Firm integration strategies and imperfect labor markets[‡]

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Abstract

This paper introduces labor market imperfections into a three country model to study the determinants of firm integration strategies in an open economy. Accounting simultaneously for the decision upon in-house production versus outsourcing and the decision upon exporting versus horizontal foreign investment, the analysis points to a crucial role of labor market frictions for the complex vertical and horizontal aspects in the integration strategies of international producers. Within this setting, we also show how changes in firm integration affect domestic labor markets and welfare in industrialized economies. Beyond that, the analysis discloses potential conflicts of interest between northern and southern economies when firms adjust their integration strategies in the process of trade liberalizaton.

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Key words: Multinational firms; International outsourcing; Complex integration strategies; Labor market imperfections

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1 Introduction

To cope with international competition, industrial producers choose from a menu of options about their integration strategies. In a horizontal dimension, they decide upon whether to enter a foreign market through exporting or foreign investment, and in a vertical dimension they choose between in-house production and international outsourcing of intermediate goods production to low-cost suppliers abroad. While both of these decisions have been extensively discussed in the literature, their possible interdependence has been disregarded for years. Only recently, trade economists aimed at explaining *complex* forms of horizontal and vertical integration strategies in an integrated framework (see Yeaple, 2003; Grossman, Helpman, and Szeidl, 2006; and Ekholm, Forslid, and Markusen, 2007). While the few existing studies have substantially improved our understanding about the determinants of firm integration, they have abstracted from one factor that seems particularly important for European economies: labor market imperfections.

Accounting for labor market imperfections is essential for at least two reasons. First, previous research highlights that labor market institutions are a key determinant of a firm's decision upon the mode of foreign market entry (Lommerud, Meland, and Sørgard, 2003; Eckel and Egger, 2007) as well as the international fragmentation of its production process (Skaksen, 2004; Egger and Kreickemeier, 2008). While these strands of the literature emphasize the relevance of labor market imperfections for certain forms of firm integration, neither of them considers the complex interaction between vertical and horizontal aspects in the respective decision of industrial producers. Second, there is no doubt that in the context of trade liberalization vis-à-vis southern economies the loss of domestic jobs is one of the major concerns of northern workers (see Scheve and Slaughter, 2001). Hence, a better understanding of how firms adjust their integration strategies to new challenges in the world economy is indispensable when governments search for policy reforms that help to mitigate the negative consequences of North-South trade liberalization for domestic labor.

It is the aim of this paper to shed light on both of these issues. For this purpose, we set up a three country model with two developed northern economies and one developing southern economy. All manufacturers are headquartered in the high-skilled labor abundant North. They decide simultaneously upon their mode of foreign market penetration in the other northern economy (exporting or foreign investment) and the organization

of their production process (in-house production of intermediate goods or international outsourcing to the South). The low-skilled abundant southern economy produces an agricultural good as well as intermediate goods if northern manufacturers choose outsourcing. While the product market side of our model is similar to Yeaple (2003), the two settings differ substantially with regard to the modeling of labor markets: while Yeaple considers labor market clearing, we assume labor markets to be imperfectly competitive in either northern country. The labor market imperfection is introduced by means of a fair-wage effort mechanism along the lines of Akerlof and Yellen (1990). This implies that a worker is willing to exert full effort only if the wage payment is at least as high as the wage considered to be fair. Relying on the fair wage specification in Kreickemeier and Nelson (2006), this provides a simple framework in which wages and thus the skill premium are not fully flexible and part of the northern low-skilled workers are involuntarily unemployed.[1]

We use this setting to shed light on the role of both northern labor market imperfections and the size of the southern labor force – as a measure of the number of southern economies that are integrated into the world economy – for the incentives of northern firms to invest abroad and to outsource the low-skilled labor intensive part of their production process to low-cost suppliers in the South. The analysis of this model suggests that considering both the vertical and the horizontal dimensions of firm integration simultaneously is indeed important. To be more specific, we show that those factors that render international outsourcing more attractive reduce the incentives for horizontal foreign investment. Intuitively, an increase in international outsourcing is accompanied by an increase of the unemployment rate and a reduction of aggregate factor income in the North. This lowers the market size of northern economies and thus renders horizontal foreign investment within the North less attractive.

The paper also provides a detailed analysis of the relationship between firm integration strategies, relative wages, and unemployment and it offers novel insights into the welfare implications of North-South trade liberalization. In particular, we shed light on a conflict of interest when firms adjust their integration strategies. Associating trade liberalization with an increase in the southern labor force, it leads to higher unemployment and lower

[1]Due to its attractiveness regarding analytical tractability and its empirical significance, the fair-wage effort model has become a standard tool to incorporate labor market imperfections into trade models. Recent examples include Grossman and Helpman (2007), Amiti and Davis (2008) and Egger and Kreickemeier (2008).

aggregate labor income in the North. The associated market size reduction renders horizontal multinational activity less attractive and leads to entry of new exporters. While this adjustment in firm integration strategies increases transport cost expenditures with adverse welfare effects on northern consumers, the South benefits from an increase in the number of available varieties since the entry of new exporters dominates the exit of multinational producers. This conflict of interest is notable because it may explain the reluctance of countries in recent years to spur global integration.

In an extension to our basic framework, we consider transport cost asymmetries and compare the consequences of a decline in North-South trade costs with those of an increase in the southern labor force in order to see whether our conclusions concerning the effects of trade liberalization are robust in this respect. In a second extension, we look at the role of unemployment benefits and analyze whether a reduction in these benefits is suitable to mitigate the negative labor market implications of North-South trade liberalization. The compensation of domestic workers for their losses from globalization is indeed considered to be one of the key challenges for policy makers in order to prevent a new wave of protectionism (Scheve and Slaughter, 2007). It is thus not surprising that this issue has also become one of the main research questions in international economics. However, while the literature on redistribution in an open economy is huge, there are only a few papers that consider labor market imperfections (see, e.g., Brecher and Choudhri, 1994; Davidson and Matusz, 2006), and none of the existing studies accounts for endogenous adjustments in the integration strategies of firms, which is at the heart of this paper's interest.

The remainder of the paper is organized as follows. The next section lays out the building blocks of our model. Section 3 describes the fundamental decision problem of a firm when choosing its optimal integration strategy. A characterization of the equilibrium and a comparative-static analysis are at the agenda of section 4. Section 5 provides a detailed welfare analysis. In section 6 we extend our basic model and study the role of trade cost asymmetries and unemployment benefits. The last section concludes.

2 The model

We consider a model with three countries: two northern economies (N) and one southern economy (S). The three countries are identical with respect to preferences and technology,

while the two northern economies differ from the southern country with respect to endowments and labor market institutions. There are two sectors of final goods production: a monopolistically competitive manufacturing industry (X) and a perfectly competitive agricultural sector (Y). Our assumptions concerning preferences, technology, and factor markets are discussed in detail in the following three subsections.

2.1 Preferences and consumer demand

The representative consumers in the three economies are characterized by the same Cobb-Douglas preferences:

$$V_j = (C_j^X)^\alpha (C_j^Y)^{1-\alpha}, \quad 0 < \alpha < 1. \tag{1}$$

C_j^Y denotes demand for the homogeneous agricultural good in country $j = N, S$ and $C_j^X = \left(\int_0^M c_j^x(i)^{(\sigma-1)/\sigma} di\right)^{\sigma/(\sigma-1)}$ is a CES-aggregator of differentiated manufactures. Parameter σ denotes the constant elasticity of substitution between the different product varieties, $c_j^x(i)$ represents demand for variety i in country j, and M is the mass of industrial firms (each producing a unique variety of the X-good). Denoting by I_j total factor income in country j, the budget constraint of the representative consumer is given by $I_j = \int_0^M p_j^x(i) c_j^x(i) di + P_j^Y C_j^Y$, where $p_j^x(i)$ and P_j^Y are consumer prices for variant i of the industrial product and the agricultural good, respectively. Due to Cobb-Douglas preferences, the representative consumer spends a constant share of her budget for the consumption of industrial and agricultural goods: $\alpha I_j = \int_0^M p_j^x(i) c_j^x(i) di = (P_j^X)^{1/(1-\sigma)} C_j^X$, where $P_j^X \equiv \int_0^M p_j^x(i)^{1-\sigma} di$ is a CES price index, and $(1-\alpha) I_j = P_j^Y C_j^Y$. Maximizing utility of the representative consumer in (1) subject to her budget constraint gives country j's demand for variety i of the industrial good:

$$c_j^x(i) = (\alpha I_j / P_j^X) p_j^x(i)^{-\sigma}. \tag{2}$$

2.2 Endowments and technology

Each of the two northern countries is endowed with H_N high-skilled and L_N low-skilled workers. The southern country is populated by L_S low-skilled workers, but has no high-skilled labor endowment. This captures in the simplest possible way the empirical fact that developed countries are high-skilled labor abundant.

Furthermore, we assume that the three countries have access to the same globally available production technologies. With regard to these technologies, we impose the following assumptions. In the agricultural sector, one efficiency unit of low-skilled labor is required to produce one unit of homogeneous output, Y. The production of one unit of final industrial output x requires the input of one unit of homogeneous intermediate good q: $x = q$.

Final goods producers can purchase the intermediate good from perfectly competitive suppliers or they can produce them in-house. In both cases, one efficiency unit of low-skilled labor is needed to produce one unit of q. Transformation of an intermediate good into industrial output requires the knowledge of locally supplied high-skilled labor. To be more specific, one efficiency unit of high-skilled labor is necessary to invent a variety of the industrial good and to set up an industrial firm. There is no additional resource requirement for operating a local production facility. However, if a firm sets up a second facility for assembling industrial output abroad it must employ $\rho > 0$ efficiency units of high-skilled labor in the host country, in order to operate and manage its local affiliate there. Hence, in the absence of migration (from which we refrain throughout our analysis), the South may produce both the agricultural and the intermediate good, but it cannot assemble final industrial output.

All goods are tradable between the three economies. While the shipment of the agricultural good is not subject to any trade impediments, there are iceberg transport costs for trade in both final and intermediate industrial goods, implying that $\tau > 1$ units of these goods must be shipped in order for one unit to arrive in the destination country. To save on notation and to present the main insights from our analysis in the simplest possible way, we assume that transport costs are the same for all country pairs. In section 6, we relax this symmetry assumption and allow the costs of shipping goods between a northern and a southern economy to differ from the respective costs of shipping goods between the two northern economies.

2.3 Factor markets

While wages in the South are determined in a perfectly competitive labor market (with each southern worker supplying one efficiency unit of low-skilled labor), we introduce a labor market imperfections in the two high-skill abundant economies by assuming that

northern workers have fairness preferences along the lines described by Akerlof (1982). The main idea of this fairness approach to efficiency wages is that the effort exerted by a northern worker of type $z = H, L$, e_N^z, depends on the wage offered by the firm, w_N^z, relative to this worker's reference wage $\hat{w}_N^z$, which represents the wage considered to be fair by this worker. The most commonly used specification of this fair-wage effort relationship dates back to Akerlof and Yellen (1988, 1990) who assume that workers provide their normal level of effort – which for convenience can be normalized to one – if the firm pays at least the fair wage, while they reduce their effort proportionally if the wage payment falls short of the fair wage: $e_N^z = \min[w_N^z/\hat{w}_N^z, 1]$.[2]

Under this fair-wage effort mechanism, firms have no incentive to pay less than the fair wage because they cannot reduce their effective labor costs by doing so. Following Akerlof and Yellen (1988, 1990), we can therefore safely assume that firms offer at least the fair wage, i.e., $w_N^z \geq \hat{w}_N^z$, and workers provide the normal level of effort, i.e., $e_N^z = 1$. Furthermore, wage payments that are higher than the reference wage of workers raise the effective labor costs and are therefore unattractive from a firm's perspective. Hence, if labor of type z is not a scarce resource, in the sense that firms can hire the required level of production workers at a wage $w_N^z \leq \hat{w}_N^z$, the equilibrium wage will equal the reference wage. In contrast, if the supply of type-z workers is the short side of the respective labor market, then competition will drive up wages above $\hat{w}_N^z$. In this case, the fairness constraint is not binding and the labor market outcome for type-z workers equals the competitive one.

In any fair-wage effort model, the reference wage plays a crucial role because it determines a lower bound for the equilibrium remuneration of workers. In line with Kreickemeier and Nelson (2006) and Egger and Kreickemeier (2008), we assume that the (fair) reference wage of workers has two components: the wage of the respective other skill group and the remuneration they could expect outside their own job, taking into account that they might be unemployed with a probability that equals the group-specific rate of unemployment, U_N^z. Assuming that unemployment benefits are zero, the reference wage of northern

[2]In the fair wage literature, e_N^z is usually interpreted as an effort norm. As pointed out by Kreickemeier and Nelson (2006), workers do not have an incentive to deviate from this norm, because it lowers their utility. To formalize this idea, they suggest to extend the utility function by a distance term of the form $-|\varepsilon_N^z - e_N^z|$, which lowers utility, whenever the effort provided by workers in their job ε_N^z differs from the respective effort norm e_N^z. This assumption ensures that individuals choose $\varepsilon_N^z = e_N^z$, so that the respective distance term disappears if workers maximize their utility.

low-skilled and high-skilled workers can be written in the following way

$$\hat{w}_N^L = \theta w_N^H + (1-\theta)\left(1 - U_N^L\right) w_N^L, \tag{3}$$

$$\hat{w}_N^H = \theta w_N^L + (1-\theta)\left(1 - U_N^H\right) w_N^H, \tag{4}$$

where $\theta \in (0,1)$ is a fairness parameter that determines the weight that workers attach to the income of the other skill group in their fairness considerations.[3]

From inspection of (3) and (4) it is immediate that the fair wage constraint cannot be binding for both skill groups simultaneously. Focussing on the empirically relevant case and assuming that the wage of high-skilled (non-production) workers is at least as high as the wage of low-skilled (production) workers, $w_N^H \geq w_N^L$, the fairness constraint is only binding for the group of low-skilled workers, implying $w_N^H \geq \hat{w}_N^H$, $U_N^H = 0$ and $w_N^L = \hat{w}_N^L$, $U_N^L \geq 0$. Substituting $w_N^L = \hat{w}_N^L$ into (3), we can reformulate the fair wage constraint as

$$\omega_N = 1 + \frac{(1-\theta)}{\theta} U_N^L, \tag{3'}$$

which determines a positive relationship between the skill premium, $\omega_N \equiv w_N^H / w_N^L$, and the unemployment rate of low-skilled workers, U_N^L. According to (3'), ω_N varies between 1 if $U_N^L = 0$ and $1/\theta$ if $U_N^L = 1$. A higher fairness parameter, θ, reduces the range for the skill premium and can thus be associated with a higher degree of labor market imperfection in the North. In the borderline case of $\theta = 0$, the skill premium becomes fully flexible and the unemployment rate, U_N^L, falls to zero, according to (3). This is the case of a perfectly competitive labor market. In contrast, with $\theta = 1$ the skill premium vanishes and we obtain $w_N^L = w_N^H$.

3 The decision problem of industrial producers

Decision making in the industrial sector can be described by a three-stage problem. At stage one, manufacturers decide upon firm integration. At stage two, they set wages and hire workers. At stage three, firms produce, set prices, and sell their output. This multi-stage decision problem can be solved through backward induction. With isoelastic consumer demand, profit maximization of the monopolistically competitive final goods

[3] In section 6, we account for a positive level of unemployment benefits and analyze how governments can use these benefits as a policy instrument to govern the labor market outcome in an open economy.

producers at stage three yields the well-known result that firms set prices as a constant markup over marginal costs, with $\sigma/(\sigma-1)$ being the respective markup. Intermediate producers, on the other hand, sell their output in a perfectly competitive market and therefore charge prices that are equal to marginal costs. Wage setting at stage two follows the process described in section 2.3. Hence, the wage of high-skilled workers is determined as if the respective labor market were perfectly competitive, while the wage for low-skilled workers equals the reference wage of this group. With these insights at hand, we can now turn to the stage one problem.

The decision of manufacturers upon their integration strategy has two dimensions: (i) how to organize the production process and (ii) how to penetrate the other northern market.[4] In summary, there are four possible integration patterns which are listed in Table 1.

		Horizontal integration	
		Single-plant EXP	Two-plant MNE
Vertical integration	In-house production	*Traditional exporter*	*Horizontal multinational*
	Outsourcing to South	*Outsourcing exporter*	*Complex multinational*

Table 1: Integration strategies

Let us first consider the decision regarding location of intermediate goods production. Manufacturers are indifferent between in-house production and *domestic* outsourcing. Hence, we can safely ignore the latter here and use the term in-house production to refer to domestic intermediates supply. Furthermore, the existence of transport costs implies that international outsourcing can only be attractive for manufacturers if foreign wages are sufficiently low relative to domestic ones. Hence, with two fully symmetric northern economies, there is no scope for North-North outsourcing, while North-South outsourcing becomes attractive if the wage differential w_N^L/w_S^L is high enough to compensate northern manufacturers for the iceberg transport costs involved in the shipping of intermediate goods. Formally, a manufacturer experiences a cost saving and therefore decides for international outsourcing of intermediate goods production to a low-cost sup-

[4]Due to our assumption that the southern economy has no high-skilled labor endowment, manufactures cannot be assembled there. They must be produced in and shipped from the northern economies.

plier in the South, if $w_N^L > \tau w_S^L$. If $w_N^L < \tau w_S^L$, in-house production is more attractive than international outsourcing and manufacturers choose the former integration strategy. Finally, if $w_N^L = \tau w_S^L$, manufacturers are indifferent between in-house production and intermediate goods purchases from a southern supplier.

With regard to the decision of how to penetrate the other northern market, manufacturers compare profits attainable under exporting with the respective profits attainable under multinational activity. Suppressing firm indices and using the results from stages two and three, profits of an exporter can be written as

$$\pi_N^{EXP} = \left[(1+\tau^{1-\sigma})(I_N/P_N^X) + \tau^{1-\sigma}(I_S/P_S^X)\right] \alpha p_N^{1-\sigma}/\sigma - w_N^H, \tag{5}$$

while the respective profits of a multinational can be written as

$$\pi_N^{MNE} = \left[2(I_N/P_N^X) + \tau^{1-\sigma}(I_S/P_S^X)\right] \alpha p_N^{1-\sigma}/\sigma - (1+\rho) w_N^H, \tag{6}$$

where $p_N^x = p_N$ denotes the consumer price of locally assembled manufactures in the northern economies, while $p_j^x = \tau p_N$ is the respective consumer price in country j of an imported variety. Subtracting (5) from (6), gives the profit differential $\Delta\pi_N \equiv \pi_N^{MNE} - \pi_N^{EXP}$, with

$$\Delta\pi_N >, =, < 0 \iff \frac{\alpha I_N}{P_N^X} p_N^{1-\sigma} >, =, < \frac{\rho\sigma}{(1-\tau^{1-\sigma})} w_N^H. \tag{7}$$

By virtue of (7), a manufacturer's decision about how to penetrate the other northern country depends on the size of the transport cost and the investment cost parameter. Both a lower resource requirement for operating a foreign affiliate, ρ, or higher transport costs for shipping exports, τ, raise the attractiveness of multinational activity. This is in line with the well-known proximity-concentration trade-off (Brainard, 1997).

Besides these exogenous model parameters, the decision of how to penetrate the other northern market also depends on three endogenous (aggregate) variables. A larger northern market, I_N/P_N^X, makes it easier for firms to bear the additional fixed costs of operating a foreign affiliate, thereby rendering multinational activity more attractive. A reduction in the wage of high-skilled workers, w_N^H, has a similar effect, because it reduces the fixed costs of foreign investment. Furthermore, a decline in the price charged by manufacturers, p_N, raises output and thus operating profits, rendering multinational activity more attractive. While these effects are well-known from the traditional literature on multinational firms, models on complex integration strategies point out that the horizontal investment

decision depends on the manufacturer's choice between in-house production and purchases of intermediate goods from a southern supplier. The novel feature of our analysis is that labor market imperfections govern the vertical decision on how to organize the production process and thereby influences the attractiveness of horizontal investment in the other northern economy.

4 Equilibrium and comparative static analysis

We now proceed with characterizing the equilibrium in our three country model. Assuming that the southern low-skilled labor endowment is large enough to guarantee production of the agricultural good, we can choose good Y as our numéraire, implying that the southern low-skilled wage equals one: $w_S^L = 1$.[5] In this case, we can distinguish three scenarios with respect to the possible production patterns.

First, the North will produce the agricultural good only if $w_N^L = 1$. In this case, the South does not produce the intermediate good. Second, if $w_N^L \in (1, \tau)$ production patterns in the two countries are fully specialized, i.e., there is no Y-production in the North and no q-production in the South. Hence, the North-South wage differential is still too low for rendering international outsourcing attractive. Third, if $w_N^L \geq \tau$, international outsourcing to a low-cost supplier in the South becomes attractive for northern manufacturers. Clearly, if $w_N^L > \tau$, production ceases in the North and all northern low-skilled workers become unemployed. Since such an outcome does not provide any additional interesting insights, we can ignore it in the subsequent analysis.

In subsections 4.1-4.3, we separately look at the three w_N^L-scenarios. We characterize the labor market equilibrium and discuss the role of fairness parameter θ – as a measure for the degree of labor market imperfection – and the size of the southern labor force L_S – an increase of which can be interpreted as integration of additional developing countries into the world economy – for the optimal integration strategies of firms. While northern low-skilled wages itself are an endogenous variable, the comparative static effects of changes in θ and L_S provide insights into the parameter domains that support the respective w_N^L-scenarios. A detailed discussion of the respective domains is at the agenda of subsection 4.4. Together with the insights from subsections 4.1-4.3, this gives a com-

[5] A sufficient condition for this is $2L_N < (1-\alpha)L_S$.

prehensive picture about how labor market imperfections and the opening up of southern countries to international trade affect production patterns, firm integration strategies, and northern wages and unemployment.

4.1 Scenario I: $w_N^L = 1$

If the low-skilled wage in the North equals the low-skilled wage in the South, production in the two northern countries is diversified, while production in the South is specialized on good Y: $Y_S = L_S$. Due to the constant expenditure share rule, southern consumers purchase $(1-\alpha)L_S$ units of the domestic supply of agricultural goods and they import industrial manufactures from the North using αL_S units of their agricultural output to trade for these imports. Half of these agricultural exports arrive in either northern economy, due to symmetry. Hence, applying the constant expenditure share rule once again, market clearing for agricultural goods implies $Y_N = (1-\alpha)I_N - \alpha L_S/2$. Furthermore, market clearing for manufactures implies $(1-U_N^L)L_N = \alpha(I_N + L_S/2)(\sigma-1)/\sigma + Y_N$.[6] Using the two market clearing conditions together with the adding-up condition for factor income, which in the case of $w_N^L = 1$ is given by $I_N = w_N^H H_N + (1-U_N)L_N$, we can derive inverse relative demand for northern labor:

$$w_N^H = \frac{2(1-U_N^L)L_N + L_S}{2H_N(\sigma/\alpha - 1)}. \tag{8}$$

Combining this labor demand schedule with the (binding) fair-wage constraint in (3′) – which replaces the relative labor supply curve of a competitive labor market – we can characterize the labor market equilibrium as depicted in Figure 1. Since the labor demand schedule is represented by a negatively sloped curve in the ω_N-U_N^L space, while the fair-wage constraint is upward sloping, we can conclude that if an equilibrium exists (which we assume from now on), this equilibrium is unique.[7]

[6] Overall employment in either northern economy for the South amounts to $\alpha L_S/(2p_N)$. Furthermore, the number of low-skilled workers needed to produce manufactures that are consumed in one of the two northern economies is given by $\alpha I_N/p_N$. Summing up, total employment in the industrial sector of a northern economy is thus given by $\alpha(I_N + L_S/2)/p_N$. Noting further that Y_N low-skilled workers are employed in the agricultural sector and that $w_N^L = 1$ implies $p_N = \sigma/(\sigma-1)$ under scenario I, it is immediate that market clearing in the industrial sector requires that $\alpha(I_N + L_S/2)(\sigma-1)/\sigma + Y_N$ equals aggregate employment $(1-U_N^L)L_N$.

[7] Note that $(L_N + L_S/2) > H_N(\sigma/\alpha - 1)$ is a necessary condition for an interior solution, because it guarantees that the negatively-sloped labor demand schedule lies above the positively-sloped fair-wage

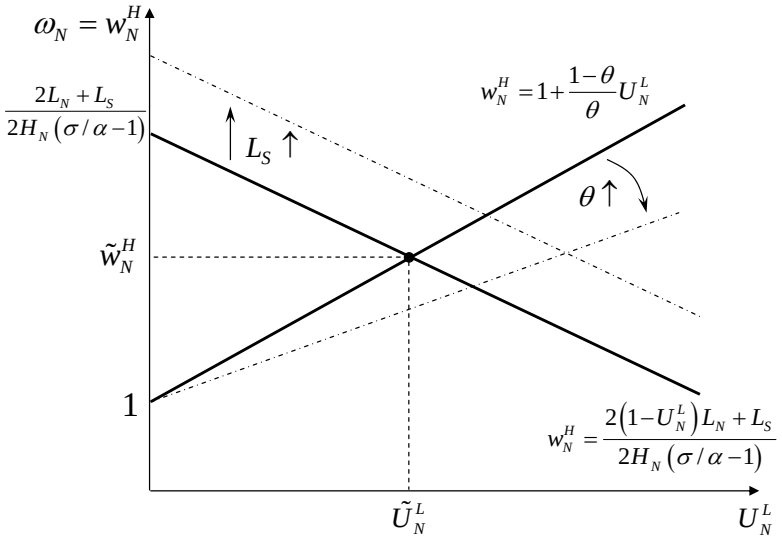

Figure 1: Labor market equilibrium

We observe from Figure 1 that more rigid labor markets – as captured by a higher fairness parameter θ in our model – induce a clockwise rotation of the fair-wage constraint. Since the labor demand schedule remains unaffected, this implies a reduction in the skill premium and aggravates the unemployment problem. In contrast to the fairness parameter, a change in the number of southern workers only affects the labor demand locus. Specifically, a higher L_S causes an outward shift and thereby raises both the unemployment rate and the skill-premium. Two effects are responsible for this result. First, a larger number of low-skilled workers in the South stimulates demand for manufactures and leads to a *pari passu* increase in the demand for low-skilled and high-skilled labor in the North. Second, all other things equal, an increase in the southern labor force raises world-wide supply of the agricultural good by more than world-wide demand, implying that relative demand for low-skilled labor shrinks in the North. A final point to make is that the labor market outcome does neither depend on transport cost parameter τ nor on investment cost parameter ρ.

To determine the share of multinational firms, we need to replace the endogenous

constraint if $U_N^L = 0$. Intuitively, world-wide endowment of high-skilled workers must not be too high relative to world-wide endowment of low-skilled workers in order for the fair-wage constraint to be binding for northern low-skilled workers.

variables in (7) by their respective equilibrium values. Using (8) we can express the adding-up condition for factor income as

$$I_N = \frac{\sigma/\alpha}{\sigma/\alpha - 1}(1 - U_N^L)L_N + \frac{1}{\sigma/\alpha - 1}\frac{L_S}{2}. \tag{9}$$

Furthermore, denoting the share of multinational firms in the overall mass of industrial competitors by μ, we can write the northern price index for manufactures as $P_N^X = (M/2)p_N^{1-\sigma}[1 + \mu + (1 - \mu)\tau^{1-\sigma}]$. Combining this expression with the labor market clearing condition for high-skilled workers, $M/2 = H_N/(1 + \rho\mu)$, we arrive at $P_N^X = H_N p_N^{1-\sigma}[1 + \mu + (1 - \mu)\tau^{1-\sigma}]/(1 + \rho\mu)$. Finally, considering again the high-skilled wage rate in (8) and substituting for I_N and P_N^X, we can rewrite (7) in the following way

$$\Delta\pi^N >, =, < 0 \iff A(\mu)\frac{(1 - U_N^L)L_N + (\alpha/\sigma)L_S/2}{(1 - U_N^L)L_N + L_S/2} >, =, < \frac{\rho}{1 - \tau^{1-\sigma}}, \tag{10}$$

where

$$A(\mu) \equiv \frac{1 + \rho\mu}{1 + \mu + (1 - \mu)\tau^{1-\sigma}}. \tag{11}$$

As in other models with a proximity-concentration trade-off (Markusen and Venables, 1998, 2000), the foreign investment cost parameter, ρ, must not be too high nor too low in order for exporters and multinational firms to coexist in equilibrium.[8] This is the case we focus on in the sequel.

We can now look at the role of L_S and θ for the decision of industrial producers on how to enter the foreign market. As noted above, a higher degree of labor market imperfection aggravates the unemployment problem and reduces the factor return to high-skilled workers as well as the skill premium. This lowers aggregate income I_N and thus consumer demand for industrial output in the two northern economies. This negative market size effect renders foreign investment less attractive and reduces μ *ceteris paribus*. However, there is a counteracting effect, as the reduction in w_N^H reduces the costs of foreign

[8] To be more specific, we can use (10) and (11) to determine two critical levels of ρ, which are denoted by $\underline{\rho}_I$ and $\bar{\rho}_I$, with $0 < \underline{\rho}_I < \bar{\rho}_I < (1 - \tau^{1-\sigma})/(1 + \tau^{1-\sigma})$. As it is shown in a technical supplement which is available upon request, the critical levels of ρ depend on the size of transport cost parameter τ. The higher the transport cost parameter, the higher is the ρ-range for which multinational activity is an attractive integration strategy, i.e., $d\bar{\rho}_I/d\tau > 0$. Furthermore, we obtain $d\underline{\rho}_I/d\tau > 0$, implying that the range of ρ that supports exporting as an attractive integration strategy declines in the prevailing transport cost level. Both of these effects are intuitive and well in line with the proximity-concentration trade-off in a firm's decision upon foreign market penetration.

investment. The market size effect is stronger than the wage premium effect, implying that a higher degree of labor market imperfection lowers the incentives for foreign investment: $d\mu/d\theta < 0$.

A higher low-skilled labor endowment in the South increases overall demand for industrial goods. This raises northern factor income and thus increases the incentives for foreign investment, *ceteris paribus*. However, there are two counteracting effects. On the one hand, the increase in unemployment lowers total factor income which reduces the share of multinational firms through a negative market size effect. On the other hand, the increase in high-skilled wages not only raises total factor income but also increases the costs for setting up a foreign affiliate. Other things equal, this reduces the incentives for foreign investment. Since the latter two effects dominate the first one, an increase in L_S exhibits a negative impact on the share of multinationals, μ. This points to a crucial role of third-country effects, when analyzing optimal integration strategies of industrial producers.

We summarize our main findings of this section in the following proposition.

Proposition 1. *If the world economy is in a scenario I equilibrium with $w_N^L = 1$ and both the North as well as the South produce the agricultural good, then a marginal increase in the fairness parameter, θ, reduces the skill premium and aggravates the unemployment problem in the North, where the incentives for horizontal foreign investment deteriorate. Similar effects with respect to unemployment and foreign investment are triggered by an increase in the southern labor force, L_S. However, the impact on the skill premium is different, as a higher L_S increases the scarcity of high-skilled labor, thereby raising its factor return.*

So far, we have conducted our analysis under the assumption that the world economy can be characterized by a scenario I equilibrium. However, we have not discussed yet which assumptions regarding our model parameters are necessary to support a scenario I outcome. In order to shed light on this question it is useful to consider the equilibrium supply of the homogeneous agricultural good in the North. This is informative, because we know that $Y_N > 0$ requires $w_N^L = 1$, while $w_N^L > 1$ implies $Y_N = 0$. Substituting (9) into $Y_N = (1-\alpha)I_N - \alpha L_S/2$ and accounting for (8), we obtain

$$Y_N = \frac{\sigma(1-\alpha)/\alpha}{\sigma/\alpha - 1}(1 - U_N^L)L_N - \frac{(\sigma-1)}{\sigma/\alpha - 1}\frac{L_S}{2}. \tag{12}$$

Recollecting the impact of changes in θ and L_S on U_N^L from above, it is immediate that an increase in either variable reduces Y_N and, therefore, brings the world economy closer to a situation with full specialization in the production patterns of the North and the South.

4.2 Scenario II: $w_N^L \in (1, \tau)$

If $w_N^L \in (1, \tau)$, the North specializes on the production of the industrial good, while the South specializes on the production of agricultural output. In this case, market clearing for manufactures implies $(1 - U_N^L)L_N = \alpha(I_N + L_S/2)(\sigma - 1)/(\sigma w_N^L)$.[9] Together with the market clearing condition for agricultural goods $(1 - \alpha)I_N = \alpha L_S/2$ and the adding-up condition for factor income, $I_N = (1 - U_N^L)L_N w_N^L + H_N w_N^H$, this determines relative labor demand in the northern economies[10]

$$\omega_N = \frac{(1 - U_N^L)L_N}{(\sigma - 1)H_N}. \tag{8'}$$

This labor demand schedule describes a negative relationship between the skill premium and the unemployment rate of northern low-skilled workers. The labor market equilibrium is determined by the intersection point of the labor demand locus and the fair-wage constraint in ω_N-U_N^L space. Similar to scenario I, a higher degree of labor market imperfection, i.e., a higher θ, rotates the fair-wage constraint clockwise and therefore raises unemployment and lowers the skill premium.

While this effect is well understood from the analysis in subsection 4.1, there is a crucial difference between scenarios I and II regarding the labor market implications of L_S-changes. Under scenario I, an increase in L_S reduces relative labor demand for low-skilled workers in the North (thus causing *intra*national wage dispersion there), whereas there is no such effect when full specialization prevails. Similar to scenario I, an increase in the southern labor force stimulates demand for manufactures and leads to a *pari passu* increase in the demand for low-skilled and high-skilled labor. However, with production being fully specialized, there is no counteracting effect on low-skilled labor demand in the North due to an expansion of agricultural production in the South. Hence, the skill

[9] This market clearing condition can be derived in analogy to scenario I, taking into account that $Y_N = 0$ and $p_N = w_N^L \sigma/(\sigma - 1)$ if $w_N^L > 1$. See the respective derivation in Footnote 6.

[10] Noting from (12) that $Y_N \to 0$ implies $L_S/2 = \{\sigma(1 - \alpha)/[\alpha(\sigma - 1)]\}(1 - U_N^L)L_N$ and substituting this expression into (8), one can show that w_N^H in (8) approaches ω_N in (8′) if $Y_N \to 0$.

premium as well as the unemployment rate remain unaffected by a marginal increase in the southern labor force if the world economy stays in a scenario II equilibrium.

However, this does not mean that an expansion of the southern labor force has no consequences at all for northern labor markets. As noted above, the increase in L_S raises demand for both high-skilled and low-skilled workers in the northern production of manufactures, thereby increasing northern factor returns relative to low-skilled wages in the South. It is worth to have a closer look at this effect. Combining the market clearing conditions for manufactures and the agricultural good (see above), gives

$$w_N^L = \frac{\alpha(\sigma-1)}{(1-\alpha)\sigma}\frac{L_S}{2L_N(1-U_N^L)}. \tag{13}$$

Accounting for (8′) further implies

$$w_N^H = \frac{\alpha}{(1-\alpha)\sigma}\frac{L_S}{2H_N}. \tag{14}$$

In contrast to scenario I, which was characterized by an international equalization of low-skilled wages, there is a wedge between the factor returns to low-skilled workers in the North and the South if these economies are fully specialized in their production patterns. In this case, an increase in the southern labor force raises the North-South dispersion of labor income. Furthermore, it is obvious from (13) and (14) that a higher degree of labor market imperfection not only raises unemployment but also increases the dispersion of low-skilled wages between the North and the South. In contrast, the differential between northern high-skilled and southern low-skilled wages remains unaffected. Again, this differs from the respective effect under scenario I, where the high-skilled wage in the North decreased relative to the low-skilled wage in the South, when θ increased.

Let us now determine the share of multinational firms in equilibrium. In analogy to scenario I, we have $P_N^X = H_N p_N^{1-\sigma}[1+\mu+(1-\mu)\tau^{1-\sigma}]/(1+\rho\mu)$. Furthermore, let us combine the market clearing conditions for manufactures and agricultural output to obtain $I_N = [\sigma/(\sigma-1)](1-U_N)L_N w_N^L$, which in view of (8′) can be reformulated to $I_N = \sigma w_N^H H_N$. Substituting into (7) then gives

$$\Delta\pi_N >, =, < 0 \iff \alpha A(\mu) >, =, < \frac{\rho}{1-\tau^{1-\sigma}}, \tag{10′}$$

where $A(\mu)$ is defined in (11).

Within scenario II, neither changes in L_S nor changes in θ exhibit an impact on the share of multinational firms in the overall mass of manufacturers – even if we focus on

interior solutions.[11] An increase in the southern labor force raises demand for industrial production and therefore induces a *pari passu* increase in low-skilled and high-skilled northern wages. Hence, the negative impact of an increase in the high-skilled wage on the incentives to invest abroad – due to a rise in the fixed costs of operating a foreign affiliate – is exactly offset by the positive market size effect triggered by the increase in total factor income. A higher fairness parameter, θ, raises the low-skilled wage, w_N^L, and reduces the employment rate, $1 - U_N^L$. Since the two effects are of the same size, there is no impact of a θ-change on aggregate income, I_N. Furthermore, there is also no impact of a θ-change on the wage of high-skilled workers, according to (14), so that the incentives to become a multinational producer remain unaffected.

The main insights from our analysis in this subsection can be summarized as follows.

Proposition 2. *If the world economy is in a scenario II equilibrium with $w_N^L \in (1, \tau)$ and the production patterns are fully specialized, then a marginal increase in the fairness parameter, θ, reduces the skill premium and aggravates the unemployment problem in the North. It also raises the international dispersion of low-skilled wages but has no impact on the incentives for horizontal multinational activity. A marginal increase in the southern labor force, L_S, raises northern factor returns relative to the wage of low-skilled labor in the South. The skill premium, the unemployment rate, and the share of multinational enterprises in the North remain unaffected.*

With the results in Proposition 2 at hand, we can also shed light on the parameter domain that supports a scenario II equilibrium. Note that the right-hand side of (13) is monotonically increasing in L_S and θ and recall that scenario II is relevant if and only if $1 < w_N^L < \tau$. Then, setting the right-hand side of (13) equal to one implicitly determines lower bounds of the L_S and θ domains which support full specialization in northern and southern production. We denote these lower bounds as $\underline{\theta}$ and $\underline{L_S}$, respectively.[12] Furthermore,

[11] In analogy to scenario I, we can use (10′) and (11) to determine a range of ρ that supports coexistence of the two possible vertical integration strategies regarding the penetration of the other northern market, i.e., that supports $\mu \in (0, 1)$. The respective parameter range is given by $\underline{\rho}_{II} < \rho < \bar{\rho}_{II}$, with both $\underline{\rho}_{II}$, $\bar{\rho}_{II}$ increasing in τ. It is also notable that both critical ρ parameters under scenario I are higher than their counterparts under scenario II, i.e., $\underline{\rho}_I > \underline{\rho}_{II}$ and $\bar{\rho}_I > \bar{\rho}_{II}$. Hence, if an increase in L_S or θ brings the world economy from scenario I to scenario II, then the parameter range that supports multinational activity shrinks. This is well in line with our findings regarding the comparative-static effects of changes in these two model parameters on the incentives for foreign investment in Proposition 1.

[12] Setting the right-hand side of (12) equal to zero gives the same $\underline{\theta}$- and $\underline{L_S}$-values.

setting the right-hand side of (13) equal to τ determines upper bounds of the relevant parameter domains, denoted by $\bar{L}_S$ and $\bar{\theta}$, respectively. These bounds have the following interpretation. If both $L_S \leq \underline{L}_S$ and $\theta \leq \underline{\theta}$, then the analysis in scenario I is relevant (see subsection 4.1). In contrast, scenario III (which is analyzed subsequently) becomes relevant if either $L_S \geq \bar{L}_S$ or $\theta \geq \bar{\theta}$. In all other cases (i.e., for intermediate levels of θ and L_S), the world economy is in scenario II. A more detailed discussion of the critical values of L_S and θ and their interdependencies is deferred to subsection 4.4.

4.3 Scenario III: $w_N^L = \tau$

If $w_N^L = \tau$, the agricultural good is produced only in the South, i.e., $Y_N = 0$, while both the North and the South engage in the production of intermediate goods. This scenario is particularly interesting because it allows a closer look at two issues that have surfaced in the limelight of interest in recent years: complex forms of firm integration strategies with multinational enterprises outsourcing part of their input production to foreign low-cost suppliers; and the relationship between international outsourcing and domestic labor markets.

Similar to the previous two subsections, we start our analysis with a characterization of the labor market equilibrium. With the South being engaged in intermediate goods production, market clearing in the agricultural sector now implies $(1-\alpha)I_N = \alpha L_S/2 - L_S^X/2$, where L_S^X denotes the amount of southern low-skilled labor used in the production of intermediate goods (see below). The adding-up condition for northern income is determined in analogy to scenario I and, accounting for $w_N^L = \tau$, it can be formulated as $I_N = w_N^H H_N + (1-U_N^L)L_N\tau$. Finally, following the steps in footnote 6, we can conclude that market clearing in the industrial sector implies $(1-U_N^L)L_N\tau = \alpha(I_N + L_S/2)(\sigma-1)/\sigma - L_S^X/2$. Combining these three conditions and noting that $w_N^L = \tau$ implies $\omega_N = w_N^H/\tau$, it is straightforward to derive inverse relative labor demand in each of the northern countries:

$$\frac{w_N^H}{\tau} = \frac{2(1-U_N^L)L_N + L_S/\tau}{2H_N(\sigma/\alpha - 1)}. \qquad (8'')$$

The relative labor demand schedule in $(8'')$ and the fair-wage constraint in $(3')$ determine the labor market outcome. The comparative-static effects of changes in L_S and θ on this outcome are similar to the respective effects under scenario I. A higher fairness parameter, θ, raises the weight of w_N^H in the reference wage of low-skilled workers. This lowers the

skill premium, ω_N, and raises the unemployment rate, U_N^L. An increase in the southern labor force raises the wage premium and aggravates the unemployment problem in the North. None of these changes has an effect on the international dispersion of low-skilled wages.

To shed light on the role of labor market imperfections and the size of the southern workforce for vertical integration strategies, we need to determine the extent of international outsourcing. We choose employment of southern labor in the production of intermediate goods, L_S^X, as our preferred measure of international outsourcing because, with τ determining the price of intermediates, L_S^X is proportional to overall northern expenditures for imported intermediate goods. We can express the respective employment level in the following way[13]

$$L_S^X = \frac{\alpha(\sigma-1)}{\sigma-\alpha} L_S - \frac{(1-\alpha)\sigma}{\sigma-\alpha} 2(1-U_N^L) L_N \tau. \tag{15}$$

A higher degree of labor market imperfection in the North, i.e., a higher fairness parameter θ, leads to a higher unemployment rate and thereby reduces the amount of northern labor used in the production of intermediate goods. Part of this decline in northern employment is compensated by an increase in international outsourcing, so that L_S^X increases with θ. Furthermore, an increase in the southern labor force, L_S, stimulates demand for manufactures and *ceteris paribus* raises southern labor used in the production of intermediate goods. Besides this direct effect, there is also an indirect one through adjustments in the northern labor market. As noted above, the increase in demand for industrial goods raises the skill premium and, due to the fair-wage effort mechanism, also unemployment in the North. Hence, less northern low-skilled labor is now available for the production of intermediate goods, which again stimulates southern employment in the industrial sector. It is also notable that an increase in the two parameters θ and L_S not only raises the level of international outsourcing, L_S^X, but it also induces a surge in the *share* of southern labor used in the production of intermediate goods: L_S^X/L_S. This implies that both a higher degree of labor market imperfection in the North as well as a growth in the southern labor force foster the structural change in the South from agricultural to industrial production.

There is no monotonic relationship between the magnitude of international outsourcing and the skill premium in the North. Rather, this relationship crucially depends on

[13] To determine how much southern low-skilled labor is used for producing intermediate goods, we can combine the two factor market clearing conditions from above. Rearranging terms and solving explicitly for L_S^X, gives (15).

the determinants of outsourcing. If the level of intermediate goods imports increases due to an expansion of the southern labor force, then our model predicts a positive relationship between the level of international outsourcing and the northern skill premium. On the contrary, if international outsourcing is triggered by an increase in the degree of labor market imperfection, the skill premium declines although more intermediate goods are imported by the two northern economies. This insight may be useful for interpreting existing empirical results concerning the impact of international outsourcing to low-wage countries on the skill premium in industrialized economies. While most of the existing studies find a positive impact, at least some authors point out that the effect may also be insignificant or even negative.[14] Furthermore, although the relationship between the skill premium and international outsourcing is not clear-cut in general, our analysis indicates that an increase in international outsourcing of the low-skilled intensive part of the production process is always accompanied by an increase in the relative employment of high-skilled workers. This result is well in line with empirical evidence for Austria (see, e.g., Egger and Egger, 2003).

A final aspect of firm integration we need to consider is the decision of manufacturers regarding the form of market penetration in the other northern economy. In line with the analysis in subsection 4.1, we can reformulate (7) in the following way

$$\Delta\pi_N >, =, < 0 \iff A(\mu)\frac{(1-U_N^L)L_N\tau + (\alpha/\sigma)L_S/2}{(1-U_N^L)L_N\tau + L_S/2} >, =, < \frac{\rho}{1-\tau^{1-\sigma}}. \qquad (10'')$$

Again, we focus on levels of ρ that ensure coexistence of exporters and multinationals.[15] It is then straightforward that an increase in L_S and θ lowers the incentives for foreign

[14] Feenstra and Hanson (1999) is an early and one of the most prominent contributions that documents a positive impact of outsourcing on wage inequality (measured by the relative wage of non-production workers). They use U.S. data for 1979-2000 in their analysis. However, in Feenstra and Hanson (1996) they show that the impact of outsourcing on the U.S. non-production wage share becomes insignificant if one considers data for the period 1972-1979. For European economies, the picture is also mixed. Hijzen (2007) finds a negative impact of international outsourcing on U.K. wage inequality. Geishecker and Görg (2008) obtain a similar result for Germany. In contrast to them, Egger and Egger (2003) show that the Austrian skill premium was almost constant in the period 1990-1998, even though outsourcing to low-cost destinations in Central and Eastern Europe increased substantially over this time interval. Using more recent data, Lorentowicz, Marin, and Raubold (2005) even find a negative impact of international outsourcing on the Austrian skill premium.

[15] In analogy to scenarios I and II, we may determine two critical levels of ρ: $\underline{\rho}_{III} < \underline{\rho}_{II}$ and $\bar{\rho}_{III} < \bar{\rho}_{II}$, respectively, where $\underline{\rho}_{III} < \rho < \bar{\rho}_{III}$ implies coexistence of exporters and multinationals in equilibrium.

investment, i.e., $d\mu/d\theta < 0$ and $d\mu/dL_S < 0$. The intuition for these effects has been extensively discussed in subsection 4.1.

Comparing the effects of changes in L_S and θ on the horizontal and vertical aspects of firm integration, it is immediate that the same factors that increase the incentives for international outsourcing, i.e., a higher θ or L_S, lower the incentives for multinational activity. This points to a substitutive relationship between North-South outsourcing and *horizontal* North-North investment. This relationship differs substantially from the one identified in Yeaple (2003), who associates the international fragmentation of production with *vertical* investment of a multinational producer instead of arms's length intermediate goods transactions, as in our model. In Yeaple's setting, operating a production plant in the South raises the fixed costs of firms. Hence, in order for vertical multinational activity to be attractive, the variable costs of producing in the South and shipping the output back to the North must be lower than the variable costs of producing the respective good at home. The requirement of lower variable production costs implies that the output level of a vertical multinational is higher than that one of a firm which chooses local production. Since larger firms can more easily cope with plant set-up costs, these firms are more inclined towards horizontal investment in the other northern economy.

Such a complementarity between the vertical and horizontal aspects of firm integration strategies is absent in our model, where international fragmentation is associated with market purchases of intermediate goods and therefore does not involve a fixed cost investment in the South. International outsourcing becomes attractive when the variable costs of producing in the South and shipping intermediates back to the North are lower than or *equal to* the respective costs of domestic production. Focussing on the case of a positive employment level of low-skilled workers in the North, we consider equivalence of variable costs in scenario III. Hence, in our model the interaction between outsourcing and horizontal foreign investment does not arise due to cost savings but rather due to a market size effect that is triggered by adjustments in the employment level and the factor returns in northern economies. This highlights the role played by labor market imperfections for the substitutability between outsourcing and horizontal multinational activity.

We can summarize our main findings in the following way.

Proposition 3. *If the world economy is in a scenario III equilibrium with $w_N^L = \tau$ and intermediate goods production is attractive in both the North and the South, then a marginal*

increase in the fairness parameter, θ, reduces the skill premium and aggravates the unemployment problem in the North. It also raises international outsourcing and lowers the incentives for horizontal multinational activity. A marginal increase in the southern labor force, L_S, exhibits similar effects on unemployment, international outsourcing and multinational activity but it raises the skill premium in the North. Finally, an increase in either θ or L_S fosters the structural change in the South from agricultural to industrial production.

4.4 International production patterns: An integrated view

In the previous three subsections, we have studied the impact of θ and L_S on firm integration strategies and the northern labor market outcome. We have shown that the respective effects crucially depend on the prevailing production patterns – which themselves are governed by the North-South differential in low-skilled wages and are thus endogenous. In this subsection, we extend our analysis and have a closer look on the role of labor market imperfections and the size of the southern labor force for the international pattern of production.

Figure 2 depicts the three possible scenarios in L_S-θ space. In view of the analysis in section 4.2, we know that there exists a set of $(\underline{L_S}, \underline{\theta})$ pairs, which separate scenario I from scenario II. These pairs are represented by locus "l-bound" in Figure 2. The shape of this locus captures the interdependence of the two parameters. Starting from a scenario I equilibrium as represented by point A, an increase in L_S lowers Y_N and thus brings the world economy closer to a scenario II equilibrium with full specialization in the production patterns. This effect can be offset by a fall in the fairness parameter θ, which lowers the degree of labor market imperfection in the North and thus increases northern output of the agricultural good. Hence, the "l-bound" must be negatively sloped in L_S-θ space.

The "u-bound" represents the set of $(\bar{L}_S, \bar{\theta})$-pairs that separate scenario II from scenario III. Again, the "u-bound" is negatively sloped, due to the interdependence of the two parameters of interest. Finally, the parameter domain that supports a scenario III outcome is confined by the dashed "r-bound". All (L_S, θ) pairs northeast of "r-bound" induce full unemployment of northern low-skilled workers. If northern labor markets were perfectly competitive, there would be no unemployment in the North and the upper bound to positive employment levels would vanish.

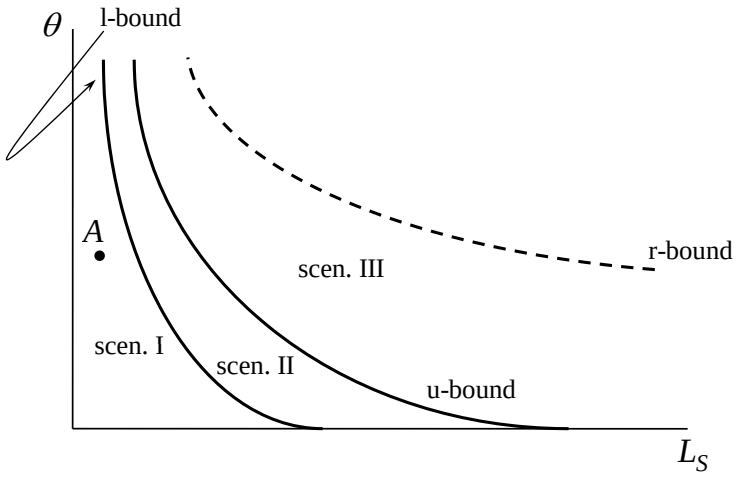

Figure 2: The three w_N^L scenarios in the θ-L_S space

Putting together the insights from subsections 4.1-4.3 and those from Figure 2, we obtain a comprehensive picture about the comparative-static effects of L_S and θ changes. Instead of simply repeating these effects, we conclude this subsection with one final remark concerning the significance of the interdependence in our two parameters of interest for the production patterns in northern economies. Starting from a scenario I equilibrium as depicted by point A in Figure 2, a given change in the southern labor force renders a shift in the patterns of production more likely, if $\theta > 0$. This implies that a northern economy with labor market imperfections is more vulnerable to structural change due to the integration of southern countries into the world economy.

5 Welfare analysis

So far, the focus of this paper has been on the interaction between labor market imperfections and the optimal integration strategies of industrial producers. We have provided a comprehensive picture of the possible effects that changes in the degree of labor market imperfection and changes in the size of the southern labor force exhibit on unemployment and wage inequality (within and between countries). However, we have not yet discussed the consequences of these changes on welfare of the representative consumer. This is the purpose of the following analysis.

Starting from a scenario I equilibrium, we analyze the impact of an increase in L_S and θ on welfare, taking into account the possible changes in firm integration strategies as determined in section 4. Substituting the utility-maximizing consumption levels, $C_j^X = \alpha I_j/(P_j^X)^{1/(1-\sigma)}$ and $C_j^Y = (1-\alpha)I_j$, with $j = N, S$, into (1) and dividing the resulting expression by the total number of (production and non-production) workers T_j – with $T_S = L_S$ and $T_N = H_N + L_N$ – we obtain a suitable utilitarian welfare measure

$$v_j = \frac{k(P_j^X)^{\frac{\alpha}{\sigma-1}} I_j}{T_j}, \qquad k \equiv \alpha^\alpha (1-\alpha)^{1-\alpha} > 0. \tag{16}$$

With the insights from section 4 at hand, we are now equipped to investigate the welfare implications of changes in the southern labor force and the degree of northern labor market imperfection. This is the purpose of the next two subsections. In subsection 5.3, we summarize the main insights from this analysis and refer to potential conflicts of interest between the northern and the southern representative consumers.

5.1 Welfare implications in the South

Noting that $I_S = T_S = L_S$ and considering $P_S^X = M(\tau p_N)^{1-\sigma}$, southern welfare can be written in the following way

$$v_S = kM^{\frac{\alpha}{\sigma-1}}(\tau p_N)^{-\alpha}. \tag{17}$$

Hence, there are two channels through which changes in L_S and θ can affect welfare in the South: first, due to adjustments in the number of available intermediate goods (a *variety effect*) and, second, due to changes in the price of manufactures (a *terms of trade effect*). Taking into account the resource constraint for northern high-skilled labor, $2H_N/(1+\mu\rho) = M$, it is immediate that a variety effect can only arise if the share of multinational firms changes – with a larger share of multinational firms reducing southern welfare due to a decline in the number of available varieties. Furthermore, taking into account that $p_N = w_N^L \sigma/(\sigma-1)$, a terms of trade effect can only arise if the wage of northern low-skilled workers changes.

Accounting for the comparative-static effects from section 4, the implications of L_S and θ changes on southern welfare are immediate. Figure 3 depicts the effects of an increase in the southern labor force. Starting point is a scenario I equilibrium with L_S^0 and v_S^0. In this case, a marginal increase in L_S does not affect northern low-skilled wages, so that

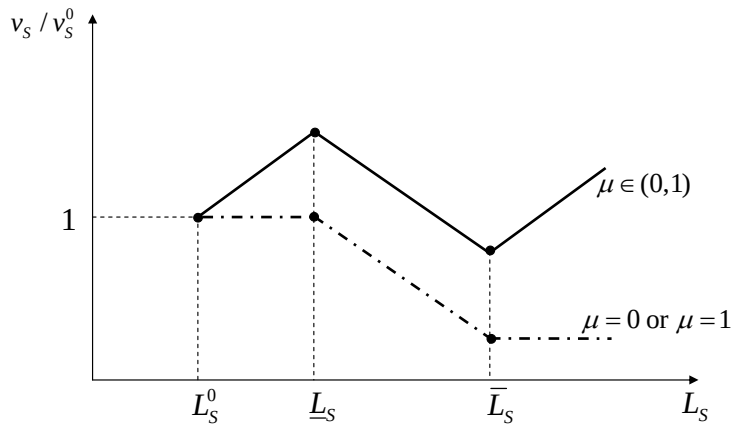

Figure 3: The impact of an increase in L_S on southern welfare

a terms of trade effect does not materialize. However, noting from proposition 1 that an increase in the southern labor force reduces the incentives for multinational activity, there may be positive welfare implications from an increase in the number of available varieties. Such a variety effect arises only if μ adjusts to a change in the southern labor force, which critically depends on the size of the foreign investment cost parameter, ρ. Figure 3 depicts two cases, one with a constant share of multinational firms, i.e., $\mu = 0$ or $\mu = 1$ (the dotted line), and one in which the share of multinationals changes, i.e., $\mu \in (0, 1)$ (the solid line).

When L_S continues to rise, the world economy approaches the critical level $\underline{L}_S$ at which Y_N falls to zero and both countries become fully specialized in their production patterns. In this case, a further increase in the southern labor force does not affect the incentives for multinational activity and there is no positive variety effect, irrespective of the size of ρ (see subsection 4.2). However, as pointed out in proposition 2, there is a positive impact on the low-skilled wage in the northern economies. Due to constant markup pricing, this deteriorates the southern economy's terms of trade with a negative effect on its welfare level, i.e., v_S falls. The increase in the northern low-skilled wage also brings the world economy closer to the second critical L_S-level, $\bar{L}_S$, at which international outsourcing becomes attractive. With both the North and the South being engaged in intermediate goods production, the North-South differential of low-skilled wages is fixed and there are no further terms of trade effects if L_S increases. However, the southern economy may benefit from a positive variety effect if μ falls (the solid line).

Noting the similarity in the comparative-static effects of changes in θ and L_S on northern low-skilled wages, w_N^L, and the incentives for multinational activity, we need not separately discuss the welfare implications of changes in the fairness parameter but rather refer the interested reader to Figure 3. This completes our discussion on southern welfare effects.

5.2 Welfare implications in the North

From the analysis in subsection 4.1 we know that the price index of manufactures in the two northern economies can be written in the following way $P_N^X = H_N p_N^{1-\sigma}/A(\mu)$. Substituting this expression into (16) gives

$$v_N = k\left(\frac{H_N}{A(\mu)}\right)^{\frac{\alpha}{\sigma-1}} \frac{I_N}{(H_N+L_N)p_N^{\alpha}}. \tag{18}$$

There are three channels through which a change in L_S or θ can influence northern welfare. The first channel is associated with a change in the share of multinationals. If μ falls, the number of available varieties increases and the northern economies benefit. However, there is a counteracting effect, as the associated increase in the number of exporters raises transport cost expenditures with adverse welfare implications in the two northern countries. It is the second effect that dominates, implying that a fall in the share of multinational firms lowers v_N, in spite of an increase in the number of available varieties. Second, there is also a terms of trade effect at work in the two northern economies. If the two factor returns increase *pari passu*, the northern terms of trade improve and v_N increases.[16] Third, with imperfect labor markets there is an additional channel of influence on northern welfare through an adjustment in the unemployment rate, U_N^L. A higher unemployment rate lowers income and thus welfare of the representative consumer in a northern economy.

From the comparative-static analysis in subsections 4.1-4.3, it follows that an increase in the fairness parameter, θ, raises the unemployment rate, U_N^L, lowers factor income, I_N, and leaves the consumer price of manufactures, p_N, unaffected if the world economy is characterized either by a scenario I or by a scenario III equilibrium. According to (18),

[16] Formally, this can be seen from substituting $I_N = w_N H_N + (1-U_N^L)L_N w_N^L$ into (18) and noting that a *pari passu* increase of w_N^H and w_N^L raises p_N proportionally, due to constant markup pricing, and therefore raises I_N/p_n^{α} into (18).

this induces a welfare decline in the North, which is reinforced if the share of multinational firms declines, i.e., if $\mu \in (0,1)$. Under scenario II, an increase in θ raises the wage of low-skilled workers in the North, w_N^L, and due to constant markup pricing also p_N. However, since the employment rate shrinks proportionally to the increase in the low-skilled wage, total factor income, I_N, remains unaffected. Hence, the increase in θ lowers northern welfare, according to (18).

Let us now turn to the welfare implications of an increase in the southern labor force, L_S. First, it is notable that an increase in L_S may increase or reduce total factor income in the North. There are two counteracting effects. On the one hand, a higher L_S raises demand for manufactures and thus northern factor prices. On the other hand, it tends to lower the employment rate of northern low-skilled workers. From the analysis in subsections 4.1-4.3, we know that a negative impact on the employment rate arises under scenarios I and III, while it is absent under scenario II. Hence, in the latter case total northern factor income unambiguously increases if the southern endowment with low-skilled workers goes up. However, under scenarios I and III such a positive effect is not guaranteed. As formally shown in the appendix, the sign of the income effect under scenarios I and III critically depends on the size of θ. The stronger the labor market imperfection in the North, the bigger is the negative employment effect and the less likely is a positive income effect. Hence, if the world economy is characterized either by a scenario I or by a scenario III equilibrium, an increase in the southern labor force may exhibit a positive or a negative impact on total factor income, I_N, and, due to a constant p_N, also a positive or a negative impact on northern welfare, v_N. Clearly, a negative welfare effect is more likely if μ adjusts endogenously to the change in L_S.

Things are different under scenario II, where the increase in factor income I_N exhibits a positive impact on northern welfare. However, there is a counteracting effect as consumer price p_N increases when the southern labor force expands. Noting that factor and consumer prices adjust proportionally and that the unemployment rate remains unaffected, it follows from (18) that the income effect dominates the price effect, so that the impact of an increase in L_S on northern welfare, v_N, is unambiguously positive. There is a different – and perhaps more intuitive – way to describe the positive welfare effect under scenario II. Since the unemployment rate does not adjust to changes in L_S if the production patterns are fully specialized, the northern economy simply benefits from a terms of trade improvement.

Figure 4 depicts the possible northern welfare effects of an increase in the southern

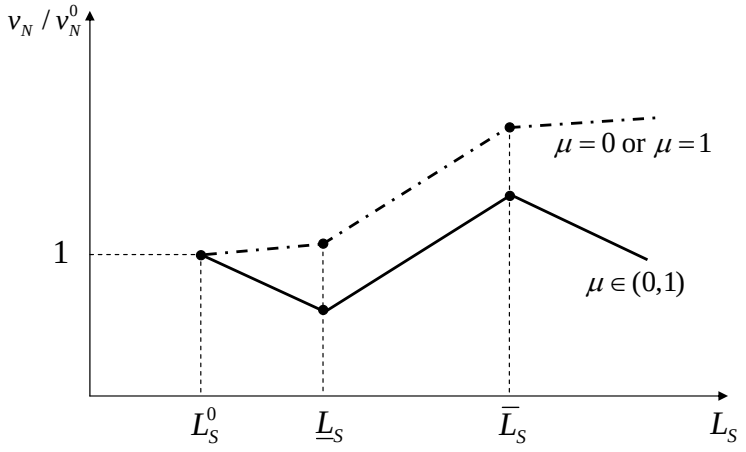

Figure 4: The impact of an increase in L_S on northern welfare

labor force. Starting point is a scenario I equilibrium with $L_S = L_S^0$ and $v_N = v_N^0$. Two cases are distinguished, one that excludes adjustments in μ (the dotted line) and one that accounts for such adjustments (the solid line).[17]

5.3 An integrated picture of the possible welfare effects

In the previous two subsections we have discussed the implications of changes in the southern labor force and the degree of northern labor market imperfection for welfare in the two regions. In this subsection, we summarize the main insights from this analysis, providing an integrated picture of the possible welfare effects. For this purpose, we consider a parameter domain with $\mu \in (0, 1)$.

Let us first focus on the impact of changes in θ. From subsection 5.1, we know that an increase in the fairness attitude of northern workers raises southern welfare under scenarios I and III, while it reduces southern welfare in the case of full specialization in the production patterns of the North and the South (scenario II). Things are different in the northern economies, where a higher degree of labor market imperfection always reduces welfare of the representative consumer. This finding is consistent with the concern of many policy makers in industrialized countries that a high degree of labor market imperfection

[17] It should be noted that in the first and the third segment of this figure, the slopes of both the dotted and the solid locus may be positive or negative.

is unsustainable, because it drives production out of the country thereby lowering welfare of domestic consumers. Taking stock, with an endogenous adjustment in the share of multinationals our analysis points to a conflict of interest between the South and the North regarding a change in the degree of northern labor market imperfection (at least if the world economy stays either in a scenario I or a scenario III equilibrium).

Let us now turn to the impact of an increase in the southern labor force. To the extent that μ adjusts endogenously, an increase in L_S raises southern welfare under scenarios I and III, while it reduces southern welfare under scenario II. Hence, our analysis identifies a potential conflict of interest within the group of developing countries regarding integration of a further southern country into the world economy. In the northern countries, the welfare implications are not clear-cut in general, if the world economy is characterized either by a scenario I or by a scenario III equilibrium. In these two cases, an increase in L_S may reduce total northern factor income, I_N, with adverse effects on v_N. In addition, the North loses from a decline in the share of multinational firms if μ adjusts endogenously. Hence, with labor market imperfections, the North may be worse off if the southern labor force increases. Things are different under scenario II, where the North benefits from a positive terms of trade effect. In any case, our analysis again points to a potential conflict of interest between the North and the South, which may provide an intuition for the reluctance of countries to spur the global integration process.

6 Extension

The previous analysis was conducted under two simplifying assumptions: first, identical transport costs for all country pairs and, second, no income of unemployed individuals. While both of these assumptions were useful to improve readability of our paper, they may be crucial for the comparative-static results and limit the apllicapbility of our analysis for real world problems. Therefore, we extend our basic model in a way that allows us to capture asymmetries in transport costs (subsection 6.1) and a positive income of unemployed individuals by means of a social security payment (subsection 6.2).

6.1 Asymmetry in transport costs

In this subsection, we assume that the costs of shipping goods between the North and the South (τ_S) differ from the respective costs of shipping goods between the two northern economies (τ_N). This allows us to shed further light on the consequences of southern integration into the world economy. In sections 4 and 5, we have associated such an integration process with an increase in L_S. In this subsection, we point to a different facet of southern integration, namely a fall in the respective iceberg transport cost parameter, τ_S.[18]

From the analysis in subsections 4.1 and 4.2 it is obvious that, within scenarios I and II, a decline in North-South transport costs for industrial goods, τ_S, does not exhibit a feedback effect on the northern economies.[19] However, the parameter domain that supports scenario II shrinks if τ_S declines, i.e., the critical low-skilled wage rate, w_N^L, at which international outsourcing becomes attractive for northern producers falls.[20] Furthermore, from the analysis in section 5 we may conclude that if the world economy is characterized either by a scenario I or by a scenario II equilibrium (*ex ante* and *ex post*), then a marginal decline in τ_S leaves northern welfare unaffected, while it raises southern welfare. This positive welfare effect in the South is triggered by an improvement in the terms of trade, as the consumer price of industrial imports declines relative to the price of agricultural exports, when τ_S falls.

Things are different under scenario III, where a change in τ_S also exhibits an impact on the two northern economies, due to changes in the price of imported intermediate goods. To provide a better understanding of this effect, we rewrite the main equations of subsection 4.3 for the case of asymmetric transport costs. We then obtain

$$\frac{w_N^H}{\tau_S} = \frac{2(1-U_N^L)L_N + L_S/\tau_S}{2H_N(\sigma/\alpha - 1)} \tag{8'''}$$

instead of the relative northern labor demand curve in (8″). A decline in τ_S shifts the rela-

[18] To the extent that parameter τ_S also represents political barriers to trade, a decline in this parameter may as well be associated with the political process of North-South trade liberalization.

[19] The absence of such a feedback effect is a direct implication of two notable model features: constant expenditure shares of consumers under Cobb-Douglas preferences and the constant markup rule in the price setting of final goods producers. These two ingredients imply that both export revenues and the labor input to produce the export good stay constant when the costs of shipping goods to the South change.

[20] Formally, we have $d\bar{L}_S/d\tau_S < 0$ and $d\bar{\theta}/d\tau_S < 0$.

tive labor demand curve outwards and – taking into account that the fair wage constraint in (3′) remains unaffected – it raises both the skill premium and the unemployment rate (similar to an increase of the southern labor force).

The impact of a τ_S decline on the level of international outsourcing can be determined by looking at

$$L_S^X = \frac{\alpha(\sigma-1)}{\sigma-\alpha} L_S - \frac{(1-\alpha)\sigma}{\sigma-\alpha} 2(1-U_N^L) L_N \tau_S. \qquad (15')$$

On the one hand, a reduction of τ_S stimulates southern demand for manufactures. For a given employment rate in the North, this raises L_S^X. On the other hand, it induces a decline in the northern employment rate (see above), which reinforces the direct effect and thus implies a further increase in L_S^X. Hence, international outsourcing unambiguously increases when τ_S declines – and so does the share of Southern workers used in the production of intermediate goods, L_S^X/L_S.

Furthermore, a decline in τ_S also affects the incentives of northern manufacturers regarding horizontal foreign investment in the other northern economy. To see this, we can replace (10″), by

$$A(\mu)\frac{(1-U_N^L)L_N\tau_S + (\alpha/\sigma)L_S/2}{(1-U_N^L)L_N\tau_S + L_S/2} \gtreqless \frac{\rho}{1-\tau_N^{1-\sigma}}, \qquad (10''')$$

where $A(\mu)$ is determined in analogy to (11) – with the mere difference that τ_N assumes the role of τ in this expression. A decline in τ_S raises unemployment and lowers low-skilled wages in the North, with negative consequences for total northern factor income.[21] This lowers the incentives for horizontal foreign investment within the North, *ceteris paribus*. Furthermore, a lower τ_S increases the high-skilled wage rate and thus renders foreign investment more expensive. Since both effects go into the same direction, the incentives for horizontal foreign investment unambiguously fall, if τ_S declines. This is well in line with the respective implications of an increase in the southern labor force, L_S.

With these insights at hand, we can now look at the welfare implications of a reduction in transport cost parameter τ_S, again assuming that the world economy is characterized by a scenario III equilibrium. From (17) it is immediate that the southern economy benefits from two channels of influence and is therefore definitely better off after the reduction in

[21] Substituting τ_S for τ in (A.6) in the appendix, it is immediate that northern factor income falls if τ_S declines.

τ_S. On the one hand, it experiences an improvement in its terms of trade as consumer prices of the imported industrial good fall relative to prices of agricultural exports. On the other hand, the southern economy can also benefit from a variety effect if μ falls. The northern economy benefits from a decline in the consumer price, p_N. However, there is a counteracting effect as total northern factor income, I_N, falls as well. This negative welfare effect is reinforced if μ declines. In sum, it is not clear, which effect dominates so that the North may be better or worse off after a decline in transport cost parameter τ_S.[22]

6.2 Unemployment benefits

In this subsection, we assume that unemployed workers earn a benefit which is proportional to the going wage rate of the respective skill group. Denoting the replacement ratio by $b_N \in (0,1)$, this implies that the income of unemployed low-skilled workers equals $b_N w_N^L$. Furthermore, assuming that unemployment benefits are financed by a lump sum tax, we can rewrite the fair wage constraint $(3')$ in the following way:

$$\omega_N = 1 + \frac{(1-\theta)}{\theta}(1-b_N)U_N^L. \qquad (3'')$$

From $(3'')$, it is immediate that an increase in b_N affects the fair-wage constraint in the same way as an increase in fairness parameter θ. This is intuitive, because an increase in either parameter is associated with a higher degree of labor market imperfection (see Egger and Kreickemeier, 2008). Hence, the main insights concerning comparative-static effects of a marginal increase in the fairness parameter are also valid for an increase in the replacement ratio. However, there is a crucial difference between the two labor market variables, while θ is a preference parameter, which cannot be influenced by governments, the replacement ratio is a policy variable.

It is therefore an interesting and relevant policy question to what extent northern governments can use a decline in the replacement ratio as an instrument for mitigating the negative labor market implications of southern integration – as reflected by an increase in L_S.[23] From the analysis in section 4, we know that a higher L_S hurts northern low-skilled

[22] Numerical simulation exercises indicate that the sign of the welfare effect depends crucially on the size of fairness parameter θ. If θ and thus the degree of labor market imperfection is low, the North can benefit from a fall in τ_S, while it tends to be worse off if the labor market rigidity is severe.

[23] As shown before, the impact of a decline in τ_S is similar and hence does not need to be separately discussed.

workers relative to northern high-skilled workers as both the skill premium and the unemployment rate increase – provided that the world economy is characterized by a scenario I or III equilibrium. In this case, lowering the replacement ratio is a reasonable policy reform if northern governments aim at alleviating the unemployment problem. However, the reduction in the replacement ratio comes at the cost of a further increase in the skill premium and thus has negative distributional consequences for those who have a job. This should be taken into account by policy makers when enforcing labor market reforms.[24]

7 Concluding remarks

In this paper, we set up a three country model with two developed northern and one developing southern economy in order to analyze how labor market imperfections in the North and an increase in the southern labor force interact in determining the open economy equilibrium. Throughout our analysis, we put particular emphasis on the role of these two factors for the integration strategies of international producers, thereby accounting for vertical aspects – in-house production versus international outsourcing – as well as horizontal ones – exporting versus foreign direct investment.

As a main result of our analysis, we find that the impact of a change in the degree of labor market imperfection or the size of the southern labor force on the preferred integration strategy depends critically on the North-South differential of low-skilled wages which governs the international pattern of production and is endogenous itself. While this result is less surprising with respect to the outsourcing decision, the role played by the international dispersion of low-skilled wages for a northern firm's mode of entering another developed country points to a new channel through which country asymmetries can influence the organization of international production. The insights from our theoretical analysis also reveal a so far unexplored relationship between outsourcing and foreign investment. Abstracting from fixed costs of outsourcing, we find that those factors that render international outsourcing more attractive, i.e., an increase in the southern labor force or an increase in the degree of northern labor market imperfection, reduce the incentives for horizontal multinational activity in other developed countries.

Furthermore, we show that the welfare implications of North-South trade liberaliza-

[24]It is notable that the representative consumers in the two northern economies benefit from a reduction in the replacement ratio, according to our analysis in subsection 5.2.

tion crucially depend on whether the integration strategies of international producers are influenced or not. In this regard, the analysis points to a potential conflict of interest. The South benefits from a reduction in the share of multinational producers because, with firm entry being endogenous, this is associated with a positive variety effect. By contrast, consumers in the two northern economies lose from the resulting increase in transport cost expenditures. Beyond that, the analysis confirms the concern of policy makers that labor market imperfections increase the incentives of firms to outsource low-skilled intensive production stages to the South with adverse consequences for northern welfare.

Finally, the paper sheds light on the scope for policy reforms in northern economies that aim at mitigating the negative implications of trade liberalization vis-à-vis the South for domestic labor. The popular view is that a reduction in unemployment benefits is suitable to reduce the unemployment problem. This is confirmed by our results, but the analysis makes clear that such a reform is less successful in reducing the ratio of high-skilled to low-skilled wages which goes up if the labor market imperfection becomes less severe. This is particularly remarkable, because in contrast to previous work our analysis takes into account that firms adjust their integration strategies endogenously to policy intervention. While this provides a first insight into the relationship between public policy and firm integration strategies, there are several aspects of this relationship – such as the role of asymmetries in northern labor market institutions – which have not been accounted for in this paper but are worthwhile to look at in future research.

Appendix

Income effects of an increase in L_S under scenario I

To determine the income effects of a marginal increase in L_S under scenario I, we can first combine the fair wage constraint in (3′) with the relative labor demand in (8) to explicitly solve for the unemployment rate

$$U_N^L = \frac{\theta[L_N + L_S/2 - H_N(\sigma/\alpha - 1)]}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N}. \tag{A.1}$$

Subtracting (A.1) from one, gives the employment rate

$$1 - U_N^L = \frac{H_N(\sigma/\alpha - 1) - \theta L_S/2}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N}. \tag{A.2}$$

We can now substitute (A.2) in (9) to arrive at

$$I_N = \frac{\sigma/\alpha}{\sigma/\alpha - 1} \frac{H_N(\sigma/\alpha - 1) - \theta L_S/2}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N} L_N + \frac{1}{\sigma/\alpha - 1} \frac{L_S}{2}. \tag{A.3}$$

Differentiating (A.3) with respect to L_S, then implies

$$\frac{dI_N}{dL_S} = \frac{1}{2(\sigma/\alpha - 1)} \left[- \frac{(\sigma/\alpha)\theta L_N}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N} + 1 \right].$$

And rearranging terms, we finally arrive at

$$\frac{dI_N}{dL_S} = \frac{(1-\theta)H_N - \theta L_N}{2[(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N]}. \tag{A.4}$$

According to (A.4), the impact of an L_S increase on I_N turns out to be ambiguous under scenario I. It is positive if the degree of labor market imperfection, i.e., fairness parameter θ, is sufficiently small, while it turns out to be negative if θ is sufficiently high.

Income effects of an increase in L_S under scenario III

To determine the income effects of a marginal increase in L_S under scenario III, we first combine the fair wage constraint in $(3')$ with the relative labor demand in $(8'')$ to obtain an explicit solution for the unemployment rate U_N^L. Subtracting the resulting expression from one, gives the employment rate

$$1 - U_N^L = \frac{H_N(\sigma/\alpha - 1) - \theta L_S/(2\tau)}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N}. \tag{A.5}$$

Accounting for the two market clearing conditions from subsection 4.3, income in either northern economy can be written as

$$I_N = \frac{\sigma/\alpha}{\sigma/\alpha - 1}(1 - U_N^L) L_N \tau + \frac{1}{\sigma/\alpha - 1} \frac{L_S}{2}.$$

Substituting for $1 - U_N^L$ from (A.5), we obtain

$$I_N = \frac{\sigma/\alpha}{\sigma/\alpha - 1} \frac{H_N \tau(\sigma/\alpha - 1) - \theta L_S/2}{(1-\theta)H_N(\sigma/\alpha - 1) + \theta L_N} L_N + \frac{1}{\sigma/\alpha - 1} \frac{L_S}{2}. \tag{A.6}$$

Differentiating (A.6) with respect to L_S and rearranging terms, we finally arrive at an expression which is identical to (A.4). This confirms that under scenario III the impact of an increase in L_S on northern income can be positive or negative with the sign of the effect depending critically on the size of fairness parameter θ.

References

Akerlof, G.A. (1982), Labor contracts as partial gifts exchange, *Quarterly Journal of Economics* **97**, 543-569.

Akerlof, G.A. and J.E. Yellen (1988), Fairness and unemployment, *American Economic Review* **78**, 44-49.

Akerlof, G.A. and J.E. Yellen (1990), The fair wage-effort hypothesis and unemployment, *Quarterly Journal of Economics* **105**, 255-283.

Amiti, M. and D.R. Davis (2008), Trade, firms, and wages: Theory and evidence, *NBER Working Paper* 14106.

Brainard, S.L. (1997), An empirical assessment of the proximity-concentration trade-off between multinational sales and trade, *American Economic Review* **87**, 520-44.

Brecher, R.A. and E.U. Choudhri (1994), Pareto gains from trade, reconsidered: Compensating for jobs lost, *Journal of International Economics* **36**, 223–238.

Davidson, C. and S. Matusz (2006), Trade liberalization and compensation, *International Economic Review* **47**, 723–747.

Eckel, C. and H. Egger (2007), Wage bargaining and multinational firms, *unpublished manuscript*, University of Bamberg.

Egger, H. and P. Egger (2003), Outsourcing and skill-specific employment in a small economy: Austria and the fall of the Iron Curtain, *Oxford Economic Papers* **55**, 625-643.

Egger, H. and U. Kreickemeier (2008), International fragmentation: Boon or bane for domestic employment?, *European Economic Review* **52**, 116–132.

Ekholm, K., R. Forslid and J.R. Markusen (2007), Export-platform foreign direct investment, *Journal of the European Economic Association* **5**, 776-795.

Feenstra, R.C. and G.H. Hanson (1996), Globalization, outsourcing and wage inequality, *American Economic Review* **86**, 240-245.

Feenstra, R.C. and G.H. Hanson (1999), The impact of outsourcing and high-technology capital on wages: Estimates for the United States, 1979-1990, *Quarterly Journal of Economics* **114**, 907-940.

Geishecker, I. and H. Görg (2008), Winners and losers: a micro-level analysis of international outsourcing and wages, *Canadian Journal of Economics* **41**, 243–270.

Grossman, G.M. and E. Helpman (2007), Fair wages and foreign sourcing, *unpublished manuscript*, Harvard University.

Grossman, G.M., E. Helpman and A. Szeidl (2006), Optimal integration strategies for the multinational firms, *Journal of International Economics* **70**, 216-238.

Hijzen, A. (2007), International outsourcing, technological change, and wage inequality, *Review of International Economics* **15**, 188–205.

Kreickemeier, U. and D. Nelson (2006), Fair wages, unemployment and technological change in a global economy, *Journal of International Economics* **70**, 451-469.

Lommerud, K.E., F. Meland, and L. Sørgard (2003), Unionised oligopoly, trade liberalization and location choice, *Economic Journal* **113**, 782-800.

Lorentowicz, A., D. Marin and A. Raubold (2005), Is human capital losing from outsourcing? Evidence for Austria and Poland, *GESY Discussion Paper* No. 76.

Markusen, J.R. and A. Venables (1998), Multinational firms and the new trade theory, *Journal of International Economics* **46**, 183–204.

Markusen, J.R. and A. Venables (2000), The theory of endowment, intra-industry, and multinational trade, *Journal of International Economics* **52**, 209–234.

Scheve, K. and M. Slaughter (2001), *Globalization and the perceptions of American workers*, Institute for International Economics, Washington, DC.

Scheve, K. and M. Slaughter (2007), A new deal for globalization, *Foreign Affairs* July/August, 34-47.

Skaksen, J.R. (2004), International outsourcing when labour markets are unionized, *Canadian Journal of Economics* **37**, 78–94.

Yeaple, S.R. (2003), The complex integration strategies of multinationals and cross country dependencies in the structure of foreign direct investment, *Journal of International Economics* **60**, 293-314.

Supplement
(not intended for publication)

In this supplement we show how the critical parameter values $\underline{\rho}_I$ and $\bar{\rho}_I$ can be derived. (The derivation of the critical parameter values $\underline{\rho}_{II}$ and $\bar{\rho}_{II}$ as well as $\underline{\rho}_{III}$ and $\bar{\rho}_{III}$ is analogous and thus not separately discussed.) Furthermore, we provide a brief discussion of the properties of $A(\mu)$ and study comparative-static effects of changes in θ and L_S on μ, provided that the world economy is in a scenario I equilibrium.

Let us first define the function

$$\Gamma_I(\rho,\mu) \equiv A(\mu)\frac{(1-U_N^L)L_N+(\alpha/\sigma)L_S/2}{(1-U_N^L)L_N+L_S/2}-\frac{\rho}{1-\tau^{1-\sigma}}, \tag{S.1}$$

with $\Delta\pi_N >,=,< 0$ if $\Gamma_I(\rho,\mu) >,=,< 0$. Furthermore, accounting for (11) and differentiating Γ_I with respect to μ, we obtain $\partial\Gamma_I/\partial\mu >,=,< 0$ if $\rho >,=,< (1-\tau^{1-\sigma})/(1+\tau^{1-\sigma}) \equiv t_I$.

Let us for the moment consider a parameter domain with $\rho \geq t_I$. In this case, we have $A(0) < \rho/(1-\tau^{1-\sigma})$ and thus $\Gamma_I(\rho,0) < 0$, according to (S.1). Hence, if $\mu = 0$, there is no incentive for an individual manufacturer to invest abroad. Furthermore, evaluating $A(\mu)$ at $\mu = 1$, we find that $A(1) >,=,< \rho/(1-\tau^{1-\sigma})$ if $(1-\tau^{1-\sigma})/2 >,=,< \rho/(1+\rho)$. Noting that the left-hand side of the latter expression increases in ρ, it is straightforward to show that $A(1) \leq \rho/(1-\tau^{1-\sigma})$ holds for any $\rho \geq t_I$. Hence, $\Gamma_I(\rho,1) < 0$ follows from (S.1), implying that a parameter domain with $\rho \geq t_I$ is not consistent with foreign investment in equilibrium. Put differently, $\rho \geq t_I$ implies $\mu = 0$.

Let us now consider a parameter domain with $\rho < t_I$. In this case, we have $A(0) > \rho/(1-\tau^{1-\sigma})$, implying that $\Gamma_I(\rho,0) > 0$ is possible. Clearly, if $\rho = 0$, then $\Gamma_I(\rho,0) > 0$, while $\rho = t_I$ implies $\Gamma_I(\rho,0) < 0$, according to (S.1). Noting further that $\partial\Gamma_I(\rho,0)/\partial\rho < 0$, it is immediate that $\Gamma_I(\rho,0) = 0$ has a unique solution at $\rho = \bar{\rho}_I$, with $\bar{\rho}_I$ determining an upper bound for the parameter domain that supports multinational activity, in the sense that $\mu > 0$ if $\rho < \bar{\rho}_I$, while $\mu = 0$ if $\rho \geq \bar{\rho}_I$. Furthermore, it is straightforward to show that $\Gamma_I(\rho,1) = 0$ also has a unique solution in ρ, which we denote by $\underline{\rho}_I$. This critical level of ρ determines a lower bound for exporting, in the sense that $\mu < 1$ if $\rho > \underline{\rho}_I$, while $\mu = 1$ if $\rho \leq \underline{\rho}_I$. With respect to the size of the two critical levels of ρ, we can note the following ranking: $0 < \underline{\rho}_I < \bar{\rho}_I < t_I$. On the one hand, it follows from (S.1) that $\Gamma_I(0,1) > 0$. Hence, $\partial\Gamma_I(\rho,1)/\partial\rho < 0$ implies $\underline{\rho}_I > 0$. On the other hand, it follows from

$\partial\Gamma_I(\rho,\mu)/\partial\mu < 0$ that $0 = \Gamma_I(\bar{\rho}_I, 0) > \Gamma_I(\bar{\rho}_I, 1)$. Accounting for $\partial\Gamma_I(\rho,1)/\partial\rho < 0$, we can therefore conclude that $\underline{\rho}_I < \bar{\rho}_I$. Due to our focus on a parameter domain with $\rho < t_I$, this establishes the above ranking.

Finally, focussing on a parameter domain with $\rho \in (\underline{\rho}_I, \bar{\rho}_I)$ the comparative-static effects of changes in L_S and θ on μ can be easily derived by applying the implicit function theorem to $\Gamma_I(\rho,\mu) = 0$ and considering $A'(\mu) < 0$, $dU_N^L/d\theta > 0$, $dU_N^L/dL_S > 0$. This completes the formal discussion of the respective results in the text of subsection 4.1.