abstract

This paper analyzes competition for capital between welfare-maximizing governments in a framework with agglomeration tendencies and asymmetric unionization. We find that a unionized country's government finds it optimal to use tax policy to induce industry to relocate towards a location with a competitive labor market instead of realizing the benefits from higher wage income while exporting part of the wage burden to foreign consumers. Via the tax regime effect, which favors the factor capital, and the efficiency effect, consumers and producers alike benefit from off-shoring industry towards a low-cost country. Our result qualifies first intuition that defending high wage industries is beneficial to a country as part of the associated cost is shifted to foreign consumers.

Keywords: tax competition, trade unions, agglomeration

JEL Classification: F12, F16, F21, H25, H73, J51

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1 Introduction

In January 2008, Nokia's Executive Vice president Veli Sundbäck announced the closure of its handset factory in Bochum in North Rhine-Westphalia (NRW) and the relocation of Nokia's manufacturing activity to Cluj (Romania) as a response to changes in market conditions and an increased requirement for cost effectiveness. However, as Nokia had received investment subsidies from the state of NRW for its production site in Bochum and will be exempt from the real estate tax in Romania, the decision to relocate its production facility to a low-labour-cost country reignited an old debate on the distribution of state subsidies. As a matter of fact, the latest case of production delocation is just another example of what has been common practice long before the enlargement of the European Union: Governments exploiting firms' responsiveness to subsidies and engaging in subsidy races.¹ Accordingly, Germany may have lost the latest race for a large manufacturer, but has come off as the winner in the past at the cost of subsidy payments when bidding for a BMW plant in 2001 against Kolin (Czech Republic) or averting Volkswagen's threats to relocate towards Hungary in 1996.

Against this background, the present paper assesses the outcome and welfare implications of a subsidy race between countries with different degrees of labor market distortions. Our analysis builds on a model in which industrial activity is inefficiently locked-in in a unionized core country. What we have in mind is that a certain region historically emerged as an industrial center which sparked the emergence of trade unions, capturing some of the location rents earned in such an agglomeration. Our most important result is that tax competition among a leading unionized industry core and a challenging emerging country is efficiency enhancing as it leads to relocation of industry towards the country with a non-distorted labor market. A government of an industrial core whose objective it is to maximize residents' welfare will find it optimal to let its competitor attract mobile capital so as to benefit from increased efficiency and the competing location's tax regime.

¹As more than three quarters of subsidies to industry in the OECD are investment subsidies (see Fuest and Huber, 2000, Table 1) there is hardly any doubt that local governments use subsidies as an instrument to influence the location decision of capital. Van Biesenbroeck (2008) gives an overview of bidding wars between the Canadian and the US government for the automotive industry. See also Greenstone and Moretti (2004).

Local labor markets are typically thought of as important determinants of subsidy policies, disregarding alternative employment opportunities of local workers and the fact that consumers across the country as well as shareholders of locally owned companies may benefit hugely from real capital moving to low-wage or low-tax regions. Our at first sight somewhat surprising result suggests that what we observe in everyday political discussions and decisions may, in some respects, be in contrast to what would be optimal policy once general equilibrium effects are taken into account.

Moreover, disentangling the welfare effects of industry relocation to factor groups reveals that capitalists are the clear winners of the subsidy race as they benefit from lower consumer prices and the repatriation of subsidy income. Workers of the non-unionized competitive industry in the winning country benefit from their government's action only if union wages have been way above the competitive wage rate such that the benefit from lower consumer prices compensates the financing costs of attracting an industry cluster. The opposite holds for non-unionized workers in the former industrial core country. Surprisingly, they suffer, together with former unionized workers, from a delocation of industry and in particular when union wages were high. Since union wages depend on the same parameter as consumers' love for variety a loss of industry will be more severe if the valuation for the industry good is high as this will have a strong impact on the country's consumer price index.

Our modelling approach has various advantages. Firstly, the monopolistic competition framework allows us to be consistent with empirical findings by Stewart (1990), Abowd and Lemieux (1993) and Nickell et al. (1994) who give evidence for unions' wage setting behaviour to depend on firms' market power next to their own bargaining power. Secondly, the model which follows recent work by Borck et al. (2009) is able to reflect the stylized fact that economic activity is not evenly distributed across space but tends to cluster according to certain agglomeration mechanisms as outlined by Marshall (1890), creating location rents for each individual firm. These location rents can to a certain extent be extracted, e.g. by governments or unions without changing the spatial allocation of firms instantaneously.

Our work draws on different strands of the literature. Recent years have seen an increasing interest in the interaction of agglomeration economies and local government tax setting behaviour (Kind et al. (2000), Ludema and Wooton (2000), Baldwin and

Krugman (2004), Borck and Pflüger (2006)) with one major insight being that the presence of agglomeration economies reduces the mobility of capital and creates taxable location rents. These models, however, do not incorporate labor market frictions as an additional factor in the competition for mobile capital. Picard and Toulemonde (2006) examine the role of trade unions on the allocation of firms across two regions. They describe how the existence of union wages reinforce the home market effect supporting the concentration of firms in one location. A parallel strand in the literature has focused on the deterring effects of unionization on foreign direct investment (Leahy and Montagna (2000); Naylor and Santoni (2003); Lommerud et al. (2003)).² These papers, however, consider only trade unions and firms while ignoring government tax policies. A notable exception is recent work by Hauffer and Mittermaier (2008) who show that a unionized country with additional location disadvantages (such as a smaller market) may end up attracting mobile foreign capital, whereby taxes have a strategic effect on the union's behavior. Our model however differs conceptually as it explicitly accounts for agglomeration tendencies which are empirically well established³ and explain the co-existence of industrialized core and lagging regions as empirically outlined in Redding and Venables (2004). Moreover, our paper, by contrast, examines the role unions plays for tax competition without their behavior being controllable (directly or indirectly so) by governments.

The remainder of this paper is organized as follows. Section 2 describes the general setup of the model. Section 3 illustrates the impact of tax competition on the allocation of industrial firms. Section 4 demonstrates the welfare effects on each single factor group. Section 5 discusses the outcomes of the game for an alternative government objective. Section 6 concludes.

²These contributions are part of a more general literature that analyzes the interaction between unionization, imperfect competition in goods markets, and economic integration. See e.g. Brander and Spencer (1988), Huizinga (1993), Driffill and van der Ploeg (1995), and Naylor (1998).

³For an overview of the empirical literature on agglomeration economies see Rosenthal and Strange (2004).

2 The basic model

The theoretical model follows the model proposed by Borck et al. (2009). We consider two countries $i \in \{h, f\}$ (h and f being mnemonic for ‘home’ and ‘foreign’) where one of the two production factors, labor (L), is immobile, whereas the other, capital (K), is mobile across countries such that it can be employed in one region while its owners (who do not move) spend its return in the other region. Countries are symmetric in technology, preferences and size, but are allowed to differ in labor market rigidity as measured by a parameter of union power. There are two sectors, an ‘ A ’ sector with perfect competition, and an industrial ‘ M ’ sector displaying differentiated goods, increasing returns to scale and monopolistic competition. Trade in the competitive good is costless, whereas the increasing returns sector faces per unit ‘iceberg’ transport costs τ à la Samuelson (1954) which means that for each unit to arrive at location j , $1 + \tau$ units have to be shipped from location i . The A sector produces a homogeneous traditional good which we choose to be the numéraire using labor only. Units are scaled such that one unit of labor produces one unit of output, so that the competitive wage also equals one.

2.1 Preferences

There are two types of households in each country, inelastically supplying their factor endowment, labor and capital, respectively. In country i , there is a total of $K_i + L_i$ households, whose utility stems from consumption of the traditional as well as the differentiated, industrial varieties. Those preferences are reflected by a two-tier utility function, whereby the upper tier is quasi-linear and the lower tier is of the C.E.S. type. The upper tier utility function of a household is

$$U_i(M_i, A_i) = \alpha \ln M_i + A_i - \alpha[\ln \alpha - 1], \quad (1)$$

where the last term is a constant that disappears when indirect utility is derived, A_i denotes consumption of the traditional good and M_i stands for differentiated industrial varieties v according to the lower-tier function

$$M_i = \left(\int_0^{n_i} m_{ii}(v)^{\frac{\sigma-1}{\sigma}} dv + \int_{n_i}^N m_{ji}(v)^{\frac{\sigma-1}{\sigma}} dv \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1, \quad N = n_i + n_j. \quad (2)$$

Here σ denotes the constant elasticity of substitution between any two varieties and n_i the mass of varieties produced in i . m_{ii} and m_{ji} denote the quantity consumed by a household in country i of a variety produced in i and j , respectively. Assuming $0 < \alpha < y_{is}$, ($i = h, f$; $s = K, L$) it is ensured that both goods will be consumed. Utility maximization yields the following demand functions:

$$\begin{aligned} M_i &= \frac{\alpha}{P_i}, & A_{is} &= y_{is} - \alpha, & s &= K, L \\ m_{ii} &= \alpha p_i(v)^{-\sigma} P_i^{\sigma-1}, & m_{ji} &= \alpha (\tau p_j(v))^{-\sigma} P_i^{\sigma-1}, \end{aligned} \quad (3)$$

where

$$P_i \equiv \left(n_i p_i^{1-\sigma} + n_j (\tau p_j(v))^{-\sigma} \right)^{\frac{1}{1-\sigma}} \quad (4)$$

denotes the perfect C.E.S. price index⁴ where we take into account that firms within one country are identical and charge identical producer prices.⁵ Indirect utility is

$$V_{is} = y_{is} - \alpha \ln P_i, \quad s = K, L \quad (5)$$

where income is either labor (' L ') income or capital (' K ') income.

2.2 Industrial production

The perfectly competitive A sector has already been described above. Every firm in the industrial sector produces one variety⁶ with a fixed input, namely one unit of capital, and labor. Moreover, a higher concentration of industry in the country lowers the labor input requirement, according to the following specification: For each unit of output, $\gamma_i \equiv 1/(1 + \theta n_i)$ units of labor are needed as a variable input, where $\theta > 1$ measures the local knowledge spill-over occurring between workers of the M sector. This way of modelling spill-overs is obviously a short-cut for considering the various channels through which industry concentration may benefit each and every single firm. It can be rationalized in the present setting by knowledge exchange or thick labor markets.⁷

⁴This is the expenditure needed to purchase a unit-level of welfare.

⁵However, producer prices across regions are no longer equal once we allow for labor market frictions.

⁶Note that this is not an assumption, but a result. For details, refer to Baldwin et al. (2003).

⁷For a thorough analysis on the micro-foundations of agglomeration economies, see Duranton and Puga (2004).

Using this specification, the firms' profit function in i reads

$$\pi_i = (p_i - w_i\gamma_i)q_i - r_i, \quad (6)$$

where p_i denotes the consumer price, w_i is the wage rate, and r_i is the capital reward rate. Equilibrium in the goods market requires total (world) demand for a domestic industrial good to equal supply of this variety. The market clearing condition reads

$$q_i = m_{ii}(L_i + K_i) + \tau m_{ij}(L_j + K_j) \quad (7)$$

This latter term shows that part of demand is indirect due to iceberg trade costs which are fully borne by consumers. Straightforward profit maximization gives us the firm's mill price

$$p_i = \frac{\sigma}{\sigma - 1} w_i \gamma_i, \quad (8)$$

whereby the same price, multiplied by τ , is charged to customers abroad. Now, since capital supply is fixed, so is the number of firms which will bid for capital; hence, its compensation adjusts so as to ensure zero profits in equilibrium. Using this zero-profit condition and (8), we obtain the output level which allows a firm to break even

$$q_i = \frac{r_i(\sigma - 1)}{w_i \gamma_i}. \quad (9)$$

Labor demand of an industrial firm reads

$$l_i^M = \gamma_i q_i. \quad (10)$$

2.3 Mobile factor's reward

In the short run the allocation of capital and hence the location of M firms is exogenous. To derive capital's reward note that, due to the fact that one unit of capital is needed to run a firm, its reward is bid up to the point where it equals operating profit. To ease notation, we will henceforth use the share notation where $s_n \equiv n_h/N$ denotes region h 's share of the world's industry, $\lambda \equiv L_h/L$ is region h 's share of world labor and $\kappa \equiv K_h/K$ denotes the share of world capital region h owns. With (8) and (9), it follows immediately that the capital reward rate r_i reflects operating profit, i.e.

$r_i = (1/\sigma)p_iq_i$. Using this, the demand functions (3) and market clearing (7) and normalizing $N = L = K = 1$, yields

$$\begin{aligned} r_h &= \frac{\alpha}{\sigma} \left(\frac{\kappa + \lambda}{s_n + \phi\chi(1 - s_n)} + \frac{((1 - \kappa) + (1 - \lambda))\phi}{\phi s_n + \chi(1 - s_n)} \right), \\ r_f &= \frac{\alpha}{\sigma} \left(\frac{\phi\chi(\kappa + \lambda)}{s_n + \phi\chi(1 - s_n)} + \frac{((1 - \kappa) + (1 - \lambda))\chi}{\phi s_n + \chi(1 - s_n)} \right); \end{aligned} \quad (11)$$

where $0 < \phi \equiv \tau^{1-\sigma} \leq 1$ stands for the level of trade freeness and $\chi \equiv \left(\frac{p_f}{p_h}\right)^{1-\sigma} = \left(\frac{w_f\gamma_f}{w_h\gamma_h}\right)^{1-\sigma}$.

In the long run capital is mobile and seeks for the highest nominal return. Local technological spillovers on the sectoral level support a locational equilibrium where all industrial activity is clustered in one region since, all else equal an increase in the number of firms in h increases operating profit in h and hence the capital reward gap $(r_h - r_f)$ which induces a further capital inflow into h . On the other hand, firms in h will face intense local competition as s_n increases which deters other firms to enter the market. However, for ongoing trade integration ϕ firms compete with other firms irrespective of their location which entails that the opportunity cost of agglomerating in one country and serving the foreign market from abroad become low. Consequently, for a sufficiently high level of trade freeness firms will be agglomerated in one region as they benefit from the spatial proximity to other firms through local industry spill-over effects. The critical level of trade freeness at which the benefit of agglomeration begins to exceed the cost of serving from one location is typically denoted as the break point level of trade freeness, ϕ^B and derived solving $\left.\frac{\partial r_h - r_f}{\partial s_n}\right|_{s_n=1/2} = 0$ for ϕ .⁸

For the purpose of our later analysis which assesses the outcome of a tax competition game between an industrialized country hosting an industry cluster ('core') and a lagging region ('periphery'), we describe a locational equilibrium where the level of trade freeness is sufficiently high ($\phi > \phi^B$) such that all industry is agglomerated in one region, say h .⁹ This could be due to historical reasons, just as the story goes in Krugman's seminal 1991 paper. For instance, one could think of a highly industrialized

⁸A formal expression of the break point is available upon request. For a more detailed model exposition see Borck et al. (2009).

⁹Tax competition within agglomeration models where trade costs are so high that no agglomeration occurs yield results that are closer in nature to the 'basic tax competition model' (see Baldwin et al. (2003)). For an analysis of such interior cases in a New Trade Theory model, refer to Egger and Seidel

country in Western Europe versus an emerging market in Eastern Europe. As said in the introduction, we think that historically determined agglomeration patterns then may have sparked labor's organization, giving rise to asymmetric unionization. Firms in the industrial core earn an agglomeration rent (Ω) which is defined as the loss a single firm would incur if it relocated to the periphery, given that all other firms stay in the core. In other words, capital is tied to the core and capital owners will have no incentive to relocate their capital unit as long as they earn positive location rents which can be expressed as

$$\Omega \equiv r_h - r_f|_{s_n=1} = \frac{\alpha}{\sigma} \left(2 - \frac{1}{\phi} \left(\frac{w_f(1+\theta)}{w_h} \right)^{1-\sigma} (1+\phi^2) \right). \quad (12)$$

Obviously, the agglomeration rent is increasing in θ the intensity of local industry spill-overs, the level of trade integration ϕ and foreign's wage rate w_f , whereas it is decreasing in core's wage, w_h .

2.4 Union wage setting

As noted earlier the emergence of an industrial cluster may have sparked labor's organization, giving rise to asymmetric unionization. We find it therefore natural to choose the industrialized core to be the unionized country whereas periphery's labor market is perfectly competitive. Hence, whereas the immobile factor's reward in the periphery is equal to the competitive wage rate, we allow firm-specific unions (which are conceptually identical to sector-specific unions in this model) in the core to set the nominal¹⁰ reward for unionized workers using a decentralized wage setting approach for two reasons: Nationwide unions are hardly observed in reality and, more importantly, the feature of our model that unions, much like competing firms, try each to get the highest rent possible without internalizing consequences for the overall price level, tax policies and industry location, is one that makes it plausible as a stylized description of many OECD countries' union behavior. Workers employed in unionized firms will enjoy higher nominal wages than those working in the non-unionized sector of

(2007) who show that a country with a stronger labor market distortion will find it optimal to choose a lower Nash tax rate in competition for mobile capital.

¹⁰Obviously, we do not use a monetary model here. We use the term 'nominal' as opposed to 'real' in the sense that the latter means taking the price index into account.

the economy. Consequently, as firms set their prices according to a fixed mark-up rule (8), consumer prices will, of course, be higher under unionization, which implies that A sector employees and capital owners will lose from it, as will foreign country's residents who buy imported differentiated goods from core's industry. The non-unionized traditional A industry serves as a 'buffer' sector for those who do not find employment in the industrial M sector, so there will be no unemployment.

We employ a monopoly union approach,¹¹ where the union maximizes the nominal wage bill of its members over and above the competitive one, $(w_h - 1)l_i^M$. The firm then exerts its 'right to manage', i.e. it chooses optimal output given the wage rate. From here on, w_h denotes the union-sector wage in h (whereas the competitive wages in core and periphery are equal to 1, see above). Using (7), (10) and the demand functions from (3), we rewrite union's objective function,

$$(w_h - 1) \gamma q_h = (w_h - 1) \gamma_h \left(\frac{\sigma}{\sigma - 1} \gamma_h w_h \right)^{-\sigma} \alpha \psi, \quad (13)$$

where $\psi \equiv [P_h^{\sigma-1}(\kappa + \lambda) + P_f^{\sigma-1}((1 - \kappa) + (1 - \lambda))]$.¹² The left hand side of (13) reveals how each union equally weighs the factors 'wage rate above competitive wage rate' and 'employment' so as to maximize the excess wage bill. The iso-elasticity of both labor demand (that stems from the iso-elasticity of product demand and constant per unit labor input requirement) and the firm's part of the Nash bargaining lead to the wage that maximizes (13)

$$w_h = 1 + \frac{1}{\sigma - 1} \quad (14)$$

which is simply a fixed mark-up on the competitive wage. Intuitively, the union wage rate falls in the elasticity of substitution which measures a firm's mark-up in the monopolistically competitive industry.¹³

¹¹This is a special case of Nash bargaining between the representative union and the firm where all the bargaining power is with the union. We are aware that this is only one out of many ways to model industrial relations; however, it seems to be the most widely used one due to its tractability. For an exhaustive overview of collective bargaining and some empirical evidence, we refer to Cahuc and Zylberberg (2004).

¹²Note that each union neglects the effects on the economy's consumer price index.

¹³It is worth noting that we get an only quantitatively different result with the more general Nash bargaining approach. The union's outside option is zero, and the firm's outside option is to produce nothing, having already sunk the fixed cost which is the same whether an agreement is reached or

A natural question that arises within a core-periphery equilibrium and unions' mark-up wages in the core is whether, in the absence of government intervention, this allocation of capital remains stable. This is a straightforward problem to tackle, which leads us to

Proposition 1 *Agglomeration rents earned in the core can partially be reaped by trade unions, up to a wage level of $w_b = (1 + \theta) \left(\frac{2\phi}{1+\phi^2} \right)^{\frac{1}{\sigma-1}}$. Beyond this point, the core-periphery equilibrium becomes unstable as the rents in f are higher.*

For the proof, we simply set r_h equal to r_f and solve the equation for w_h , evaluating the expression at $s_n = 1$. This is the 'break wage rate' above which each and every unit of capital is better off in country f than in the core h . The first derivatives are straightforward: w_b rises in local technological spill-over (θ) and falls with market integration (ϕ). Fig. 1 illustrates the stability of the core-periphery equilibrium under asymmetric unionization.

Fig. 1 reveals that as long as the union wage rate set in the core does not exceed the break wage rate w_b , capital will be tied to the region where it earns an agglomeration rent. Of course, with the presence of unions in the agglomerated core part of the location rent which, in the absence of labor market distortion fully accrued to capital owners are now redirected to unionized workers.

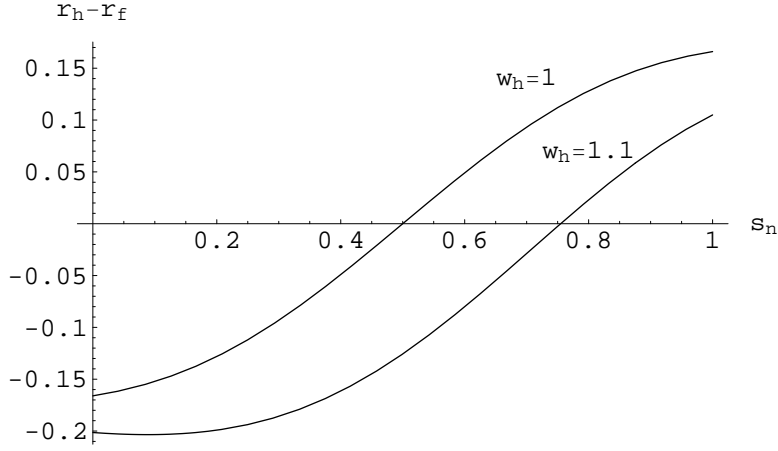
3 Tax competition

Governments maximize residents' welfare and deploy lump-sum taxes on factor endowment, using the revenues for a direct subsidy to capital employed within their borders.¹⁴ In accordance with the models in this literature (see Baldwin and Krugman (2004),

not and hence cancels from the Nash maximand (This point is parallel to Picard and Toulemonde (2006). They emphasize that this assumption is implicitly made in many models where fixed costs are set to zero). Adding weights of β and $1 - \beta$ to the union's and firm's objectives in the Nash product, respectively, and maximizing yields $w_h = 1 + \beta/(\sigma - 1)$. Since this does not provide us with additional insights, we do not pursue this further.

¹⁴Tax competition here is modelled in a very simple way: Given that the *owners* of both factors are immobile, they are simply taxed on their endowment, i.e. residence-based taxes are employed.

Figure 1: Stability of core-periphery equilibria under asymmetric unionization



$$\sigma = 4; \alpha = 0.5; \theta = 0.3; \phi = 0.6.$$

Borck and Pflüger (2006)), we assume that the core is a Stackelberg leader in that it gets to set its tax rate first. In our framework, this assumption can be rationalized in the following way: The country that disposes of the unionized industries knows that it may face competition from a challenger and will essentially play an ‘entry-deterrence’ game.

Letting z_i denote a subsidy to capital employed in i and $r_i + z_i$ the return to capital including subsidies, we end up with the government budget constraints

$$s_n z_h = T_h(\kappa + \lambda); \quad (1 - s_n)z_f = T_f((1 - \kappa) + (1 - \lambda)), \quad (15)$$

with T_i denoting the tax rate. To best disentangle the effects of asymmetric unionization on the location of capital we assume that countries are of equal size ($\kappa = \lambda = 0.5$).¹⁵ Governments are utilitarian and maximize the sum of residents’ indirect utility, where welfare of unionized M and non-unionized A workers as well as capitalists, in h reads

$$V_h^M = L_h^M(w_h - \alpha \ln P_h - T_h), \quad (16)$$

$$V_h^A = (L - L_h^M)(1 - \alpha \ln P_h - T_h), \quad (17)$$

$$V_h^K = K_h(y_K - \alpha \ln P_h - T_h), \quad (18)$$

¹⁵The interested reader is referred to Borck et al. (2009) who consider inefficiencies arising through asymmetrically sized countries.

where y_K denotes capitalist's income and $L_h^M = l_h^M n_h$ is the core's industrial sector's labor demand. Observe that since the world is a lumpy place in this model, both parties will effectively compare two situations: being the core (henceforth indicated by the superscript 'c') or the periphery (indicated by 'p'). At this point, the simple structure of the model gives us a lot of mileage when it comes to optimal policy analysis as we get a closed-form welfare function. Taking the example of country h being the core,¹⁶ welfare is derived adding up (16)-(18) evaluated at $s_n = 1$

$$WF_h^c = \frac{1}{2} \left(1 - z_h + \frac{2\alpha}{\sigma} \right) + L_h^{Mc} (w_h - 1) - \alpha \ln P_h^c, \quad (19)$$

where $L_h^{Mc} \equiv \frac{2\alpha(\sigma-1)}{\sigma w_h}$. Country f 's welfare in this case is

$$WF_f^p = \frac{1}{2} \left(\frac{2\alpha}{\sigma} + z_h + 1 \right) - \alpha \ln P_f^p. \quad (20)$$

If, by contrast, all industry locates in f , the welfare terms are

$$WF_h^p = \frac{1}{2} \left(\frac{2\alpha}{\sigma} + z_f + 1 \right) - \alpha \ln P_h^p \quad (21)$$

$$WF_f^c = \frac{1}{2} \left(\frac{2\alpha}{\sigma} - z_f + 1 \right) - \alpha \ln P_f^c \quad (22)$$

The simplified price indices are obtained using (8) and (14) in (see (4))

$$\begin{aligned} P_h^c &= \frac{\sigma}{\sigma-1} w_h \gamma, & P_h^p &= \frac{\sigma}{\sigma-1} \phi^{1/(1-\sigma)} \gamma, \\ P_f^c &= \frac{\sigma}{\sigma-1} \gamma, & P_f^p &= \frac{\sigma}{\sigma-1} \phi^{1/(1-\sigma)} w_h \gamma. \end{aligned} \quad (23)$$

where $\gamma \equiv 1/(1 + \theta)$. Note that part of core's union wage rate is borne by consumers abroad ('wage cost exporting').

Moreover, given our assumption that the labor market distortion occurs only in h , we can show that global welfare $WF^{glob} = WF_h + WF_f$ could be enhanced if the industry core shifted towards the non-unionized periphery:

Proposition 2 *For high levels of trade freeness and $w_f < w_h < w_b$ the core-periphery equilibrium $s_n = 1$ is stable but globally inefficient,*

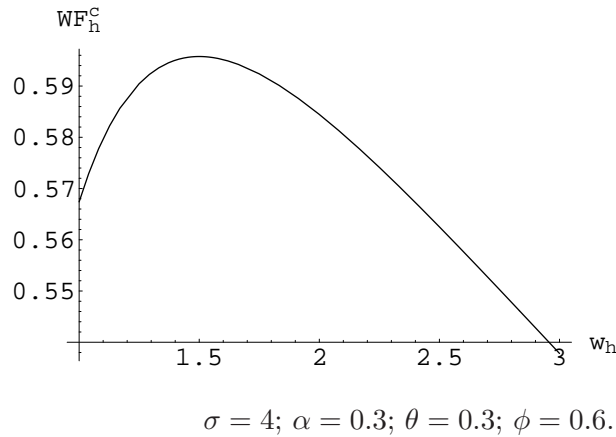
$$WF^{glob}|_{s_n=1} < WF^{glob}|_{s_n=0}.$$

¹⁶Note that $r_h|_{s_n=1} = r_f|_{s_n=0} = 2\alpha/\sigma$.

Proof: See Appendix A. ■

The obvious question then is whether core will defend its industry cluster and prevent the shift of industry towards an efficient allocation, using a generous tax regime to compensate capital for high union wages and at the same time ensuring higher nominal wages for its industrial workers. Hosting the industry core is attractive since local production avoids consumer-borne trade costs for one’s residents (‘cost-of-living effect’). Moreover, whereas the benefit of higher nominal wages accrues to unionized workers in the core only, part of the resulting higher consumer prices is borne by consumers abroad (‘wage cost exporting’). However, the latter effect enhances welfare in the core only up to a certain union wage level after which consumer prices become so high that less workers will be employed in the unionized sector as less of the industrial good is demanded. This is illustrated in Fig. 2 which depicts core’s welfare as a function of union wages in the absence of subsidies

Figure 2: Core’s welfare function for different union wages



3.1 Second Stage: Periphery’s government

Solving the game via backward induction, we start with the government of the periphery at stage two of the tax game. As all firms are alike, this is a straightforward exercise: The government of the periphery, government f , has a maximum subsidy/minimum tax it is willing to offer. This can be found at the point where its overall welfare level is the same no matter if it hosts the industry or not, $WF_f^c = WF_f^p$. Solving this for

the subsidy, we obtain ‘ z_f^{max} ’:

$$z_f^{max} = -z_h + 2\alpha \left(\ln w_h - \frac{\ln \phi}{\sigma - 1} \right) \quad (24)$$

The first term denotes the foregone repatriation of subsidy income from c for periphery’s capitalists once p attracts the industry. The second term captures the benefits of industry relocation towards the non-unionized country. Residents in the periphery benefit from lower consumer prices since wages are competitive and transport costs are absent for them once industry locates in the periphery. On the other hand, the government of the periphery knows that it has to offer each firm at least what core’s government offers, in addition to the agglomeration rent Ω . We call this subsidy level ‘ z_f^{min} ’ which is obtained solving $\Omega + (z_h - z_f) = 0$ for z_h using (12):

$$z_f^{min} = z_h + \frac{\alpha}{\sigma} \left(2 - \frac{1}{\phi} \left(\frac{1 + \theta}{w_h} \right)^{1-\sigma} (1 + \phi^2) \right). \quad (25)$$

Now, as long as z_f^{max} is greater than z_f^{min} , periphery can profitably attract the capital from the core. Note that these terms depend only on core’s tax policy (z_h) and exogenous parameters (as the monopoly unions’ wage, w_h , only depends on the parameter σ). The next step is to examine government h ’s behavior.

3.2 First Stage: Core’s government

The core’s government is aware of the influence its policy exerts on the ability and willingness of the periphery to attract capital. To determine core’s optimal behavior, we first determine the policy at which periphery’s government will not be able to profitably attract the mobile capital. In a next step we check whether core’s government will actually want to hold on to the industrial core.

From inspection of (24) and (25), it can easily be seen how we can work out the ‘knife-edge’ level of subsidy, say z_h^d , at which the core can make it unprofitable for the periphery to attract the industry which will be the case whenever z_f^{min} is at least as large as z_f^{max} . We set (24) equal to (25) and solve for z_h :

$$z_h^d = \frac{\alpha}{2\sigma} \left(\frac{1}{\phi} w_h^{\sigma-1} (1 + \theta)^{1-\sigma} (1 + \phi^2) + 2\sigma \ln w_h - \frac{2\sigma \ln \phi}{\sigma - 1} - 2 \right). \quad (26)$$

This means that core's offer has to be at least z_h^d to make sure that the periphery's government will not be a threat to the pre-existing allocation.¹⁷

It is however not immediately obvious what core's government opts for: Production in its part of the world leads to a lower price index for all of its consumers ('cost-of-living effect'). Moreover, industrial workers in the core earn higher wages than they otherwise would - whereby part of this excess wage bill is paid, via higher prices, by foreigners ('wage cost exporting effect'). On the other hand, allowing the industry to delocate to f means h 's capitalists would benefit from the repatriation of subsidy income and also that its consumers would be able to buy goods produced in a low-wage region. So, in the case where core holds on to its industry, it will set $z_h = z_h^d$. In the case where it does not, it will set the subsidy level marginally smaller, $z_h = z_h^d - \epsilon$, where ϵ is some small but positive number. To see this latter point, note that this guarantees the highest possible subsidy transfer from the periphery (remember, $z_f^{min} = z_h + \Omega$). Core's optimal policy can therefore be summarized by

$$z_h^* = \begin{cases} z_h^d & \text{if } WF_h^c(z_h^d) \geq WF_h^p(z_f^{min}(z_h)), \\ z_h^d - \epsilon & \text{otherwise.} \end{cases}$$

This gives us also f 's optimal policy when it attracts all industry: As the second mover, it takes the given z_h^* . So we plug z_h^d for z_h into (25), which is optimal by a similar argument to the one above: It is the cheapest way to attract the industry. On the contrary, in case of no industry delocation it is simple to conclude that the subsidy to capital and hence the tax on L and K will be zero as being the periphery implies not hosting any industry.

Now that we derived each countries' optimal policies in the two cases, we proceed to the equilibrium outcome of the game. The reduced-form equations can be obtained by plugging the optimal policies for each case into the region's respective welfare functions (19)-(22) using (25) and (26). It is then a straightforward exercise to compare welfare levels. Core's government will simply compare the difference between $WF_h^c(z_h^*)$ and $WF_h^p(z_f^*)$. If it is positive, then the country as a whole is better off holding on to its industry; if it is negative, the opposite holds true. Using (19) and (21) the welfare

¹⁷Obviously, every better offer will do the trick, but will never be optimal since the subsidies do not alleviate any distortion. Rather, they amount to a transfer to the other country which will be kept as tiny as possible.

differential can be written as

$$WF_h^c - WF_h^p = L_h^{Mc}(w_h - 1) - \frac{z_h^*}{2} - \frac{z_f^*}{2} - \alpha \ln\left(\frac{P_h^c}{P_h^p}\right). \quad (27)$$

The excess wage bill in the first term reflects the benefits of keeping all industry whereas the second and third term reflect the financing cost and the foregone subsidy payment of doing so, respectively. The last term's sign is ambiguous as both P_h^c and P_h^p will exceed one. Hence, depending on the level of trade freeness and the union wage the last term will be positive or negative. Note that both governments take into account all general equilibrium effects. Specifically, all tax and wage effects as well as trade cost and price effects are taken into account. We can now state

Proposition 3 *A welfare-maximizing government in the unionized core will find it in its best interest to let the industrial core move to the periphery i.e.,*

$$WF_h^c(z_h^d) - WF_h^p(z_f^{min}) < 0.$$

Proof: See Appendix B. ■

This result is striking at first sight. After all, the core acts as a Stackelberg leader and maximizes welfare within its border. So one might have expected it to hold on to its industry via a generous tax regime since the costs of higher union wages are partly borne by consumers abroad while the benefits of higher wage income accrue solely to workers within the country. Upon closer inspection, however, our result is quite intuitive: By letting its capital relocate to f , while still owning it, country h gets rid of the labor market distortion¹⁸ and, at the same time, makes sure capital owners get a favorable tax regime abroad, leading to repatriated subsidies. This makes a nice case why governments may, in bidding for mobile factors, make favorable offers: They may have in mind the preferential regimes their countrymen's businesses will get abroad. Furthermore, the presence of a challenging emerging market, i.e. tax competition leads to increased global welfare via restoring an efficient allocation of industry.

¹⁸Trade costs will, at a certain point, counteract the 'lower-wage' effect on prices. However, high trade costs undermine stability of the core-periphery equilibrium in the first place, which is why we concentrated on lower levels of τ from the outset.

4 Winners and losers of the subsidy race

The above analysis showed that unionized core benefits from inducing a relocation of firms towards the periphery country f . It chooses a subsidy level at which the periphery can profitably attract all industry. Hence, both countries are clearly winners of the game and benefit from delocating industry towards a country with a non-distorted labor market. This section identifies the winners and the losers of the subsidy race within the different income groups. We begin with country h 's and f 's capital owners.

Proposition 4 *Capitalists in both locations are the clear winners of the subsidy race. Capitalists in h win due to the repatriation of capital income whereas capitalists in f benefit from a lower cost-of-living index.*

Proof: See Appendix C. ■

For core's capital owners, the benefits from repatriating subsidies exceed the cost of incurring transport costs for imported varieties. Capitalists in f benefit from a lower cost-of-living index while the financing cost for subsidies are shared between capitalists and workers.

The impact on workers in the new core country is however ambiguous. To begin with workers of the new core the indirect utility ($V_{f,w}$) differential of workers in f before and after reads

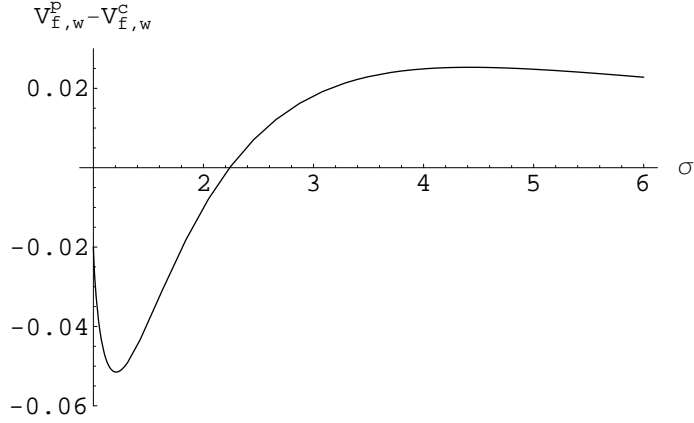
$$V_{f,w}^p - V_{f,w}^c = L_f \left(\alpha (\ln P_f^c - \ln P_f^p) + z_f^{min} \right). \quad (28)$$

The difference in price indices is negative since $P_f^c < P_f^p$, indicating that workers are better off with firms producing in their country. The last term, however, indicates that workers might be better off in a periphery when financing costs are high. Fig. 3 illustrates the welfare differential in (28).

Fig. 3 reveals that workers in f will only benefit from an industry relocation for low σ . Put differently, workers in f win only if they have severely suffered from wage cost exporting, i.e. for high union wages (low σ) such that it becomes worthwhile to incur the financing costs of attracting firms.

Intuitively, union members as a whole lose as industry shifts towards f . Their real income unambiguously falls on two counts, the decline of the nominal wage and the increase of the price index. The difference of before and after welfare of union workers

Figure 3: Foreign workers' welfare differential



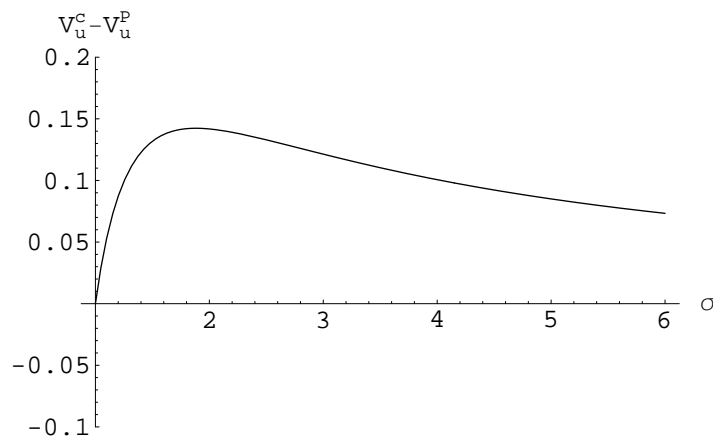
$$\phi = 0.6; \alpha = 0.3; \theta = 1.$$

denoted as V_u^c and V_u^p , respectively is derived using (16) and (23) for the core and periphery case

$$V_u^c - V_u^p = \frac{2\alpha}{\sigma} \left(\frac{\sigma - 1}{\sigma} \right) \left(1 + \alpha [(\sigma - 1) \ln \left(\frac{\sigma - 1}{\sigma} \right) - \ln \phi] \right). \quad (29)$$

Fig. 4 depicts union workers' welfare differential in (29) for different σ which confirms that union workers particularly suffer from subsidy competition for low σ , i.e. high union wages.

Figure 4: Welfare of h 's union workers before and after industry relocation



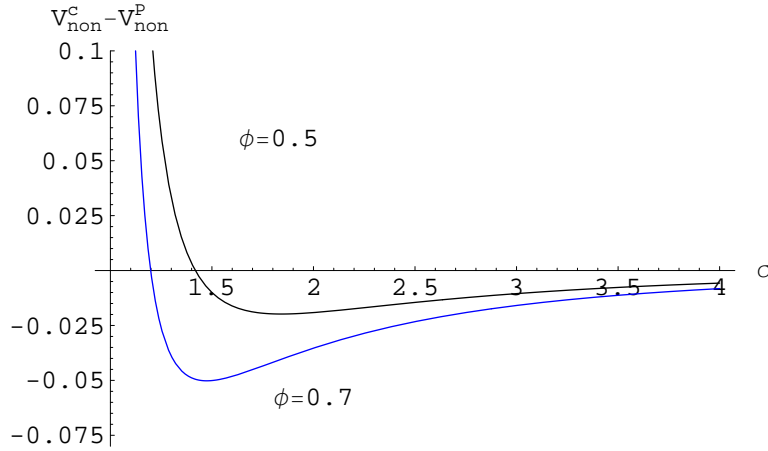
$$\phi = 0.6 \text{ and } \alpha = 0.3.$$

Turning to non-union workers in h , their welfare differential is obtained after inserting the respective price indices into h 's non-union workers' indirect utilities using (17) for both cases

$$V_{non}^c - V_{non}^p = -\alpha(\lambda - L_h^{Mc})(\ln w_h - \frac{1}{1-\sigma} \ln \phi) \quad (30)$$

From inspection of (30) it is not ex ante clear whether non-union workers unambiguously benefit from industry relocation towards a country with no labor market distortion. More precisely, non-union workers benefit from industry delocation as they no longer bear high consumer prices resulting from asymmetric unionization (this effect is captured in ' $\ln w_h$ ') whereas they suffer from losing all industry as they have to bear transport costs for imported varieties which is reflected through ' $\ln \phi$ '. To learn whether the overall effect is positive or negative Fig. 5 displays non-union workers' before and after welfare differential at different levels of σ evaluated at different degrees of trade freeness.

Figure 5: Welfare of h 's non-union workers (before and after industry relocation)



$$\alpha = 0.3.$$

Surprisingly, non-union workers were *better off* for low σ , i.e. under (high) union wages and experience higher welfare from industry relocation only for higher σ (low union wages). This seems to be counterintuitive at first sight as we would expect non-union workers to gain (like workers in f) especially for low σ , i.e. for high union wages. To understand the result, first note that non-union workers face a trade off between higher consumer prices due to union wages and higher consumer prices because of shipping

costs. However, recall that a low elasticity of substitution σ implies high union wages but at the same time indicates a high love for variety. Consequently, consumers in h suffer from industry delocation especially if their valuation for the industrial good is high as this leads to a strong increase in the cost-of-living index P_h which depresses households' purchasing power in h . Formally, this effect reads

$$\frac{\partial P_h^p}{\partial \sigma} = \frac{\phi^{\frac{1}{1-\sigma}}(\sigma \ln \phi + 1 - \sigma)}{(1 + \theta)(\sigma - 1)^3} < 0, \quad \frac{\partial^2 P_h^p}{\partial \sigma \partial \phi} = \frac{\phi^{\frac{\sigma}{1-\sigma}}(\sigma^2 - 1 - \sigma \ln \phi)}{(1 + \theta)(\sigma - 1)^4} > 0. \quad (31)$$

which reflects that an increasing elasticity of substitution (a declining 'love for variety' and lower union wages) attenuates the loss arising from a high peripheral cost-of-living index. This effect is amplified by decreasing levels of trade freeness.

5 Discussion

Obviously, our strong main result arises out of two specific assumptions: Firstly, governments are true welfare-maximizers and weigh workers' and capital owners' utility equally. Then, the most efficient solution prevails, which is offshoring production to a location where the labor market is not distorted.¹⁹ A straightforward extension here is to assume a government that only cares about workers, which could be due to its preferences or the fact that capital ownership is concentrated in very few hands, whereas the by far biggest share of households are labor households. In this case, the core will not find it optimal to get rid of its industry up to a certain union wage, but will rather accept the distortion which is partially borne by periphery's residents. We briefly illustrate the case of a government that does not care about capital owners: Such a government's objective function has as its arguments only A - and M -sector workers' utility. Apart from that, we proceed in perfect analogy to the analysis above, i.e., we compare price indices and welfare levels with all industrial activity in h and f , respectively, and work out the critical tax/subsidy levels \hat{z}_h^{max} , \hat{z}_h^d under this alternative scenario. Finally, inserting the optimal policies under the revised scenario into the government objective function and conducting government h 's welfare comparison, like

¹⁹The tax game here has, as is true of many of the models in this literature, an auction-like character - hence the globally efficient outcome.

before leads to the welfare differential

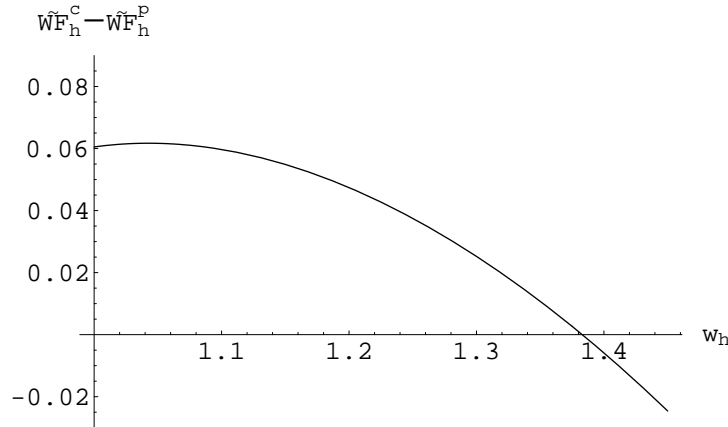
$$\tilde{W}F_h^c - \tilde{W}F_h^p = L_h^{Mc}(w_h - 1) - \frac{z_h}{2} - \alpha \ln\left(\frac{P_h^c}{P_h^p}\right). \quad (32)$$

Inserting the new subsidy levels \hat{z}_h^d and the corresponding price indices finally yields

$$\tilde{W}F_h^c - \tilde{W}F_h^p = 2\alpha - \frac{1}{w_h} \frac{2\alpha(\sigma - 1)}{\sigma} - \frac{\alpha}{\sigma} \left(1 + \frac{(1 + \phi^2)}{2\phi} \left(\frac{1 + \theta}{w_h}\right)^{1-\sigma}\right) - \alpha \ln w_h. \quad (33)$$

As one would expect, it is rising in the agglomeration force (θ) and in trade freeness (ϕ). Since technological spillovers as well as the level of trade integration increase the agglomeration rent, it also decreases the cost of financing a subsidy level necessary to defend the core. These familiar effects notwithstanding, core's optimal decision in this alternative 'leftist' scenario is no longer as clear cut as it was in Section 3. To see this Fig. 6 illustrates the welfare difference as a function of the union wage rate w_h .

Figure 6: h 's welfare difference between being core and periphery for different union wages



$$\sigma = 4; \alpha = 0.5; \theta = 0.3; \phi = 0.6.$$

For moderate union wages a 'leftist' government that represents workers' interests will set a subsidy level low enough to prevent a relocation of industry towards an efficient outcome. This may not seem too surprising as unionized workers benefit from the distortion, but remember that non-union workers and home capitalists equally enter the government's welfare calculus.

Even though the model is highly stylized, we think the model and its predictions have intuitive appeal: Due to the quasi-linearity of the utility function, the M -sector can

be thought of as one specific industry producing differentiated goods, whereas the competitive sector represents the ('big') rest of the economy. If such a sector suffers from a labor market distortion, it may not be ex ante clear that a government will find it in its best interest to compensate mobile factors for high wages. Rather, it may well be welfare-enhancing to use tax instruments or other government action to get industries offshored to low-wage countries, which benefits consumers with low consumer prices and shareholders with higher dividends. Thinking of particular industries such as consumer electronics, it may well be that industrialized countries' governments have understood that it can be in their best interest to allow production and assembling to be shifted to places with lower labor costs. Then, downward pressure on taxes benefits them as national shareholders gain from them. Thinking of the car industry, on the contrary, one typically has in mind that jurisdictions do a lot to hold on to it, which may show the importance of local interest groups as decisions on industry- or even firm-specific tax breaks or subsidies will not only, in general, be based on national welfare-maximizing behavior, but also on the interests of local politicians.

6 Conclusion

In a simple model of tax competition between countries with asymmetric union power and agglomeration tendencies, we have shown that the government of the agglomerated and unionized country may not have an incentive to try to hold on to its industry. Instead of realizing the benefits from higher wage income while exporting part of the wage burden to foreign consumers via higher prices, it rather allows the competing country to attract industry and benefit from the other country's generous tax regime as well as low production costs, leading to low consumer prices. Tax competition is welfare enhancing as it leads to a relocation of industry towards a country with a non-distorted labor market. In contrast to the previous literature which focused on the agglomeration-holding country's ability to hold on to the core, we show why its willingness to do so may be curtailed. The finding has intuitive appeal when one thinks of the fact that welfare is, after all, driven by consumption, which in this case is increased by two facts: Lower prices because of the circumvented labor market distortion, and higher income because of capitalists' repatriated income. We highlight the way in which winners and

losers are generated in tax competition and leave it for future work to look into this in more depth empirically. In terms of theory, it seems promising to examine the role of special interest groups and their organization when it comes to influencing governments in their choice of policy variables in the presence of international tax competition.

Appendix

A Proof of proposition 2

Global welfare is derived adding up the indirect utility functions of A sector workers, unionized and non-unionized M workers as well as capital owners across countries. Taking the difference of global welfare evaluated at $s_n = 1$ and global welfare at $s_n = 0$ gives, after inserting $w_h = \frac{\sigma}{\sigma-1}$,

$$WF^{glob}|_{s_n=0} - WF^{glob}|_{s_n=1} = -1 - \frac{\sigma^2}{\sigma-1} \ln \left(\frac{\sigma-1}{\sigma} \right). \quad (\text{A.1})$$

one can easily see that the expression above is non-negative for $\sigma > 1$. ■

B Proof of proposition 3

Setting $z_h = z_h^d$ and $z_f = z_f^{min}(z_h)$ in equation (27), as well as inserting the respective price indices from (23) reduces to

$$WF_h^c(z_h) - WF_h^p(z_f) = \frac{2\alpha(\sigma-1)}{w_h\sigma} (w_h - 1) - 2\alpha \ln w_h. \quad (\text{A.2})$$

Note that the first term is simply union's objective which is the excess wage bill of its members whereas the second term denotes the potential benefit of a relocation, namely getting rid of the distortion. This equals, after substituting $w_h = \frac{\sigma}{\sigma-1}$,

$$WF_h^c(z_h) - WF_h^p(z_f) = \frac{2\alpha(\sigma-1)}{\sigma^2} - 2\alpha \ln \left(\frac{\sigma}{\sigma-1} \right). \quad (\text{A.3})$$

This term is smaller than zero for any $\alpha > 0, \sigma > 1$, indicating that the government in h will always be better off when the core is in f . The equilibrium subsidy levels are given by $z_h^* = z_h^d - \epsilon$ and $z_f^* = z_f^{min}(z_h^*)$, for some small ϵ . ■

C Proof of proposition 4

The indirect utility differential of capitalists in h reads

$$V_{h,cap}^c - V_{h,cap}^p = K_h(\alpha(\ln P_h^p - \ln P_h^c) - z_f^{min}) \quad (\text{A.4})$$

Inserting the respective price indices, (23), and the union wage yields

$$V_{h,cap}^c - V_{h,cap}^p = \frac{\alpha}{4\sigma^2} \frac{(1+\theta)^{1-\sigma}(\sigma-1)^{1-\sigma}\sigma^\sigma(1+\phi^2)}{\phi} + \frac{\alpha[2\sigma(\ln(\sigma-1) - \ln \sigma) - 1]}{2\sigma}. \quad (\text{A.5})$$

This expression will be infinitely negative for $\sigma \rightarrow 1$ and approaches zero for $\sigma \rightarrow \infty$. Hence, capitalists in h gain from firms' relocation towards the union-unionized country. The welfare differential of capital owners in f reads simply

$$V_{f,cap}^c - V_{f,cap}^p = K_f(\alpha(\ln P_f^p - \ln P_f^c)). \quad (\text{A.6})$$

After inserting the respective price indices and w_h simplifies to

$$V_{f,cap}^c - V_{f,cap}^p = \frac{\alpha}{2} \left(\ln \sigma - \ln(\sigma-1) - \frac{1}{\sigma-1} \ln \phi \right), \quad (\text{A.7})$$

which is unambiguously positive for any $\alpha > 0$, $\sigma > 1$ and $0 < \phi < 1$. ■

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