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How Bad is Globalization for Labour Standards in the North?

Alejandro Donado[1] and Klaus Wälde[2]

Abstract

We analyse a world consisting of 'the North' and 'the South' where labour standards in the North are set by trade unions. Standards set by unions tend to increase output and welfare. There are no unions in the South and work standards are suboptimal. Trade between these two countries can imply a reduction in work standards in the North. Moreover, when trade unions are established in the South, the North, including northern unions, tends to lose out. Quantitatively, these effects are small and overcompensated for by gains in the South. The existing empirical literature tends to support our findings.

JEL: J 51, J 81, F 16, F 21
Keywords: occupational health and safety, trade unions, international trade, welfare

The authors

[1] University of Würzburg, Department of Economics, 97070 Würzburg, Germany, alejandro.donado@uni-wuerzburg.de . Phone: +49.931.31-82952, fax: +49.931.31-87025.

[2] Mainz School of Management and Economics, University of Mainz, Jakob-Welder-Weg 4, 55131 Mainz, Germany, klaus@waelde.com , http://www.waelde.com, Phone + 49.6131.39-20143, Fax + 49.6131.39-23827.

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Alejandro Donado[(a)] and Klaus Wälde[(b), 1]
[(a)]University of Würzburg
[(b)]University of Mainz, Université catholique de Louvain and CESifo

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We analyse a world consisting of 'the North' and 'the South' where labour standards in the North are set by trade unions. Standards set by unions tend to increase output and welfare. There are no unions in the South and work standards are suboptimal. Trade between these two countries can imply a reduction in work standards in the North. Moreover, when trade unions are established in the South, the North, including northern unions, tend to lose out. Quantitatively, these effects are small and overcompensated for by gains in the South. The existing empirical literature tends to support our findings.

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1 Introduction

There is a widespread public perception in industrialized countries that globalization can lead to a deterioration of labour conditions. The claim is that rich countries that open their borders to trade with and FDI to poor countries are forced to reduce their labour standards in order to keep up with the increased competition. This would lead to what has been called a "race to the bottom" in labour standards.

[1]Alejandro Donado: University of Würzburg, Department of Economics, 97070 Würzburg, Germany, alejandro.donado@uni-wuerzburg.de. Phone: +49.931.31-82952, fax: +49.931.31-87025. Klaus Wälde: Mainz School of Management and Economics, University of Mainz, Jakob-Welder-Weg 4, 55131 Mainz, Germany, klaus@waelde.com, http://www.waelde.com, Phone + 49.6131.39-20143, Fax + 49.6131.39-23827. We would like to thank numerous seminar (including Louvain-la-Neuve, Heidelberg and Yale) and conference (including conferences of the Royal Economic Society, EEA, EALE and CESifo) participants for lively discussions and comments, especially Raouf Boucekkine, Bill Brainard, Guido Cozzi, Matthias Doepke, Switgard Feuerstein, Michael Kaganovich, Andrey Launov, Jürgen Meckl, Giuseppe Moscarini, Paul Segerstrom, Hylke Vandenbussche and Fabrizio Zilibotti. This paper and the companion paper Donado and Wälde (2010) are extended versions of an earlier version circulated as Donado and Wälde (2008).

Empirically, we know little about the effect of trade or FDI on labour standards in the North (see section 5 below for a detailed discussion). We do know, however, that there are considerable international differences in occupational health and safety (OHS) standards. In industrialized countries, employees are protected against excessive exposure to chemicals and there are exposure limits for radiation protecting medical personnel and computer users sitting in front of a screen or using wi-fi. Construction workers have to wear helmets and are protected against falling by safety belts. More generally speaking, there are many regulations in place targeted at guaranteeing safety at workplaces. But what about developing countries? If we are willing to concede a link between OHS standards and accident rates, the difference is substantial. While in OECD countries the annual number of work-related fatal accidents per 100.000 employees is estimated to lie around 4, occupational accident rates rise up to 10 for India or China or even above 20 for other Asian countries or sub-saharan Africa (Hämäläinen et al., 2006). When countries compete with each other over international investments, do these differences constitute "unfair competition"? Can globalization potentially degrade labour conditions in the rich countries?

Given the scarcity of empirical knowledge, this paper develops a theoretical framework which identifies conditions under which capital outflows in the form of FDI reduces labour standards in the North. Based on this framework, we provide estimates of how important the effects of globalization are on OHS from a quantitative perspective. We build on the analysis of Donado and Wälde (2010) who study how the presence of unions in a closed economy affects OHS standards. Their central argument is the informational advantage of a union compared to individual workers. Given that unions have many members, they can collect more information than individuals and thereby are able to set OHS standards at a level which is Pareto-superior (given realistic parameter assumptions) to levels under laissez-faire or when set by a government. Narrative evidence from the history of OHS standards supports this view.

In the present paper, we carry the analysis forward and consider the welfare impact of unions in a globalizing world. We ask three questions: Given endogenous OHS standards in the North set by unions, how does this affect international capital flows? Next, what are the repercussions of these trade flows on northern standards? Finally, what are the effects of rising OHS standards in the South? Our framework is a two-country world with a capital-rich North and a capital-poor South. In addition to having more capital, the North has trade unions that set high OHS standards. In the South, there are initially no unions and OHS standards are therefore low. We allow for free trade in the final homogenous good and capital and analyze the welfare impact on OHS standards. Capital flows from North to South until its marginal productivity is equal in both regions. As in traditional factor movement models, we find that the impact of globalization due to a better capital allocation is welfare increasing for both regions. However, since the capital stock in the North is reduced, we also find that workers' wage income decreases, and trade unions react by reducing their demands on high OHS standards. This has a negative effect on welfare in the North. This effect goes beyond

the traditional distributional effect caused by factor movements.

We then consider the impact of globalization when trade unions are introduced in the South. We show that higher OHS standards set by southern unions have a positive welfare impact, as in the autarky case, but it also implies an increase in the marginal productivity of capital in the South. This leads to even more capital flowing from North to South. The impact of globalization due to better capital allocation is also unambiguously positive in both regions. In the North, however, unions set even lower OHS standards, further reducing northern welfare. In the South, the higher capital stock implies that unions increase southern OHS standards, magnifying the positive impact of globalization on southern welfare.

We then ask how strong the two central predictions of our model are from a quantitative perspective. These predictions are: (i) FDI inflows into the South increase when labour standards improve the health of workers and: (ii) Capital outflows from the North lead to a reduction of work standards in the North. Concerning (i), we find quantities which are far from negligible: If the safety levels in the South were at the same level as in the North, GDP in the South would be 6.3% higher. With respect to (ii), we find that labour standards in the North do fall when capital flows into the South. But this effect is small - both when we allow for a "what if globalization had not taken place"-scenario and when we increase safety in the South. When the South increases safety standards, the negative welfare impact in the North caused by a reduction in the northern labour standards is overcompensated for by the positive welfare impact in the South caused by better working conditions. Overall, world welfare increases due to globalization. Again,with an increase of southern safety levels in line with northern ones, northern GDP falls by .3% while world GDP as a whole would rise by .6%.

Our paper is related to various strands of the literature. First, there is a policy-oriented discussion on labour standards and the effect of globalization[2]. Srinivasan (1996, 1998) shows that endogenous labour standards will naturally differ between countries with different levels of development - as we find in our analysis - and that diversity in labour standards is not an argument against free trade. He also states that labour standards might not be provided efficiently in the presence of some market failures. Brown, Deardorff and Stern (1996, 1998) provide a broad overview and argue inter alia that in the case of market failures, minimum safety standards do not automatically restore Pareto optimality. For an international trade setup, universal labour standards will not internalize country-specific inefficiencies. We will extend their arguments and focus more strongly on the issue of inefficiencies and internalization. Elliot and Freeman (2003) are more favourable to including labour standards into WTO trading rules. In his discussion, Maskus (2004) agrees that "individual enterprise owners can gain from weak labor rights [...] even if the economy is generally harmed". This is exactly our

[2]This literature in turn partially builds on more micro-oriented analyses of risk and regulation of which labour standards are an example. An early survey of research on labour standards is by Dickens (1984). An excellent recent introduction and overview is by Viscusi (2007). For further related literature, see section 5.

starting point and the fundamental assumption we build into our model.[3]

A paper which deserves special mention is by Dinopoulos and Zhao (2007) on child labour and trade. Their framework is a small open economy with a modern and an agrarian sector. Children are employed only in the agrarian sector. In their model-based analysis, they conclude that trade policies or FDI that increase the modern-sector output reduce the incidence of child labor.[4]

Second, our paper is related to the "pro-union literature". Various authors have stressed that collective action by workers - in the form of unions or other - can be beneficial to an economy. For examples, see Viscusi (1979, ch. 11), Malcomson (1983), Freeman and Medoff's (1984), Booth and Chatterji (1998), Agell (1999, p. F144), Brugiavini et al. (2001, ch. II.2.1), Acemoglu et al. (2001) and Boeri and Burda (2009). This literature is presented in more detail in the companion paper by Donado and Wälde (2010).

There is also a larger literature which analyses the role of unions in an international trade setup focusing mainly on wage and welfare effects. Examples include Mezzetti and Dinopoulos (1991), Brander and Spencer (1988), Naylor (1999), Zhao (1995, 1998), and Skaksen and Sørensen (2001). None of these papers takes OHS issues into account. Three recent papers are noteworthy as they also consider static setups with unions and free international capital flows. Aloi et al. (2009) show that workers in the unionized country oppose international integration and that there are aggregate losses from integration. Boulhol (2009) shows how capital market integration reduces labour market rigidities and thereby increases employment. One key channel is the increased bargaining position of capital owners caused by the improvement of the outside option resulting from capital market integration. This mechanism is similar to Eckel and Egger's (2009) view where FDI increases firm's bargaining power in domestic wage negotiations with unions. We differ from these approaches by presenting a setup where "unions are good" in the first place. If unions distort the economy, their impact should be reduced. If they correct a distortion as in our view, their impact should be welcome.

Finally, there is a huge empirical literature on labour standards and globalization (very broadly speaking). As the detailed discussion in section 5 will show, some of these analyses indirectly support our view, especially prediction (i) from above, and none contradicts it. Unfortunately, at the moment there is no study (to the best of our knowledge) which explicitly analyses our quantitative prediction (ii) on health effects in the North.

[3]Much more has been written in this relatively large but also very policy oriented literature. See sect. 5.2.2 below.

[4]For a theoretical analysis of South-South competition (potentially) leading to lower standards in the sense of "race to the bottom - from the bottom", see Chau and Kanbur (2006)

2 The two-country model

2.1 Basic structure

Our model economy generalizes Donado and Wälde (2010) to a two-country world consisting of the capital-rich North and the South. Both countries produce a homogenous aggregate good Y^i, where i denotes either North or South. A typical firm produces the quantity y^i by employing capital k^i and labour l^i, the latter of which is measured in working hours. All firms use the same technology with TFP $A\left(s^i\right)$,

$$y^i = A\left(s^i\right) f\left(k^i, l^i\right), \tag{1}$$

where capital and labour inputs have the usual neoclassical effects on output. We assume that all firms can hire from a spot market. There are no hiring or firing costs and it does not take any time to find a worker. Factors are paid their value marginal product.

The central focus of this paper is occupational health and safety (OHS) in a global world. This aspect is reflected in the production process via the TFP component $A\left(s^i\right)$. A job is safe(r) if a worker is (more) certain to return home in good health after 8 (or more) hours of work. We capture safer jobs by a higher $s^i > 0$.

Safe workplaces are clearly in the interest of the worker, and in many cases, OHS is also a central concern for employers. More often, however, there is a fundamental conflict of interest since OHS measures are costly. For modelling purposes, we go to the extreme and exclude firms from any benefits resulting from higher safety. We capture safety costs by letting OHS measures reduce TFP, $A_{s^i} < 0$, where throughout the paper subscripts denote partial derivatives. Given the spot market assumption, a sick worker would simply be replaced by a new healthy worker.

Utility of workers increases in consumption c^i and health $z\left(s^i\right)$ but with a decreasing slope. We assume that better safety measures s^i improve health, $z_{s^i} > 0$. The utility function is given by

$$u^i = u\left(c^i, z\left(s^i\right)\right). \tag{2}$$

On the aggregate level, consumption equals output $C^i = Y^i$ and labour demand L^i equals labour supply,

$$L^i = z\left(s^i\right) N^i, \tag{3}$$

where N^i denote potential employment (also measured in hours and assumed to be fixed) multiplied by the share $z\left(s^i\right)$ of time workers are healthy and can actually work. More safety, implying more health, implies higher labour supply in each country.

We finally turn to trade unions. Trade unions can operate at the country, sectorial or firm level. They played a very important historical role in setting OHS standards as discussed in detail in Donado and Wälde (2010). We assume here that unions operate at the firm level only. Due to the spot market assumption, there is no attachment of workers to the

firm. Hence, membership of firm-level unions is just as volatile as employment at the firm. As a consequence, the union only cares about the overall well-being of the l^i workers in this particular firm. Given historical examples of union behaviour in what are now OECD countries and preferences of households in (2), unions not only care about labour income $w^i l^i$, but they also care about a worker's health $z\left(s^i\right)$. The union's utility function increases in both arguments and reads

$$v^i = v\left(w^i l^i, z\left(s^i\right)\right). \tag{4}$$

Labour income of union members depends on the market wage w^i and on labour demand l^i as chosen by the firm. Depending on the importance attached to each of these two objectives, the union might be called income-oriented or health-oriented.

2.2 Occupational health and safety

Nowadays, health and safety standards in OECD countries are by and large regulated by government agencies. Historically speaking, however, worker movements or trade unions played a very important role. This is still the case for developing countries today where governmental institutions are not as strong as in OECD countries. There is also evidence that unions in developed countries still play an important role when it comes to the *implementation* of statutory OHS standards. Weil (1991, 1992) shows that OHS standards are better enforced in the presence of unionized workers. In the case of new technologies or new evidence of health implications, physical working conditions are one important issue which trade unions and management still negotiate over today (Millward et al., 1992, pp. 249-254). Due to the historical and current importance of unions for OHS in OECD countries, in the following we will talk about OHS setting as an activity which maximizes the utility function (4) of the union. One could also think of (4) as the objective function of a government agency which took over unions' role of taking care of OHS setting.[5]

We now ask what the OHS standard in the North would be if standards are set by (i) a firm-level union/government agency and, as reference points, (ii) by a central planner focusing on output and (iii) by a central planner focusing on welfare. For later purposes, we (iv) also calculate the interest-rate maximising OHS level. The respective objective functions and the optimality conditions are summarized in tab. 1. For a derivation of optimality conditions, see app. A.

[5]The analogy would not work entirely if government agencies take an economy-wide approach to OHS in contrast to our firm-level unions. If the government agency is structured according to industries as safety standards are very industry-specific, however, then the analogy would work. It would clearly be of interest to look at OHS setting also from a political-economy point of view.

agent	objective function	
consumption planner: s^C	$C(s) = Y(A(s), K - \Delta(s), z(s)N) + r^*(s)\Delta(s)$	(a)
welfare planner: s^U	$U(s) = U(C(s), z(s))$	(b)
firm-level union: s^v	$v(s) = v(wl(s), z(s))$	(c)
capital owners: s^R	$r[K - \Delta(s)] + r^*(s)\Delta(s)$	(d)

(5)

	optimality condition	
s^C	$\left[\varepsilon_{YA} + \varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As} = \left[\varepsilon_{YL} + \varepsilon_{\tilde{r}L}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}$	(a)
s^U	$\varepsilon_{UC}\left[\varepsilon_{YA} + \varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As} = \left[\varepsilon_{UC}\varepsilon_{YL} + \varepsilon_{Uz} + \left[\varepsilon_{UC}\varepsilon_{\tilde{r}L} + \varepsilon_{Uz}\right]\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}$	(b)
s^v	$\varepsilon_{vwl}\varepsilon_{lA}\varepsilon_{As} = \varepsilon_{vz}\varepsilon_{zs}$	(c)
s^R	$\varepsilon_{\tilde{r}A}\varepsilon_{As} = \varepsilon_{\tilde{r}L}\varepsilon_{zs}$	(d)

(6)

Table 1 *Optimal occupational health and safety levels in the North*

For readability, all elasticities throughout this paper are defined as positive quantities. Only the OHS elasticity of TFP requires a minus sign in its definition,

$$\varepsilon_{As} \equiv -\frac{\partial A}{\partial s}\frac{s}{A}, \qquad \text{and} \qquad \varepsilon_{xy} \equiv \frac{\partial x}{\partial y}\frac{y}{x} \qquad \text{for all} \quad xy \neq As. \tag{7}$$

North-South capital flows are denoted by Δ[6] and the equilibrium interest rate is denoted by $\tilde{r}$.[7]

The optimality condition (6c) of firm-level unions given the objective (5c) is identical to the closed-economy findings of Donado and Wälde (2010) as firm-level unions look at the wage only and take the aggregate capital stock as given. The central planner in a two-country world does however take into account that more or less OHS standards imply more or less capital. In addition to this, income is no longer given by domestic production but by domestic production plus foreign capital income - which is consumption $C(s)$ in (5a). The welfare planner has structurally the same objective function (5b) as in the closed economy but needs to take international capital flows into account. The objective function of capital owners in (5c) adds domestic capital income to foreign capital income.

The left-hand sides (LHS) of the optimality conditions in (6) show the costs and the right-hand sides (RHS) the benefits of an increase in the safety level from each agent's perspective.

[6]Maybe one should not talk about flows in a static model. Strictly speaking, Δ is the stock of capital installed in the South but owned by the North.

[7]When we want to stress that a variable or parameter belongs to the South, we denote it by an asterisk "*". For the North, we use nothing, as in tab. 1, which refers to the North only. In this sense, in section 2.1, i stands for either nothing or this asterisk.

In all three conditions the costs originate from a reduction of TFP caused by an increase in the safety level, but the variables affected are different. In fact, a lower TFP implies in condition (6a) a lower consumption C (due to a reduction in both Y and $\tilde{r}$), in condition (6b) a lower welfare U (due to a reduction in consumption), and in condition (6c) a lower union's utility v (due to a reduction in the firms' labour demand l). For example, the LHS of condition (6b) has a straightforward interpretation: A one-percent increase in the safety level reduces the TFP and thereby output by $\varepsilon_{YA}\varepsilon_{As}$ percent and the world interest rate by $\varepsilon_{\tilde{r}A}\varepsilon_{As}$ percent. Multiplying these terms with the consumption elasticity of welfare, ε_{UC}, yields the percentage reduction in welfare due to lower consumption. The second term is weighted with $\tilde{r}\Delta/Y$ implying that the negative impact on consumption via a reduction in capital income is greater, the more important capital income $\tilde{r}\Delta$ is relative to output Y.

The benefits on the RHS of all three conditions originate from an improvement in the health level z of the labour force. A higher health level implies in condition (a) a higher consumption C (due to an increase in both Y and $\tilde{r}$), in condition (6b) a higher welfare U (due to an increase in consumption), and in condition (6c) a higher union's utility v (since better health has a direct positive impact on the union's utility). Again, the RHS of (6b) has a simple interpretation: A one-percent increase in the safety level increases the health level of the labour force, raising output by $\varepsilon_{YL}\varepsilon_{zs}$ percent and the world interest rate by $\varepsilon_{\tilde{r}L}\varepsilon_{zs}$ percent. Multiplying these terms with the consumption elasticity of welfare, ε_{UC}, yields the percentage increase in welfare caused by a higher consumption. Moreover, terms two and four, $\varepsilon_{Uz}\varepsilon_{zs}$ and $\varepsilon_{Uz}\varepsilon_{zs}\tilde{r}\Delta/Y$, on the RHS of (b) show that better health also has a direct positive impact on welfare.

There are three interesting aspects to the optimality conditions that should be highlighted. First, if the planner focused only on consumption maximization (that is, if $\varepsilon_{Uz} = 0$), the optimality condition (6b) would be reduced to (6a). Second, the optimality conditions (6a) and (6b) are equal to their counterparts in the closed economy if we set $\Delta = 0$ (see Donado and Wälde 2010). Finally, even if condition (6c) is equal to its closed-economy counterpart, the resulting safety levels are different. The reason is that the safety levels are dependent on aggregate wages and these wages depend positively on the country's capital stock. As a consequence, if capital leaves the country, wages are lower, and trade unions demand lower safety levels.

To conclude, the trade-off for capital owners in (6d) is easy to understand. The LHS shows the losses due to lower TFP, the RHS shows the gains in the North due to more healthy workers. Both losses and gains affect capital owners through the equilibrium interest rate $\tilde{r}$.

2.3 Equilibrium

The North can carry out FDI and trade the final homogeneous good with the South. In autarky, the South has a lower capital stock per capita and safety levels are lower as well.

For simplicity and without losing any insight, we consider the southern safety level to be exogenous. As the law of one price holds without barriers to trade, the single determinant for capital flows are international differences in the marginal product of capital. Using the aggregate version of technology (1) and the equilibrium on the labour market (3), the marginal product of capital in the North is given by

$$r = r\left(s, K - \Delta\right) = A\left(s\right) \frac{\partial f\left(K - \Delta, z\left(s\right) N\right)}{\partial\left(K - \Delta\right)}, \tag{8}$$

where K is the endowment of the capital stock in the North and Δ are North-South capital flows. As this expression shows, OHS standards s have an ambiguous effect on the interest rate: If the safety level is too low, capital owners are in favour of more safety since they see the overall positive effect of healthier workers. If the safety level s is too high, the TFP-reducing effect is stronger than the labour-supply effect.

Equilibrium on the world capital market requires equality of the factor rewards for capital,

$$r\left(s, K - \Delta\right) = r\left(s^*, K^* + \Delta\right), \tag{9}$$

where an asterisk denotes southern variables. This equation determines Δ, given the exogenous autarky endowments K and K^*, an exogenous southern safety level s^* and the endogenous safety level s in the North, i.e. $\Delta = \Delta\left(s\right)$. The latter continues to be determined by unions in the North as described by (6c). An equilibrium in our setup is therefore given by (9) and (6c). These two equations determine two endogenous variables: capital flows Δ from North to South and safety levels s in the North.[8]

The equilibrium on capital markets is plotted in fig. 1. The horizontal axis shows the northern capital stock from the left and the southern from the right such that the total length of the horizontal axis reflects world endowment with capital, $K + K^*$. The vertical axis on the left shows the northern interest rate, the one on the right the interest rate in the South. Capital demand curves plot loci which give the interest rate as a function of capital used in the North and South, respectively.

[8] Keeping s^* exogenous simplifies the exposition. It becomes endogenous if we assume that an equation in analogy to (6c) would hold for the South as well. We would then have a setup where unions do not act strategically. One could also study North-South games to explain why international union cooperation so often failed in the past (see p. 15 for references).

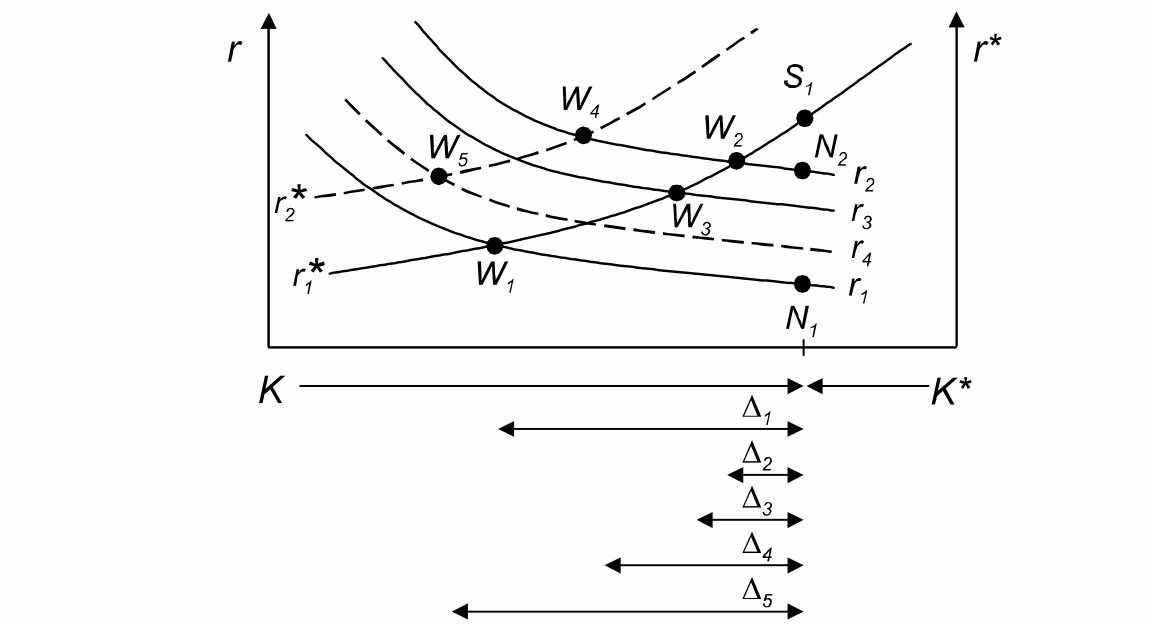

Figure 1 *Autarky equilibria N_i and S_i and world equilibria W_i with free capital flows*

3 OHS under trade and capital flows

Let us now analyse the effects of "globalization", i.e. international capital flows, on safety standards and thereby on output and welfare.

3.1 Capital flows in a two-country world

Thinking of a scenario where countries are in autarky and then open up for capital flows, let us assume first that countries in autarky differ only in their per-capita capital stock. There are no union activities and safety levels are identical and low. When the initial capital endowment before capital flows is given as drawn in fig. 1, factor rewards in the South at S_1 are higher than in the North at N_1. With free capital flows, the new world-equilibrium point is at W_1 where capital flows from the North to the South of a total volume of Δ_1 imply an equalization of returns to capital.

Are capital flows from the North to the South a realistic description of reality? It is well-known that the US as one of the richest countries in the world is one of the biggest recipient of foreign investments. When capital flows in "all" countries in the world are analysed, capital flows from the North to the South from the 70s to the mid 80s, reverses subsequently and flows South to North from the end of the 90s (Prasad et al., 2006, chart 2). If the focus is on FDI, however, capital always flows from North to South (chart 4). If the world excluding the

US is analysed, capital also flows from North to South (chart 3). Lane and Milesi-Ferretti (2007, fig. 9) make a similar point: Net foreign assets (i.e. accumulated flows) are positive for industrialized countries and negative for the US and emerging and developing countries. Capital flows from North to South are therefore a realistic view of the world if the focus is on FDI (which comes the closest to our variable Δ in this long-run static equilibrium) or if the focus is on industrialized countries other than the US.[9]

Second, if we introduce trade unions in the North, the autarky safety level is higher than without unions. Let us assume this OHS level does not respond to changes in the capital stock. Donado and Wälde (2010, sect. 5.3) have shown that this holds for the firm-level union if the union's objective function (4) has a Cobb-Douglas structure. As long as this OHS level is not beyond the capital-return maximizing point (i.e. as long as $s^v < s^R$ from (6)), the capital demand function moves up from r_1 to r_2. As has been discussed after the expression for the marginal productivity of capital in (8), capital owners are actually in favour of higher safety levels as long as this has a positive effect on capital rewards. Starting with the same initial capital distribution, the starting points are now S_1 and N_2 and the new world-equilibrium point is W_2. Capital flows from the North to the South are now lower and amount to Δ_2 only. Higher (but not too high) safety levels reduce capital outflows from the North.

When we return to the realistic situation where health and income are bad substitutes,[10] safety standards fall after capital outflows. Starting from N_2 and S_1 as before, capital outflows will lead to a "temporary" equilibrium at W_2. Falling OHS levels reduce the northern capital demand function to r_3 and the final equilibrium point is W_3. Capital outflows are larger due to the fall in OHS levels in the North but still lower than in a situation without any northern OHS standards. Generally speaking, this contradicts the often stated view that capital flows to where standards are lower. If standards are so low that marginal productivity of capital suffers, capital will stay in the North.

3.2 Capital flows and welfare

Let us now turn to the welfare effects of international capital flows. Welfare in both countries in (5b) is a function of consumption and health. In the North, endogenous OHS standards s and therefore health are a function of capital flows, $z(\cdot) = z(s(K - \Delta))$. In the South, health $z^*(s^*)$ is exogenous due to exogenous safety levels s^*. Consumption in the North is given by domestic production plus capital income from abroad, $Y + r^*\Delta$, while in the South it is domestic production minus capital income paid to foreign capital owners in the North, $Y^* - r^*\Delta$. Making the dependence of consumption on capital flows Δ explicit, we obtain an

[9] If one focuses on gross flows, it is even more apparent that North-South flows are very relevant. Capital outflows from the US from 1960 to 2007 are on average 3.8 times higher than (absolute) net flows (BEA, 2008).

[10] This corresponds to a negative λ in our CES utility function further below in (16). See Donado and Wälde (2010, sect. 5.3) for a proof.

expression related to (5a),

$$C = Y\left(A\left(s\left(K-\Delta\right)\right), K-\Delta, z\left(s\left(K-\Delta\right)\right)N\right) + r^*\left(K^*+\Delta\right)\Delta, \tag{10}$$

$$C^* = Y^*\left(A^*\left(s^*\right), K^*+\Delta, z^*\left(s^*\right)N^*\right) - r^*\left(K^*+\Delta\right)\Delta, \tag{11}$$

we see that capital flows Δ affect the northern consumption level through TFP, the capital stock, labour supply and the northern interest income. For the South, only the southern capital stock and the interest payments are affected. Computing the welfare effects of capital flows then gives (see app. C.1)

$$\frac{dU}{d\Delta} = U_C\left[r^* - r + r^*_\Delta\Delta\right] + U_C Y_s\frac{\partial s}{\partial\Delta} + U_z z_s\frac{\partial s}{\partial\Delta}, \tag{12}$$

$$\frac{dU^*}{d\Delta} = -U^*_{C^*}r^*_\Delta\Delta > 0, \tag{13}$$

where again subscripts denote partial derivatives: e.g. r^*_Δ is the change in the southern interest rate due to capital inflow into the South.

Capital flows influence northern welfare through the "classic channel", the "efficiency channel" and the "health channel". The first term in (12) starting with U_C is the classic channel which says that if the southern interest rate r^* does not react to capital flows from the North (that is, if $r^*_\Delta\Delta = 0$), there are welfare gains as long as the foreign interest rate is larger than the domestic one ($r^* > r$). This is the well-known condition for gains from capital mobility. However, if a sizable amount of capital has already flowed out and the southern interest rate falls when more capital flows (that is, if $r^*_\Delta\Delta < 0$), there might not be gains from additional capital flows. In fact, in a two-country world, welfare-maximizing capital flows should stop before the domestic interest rate equals the foreign one.[11] As the gains from higher capital rewards abroad compensate for the losses from the fall in foreign capital rewards when capital flows just start, we conclude that, overall, there are gains from international capital flows.

The second term, $U_C Y_s\partial s/\partial\Delta$, can be called the "efficiency channel". If the planner in the North maximized output and set OHS standards equal to s^Y, this term would be zero, $Y_s = Y_A A_s + Y_L z_s N = 0$. The negative TFP effects of safety (the expression $Y_A A_s$) would just be compensated for by the positive labour supply effect $Y_L z_s N$. If, however, OHS standards were below the output-maximizing safety s^Y, that is if $Y_s > 0$, and noting that an outflow of capital reduces the safety level ($\partial s/\partial\Delta < 0$, as discussed after fig. 1), a further reduction of s caused by capital outflows would increase inefficiencies in the North and thereby reduce output.

[11] This effect is familiar from the literature on international factor flows in two-country worlds or in the case of *large* open economies. So far, however, we have been unable to find a reference. We are grateful to Juergen Meckl for discussion of this point.

The final term in (12) $U_z z_s \partial s/\partial \Delta$ relates more to trade unions and their impact on higher OHS standards. The closer the union-set safety level is to the social welfare-maximizing level s^U, the higher the social welfare is. If the union safety level is lower than s^U, that is, if $U_z > 0$, any reduction in safety levels (due to capital outflows) reduces welfare. Consequently, the welfare effect of reduced OHS standards is negative.

Combining all three channels, capital flows increase northern welfare due to a more efficient factor allocation but reduce welfare since less capital implies lower OHS standards which were already too low before capital flows. This reduction has a negative effect on efficiency and health per se. Welfare gains through capital flows are therefore reduced by negative OHS effects.[12]

For the South, however, the welfare effects are unambiguously positive. For each unit of capital flowing into the country, it pays the local marginal product. Hence, the term $r - r^*$ we see in (12) is zero in (13). It benefits, however, from the reduction of the domestic interest rate caused by inflows, $r^*_\Delta < 0$. There is no health channel as safety standards are invariant.

4 Trade unions go global!

This section is motivated by the general discussion about the desirability of trade unions and their role in a global world. Given competition between the North and the South, can the North afford to have "old-fashioned" institutions like trade unions? Do "modern global times" not require unions to be abolished in order to make a country more "competitive"? Or should governments rather encourage trade union activities in the South as well?

In order to address these questions, we now ask how the results obtained so far are affected if trade unions are also introduced in the South. What are the welfare consequences for the North, the South, and the world economy and how would northern trade unions react to this?

4.1 International capital flows and OHS

We stipulate that an increased presence of trade unions in the South would increase southern safety levels. If we assume that this new level is still lower than the interest-maximizing southern safety level (that is, if $s^* < s^{R^*}$), an increase in the southern safety level will increase the capital demand curve from r^*_1 to r^*_2 (see fig. 1). Capital owners are better off. Of course the question arises why it takes trade unions to help capital owners to increase their returns from investment. However, the answer is simple: In a society with few economic institutions and no well-functioning financial systems, each capital owner is basically an entrepreneur who owns his own firm. OHS standards imply costs but there are no institutions which would

[12] Clearly, if one believes that OHS standards are excessive, i.e. above s^U, capital outflows implying a reduction of safety levels would imply welfare gains caused by capital flows per se and by reduced OHS standards.

allow capital owners to coordinate their activities and credibly jointly increase safety levels. Firms are caught in a prisoners' dilemma. The need for higher safety levels is more pressing for workers as they are physically affected by negative health effects. Hence, even though each individual firm in the South will be opposed to higher OHS standards, capital owners as a group will gain.

For an invariant safety level in the North (again, the Cobb-Douglas case for union preferences (4)), this implies that the equilibrium moves from W_2 to W_4 and the flow of capital to the South increases from Δ_2 to Δ_4. For the empirically most relevant bad-substitution case (i.e. $\lambda < 0$ in the parametric version below in (16)), capital outflows to the South reduce safety levels in the North. If safety levels were below the interest rate maximizing level s^R, capital demand in the North would be reduced from r_3 to r_4 and the equilibrium would move from W_3 to W_5. Capital outflows from the North would increase from Δ_3 to Δ_5.

At first glance, it might be surprising that introducing trade unions in the South can increase capital inflows to this country. But, if TFP losses are not too large, northern investors simply profit from a healthier labour force in the South. This idea is supported by empirical evidence. For example, Alsan et al. (2006) find that an improvement in a population's health increases gross FDI inflows to low- and middle-income countries. More directly, Flanagan (2006) finds a significant negative correlation between fatal job accident rates and FDI inflows. See sect. 5 for more details. If trade unions can play a similar role in the South today as they played historically in what are now OECD countries, trade unions can be good for the health and growth of a developing country.

4.2 Global unions and welfare

- The North and the South

What are the welfare implications if trade unions in the South increase southern safety levels? Preserving s^* as an exogenous quantity, welfare effects for the North and South are (see app. C.2),

$$\frac{dU}{ds^*} = U_C r^*_{s^*} \Delta + U_C Y_s \frac{\partial s}{\partial s^*} + U_z z_s \frac{\partial s}{\partial s^*}, \tag{14}$$

$$\frac{dU^*}{ds^*} = -U^*_{C^*} r^*_{s^*} \Delta + U^*_{C^*} Y^*_{s^*} + U^*_{z^*} z^*_{s^*}. \tag{15}$$

These conditions look similar to those in (12) and (13) where the effects of capital flows were analysed. In fact, term one in (14) corresponds to the classic channel above. In contrast to above, however, we start from an integrated world economy with $r = r^*$ and capital flows are now induced by changes in southern OHS standards s^*. However, this term is now positive since we are making the plausible assumption that the southern safety level s^* is lower than the interest-maximizing safety level s^{R^*}. The second term is the efficiency channel and the

third term is the direct health channel. More safety in the South has a positive effect on interest payments but reduces output and health levels in the North.

We saw above that capital flows increase northern welfare but falling OHS standards can reduce these welfare gains. What remains here on balance? First of all, an increase in southern safety increases interest rates paid on previous investments Δ since $r^*_{s^*} > 0$. As opposed to (12), the classic channel here leads to gains for the North: Higher s^* increases returns for investors as higher labour supply in the South increases marginal productivities of capital in the South (by more than lower southern TFP would reduce it). The second, efficiency, channel is negative if the safety level in the North is below its output-maximizing level (i.e. $Y_s > 0$) and if more safety in the South implies capital outflows from the North and thereby a reduction of safety levels in the North, i.e. $\partial s/\partial s^* < 0$. The third channel does not bring good news for the North either: If OHS standards s and thereby the average health level fall, welfare falls through this health channel as well.

For the South, two new terms as compared to (13) appear. The second and third term can easily be identified as the efficiency and health channels in the South. Term one is negative; terms two and three are positive: The South looses out due to higher interest payments to the North but gains from efficiency gains in production caused by higher OHS standards and from health per se.

- The conflict between northern and southern unions

There are numerous examples in the media where northern trade unions help establish southern unions. One often mentioned reason is that unions in the South increase southern wages which reduces low-wage competition in the North. Looking at trade union cooperation in more detail, however, some authors have suggested that international cooperation has been rather marginal (see, for example, Northrup and Rowan (1979), Enderwick (1985), pp. 147-154, and the references therein, and Gordon and Turner (2000)). Our model suggests one possible reason why there is actually a conflict between northern and southern unions. Both unions benefit from capital flows. More capital means higher wages and, as a consequence, higher safety levels. Both enter the objective function of unions positively. Building up a union in the South implying higher safety levels results in a capital outflow and northern union members lose out.

5 Quantitative findings

Our model makes two central qualitative predictions: (i) FDI inflows increase when labour standards improve health/ productivity of workers so that returns to capital investment increase. (ii) Capital outflows from the North lead to a reduction of work standards in the North. The purpose of this section is to offer a quantitative picture of these predictions. How strong are these effects? Before we do so, however, we offer a brief overview of related

empirical work. This will allow us to put our findings into a broader context and draw more convincing conclusions about the central question posed in the title of our paper.

There is relatively good empirical support for our first prediction. The second prediction will sound controversial to many. When we look at existing empirical work, however, there is no study which contradicts our view and there are some who indirectly support it.[13]

5.1 The effect of standards

The empirical literature can be classified into whether standards are used as an explanatory variable or whether standards are to be explained. When standards are used as explanatory variables, one can inquire into the effect e.g. on trade patterns. The OECD (2000) provides a summary of various studies. They ask whether labour standards influence or "bias" trade patterns in any way. While there are some surprising findings (higher standards reduce exports of skill-intensive goods), it is not always straightforward to draw conclusions from these findings. See Brown (2000) for a detailed appraisal.

One can also analyse the effects of standards on FDI. Flanagan (2006, p. 135 and tab. A6.3) points out that "with one exception, labor conditions in a country are not significantly correlated with the country's share of investment inflows. The exception is job safety: other things equal, investment shares are lower in countries with relatively high fatal job accidents rates." Other labour standards (like right for collective bargaining etc.) have basically no effect.

A study which does *not* explicitly use standards as an explanatory variable is undertaken by Alsan et al. (2006). They find empirical evidence that an improvement in a population's health increases gross FDI inflows to low- and middle-income countries. They measure population health by life expectancy. The study is useful for our question as a simple (yet conditional) conclusion can be drawn from it. *If* standards have a positive effect on life expectancy (something one would expect), better standards increase FDI.

5.2 Determinants of standards

Generally speaking, the empirical literature finds that there are no harmful effects caused by trade or FDI on labour standards in the South. We did not find any explicit analysis of the effects on northern countries.

[13] Before we proceed, it is worth pointing out that we do not take the huge empirical literature on the effects of trade on wages, relative wages or unemployment into account. While this might sound obvious, some commentators conclude that trade can not have an effect on standards as it has no effect on the wage structure. We believe that conclusions of this type are not really supported by evidence.

5.2.1 The child labour literature

In the child-labour literature, Edmonds and Pavcnik (2006) find that countries that trade more have less child labour. They attribute this relationship to the positive effect of trade on income. Levine and Rothman (2006) have basically very similar findings. Neumayer and Soysa (2005) find that the effect of FDI is just as positive as trade. This effect is confirmed by Davies and Voy (2009). This suggests that globalization is not so bad for the South after all.

Davies and Voy (2009) use data from the ILO on labour force participation of children aged 10-14 as their dependent variable. They find in their regressions, instrumented, pooled or not, that FDI has a negative significant or a negative insignificant effect on child labour. The effect becomes insignificant when income is added as an explanatory variable. As income is highly significant in basically all of their regressions (tables 1 to 3), child labour seems to be a poverty problem but not an FDI problem. They conclude that FDI is a good instrument to combat child labour as FDI increases income.

5.2.2 Informal discussions of labour standards

There is a huge literature which discusses labour standards and the effects of globalization in an informal way. This literature is very informative and full of details but can not be used as a test for our model. An excellent introduction to issues surrounding labour standards and trade is provided by Basu et. al (2003). Aspects related to "races to the bottom" are discussed in this book by Singh (2003, part II, ch. 2). OECD (2000) has a short informal section on "race to the bottom". Various informal discussions stress that competition under perfect information limits firms' possibilities for reducing labour standards. It is acknowledged that this might not hold in second-best economies. Historical evidence concerning the US seems to suggest that there was a race to the bottom concerning child-labour before 1938.

Elliot and Freeman (2003, p. 126) conclude their detailed description of various case studies by stating that "trade pressure and incentives from consumers and governments can lead to improved labor standards in LDCs". In this sense, trade combined with the right incentives is beneficial for standards as well.

5.2.3 Investigating standards more directly

Turnbull and Wass (2007) provide a careful analysis of various case studies concerning the effect of reforms in ports. They argue that "globalization [...] brought in its wake a marked deterioration in dock workers' terms and conditions of employment." They find that reforms generally worsen workers' working conditions. These results are not derived, however, by standard econometric analysis.

The most informative analysis is undertaken by Flanagan (2006). He uses various measures for standards as dependent variables. They include "weekly hours", "life expectancy" or "child

labour" but also "fatal accidents" (on the job). As reported in tab. A3.3, GDP per capita significantly reduces fatal accidents (and also child labour or weekly hours). These results are less strong, however, when additional institutional variables are added as explanatory variables (tab. A3.4), at least for fatal accidents. In a panel analysis with fixed effects (tab. A4.1), the trade share and a measure of "open policy" has a negative impact on fatal accidents. Unfortunately, the complete results of regressions including GDP per capital and openness measures are not reported. One could conclude, however, that trade and higher GDP per capital reduces job injuries and improve standards. This is similar to the findings for FDI and trade on child labour cited above.

This positive conclusion is in line with Flanagan himself who, generally speaking, draws a very positive picture about the link between trade and standards. He also finds, however, that firms in import-competing sectors in the North tend to reduce (or at least do not increase) labour standards. (The same is true for some firms in export-processing zones.) He also states (p. 85) that "more open trade may be threatening the working conditions of some workers in industrialized countries".

5.3 Our quantitative predictions

We now return to our two-country world and calibrate it so that various targets are met. We then use this calibrated version in order to analyse the effects of international capital flows on northern safety and the effects of unions in the South.

5.3.1 Calibration

- Functional forms and first-order conditions

We now assume a CES structure for the utility function of the union,

$$v = \left\{ \gamma \left[wl \right]^{\lambda} + \left[1 - \gamma \right] z\left(s \right)^{\lambda} \right\}^{1/\lambda}, \tag{16}$$

and a Cobb-Douglas production function for firms,

$$y^{i} = A\left(s^{i} \right) \left(k^{i} \right)^{\alpha} \left(l^{i} \right)^{1-\alpha}. \tag{17}$$

Following Donado and Wälde (2010), the link between safety s and TFP $A\left(s \right)$ and the share $z\left(s \right)$ of the healthy workforce is assumed to follow

$$A\left(s \right) = be^{-\phi s}, \qquad z\left(s \right) = 1 - qe^{-\chi s}. \tag{18}$$

The parameter b gives the upper bound to TFP which is obtained under zero safety measures ($s = 0$). The elasticity of TFP with regard to safety is captured by ϕ. Similarly, q captures

the share of sick individuals in an economy without safety measures and χ is the response elasticity with respect to s. Optimal safety levels for these functional forms are special cases of the general results in (6) and are provided in tab. 2.

	optimality condition	
$s^C = s^R$	$s^C = \frac{\ln\left[\left(1+(1-\alpha)\frac{\chi}{\phi}\right)q\right]}{\chi}$	(a)
s^U	$\frac{\varepsilon_{As}}{\varepsilon_{zs}} = 1-\alpha+\frac{\varepsilon_{Uz}\left[1+\frac{\tilde{r}\Delta}{Y}\right]}{\varepsilon_{UC}\left[1+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]}$	(b)
s^v	$s^v = \frac{\ln\left[\left(1+\frac{\varepsilon_{vz}(s^v)}{\varepsilon_{vwl}(s^v)}\alpha\frac{\chi}{\phi}\right)q\right]}{\chi}$	(c)

(19)

Table 2 *Optimal safety levels for specific functional forms*

The (firm-level) union safety level is known from Donado and Wälde (2010, tab. 1 (c)). The expression does not change as a firm-level union takes aggregate quantities as given, both in a closed and in an open economy. The actual level s^v can of course differ as s^v is a function of endogenous variables such as the domestic capital stock.

It is remarkable that the expression for the consumption maximizing safety level s^C is also identical to the one of the closed economy. Whether a planner maximizes consumption in a closed economy (where consumption is identical to output) or in a two-country world, the planner always chooses the same level s^C. Note that this consumption maximizing health level s^C is identical to the interest-rate maximizing level s^R. This is mainly due to the Cobb-Douglas structure of the production function and reminds us of identical closed-economy results in Donado and Wälde (2010).

- Parameter values

Given these functional forms, we can now calibrate our model. As we would like to understand the implications of various policy experiments, we need an initial equilibrium which reflects the real world in a quantitatively sufficiently good way. Our initial equilibrium should satisfy four targets. It should display (i) a reasonable endogenous share $z\left(s^v\right)$ of healthy workers in the North, (ii, iii) GDP levels in the North and South which represent relative economic importance and (iv) a share $z\left(s^C\right)$ of healthy workers under the consumption planner which satisfies $z\left(s^C\right) > z\left(s^v\right)$. This makes sure that trade unions do have some effect in increasing safety levels above the level desired by each individual firm. Unions do not succeed, however, in pushing the safety level all up the way to the consumption-maximizing level. We believe this to be a plausible outcome of some deeper political-economy mechanism where firms and firm-level unions determine safety levels.

The desired quantities for these targets are shown in the upper left part of tab. 3. In the European Union, 2% of working days are lost due to health issues related to work (Parent-Thirion et al., 2007, Table 7.3), i.e. $z(s^v) = .98$. Relative economic importance of the North and the South is captured by setting Y equal to the GDP of the average G7 country and Y^* to the population-weighted mean of China and India.[14] Our calibration therefore captures the effect of integrating capital markets of the average of China's and India's economies with the capital markets of the average G7 country. We achieve target (iv) by setting $z\left(s^C\right)$ at .99.

We further set various parameters at levels which correspond to observations in the data. This group appears in the upper right corner of tab. 3. Taking into account that accident rates in non-industrialized countries are 4 to 6 times higher than in industrialized countries (Hämäläinen et al., 2006), the absence rate due to health is, say, $5 * 2\% = 10\%$ in the South and therefore $z^* = .9$. The parameter q will determine (see the discussion after (18)) the share of healthy workers when there are no safety measures at all. If we are willing to assume that high accident countries (i.e. $z = .9$) are countries with close to no safety measures (i.e. $s = 0$), we can conclude $q = .1$ from (18). The output elasticity α for capital is standard and does not need further discussion. Population size N in the North is normalized to unity and population size N^* in the South corresponds to the ratio of the population size of China plus India to the population size of the G7 countries.

Parameters which are not reported in the table are ϕ, χ, λ and $K + K^*$. The parameters ϕ and χ from (18) matter only as their ratio $\Phi \equiv \phi/\chi$ to be discussed below. The parameter λ is set equal to -1 (which is the bad-substitution case often referred to above) and does have only minor effects on parameters or equilibrium properties. The world capital stock was set to 300 which gives a reasonable interest rate of 4.9%.

We hit our targets $z(s^v)$, Y, Y^* and $z\left(s^C\right)$ by calibrating the parameters b, b^*, γ and $\Phi \equiv \phi/\chi$, taking equilibrium equations (9) and (6c) from tab. 1 of our model into account. The parameters are shown in the lower left corner. For a summary of calibration equations, see app. D.5.

endogenous quantities to be matched

$z(s^v)$	Y	Y^*	$z\left(s^C\right)$
.980	38,000[14]	5,800	.990

parameters from other data

z^*	q	α	N^*
.90	.10	.33	$\frac{2422}{722}$

calibrated parameters

b	b^*	γ	ϕ/χ
6.10	.81	.96	.0067

equilibrium quantities

$\frac{K-\Delta}{K+K^*}$	$z\left(s^U\right)$
84.3%	.997

Table 3 *Calibrating the free capital flow equilibrium (see text for details)*

[14] All nominal data is in 2006 PPP US$. All data is taken from World Bank (2008).

The calibrated values are in the range one would expect. Relative TFP between the North and South implied by b and b^*, is maybe a bit larger than usual; if differences in education and experience levels between workers in the North and South are taken into consideration, however, relative TFP would fall and become closer to standard ratios. The parameter with a relatively high value is γ, the weight attached by unions to labour income.

In the resulting equilibrium, 84.3% of the world capital stock is used in the North. The health level of a welfare maximizing planner would be 99.7% i.e. it exceeds the output-maximizing level by 0.7%.

5.3.2 Quantitative globalization effects on northern safety

We can now provide an estimate of how much safety in the North fell (or rose) due to globalization. We know the stock of wealth F^i for country i held abroad from estimates by Lane and Milesi-Ferretti (2007). We obtain comparable capital stocks K^i in G7 countries from AMECO (2010). When F^i is positive, we assume that the capital stock in a hypothetical closed economy would be $K^i + F^i$. This is clearly an extreme view where any unit of capital invested abroad is one unit lost at home (there is evidence on the aggregate level supporting this assumption, see Desai et al., 2005). We see the implied estimate for the loss of safety due to globalization as an *upper* bound. The true value probably lies below the one we report. For countries where F^i is negative, globalization implied an inflow of capital, improved the domestic health level and the hypothetical closed economy would be endowed with K^i only.

In both cases, we can compute the hypothetical safety level s_i^{hyp} in this hypothetical closed economy i with a hypothetical capital stock of K^i (when F^i is negative) and $K^i + F^i$ (when F^i is positive) by using expression (6c) for the firm-level union. As we discussed above, this expression is identical to the closed-economy setup of Donado and Wälde (2010, tab. 1). Hence, by computing s_i^{hyp} using (6c) with the hypothetical capital stock, we obtain the safety level in such a non-globalized closed economy. The difference between s_i^{hyp} and the percentage of healthy workers as given in the data (we used .98 above in tab. 3 in our EU average) is the gain or loss caused by globalization.

When looking at the ratio of $\rho \equiv \left(K^i + F^i\right)/K^i$ for G7 countries (excluding Japan for data inconsistency reasons) from 1991 to 2004, it varies from 82.2% (i.e. $F^i < 0$) for Canada in 1991 to 105.9% for Germany in 1991. For all years where $\rho < 100\%$, globalization actually *improved* health levels in the North as capital flowed into the country. Starting from our 98% health level under globalization from tab. 3, the range we attribute to globalization extends from an increase in the health level in the North from 97.85% without international capital flows to 98% (the Canadian case) and a decrease from 98.04% to 98% (the German case).

These results are clearly *very* small and negligible. Even a reduction of the capital stock by 20% leads to an increase in the sickness rate from 2% to 2.15% only. The main reason for this very low capital-stock-to-health elasticity is the fact that the North is very close to the social optimum. At this point, the slope of health with respect to the capital stock is very

low. As our estimates are an upper bound, we can conclude that northern inhabitants should not worry too much about negative effects of capital outflows on northern health standards.

5.3.3 The quantitative effects of southern unions

Qualitatively, we have seen that the North tends to lose out due to higher OHS standards in the South, northern unions are definitely worse off and only the South seems to gain. Should OHS standards in the South then be increased? We can provide a more convincing answer to this question by quantifying the effects. Starting from the equilibrium in tab. 3, our policy experiment consists of increasing the Southern level z^* from .9 to the northern level of .98. Put differently, absence rates decrease in the South from 10% to 2%.

The implied capital flows from the North to the South constitute the "real test" for our calibration as these flows should be consistent with the estimates of Alsan et al. (2006). They find that every additional year of life expectancy implies a 9% increase in FDI inflows to low- and middle-income countries. Average life expectancy in their sample is 64.6 years, i.e. one can translate an additional year into a 100/65%≈1.5% increase in hours worked. Increasing hours worked from 90% to 98% in our counter-factual experiment corresponds to an increase of approx. 9% (not percentage points), i.e. an increase of $9/1.5 = 6$ additional years in life expectancy. Such a change should imply an increase of inflows of 6*9%=54%. As \$1 of inflows amounts to an increase of domestic investment of \$1 (on the aggregate level, see Desai et al., 2005) and investment to capital stock ratios are around 10%, a 54% increase in inflows implies a 5.4% increase in the capital stock. Hence, our policy experiment where we increase southern health shares from 90% to 98% should imply an increase of the southern capital stock by 5.4%.

We find that our capital flows amount to a 6.7% increase in the southern capital stock, i.e. they are very consistent with the findings of Alsan et al. (2006).[15] Concerning health effects, international capital flows imply a decrease in safety levels s in the North which imply that the share $z(s)$ of time individuals are healthy decreases by 0.006%. GDP in the North decreases by 0.29% and increases in the South by 6.3% implying an increase of world GDP by .6%. Put differently, rising OHS standards in the South do have a theoretical but not a practical negative effect on work standards in the North. Similarly, higher southern standards do reduce domestic production in the North, but only by a negligible amount. In contrast, southern production increases considerably, leading to an overall increase in world output.

5.3.4 What does this tell us?

Given our brief survey of the empirical literature and given our quantitative results, what do we learn from this? Concerning our first prediction about FDI inflows, our findings are

[15] We did try to calibrate λ so that the flows would match the ones in the data exactly. While λ does have an effect on the flows, it is much too small to be relevant here.

in line with the findings of Flanagan (2006) and (indirectly) Alsan et al. (2006) concerning the effects of standards as explanatory variables for capital inflows. We provide a theoretical setup which offers a possible explanation for their findings that lowering fatal job accident rates and increasing life expectancy increases FDI. The new condition we identify for these findings to be theoretically consistent says that OHS standards in the South are lower than the interest-rate maximizing safety level s^R. If this is the case, any improvement increases inflow of FDI. If some countries have well-functioning institutions and the safety level is close to s^R, the effect of an increase in OHS standards - while it could still increase welfare - might reduce FDI inflows.

Let us turn to the second strand of the literature inquiring into the determinants of standards (mainly in the South). According to our setup, it is no surprise to find no effect of trade and FDI in the South if the South lacks institutions which face and solve a health-wage trade-off as modelled here for the North in (4). It would be very interesting to look at the effects of FDI outflows on safety in the North: our second prediction claims that an outflow of capital in the North reduces standards in the North. If we translate this into an empirical statement, we need to be careful about "outflow of capital". Our model really predicts that a reduction in the capital stock in the North (keeping TFP constant) reduces standards in the North. We therefore would *not* expect that large FDI outflows reduce standards if the domestic capital stock does not change. Similarly, large FDI outflows even with a reduction of the domestic capital stock would *not* reduce standards according to our model, if there is a simultaneous TFP increase which keeps labour income constant as in (4). Care should therefore be taken when trying to identify the effects of FDI outflows on capital stocks and wages.

Evaluating the second prediction given that we have seen here that effects are probably very small and that FDI flows relative to stocks are also very small, we would conclude that globalization is bad for labour standards in the North - but only in a marginal sense. If globalization acts through the channels that we have looked at here, there is no need for big concerns.

6 Conclusion

There are three questions we pose in this paper: What is the effect of international differences in occupational health and safety (OHS) standards on international capital flows? What is the effect of these capital flows (i.e. "globalization") on OHS standards when the latter are endogenous? How does a rise in standards in the South affect northern standards and international capital flows?

International differences in OHS levels caused by trade unions setting high standards in the North can lead to more or less capital in the North relative to a situation where unions are absent. If unions in the North are moderate, capital flows to the South will be reduced

(compared to an economy without unions) as some level of health is better than none and marginal productivities of capital are higher with unions. Clearly, if unions put a lot of emphasis on health or even when the social planner maximizes welfare, some capital will be driven out of the country due to high OHS standards - but still less than in a laissez-faire economy. Capital outflows from the North to the South reduce safety standards in the North.

When unions become active in the South, output in the world as a whole will rise and so will welfare. There are strong distributional effects, however, and the North might lose out, as will unions in the North. These distributional effects point to the potentially beneficial effects of side payments from unions in the South to unions in the North. If this cooperation can be achieved, Pareto gains from globalization should be possible.

The quantitative analysis has shown that the effects of integrating capital markets on northern standards is not too high. A 1% reduction of the northern capital stock would lead to an increase in the sickness level of less than one tenth of a percentage point. Globalization effects on OHS standards through the channel we look at do therefore not provide an argument against globalization. The gains from higher OHS standards in the South for the South, however, can not be neglected. To the extent that collective action via unions can push southern OHS standards, this is desirable for the South and the world as a whole. The losses in the North caused by further capital outflows are again negligible and are by far overcompensated by gains in the South.

The paper has various shortcomings which can be overcome in future work. Capital is not produced in our static model and is therefore highly rivalrous between the North and the South. In this sense, the effects presented so far neglect positive growth effects which would result from higher health levels in the South. A dynamic analysis could take this into account and probably draw an even more optimistic picture of higher safety levels in the South. Second, what happens if unions are allowed to set or bargain wages? Is the positive effect of better OHS standards in the South undone by the labour supply distortion? Third, how do strategic interactions between a union in the North and one in the South with endogenous safety levels in both countries affect our conclusions? Fourth, and maybe most importantly, the theoretical and quantitative assumption that equilibrium safety standards (set by unions or a government agency) are lower than standards which maximize returns to capital owners should be formulated in a way which allows for empirical testing. All of this is left for future work.

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Referees' appendix for 'How Bad is Globalization for Labour Standards in the North?'

- not for publication -

Alejandro Donado and Klaus Wälde
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This paper and the companion paper (Donado and Wälde, 2010) are extended and improved versions of earlier work entitled "Trade Unions Go Global!" (Donado and Wälde, 2008). We decided to split this earlier work into two papers as the material we had to cover is too much for one single paper. The paper "Trade Unions Go Global!" is not under submission at this moment and will not be so in the future.

A The central planner's optimality conditions in a two-country world

A.1 The consumption-maximizing safety level (s^C)

Consumption in the North is given by

$$C(s) = Y(A(s), K - \Delta(A(s), z(s)N), z(s)N) + r^*(A(s), z(s)N)\Delta(A(s), z(s)N). \tag{20}$$

Setting to zero the derivative of this with respect to s yields

$$C_s = Y_A A_s + Y_\Delta [\Delta_A A_s + \Delta_L z_s N] + Y_L z_s N + [r^*_A A_s + r^*_L z_s N]\Delta + r^*[\Delta_A A_s + \Delta_L z_s N] = 0.$$

Plugging $-Y_\Delta = r$ and rearranging yields

$$C_s = Y_A A_s + [r^* - r][\Delta_A A_s + \Delta_L z_s N] + Y_L z_s N + [r^*_A A_s + r^*_L z_s N]\Delta = 0.$$

In equilibrium $r^* = r = \tilde{r}$, so that

$$C_s = Y_A A_s + Y_L z_s N + [\tilde{r}_A A_s + \tilde{r}_L z_s N]\Delta = 0. \tag{21}$$

Multiplying all terms by $s\frac{Y}{Y}\frac{A}{A}\frac{z}{z}\frac{\Delta}{\Delta}\frac{\tilde{r}}{\tilde{r}}$ and rearranging yields

$$-Y_A \frac{A}{Y} A_s \frac{s}{A} - \tilde{r}_A \frac{A}{r^S} A_s \frac{s}{A}\frac{\tilde{r}\Delta}{Y} = Y_L \frac{zN}{Y} z_s \frac{s}{z} + \tilde{r}_L \frac{zN}{r^S} z_s \frac{s}{z}\frac{\tilde{r}\Delta}{Y}.$$

Plugging in the definitions of the elasticities from (7) finally yields

$$\left[\varepsilon_{YA} + \varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As} = \left[\varepsilon_{YL} + \varepsilon_{\tilde{r}L}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}.$$

A.2 The welfare-maximizing safety level (s^U)

Welfare in the North is given by $U\left(C\left(s\right),z\left(s\right)\right)$, where consumption is (20). Setting to zero the derivative of this with respect to s yields

$$U_s = U_C C_s + U_z z_s = 0.$$

Plugging (21) and rearranging gives

$$U_C\left[Y_A A_s + Y_L z_s N + \left[\tilde{r}_A A_s + \tilde{r}_L z_s N\right]\Delta\right] + U_z z_s = 0.$$

Multiplying all terms by $\frac{C}{U}\frac{Y}{Y}\frac{A}{A}\frac{z}{z}\frac{\Delta}{\Delta}\frac{\tilde{r}}{\tilde{r}}s$ and rearranging gives

$$-U_C\frac{C}{U}\left[Y_A\frac{A}{Y}A_s\frac{s}{A}Y + \tilde{r}_A\frac{A}{r^S}A_s\frac{s}{A}\tilde{r}\Delta\right] = \left[U_C\frac{C}{U}Y_L\frac{zN}{Y}Y + U_C\frac{C}{U}\tilde{r}_L\frac{zN}{\tilde{r}}\tilde{r}\Delta + U_z\frac{z}{U}C\right]z_s\frac{s}{z}.$$

Plugging $C = Y + \tilde{r}\Delta$ and rearranging yields

$$-U_C\frac{C}{U}\left[Y_A\frac{A}{Y}A_s\frac{s}{A} + \tilde{r}_A\frac{A}{r^S}A_s\frac{s}{A}\frac{\tilde{r}\Delta}{Y}\right] = \left[U_C\frac{C}{U}Y_L\frac{zN}{Y} + U_z\frac{z}{U} + \left[U_C\frac{C}{U}\tilde{r}_L\frac{zN}{\tilde{r}} + U_z\frac{z}{U}\right]\frac{\tilde{r}\Delta}{Y}\right]z_s\frac{s}{z}.$$

Using the definitions of the elasticities from (7) finally yields

$$\varepsilon_{UC}\left[\varepsilon_{YA} + \varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As} = \left[\varepsilon_{UC}\varepsilon_{YL} + \varepsilon_{Uz} + \left[\varepsilon_{UC}\varepsilon_{\tilde{r}L} + \varepsilon_{Uz}\right]\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}.$$

A.3 The union's safety level (s^v)

The union maximizes (4) taking the wage as given, i.e. $\max_s v = v\left(wl\left(A\left(s\right)\right),z\left(s\right)\right)$. The first-order condition is

$$v_s = v_{wl}wl_A A_s + v_z z_s = 0 \Leftrightarrow -\frac{v_{wl}wl}{v}\frac{l_A A}{l}\frac{A_s s}{A} = \frac{v_z z}{v}\frac{z_s s}{z}.$$

Using (7) yields $\varepsilon_{vwl}\varepsilon_{lA}\varepsilon_{As} = \varepsilon_{vz}\varepsilon_{zs}$ which is (6c).

A.4 The interest-rate-maximizing safety level (s^R)

There are two approaches to computing the interest-rate-maximizing safety level. The key difference between these two approaches is when the equilibrium condition $r^* = r$ is used in the computation. One can insert this condition either after computing the first-order condition (approach 1) or right away after defining the objective function (approach 2). We will show that these two approaches lead to the same first-order condition, but that the second is faster.

- Approach 1: Using $r^* = r$ after first-order condition

Capital income in the North is given, using (8) and taking $\Delta(s) = \Delta(A(s), z(s)N)$ from (9) into account, by

$$r(s, \Delta(s))[K - \Delta(s)] + r^*(\Delta(s))\Delta(s). \tag{22}$$

When we compute the derivative with respect to s and set this to zero we obtain

$$\left[\frac{d}{ds} r(s, \Delta(s))\right][K - \Delta(s)] - r(s, \Delta(s))\Delta_s + \left[\frac{d}{ds} r^*(\Delta(s))\right]\Delta(s) + r^*(\Delta(s))\Delta_s = 0.$$

Plugging the equilibrium condition $r = r^* = \tilde{r}$ yields

$$\left[\frac{d}{ds} r(s, \Delta(s))\right][K - \Delta(s)] + \left[\frac{d}{ds} r^*(\Delta(s))\right]\Delta(s) = 0.$$

As in equilibrium the interest rates are the same, so must be their derivatives. Hence,

$$\left[\frac{d}{ds}\tilde{r}(s)\right]K = 0. \tag{23}$$

- Approach 2: Using $r^* = r$ after objective function

Capital income in the North is still given by (22). Plugging the equilibrium condition $r = r^* = \tilde{r}$ yields

$$\tilde{r}(s)K.$$

Computing the derivative of this expression with respect to s and setting it equal to zero yields

$$\left[\frac{d}{ds}\tilde{r}(s)\right]K = 0,$$

which is the same as (23).

- Rearranging the first-order condition

Since $\tilde{r}(s) = \tilde{r}(A(s), z(s)N)$, the first-order condition (23) can be expressed as

$$\tilde{r}_A A_s + \tilde{r}_L z_s N = 0.$$

Multiplying all terms by $\frac{A}{A}\frac{z}{z}\frac{\tilde{r}}{\tilde{r}}s$ and rearranging gives

$$-\tilde{r}_A \frac{A}{\tilde{r}} A_s \frac{s}{A} = \tilde{r}_L \frac{zN}{\tilde{r}} z_s \frac{s}{z}.$$

Using the definitions of the elasticities from (7) again finally yields the first-order condition

$$\varepsilon_{\tilde{r}A}\varepsilon_{As} = \varepsilon_{\tilde{r}L}\varepsilon_{zs}. \tag{24}$$

B Explicit elasticities

The following elasticities are necessary in order to compute the first-order conditions reported in tab. 1 in the main text. The elasticities derived in this section are to some extent the same computations as in the referees' appendix from Donado and Wälde (2010) but are replicated here for convenience.

B.1 The elasticities for the Cobb-Douglas production function

The elasticities here are computed assuming a Cobb-Douglas production function

$$y = A(s)\, k^{\alpha} l^{1-\alpha} \tag{25}$$

at the firm level and

$$Y = A\left[K-\Delta\right]^{\alpha}\left[zN\right]^{1-\alpha} \qquad \text{and} \qquad Y^{*} = A^{*}\left[K^{*}+\Delta\right]^{\alpha}\left[z^{*}N^{*}\right]^{1-\alpha} \tag{26}$$

at the aggregate level.

- **TFP elasticity of labour**

  The firm first-order condition with respect to l is

$$w = Ak^{\alpha}\left[1-\alpha\right]l^{-\alpha} \Leftrightarrow l = \left[\frac{A\left[1-\alpha\right]}{w}\right]^{\frac{1}{\alpha}} k$$

  which can be used to compute the TFP elasticity of labour

$$\varepsilon_{lA} \equiv l_{A}\frac{A}{l} = \frac{d\ln l}{d\ln A} = \frac{1}{\alpha}.$$

- **Elasticities based on the world interest rate**

In order to compute the elasticities ε_{rA} and ε_{rL} we first need an expression for Δ and for r. For a Cobb-Douglas production function Δ is given by

$$r = r^{*} \Leftrightarrow A\alpha\left[K-\Delta\right]^{\alpha-1}\left[zN\right]^{1-\alpha} = A^{*}\alpha\left[K^{*}+\Delta\right]^{\alpha-1}\left[z^{*}N^{*}\right]^{1-\alpha} \tag{27}$$

$$\Leftrightarrow \Delta = \frac{\left[\frac{A^{*}}{A}\right]^{\frac{1}{1-\alpha}}\frac{z^{*}N^{*}}{zN}K - K^{*}}{1+\left[\frac{A^{*}}{A}\right]^{\frac{1}{1-\alpha}}\frac{z^{*}N^{*}}{zN}}. \tag{28}$$

Plugging this in r or in r^{*} and rearranging gives the world interest rate

$$\tilde{r} = \alpha\left[\frac{\left[A^{*}\right]^{\frac{1}{1-\alpha}} z^{*}N^{*} + A^{\frac{1}{1-\alpha}} zN}{K+K^{*}}\right]^{1-\alpha}. \tag{29}$$

The TFP elasticity of the world interest rate is

$$\begin{aligned}\varepsilon_{\tilde{r}A} &= \tilde{r}_A \frac{A}{\tilde{r}} = \alpha\left[1-\alpha\right]\left[\frac{\left[A^*\right]^{\frac{1}{1-\alpha}} z^*N^* + A^{\frac{1}{1-\alpha}} zN}{K+K^*}\right]^{-\alpha} \frac{\frac{1}{1-\alpha} A^{\frac{1}{1-\alpha}-1} zN}{K+K^*} \frac{A}{\alpha\left[\frac{\left[A^*\right]^{\frac{1}{1-\alpha}} z^*N^* + A^{\frac{1}{1-\alpha}} zN}{K+K^*}\right]^{1-\alpha}} \\ &= \frac{1}{1+\left[\frac{A^*}{A}\right]^{\frac{1}{1-\alpha}} \frac{z^*N^*}{zN}}. \end{aligned} \tag{30}$$

The labour elasticity of the world interest rate is

$$\begin{aligned}\varepsilon_{\tilde{r}L} &= \tilde{r}_L \frac{L}{\tilde{r}} = \alpha\left[1-\alpha\right]\left[\frac{\left[A^*\right]^{\frac{1}{1-\alpha}} z^*N^* + A^{\frac{1}{1-\alpha}} L}{K+K^*}\right]^{-\alpha} \frac{A^{\frac{1}{1-\alpha}}}{K+K^*} \frac{L}{\alpha\left[\frac{\left[A^*\right]^{\frac{1}{1-\alpha}} z^*N^* + A^{\frac{1}{1-\alpha}} L}{K+K^*}\right]^{1-\alpha}} \\ &= \left[1-\alpha\right] \frac{1}{1+\left[\frac{A^*}{A}\right]^{\frac{1}{1-\alpha}} \frac{z^*N^*}{zN}}. \end{aligned} \tag{31}$$

B.2 The elasticities for the CES utility functions

The elasticities here are computed assuming CES utility functions

$$v = \left\{\gamma\left[wl\right]^{\lambda} + \left[1-\gamma\right] z\left(s\right)^{\lambda}\right\}^{1/\lambda} \tag{32}$$

for the trade union and

$$U = \left\{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}\right\}^{\frac{1}{\lambda}} \tag{33}$$

for the central planner.

- **The elasticities for the central planner**

The output elasticity of welfare is

$$\begin{aligned}\varepsilon_{UC} &\equiv \frac{\partial U}{\partial C}\frac{C}{U} = \frac{1}{\lambda}\left\{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}\right\}^{\frac{1}{\lambda}-1} \mu\lambda C^{\lambda-1} \frac{C}{\left\{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}\right\}^{\frac{1}{\lambda}}} \\ &= \frac{\mu C^{\lambda}}{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}} = \frac{1}{1+\frac{1-\mu}{\mu}\left[\frac{z}{C}\right]^{\lambda}}. \end{aligned}$$

The health elasticity of welfare is

$$\begin{aligned}\varepsilon_{Uz} &\equiv \frac{\partial U}{\partial z}\frac{z}{U} = \left\{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}\right\}^{\frac{1}{\lambda}-1} \frac{\left[1-\mu\right] z^{\lambda}}{z} \frac{z}{\left\{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}\right\}^{\frac{1}{\lambda}}} \\ &= \frac{\left[1-\mu\right] z^{\lambda}}{\mu C^{\lambda} + \left[1-\mu\right] z^{\lambda}} = \frac{1}{1+\frac{\mu}{1-\mu}\left[\frac{C}{z}\right]^{\lambda}}. \end{aligned}$$

- **The elasticities for the firm-level trade union**

The labour income elasticity of utility is

$$\begin{aligned}\varepsilon_{vwl} &\equiv \frac{\partial v}{\partial wl}\frac{wl}{v} = \frac{1}{\lambda}\left\{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}\right\}^{\frac{1}{\lambda}-1}\gamma\lambda\left[wl\right]^{\lambda-1}\frac{wl}{\left\{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}\right\}^{\frac{1}{\lambda}}} \\ &= \frac{\gamma\left[wl\right]^{\lambda}}{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}} = \frac{1}{1+\frac{1-\gamma}{\gamma}\left[\frac{z}{wl}\right]^{\lambda}}.\end{aligned}$$

The health elasticity of utility is

$$\begin{aligned}\varepsilon_{vz} &\equiv \frac{\partial v}{\partial z}\frac{z}{v} = \frac{1}{\lambda}\left\{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}\right\}^{\frac{1}{\lambda}-1}\left[1-\gamma\right]\lambda z^{\lambda-1}\frac{z}{\left\{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}\right\}^{\frac{1}{\lambda}}} \\ &= \frac{\left[1-\gamma\right]z^{\lambda}}{\gamma\left[wl\right]^{\lambda}+\left[1-\gamma\right]z^{\lambda}} = \frac{1}{1+\frac{\gamma}{1-\gamma}\left[\frac{wl}{z}\right]^{\lambda}}.\end{aligned}$$

B.3 The elasticities for the particular forms of A and z

The elasticities here are computed using the particular forms

$$A\left(s\right) = be^{-\phi s}, \qquad z\left(s\right) = 1-qe^{-\chi s}. \tag{34}$$

The safety elasticity of TFP is

$$\varepsilon_{As} \equiv -\frac{\partial A}{\partial s}\frac{s}{A} = -\left[-\phi\right]be^{-\phi s}\frac{s}{be^{-\phi s}} = \phi s. \tag{35}$$

The safety elasticity of health is

$$\varepsilon_{zs} \equiv \frac{\partial z}{\partial s}\frac{s}{z} = -\left[-\chi\right]qe^{-\chi s}\frac{s}{z} = \frac{1-z}{z}\chi s = \left[z\left(s\right)^{-1}-1\right]\chi s. \tag{36}$$

C Welfare implications

C.1 Capital flows and welfare

- **Impact on the North**

The derivative of the northern welfare function with respect to Δ is $\frac{dU}{d\Delta} = U_C \frac{\partial C}{\partial \Delta} + U_z z_s \frac{\partial s}{\partial \Delta}$, where

$$\frac{\partial C}{\partial \Delta} = Y_A A_s \frac{\partial s}{\partial \Delta} + Y_\Delta + Y_L z_s \frac{\partial s}{\partial \Delta} N + r^*_\Delta \Delta + r^*.$$

Plugging $-Y_\Delta = r$ and rearranging gives

$$\begin{aligned} \frac{dU}{d\Delta} &= U_C \left[r^* - r + r^*_\Delta \Delta\right] + U_C \left[Y_A A_s + Y_L z_s N\right] \frac{\partial s}{\partial \Delta} + U_z z_s \frac{\partial s}{\partial \Delta} \\ &= U_C \left[r^* - r + r^*_\Delta \Delta\right] + U_C Y_s \frac{\partial s}{\partial \Delta} + U_z z_s \frac{\partial s}{\partial \Delta}, \end{aligned}$$

where in the last step we used $Y_s = Y_A A_s + Y_L z_s N$.

- **Impact on the South**

The derivative of the southern welfare function with respect to Δ is

$$\frac{dU^*}{d\Delta} = U^*_{C^*} \left[Y^*_\Delta - r^*_\Delta \Delta - r^*\right] = -U^*_{C^*} r^*_\Delta \Delta > 0,$$

since $Y^*_\Delta = r^*$. Notice that the derivative is positive since $r^*_\Delta < 0$.

C.2 Global unions and welfare

- **Impact on the North**

The northern welfare is given by $U = U\left(C\left(s^*\right), z\left(s\left(s^*\right)\right)\right)$, where

$$C\left(s^*\right) = Y\left(A\left(s\left(s^*\right)\right), K - \Delta\left(s^*\right), z\left(s\left(s^*\right)\right) N\right) + r^*\left(A^*\left(s^*\right), K^* + \Delta\left(s^*\right), z^*\left(s^*\right) N^*\right) \Delta\left(s^*\right).$$

We now compute $\frac{dU}{ds^*} = U_C \frac{\partial C}{\partial s^*} + U_z z_s \frac{\partial s}{\partial s^*}$, where

$$\frac{\partial C}{\partial s^*} = Y_A A_s \frac{\partial s}{\partial s^*} + Y_\Delta \frac{\partial \Delta}{\partial s^*} + Y_L z_s N \frac{\partial s}{\partial s^*} + r^*_{s^*} \Delta + r^* \frac{\partial \Delta}{\partial s^*}.$$

Plugging $-Y_\Delta = r$ and rearranging gives

$$\begin{aligned} \frac{dU}{ds^*} &= U_C \left[Y_A A_s \frac{\partial s}{\partial s^*} - r \frac{\partial \Delta}{\partial s^*} + Y_L z_s N \frac{\partial s}{\partial s^*} + r^*_{s^*} \Delta + r^* \frac{\partial \Delta}{\partial s^*}\right] + U_z z_s \frac{\partial s}{\partial s^*} \\ &= U_C r^*_{s^*} \Delta + U_C Y_s \frac{\partial s}{\partial s^*} + U_z z_s \frac{\partial s}{\partial s^*}, \end{aligned}$$

where in the last step we used $r^* = r$ and $Y_s = Y_A A_s + Y_L z_s N$.

- **Impact on the South**

The southern welfare function is given by $U^* = U^*\left(C^*\left(s^*\right), z^*\left(s^*\right)\right)$, where

$$C^*\left(s^*\right) = Y^*\left(A^*\left(s^*\right), K^* + \Delta\left(s^*\right), z^*\left(s^*\right) N^*\right) - r^*\left(A^*\left(s^*\right), K^* + \Delta\left(s^*\right), z^*\left(s^*\right) N^*\right) \Delta\left(s^*\right).$$

We now compute $\frac{dU^*}{ds^*} = U^*_{C^*}\frac{\partial C^*}{\partial s^*} + U^*_{z^*} z^*_{s^*}$, where

$$\frac{\partial C^*}{\partial s^*} = Y^*_{A^*} A^*_{s^*} + Y^*_{\Delta}\frac{\partial \Delta}{\partial s^*} + Y^*_{L^*} z^*_{s^*} N^* - r^*_{s^*}\Delta - r^*\frac{\partial \Delta}{\partial s^*}.$$

Plugging $Y^*_{\Delta} = r^*$ and rearranging gives

$$\begin{aligned}\frac{dU^*}{ds^*} &= U^*_{C^*}\left[Y^*_{A^*} A^*_{s^*} + Y^*_{L^*} z^*_{s^*} N^* - r^*_{s^*}\Delta\right] + U^*_{z^*} z^*_{s^*} \\ &= -U^*_{C^*} r^*_{s^*}\Delta + U^*_{C^*} Y^*_{s^*} + U^*_{z^*} z^*_{s^*},\end{aligned}$$

where in the last step we used $Y^*_{s^*} = Y^*_{A^*} A^*_{s^*} + Y^*_{L^*} z^*_{s^*} N^*$.

D Quantitative analysis

These derivations were used for the quantitative analysis. The implementation was undertaken in matlab and the code is available upon request. The utility functions are of the CES type as in (32) and (33) and the production functions are Cobb-Douglas as in (25) and (26).

D.1 Safety level of the firm-level union

We present here an expression for the OHS level as set by a firm-level union which is different from the expression in tab. 1. The expression here is more suitable for numerical implementation.

The optimality condition from (6c) in tab. 1 reads $\varepsilon_{vwl}\varepsilon_{lA}\varepsilon_{As} = \varepsilon_{vz}\varepsilon_{zs}$. Plugging the explicit elasticities derived in app. B gives

$$\begin{aligned}\frac{1}{1 + \frac{1-\gamma}{\gamma}\left[\frac{z}{wl}\right]^{\lambda}}\frac{1}{\alpha}\phi s &= \frac{1}{1 + \frac{\gamma}{1-\gamma}\left[\frac{wl}{z}\right]^{\lambda}}\frac{1-z}{z}\chi s \Leftrightarrow \\ (1+\Omega)\,\phi &= \left(1 + \Omega^{-1}\right)\alpha\frac{1-z}{z}\chi, \quad \Omega \equiv \frac{\gamma}{1-\gamma}\left[\frac{wl}{z}\right]^{\lambda}. \qquad (37)\end{aligned}$$

Now, observe that $\frac{wl}{z}$ can be rewritten using $l = z\left(s\right) n$, similar to (3), and using the expression for the market wage at the aggregate level. Then

$$\frac{wl}{z} = \frac{wl}{l/n} = wn = A\left[1-\alpha\right]\left[\frac{K-\Delta}{zN}\right]^{\alpha} n,$$

where n is the number of workers required to obtain a labour supply of l and Δ is given by (28). Note that n can be replaced by N/M where M is the number of unions/ firms or sectors in a country with sectorial unions. Hence,

$$\Omega = \frac{\gamma}{1-\gamma}\left[A\left[1-\alpha\right]\left[\frac{K-\Delta}{zN}\right]^{\alpha}\frac{N}{M}\right]^{\lambda}. \tag{38}$$

This expression for Ω can be used with (37) to quantitatively determine z.

For the autarky case, the condition for z looks the same as in (37). The expression for Ω for the autarky case is given by (38) with Δ set equal to zero.

D.2 The consumption-maximizing safety level

The consumption-maximizing safety level is denoted by s^C. The optimality condition (6a) from tab. 1 reads

$$\left[\varepsilon_{YA}+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As}=\left[\varepsilon_{YL}+\varepsilon_{\tilde{r}L}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}.$$

Assuming a Cobb-Douglas production function as in (26), the output elasticities become $\varepsilon_{YA}=1$ and $\varepsilon_{YL}=1-\alpha$. Moreover, the world interest elasticities computed in (30) and (31) imply that $\left[1-\alpha\right]\varepsilon_{\tilde{r}A}=\varepsilon_{\tilde{r}L}$. After plugging all these elasticities, the first-order condition simplifies to

$$\begin{aligned}\left[1+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As}&=\left[\left[1-\alpha\right]+\left[1-\alpha\right]\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}\\ \Leftrightarrow\varepsilon_{As}&=\left[1-\alpha\right]\varepsilon_{zs}.\end{aligned} \tag{39}$$

Plugging (35) and (36) yields

$$\phi s=\left[1-\alpha\right]\left[\frac{1}{1-qe^{-\chi s}}-1\right]\chi s \tag{40}$$

$$\Leftrightarrow s^C=\frac{\ln\left[\left(1+\left(1-\alpha\right)\frac{\chi}{\phi}\right)q\right]}{\chi}. \tag{41}$$

Comparing this to Donado and Wälde (2010, tab. 1, eq. (b)) shows that this is exactly the same safety level as the output-maximizing safety level in the closed economy s^Y.

For numerical purposes, a rewritten version in terms of z is more useful. We obtain from (40)

$$\frac{\phi}{\left(1-\alpha\right)\chi}=\frac{1}{z^C}-1\Leftrightarrow z^C=\frac{1}{\frac{\phi}{(1-\alpha)\chi}+1}. \tag{42}$$

This is used for the matlab code. In a more complicated way from (41)

$$\begin{aligned} -\chi s^C &= \ln\left[\left(1+(1-\alpha)\frac{\chi}{\phi}\right)q\right]^{-1} \Leftrightarrow qe^{-\chi s^C} = \left[1+(1-\alpha)\frac{\chi}{\phi}\right]^{-1} \Leftrightarrow \\ z^C &= 1-\left[1+(1-\alpha)\frac{\chi}{\phi}\right]^{-1} = \frac{1+(1-\alpha)\frac{\chi}{\phi}}{1+(1-\alpha)\frac{\chi}{\phi}} - \frac{1}{1+(1-\alpha)\frac{\chi}{\phi}} \\ &= \frac{(1-\alpha)\frac{\chi}{\phi}}{1+(1-\alpha)\frac{\chi}{\phi}} \end{aligned}$$

which is the same.

D.3 The welfare-maximizing safety level

The welfare-maximizing safety level is denoted by s^U. The optimality condition (6b) from tab. 1 reads

$$\varepsilon_{UC}\left[\varepsilon_{YA}+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{As} = \left[\varepsilon_{UC}\varepsilon_{YL}+\varepsilon_{Uz}+\left[\varepsilon_{UC}\varepsilon_{\tilde{r}L}+\varepsilon_{Uz}\right]\frac{\tilde{r}\Delta}{Y}\right]\varepsilon_{zs}.$$

Assuming a Cobb-Douglas production function as in (26), the output elasticities become $\varepsilon_{YA} = 1$ and $\varepsilon_{YL} = 1-\alpha$. Moreover, the world interest elasticities computed (30) and (31) imply that $[1-\alpha]\,\varepsilon_{\tilde{r}A} = \varepsilon_{\tilde{r}L}$. After plugging all these elasticities and rearranging, the first-order condition simplifies to

$$\begin{aligned} \varepsilon_{As} &= [1-\alpha]\,\varepsilon_{zs} + \frac{\varepsilon_{Uz}\left[1+\frac{\tilde{r}\Delta}{Y}\right]}{\varepsilon_{UC}\left[1+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]}\varepsilon_{zs} \Leftrightarrow \\ \frac{\varepsilon_{As}}{\varepsilon_{zs}} &= 1-\alpha+\frac{\varepsilon_{Uz}\left[1+\frac{\tilde{r}\Delta}{Y}\right]}{\varepsilon_{UC}\left[1+\varepsilon_{\tilde{r}A}\frac{\tilde{r}\Delta}{Y}\right]}. \end{aligned}$$

This includes (39) as a special case (it needs to) for $\varepsilon_{Uz} = 0$.

D.4 The interest-rate-maximizing safety level

The interest-rate-maximizing safety level is denoted by s^R. The optimality condition from (6d) reads $\varepsilon_{\tilde{r}A}\varepsilon_{As} = \varepsilon_{\tilde{r}L}\varepsilon_{zs}$. Assuming a Cobb-Douglas production function as in (26), the world interest elasticities computed in (30) and (31) imply that $[1-\alpha]\,\varepsilon_{\tilde{r}A} = \varepsilon_{\tilde{r}L}$, and the first-order condition simplifies to

$$\varepsilon_{As} = [1-\alpha]\,\varepsilon_{zs}. \tag{43}$$

As this is identical to (39), we conclude that in a two-country world with a Cobb-Douglas production function, consumption and interest rate maximizing health levels are the same.

Incidentally, they are also the same as output, consumption and interest-rate maximizing levels in a closed economy. More practically speaking, this implies for calibration that the condition for an interest-rate-maximizing safety level is the same as in (42).

D.5 The equation system for determining parameter values

We first describe a setup where we have three targets. This allows us to understand the basic structure of the calibration. We then add a fourth target which implies a structure which is a modified version of the basic structure.

D.5.1 Y, Y^* and z as targets

We require certain GDP levels. Hence, we require with $Y = A(s) K^{\alpha} [z(s) N]^{1-\alpha}$ and (18)

$$Y(s) = 38 \Leftrightarrow A(s) (K)^{\alpha} [z(s) N]^{1-\alpha} = 38.$$

We can express $A(s)$ as a function of z. First, using (18),

$$z = 1 - qe^{-\chi s} \Leftrightarrow -\chi s = \ln \frac{1-z}{q} \Leftrightarrow s = \ln \left[\left(\frac{1-z}{q} \right)^{-1/\chi} \right]. \tag{44}$$

Then, with (18) again, we get

$$A(z) = be^{-\phi s} = be^{-\phi \ln \left[\left(\frac{1-z}{q} \right)^{-1/\chi} \right]} = be^{\ln \left[\left(\frac{1-z}{q} \right)^{\phi/\chi} \right]} = b \left[\frac{1-z}{q} \right]^{\phi/\chi}.$$

Hence, our first equation used for calibration reads

$$Y = A(z) (K)^{\alpha} [zN]^{1-\alpha} = 38, \text{ where } A(z) = b \left[\frac{1-z}{q} \right]^{\phi/\chi}. \tag{45}$$

In contrast to the main text, we do not use $K - \Delta$ or $K^* + \Delta$ to denote capital used in the North and South for production. Rather, we use - mainly for programming convenience - K^{World} to denote world endowment with capital and $K$and $K^{World} - K$to denote the amount of capital used for production in the North and South, respectively.

When we do the same for the South, we obtain our second equation for calibration,

$$Y^* = A(z^*) \left(K^{World} - K \right)^{\alpha} (z^* N^*)^{1-\alpha} = 5.8, \text{ where } A(z^*) = b^* \left[\frac{1-z^*}{q} \right]^{\phi/\chi}. \tag{46}$$

As we calibrate for equilibrium, we also use the equilibrium conditions for calibration. The first equilibrium condition comes from (9) with (27), expressed in terms of z,

$$r(z, K) = r\left(z^*, K^{World} - K\right) \Leftrightarrow A(z) \left[\frac{zN}{K} \right]^{1-\alpha} = A(z^*) \left[\frac{z^* N^*}{K^{World} - K} \right]^{1-\alpha} \tag{47}$$

where Kadjust endogenously and s (i.e. z) comes from (37) with (38), reprinted here

$$1+\Omega=\left(1+\Omega^{-1}\right)\alpha\frac{1-z}{z}\frac{\chi}{\phi},\quad \Omega=\frac{\gamma}{1-\gamma}\left[A\left(z\right)\left[1-\alpha\right]\left[\frac{K}{zN}\right]^{\alpha}\frac{N}{M}\right]^{\lambda}. \tag{48}$$

where, as in (38), M is the number of unions/ sectors in the economy. For our numerical solution and as is common in many models with sectorial unions, we normalize this quantity to one.

These four equations contain parameters α, N, b, z, q, ϕ, χ, in (45), in addition to K^{World}, z^*, N^*, b^* in (46), nothing new in (47) and γ, M and λ in (48). The parameters z and z^* are fixed by data. The only endogenous variable is K. For calibration purposes, Kadjusts to satisfy (47), b and b^* adjust to satisfy (45) and (46) and χ is chosen to satisfy (48).

D.5.2 Adding z^C as target

In addition, we would like the output and consumption maximizing share of healthy workers from (42) to be given by .99, $z^C=\frac{1}{\frac{\phi}{(1-\alpha)\chi}+1}=.99$. We can rewrite this as

$$\left(\frac{1}{.99}-1\right)(1-\alpha)=\frac{\phi}{\chi}\equiv\Phi,$$

i.e. this fixes ϕ/χ. When we insert this into (45) to (48) and denote it by Φ which is to be understood as a fixed number (as α is set equal to 1/3), our system reads

$$\begin{aligned}
Y &= A\left(z\right)\left(K\right)^{\alpha}\left[zN\right]^{1-\alpha}=38,\ \text{where } A\left(z\right)=b\left[\frac{1-z}{q}\right]^{\Phi},\\
Y^* &= A\left(z^*\right)\left(K^{World}-K\right)^{\alpha}\left(z^*N^*\right)^{1-\alpha}=5.8,\ \text{where } A\left(z^*\right)=b^*\left[\frac{1-z^*}{q}\right]^{\Phi},\\
A\left(z\right)\left[\frac{zN}{K}\right]^{1-\alpha} &= A\left(z^*\right)\left[\frac{z^*N^*}{K^{World}-K}\right]^{1-\alpha},\\
1+\Omega &= \left(1+\Omega^{-1}\right)\frac{\alpha}{\Phi}\frac{1-z}{z},\quad \Omega=\frac{\gamma}{1-\gamma}\left[A\left(z\right)\left[1-\alpha\right]\left[\frac{K}{zN}\right]^{\alpha}\frac{N}{M}\right]^{\lambda}.
\end{aligned}$$

Hence, requiring z^C to take a certain level removes χ from the system and we need to calibrate by using $0<\gamma<1$ from (16)

With this notation, the autarky output maximizing health level z^Y, corresponding to the safety level s^Y, which is identical to the trade consumption maximizing health level z^C from (42), is expressed as

$$z^C=\frac{1}{\frac{\Phi}{1-\alpha}+1}$$

Concerning calibration, this system shows that equations one to three fix the capital allocation $K$and parameters when z and z^* are given. After that, the final equation can be used to calibrate either γ or λ, both of which are preference parameters coming from the union's objective function (16). As one parameter can not be determined, we fix λ at -1 and let γ be determined in the calibration.