On the Welfare Effects of Trade and Investment Liberalization

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Abstract

Using a three factor knowledge-capital model of trade and multinational activity, we consider a set of 15 policy experiments to assess the welfare effects of trade and investment liberalization in general equilibrium. Specifically, we address the question of whether and under which circumstances a single versus a combined trade/investment liberalization strategy or an unilateral versus a bilateral policy change is preferable from a single country's and the world's point of view. The focus of this paper is to look at three highly relevant questions. First, when is investment liberalization beneficial and when is it harmful for a single economy or the whole word. Second, is pure investment liberalization a welfare maximizing strategy. Third, when is either kind of liberalization (trade, investment or both) welfare improving and when neither.

Key words: Investment Liberalization; Trade Liberalization; Welfare Effects; Multinationals

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1 Introduction

Since the late 50s of the last century, we observe a strong tendency of both world-wide trade and investment liberalization. While trade liberalization is evident from the reduction in tariffs (see Baier and Bergstrand, 2001) and the fast growth of bilateral trade agreements and new regionalism (see Winters, 1996), investment liberalization shows up in the significant increase in the number of bilateral investment treaties (BITs) during the last few decades.

- Table 1 -

Table 1 illustrates the pace of liberalization between the 70s and the 90s for a set of 98 economies. On average, a country has signed more than 13 BITs in these two decades, whereas tariffs have been reduced by more than 5% per annum. This trend has been even more pronounced for the large and/or skilled labor-abundant countries, motivating the question about the welfare effects of these liberalization policies depending on size, factor endowments and the presence of multinational enterprises (MNEs).

An analysis of the welfare effects of trade and investment liberalization should be based on general equilibrium models of trade and MNEs (Carr et al., 2001; Egger and Pfaffermayr, 2003a, 2003b; Helpman, 1984, 1985; Markusen, 1984, 1995; Markusen and Maskus, 2002; Markusen and Venables, 1998, 2000). In these models, the exploitation of factor cost differences by unbundling headquarter services and production (vertical MNEs) and the trade-off between proximity to the market and concentration of production activities (horizontal MNEs) determine the existence of MNEs. So far, the literature predominantly has concentrated on two aspects: (i) the explanation of the equilibrium plant configuration (e.g., the existence and type of multinational firms) and the economic activity levels (trade and multinational sales) on the one hand, and (ii) the impact of MNEs on factor prices in the home and the host countries on the other hand.

In a model with national and only horizontal multinational firms, Markusen and Venables (1997) find that investment liberalization raises the factor reward of skilled labor in the skilled labor-abundant economy. Further, the wages of skilled labor tend to rise in both economies. In contrast, trade liberalization exerts the opposite effect, putting downward pressure on skilled labor's factor rewards. Similarly, Markusen (1999) concludes that investment liberalization raises the share of headquarters in the skilled labor-abundant country and, due to the factor intensity assumptions, the effects on factor rewards are biased towards skilled labor.

Wong (2001) analyzes the impact of (unilateral and bilateral) investment liberalization in a specific factors model. He focusses on the factor price impact of investment liberalization without considering welfare explicitly. Investment liberalization between small economies (i.e., at exogenous commodity prices) rises the rewards of some factor owners, while it is detrimental for others. Only for large economies (i.e., at endogenous commodity prices), the capital movements associated with investment liberalization may be Pareto improving and make all factor owners better off.

However, there is much less research on the welfare effects of trade and investment liberalization available. Using the knowledge-capital model of multinational firms and trade (see also Carr et al., 2001; Markusen and Maskus, 2002), where national firms and both horizontal and vertical MNEs may exist, Markusen (1997) derives a couple of important results regarding the welfare effects of liberalization. He finds that (i) the two policies separately have opposite effects on important variables like activity levels (i.e., they are not substitutive), (ii) a combined trade and investment liberalization has quite different effects than applying each policy separately, and the two policies are complementary in a welfare sense, and (iii) a combined liberalization may rise all factors' real incomes though the relative price of one factor may fall.

Markusen (2002) is more explicit on the welfare effects of trade and investment liberalization in the knowledge-capital model with Cournot competition. He con-

cludes that (i) either country likely gains from bilateral investment liberalization, and (ii) if a country loses at all, it tends to be the larger one.

This paper extends the discussion in several directions and provides a thorough welfare analysis of trade and investment liberalization in the knowledge-capital model with three factors of production and monopolistically competitive firms (see Egger and Pfaffermayr, 2003b). The three factor framework allows to explicitly disentangle the two-fold nature of headquarter services, namely the provision of firm-specific assets (e.g., research and brand proliferation) and capital services, i.e., foreign direct investment (FDI). In accordance with the previous literature, we adopt numerical simulations to assess how trade and investment liberalization affect welfare. The analysis accounts for the following features, which have not been comprehensively addressed so far:

- *Unilateral* versus *bilateral* liberalization strategies. The majority of available results on the impact of trade and investment liberalization is based on bilaterally undertaken policies.

- The impact of liberalization on the *world's* versus on the *single countries'* welfare. Many of the available results on the welfare consequences of trade and investment liberalization only discuss the impact on single economies.

- A *single* trade or investment liberalization policy versus a *combined* policy. To the best of our knowledge, only Markusen (1997, 2002) mentions possible differences between single and combined liberalization strategies.

- Coexistence of horizontal and vertical MNEs and of national firms in large areas of the endowment space.

- The dependence of the welfare consequences of liberalization on factor endowments and the pre-liberalization equilibrium plant configuration.

- The association of trade liberalization with falling tariffs rather than iceberg transport costs in both sectors. Trade liberalization in models of MNEs is commonly associated with a reduction in iceberg trade costs. However, a

welfare analysis should distinguish between (iceberg) trade costs and tariffs, since the former generate factor income in the country where the good is produced whereas the latter generate income in the country where the good is consumed.

We do not analyze strategic interaction and, therefore, do not claim that the analyzed liberalization policies will actually be implemented (either in a non-cooperative game or in bilateral negotiations).[1] Rather, we obtain marginal welfare effects of liberalization and can compare different policies both from a single country's as well as the world's perspective.

We confine our analysis to three questions of interest. First, when (i.e., under which relative factor endowment and size configurations) is investment liberalization beneficial/harmful from a single economy's versus both countries' perspective. Second, we investigate whether pure investment liberalization is a welfare maximizing policy. Third, we ask whether there are endowment/plant configurations, where country does not lose/gain, irrespective of which policy it adopts. We extensively assess the robustness of our findings with respect to (i) the elasticity of substitution between varieties (i.e., the markup over marginal costs), (ii) the allocation of world factor endowments across countries, (iii) the substitutability of production within each country, (iv) the possibility for MNEs to use also foreign capital in setting up a subsidiary abroad (Egger and Pfaffermayr, 2003a), and (v) asymmetric policy parameters instead of identical ones across countries in the baseline scenario.

[1] See Baier and Bergstrand (2003), for a similar reasoning in analyzing the welfare effects of free trade area membership.

2 The Model

2.1 Households

We model consumer preferences as a nest of homogeneous Z-goods and differentiated X-goods, assuming Dixit-Stiglitz preferences (Dixit and Stiglitz, 1977) for the inner nest of X-varieties:

$$W_i = \left[(n_i + h_i + h_j + v_j)\, x_{ii}^{\frac{\epsilon-1}{\epsilon}} + (n_j + v_i) \left(\frac{x_{ji}}{(1+\tau)(1+t_{xij})} \right)^{\frac{\epsilon-1}{\epsilon}} \right]^{\frac{\epsilon}{\epsilon-1}\alpha} (Z_{ii} + Z_{ji})^{1-\alpha}, \tag{1}$$

where W_i is country i's welfare level, $i = 1, 2$, α denotes the Cobb-Douglas expenditure share for differentiated products, and $\epsilon > 1$ is the elasticity of substitution between varieties. n_i is the number of national firms of country i, which sells on the local market and exports to country j, h_i denotes the number of horizontal multinationals headquartered in i, but running production plants in both economies, and v_i is the number of vertical multinationals with headquarters in i and production plants only in j. In contrast to horizontal MNEs, vertical ones engage in goods trade. Quantities are indexed twice, with the first subscript indicating the country the good originates from, and the second one referring to the country, where the good is consumed.

Tariffs on X-goods (t_{xij}, t_{xji}), and on Z-goods (t_{zij}, t_{zji}), and equivalent iceberg transport costs on both types of goods (τ) impede goods trade, where the two subscripts again denote the source and destination country of exports, respectively. Hence, country j levies tariffs t_{xij} on imports of X-goods from country i. In quantity terms, one unit of consumption of an X-variety in country j requires a firm in i to send $(1+\tau)(1+t_{xij})$ units. Similarly, one consumption unit of a foreign Z-good in j requires to send (i.e., to produce) $(1+\tau)(1+t_{zij})$ units. For convenience, x_{ij} and x_{ji} are defined as (both national and vertical MNE) firm-specific *productions* for the respective foreign market, whereas Z_{ij} and Z_{ji} are normalized to represent *consumed* rather than *produced* quantities. Product

market clearing and the complementary goods prices are then given by

$$x_{ii} \geq p_i^{-\epsilon} s_i^{\epsilon-1} \alpha E_i \quad \perp \quad p_i \geq 0 \tag{2}$$

$$x_{ij} = p_i^{-\epsilon} \left((1+\tau)(1+t_{xij})\right)^{1-\epsilon} s_j^{\epsilon-1} \alpha E_j \tag{3}$$

$$Z_{ii} + Z_{ji} \geq \frac{1-\alpha}{q_i} E_i \quad \perp \quad q_i \geq 0, \tag{4}$$

where $\perp$ indicates that at least one of the adjacent conditions has to hold with equality. p denotes the price of X-varieties, and q that of Z-goods. Noteworthy, prices are only indexed once, since all (indigenous and foreign) homogeneous goods consumed at one location must face the same price. Therefore, q_i is the price of homogeneous goods *consumed* in i. Further, p_i is the price of differentiated goods *produced* in i. Accordingly, the price of X-goods originating from i and exported to j amounts to $p_i(1+\tau)(1+t_{xij})$. All varieties *produced* and *consumed* at the same location sell at the same price because of equal marginal costs. The price aggregator s_i of differentiated goods *consumed* in country i is

$$s_i = \left[(n_i + h_i + h_j + v_j)\, p_i^{1-\epsilon} + (n_j + v_i)\left((1+\tau)(1+t_{xji})p_j\right)^{1-\epsilon}\right]^{\frac{1}{1-\epsilon}}. \tag{5}$$

2.2 Factor Markets and Production

The Z-sector is perfectly competitive, and we take q_1 as the numéraire. Since Z-production only uses unskilled labor (L), variable unit costs (i.e., marginal costs) c_{zi} satisfy

$$c_{zi} \geq w_{Li} \quad \perp \quad Z_{ii} \geq 0, \tag{6}$$

where w_{Li} is the wage rate of unskilled workers in i. This implies

$$c_{zi}(1+\tau)(1+t_{zij}) \geq q_j \quad \perp \quad Z_{ij} \geq 0. \tag{7}$$

There is monopolistic competition in the X-sector, where each firm produces under a CES technology, using all three input factors (where "a" is the coefficient for capital, "b" for unskilled labor and "1-a-b" for skilled labor), with an elasticity of substitution of ρ. Cost minimization subject to this technology obtains the country-specific unit input coefficients for the three factors of X-production

(skipping the arguments): a_{Kxi}, a_{Lxi}, a_{Sxi}. Additionally, national firms, and horizontal and vertical MNEs require capital to set-up plants $(a_{Kni}, a_{Khi}, a_{Kvi})$, and they employ skilled labor to produce firm-specific assets and blue-prints $(a_{Sni}, a_{Shi}, a_{Svi})$.

Factor market clearing requires

$$\begin{aligned} K_i &\geq a_{Kxi}\left(\left(n_i + h_i + h_j + v_j\right) x_{ii} + \left(n_i + v_j\right) x_{ij}\right) + a_{Kni} n_i + a_{Khi} h_i + a_{Kvi} v_i \\ &\perp \quad w_{Ki} \geq 0 \qquad (8) \\ L_i &\geq a_{Lxi}\left(\left(n_i + h_i + h_j + v_j\right) x_{ii} + \left(n_i + v_j\right) x_{ij}\right) + Z_{ii} + Z_{ij}(1+\tau_{ij})(1+t_{zij}) \\ &\perp \quad w_{Li} \geq 0 \qquad (9) \\ S_i &\geq a_{Sxi}\left(\left(n_i + h_i + h_j + v_j\right) x_{ii} + \left(n_i + v_j\right) x_{ij}\right) + a_{Sni} n_i + a_{Shi} h_i + a_{Svi} v_i \\ &\perp \quad w_{Si} \geq 0, \qquad (10) \end{aligned}$$

where K_i, L_i, and S_i are country i's capital, unskilled labor and skilled labor endowments. The factor rewards are denoted by w_{Ki}, w_{Li}, and w_{Si}, respectively. Variable unit costs of producing x_{ii} or x_{ij} are given by $c_{xi} = a_{Kxi} w_{Ki} + a_{Lxi} w_{Li} + a_{Sxi} w_{Si}$. There is a fixed markup over variable costs, which is determined by the elasticity of substitution between varieties, so that we obtain

$$p_i \leq c_{xi} \frac{\epsilon}{\epsilon - 1} \quad \perp \quad x_{ii} \geq 0. \qquad (11)$$

Free entry implies that firms earn zero profits, since operating profits are used to cover fixed costs. Therefore, the number of firms is determined by Chamberlin's "tangency solution". Since national firms in i have to bear fixed costs of $a_{Kni} w_{Ki} + a_{Sni} w_{Si}$, we have

$$a_{Kni} w_{Ki} + a_{Sni} w_{Si} \geq \frac{p_i \left(x_{ii} + x_{ij}\right)}{\epsilon} \quad \perp \quad n_i \geq 0 \qquad (12)$$

and similarly for vertical and horizontal MNEs:

$$\begin{aligned} a_{Kvi} w_{Ki} + a_{Svi} w_{Si} &\geq \frac{p_j \left(x_{jj} + x_{ji}\right)}{\epsilon} \quad \perp \quad v_i \geq 0 \qquad (13) \\ a_{Khi} w_{Ki} + a_{Shi} w_{Si} &\geq \frac{p_i x_{ii} + p_j x_{jj}}{\epsilon} \quad \perp \quad h_i \geq 0. \qquad (14) \end{aligned}$$

In line with the literature, we assume $a_{Kni} w_{Ki} + a_{Sni} w_{Si} < a_{Kvi} w_{Ki} + a_{Svi} w_{Si} < a_{Khi} w_{Ki} + a_{Shi} w_{Si}$, and, specifically, $a_{Kni} = a_{Sni} = 1$, $a_{Svi} = a_{Shi} = 1 + \delta$,

$a_{Kvi} = 1 + \gamma_{ij}$, and $a_{Khi} = 2 + \gamma_{ij}$, without loss of generality. Thereby, δ is the additional skilled labor requirement to organize a multinational network, and $1 + \gamma_{ij}$ are the fixed costs country i's MNEs have to incur to set-up a foreign plant in j. As mentioned above, horizontal MNEs also run domestic production plants, which is reflected by $a_{Khi} > a_{Kvi}$.

2.3 Income and Balance of Payments

We assume that all factors are owned by households, so that consumer income (i.e., GNP) in country i is given by

$$\begin{aligned} E_i &= \underbrace{w_{Ki}K_i + w_{Li}L_i + w_{Si}S_i}_{A} + \underbrace{(n_j + v_i)\, p_j t_{xji} x_{ji}}_{B} \\ &\quad + \underbrace{q_i t_{zji} Z_{ji}}_{C} - \underbrace{(n_i + v_j)\, p_i t_{xij} x_{ij}}_{D} - \underbrace{q_j t_{zij} Z_{ij}}_{E}, \end{aligned} \tag{15}$$

where "A" are factor rewards, "B" is tariff income from X-sector imports, "C" are tariff revenues from Z-sector imports, "D" is country i's tariff payments to j from X-sector exports, which has to be subtracted in order to avoid double counting due to the formulation of x_{ij}. Note that tariff payments are included in country i's factor rewards. Similarly, we subtract country i's tariff payments to j from Z-sector exports labelled as "E".[2] The equivalence of total factor income (E_i, E_j) and demand in each economy implicitly balance international payments.

2.4 Welfare

We measure the welfare changes associated with trade and investment liberalization by the equivalent variation (EV), which - in contrast to the compensating variation - evaluates the welfare changes at initial prices. Constant prices facilitate the comparison of different counterfactual scenarios with the baseline scenario (confer Varian, 1992).

[2]Remember that, in quantity terms, one has to send $x_{ij}(1+\tau)(1+t_{xij})$ or $Z_{ij}(1+\tau)(1+t_{zij})$ units for x_{ij} or Z_{ij} units to arrive.

To compute the EV, we use the indirect utility function

$$V_i = \frac{E_i}{\pi_i}\alpha^{\alpha}(1-\alpha)^{1-\alpha}, \tag{16}$$

where

$$\pi_i = s_i^{\alpha} q_i^{1-\alpha} \tag{17}$$

may be interpreted as the price of an additional unit of utility.[3] EV_i is defined as

$$EV_i = 100 \cdot \frac{\frac{\pi_{i,0}V_i}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} - E_{i,0}}{E_{i,0}}, \tag{18}$$

where $\pi_{i,0}$ is the initial (pre-liberalization) price of an additional unit of utility in country i, V_i is the post-liberalization welfare level and $E_{i,0}$ denotes pre-liberalization GNP.

The whole world's welfare (referred to as welfare from a social planner's perspective) is measured by the following average EV:

$$EV_{i+j} = 100 \cdot \frac{\left(\frac{\pi_{i,0}V_i}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}} + \frac{\pi_{j,0}V_j}{\alpha^{\alpha}(1-\alpha)^{1-\alpha}}\right) - (E_{i,0} + E_{j,0})}{E_{i,0} + E_{j,0}}. \tag{19}$$

3 Policy Experiments

3.1 Set-up of the Experiments

To assess the impact of trade and/or investment liberalization on country-specific and international welfare, we run 15 policy experiments, where we gradually reduce the levels of tariffs and/or foreign plant set-up costs. The design of the experiments is summarized in Table 2.

– Table 2 –

We distinguish between different categories of liberalization policies: *unilateral* (Experiments 1-6, 10-11, 13-14) versus *bilateral* policies (Experiments 7-9, 12,

[3]Therefore, we have to divide prices in country j by q_j, such that all prices in country j are measured in units of domestic homogeneous goods, similar to country i.

15), and *single* (Experiments 1-9, 13-15) versus *combined* policies (Experiments 10-12).[4] Whereas we assume a finite and moderate level of tariffs in Experiments 1-12, we assess the welfare consequences of investment liberalization under fully liberalized trade (i.e., zero tariffs but $\tau = 0.15$) in Experiments 13-15.

The parameter values for the respective baseline scenarios and a brief discussion of the parametrization are given in the Appendix. Specifically, we assume $t_{xji} = t_{zji} = 0.2$ in all baseline scenarios. The baseline values of t_{xij} and t_{zij} are set at 0.2, γ_{ji} is always 0.3 in the base case. Since we only discuss liberalization scenarios, Δt_x, Δt_z, and $\Delta\gamma$ indicate reductions in the respective policy parameters. In any case, reductions in policy parameters amount to 30% of the baseline values. Hence, $\Delta\gamma_{ij}$ means that γ_{ij} is reduced from 0.3 to 0.21. In all pre-liberalization scenarios, our calibration involves both two-way trade and MNE activity (cross-hauling), and not just horizontal MNE activity as in Markusen (1997; 2002, p. 143).

We obtain numerical solutions for each of the 15 experiments evaluated at 101×101 cells of the endowment box. To avoid numerical problems at extreme endowment points, we skip both the first and the last rows and columns of the resulting welfare matrices. This gives a 99×99 matrix of results for the baseline scenario and each of the 15 counterfactual liberalization cases. The associated EV_i, EV_j or the overall world's EV_{i+j} (a weighted average of EV_i and EV_j), are simply computed according to (18) and (19).[5] For the moment, this gives $99 \cdot 99 = 9801$ results in each experiment and factor-endowment box. Since our model accounts for three factors, the world Edgeworth-box is a cube. For ease and clarity of

[4]To reduce the complexity of the analysis, we do not consider the possibility of a combined homogeneous and differentiated goods trade liberalization without any investment liberalization. Further, we do not look at unilateral combined policies, where, e.g., one country reduces tariffs and the other liberalizes only investment. Therefore, we only talk about the optimality of *considered* policies. However, if, say, a pure investment liberalization policy is inferior as compared to other considered policies, we may well conclude that it is not the preferred policy without having considered all opportunities.

[5]We always refer to the assessment of the consequences for world welfare as the social planner's perspective.

presentation, we always look at only two dimensions of the cube as in Figures 1 and 2. These correspond to "slices" of the factor cube. The first slice represents all capital to unskilled labor endowments, where countries are equally endowed with skilled labor. The second one includes all capital to skilled labor endowments, where countries are equally endowed with unskilled labor. At first glance, this choice might seem arbitrary. Therefore, we check for the robustness of our welfare results by cutting the cube at different endowment allocations in Section 3.5.

In the analysis below, we pool the results for these two boxes and extract information from $2 \cdot 9801 = 19602$ cells of welfare changes as expressed by the equivalent variation for each experiment after pooling. Of course, the results from all these experiments are numerous. Therefore, we present only a few of them graphically,[6] and we systematically analyze the welfare effects of trade and investment liberalization using econometric and analysis of variance methods, assuming the parameterized knowledge-capital model represents the data-generating process. In the three-factor model, this is a convenient way to assess (i) the role of factor endowments and size and (ii) the home and host country welfare effects of liberalization.

– Figures 1 and 2 –

To give a first insight into the relevance of this analysis, we present two figures, reflecting the associated equivalent variation in country i of a *bilateral* liberalization of trade or investment (Experiments 7-9). Each liberalization policy is undertaken separately, so that no conclusions about combined policies can be drawn here. The white areas in Figures 1 and 2 reflect factor endowment configurations, where each of the policies (i.e., trade or investment liberalization) leads to a rise in EV_i. At factor endowments associated with black areas, neither policy

[6]For instance, we only present the capital to skilled labor slices and refer the reader interested in the corresponding capital to unskilled labor figures to the supplementary material following page 39.

rises country i's welfare in terms of EV_i.[7] In the dark-gray (medium-gray) area, only one (two) policies rise EV_i. The figures suggest two important conclusions. First, for the majority of factor endowment configurations (i.e., the medium-gray and dark-gray areas) it is relevant to know for a country, which bilateral policy to support, in order to avoid domestic welfare losses and to create welfare gains instead. Second, if a country is relatively well endowed with unskilled labor (see Figure 2), two if not all three policies are likely to raise the country's welfare. Hence, we would expect such a country to be in favor of any bilateral liberalization scenario. However, a combination of policies could reduce or rise country i's welfare, depending on its factor endowment, size and the initial degree of liberalization, respectively. Accordingly, the possibility of a combination of trade and investment liberalization is additionally taken into account, below.

First and in line with Markusen (2002), we look at whether and how the impact of trade and investment liberalization on welfare depends on differences in size and relative factor endowments. Therefore, we regress EV_i on the changes of tariffs, of the foreign investment cost parameter and on interaction terms of these liberalization parameters with size (E_i) and relative factor endowments (K_i/L_i and K_i/S_i), respectively.[8]

Since the specifications include interaction terms, we have to look at the marginal effects of liberalization. We evaluate the marginal effects of changes of the policy parameters at the 25 and the 75 percentiles of the distribution of E_i and K_i/L_i, whereas we always set K_i/S_i at the median (the latter implies that we think about

[7]For numerical reasons, we always request a positive EV of larger than 0.01% to label liberalization policies as welfare raising.

[8]Specifically we run the following regression: $EV_i = \beta_0 + \beta_1\gamma_{ji} + \beta_2\gamma_{ij} + \beta_3 t_{zji} + \beta_4 t_{zij} + \beta_5 t_{xij} + \beta_6 t_{xji} + \beta_7\gamma_{ji}E_i + \beta_8\gamma_{ij}E_i + \beta_9\gamma_{ji}\frac{K_i}{L_i} + \beta_{10}\gamma_{ij}\frac{K_i}{L_i} + \beta_{11}\gamma_{ji}\frac{K_i}{S_i} + \beta_{12}\gamma_{ij}\frac{K_i}{S_i} + \beta_{13}t_{zji}E_i + \beta_{14}t_{zij}E_i + \beta_{15}t_{zji}\frac{K_i}{L_i} + \beta_{16}t_{zij}\frac{K_i}{L_i} + \beta_{17}t_{zji}\frac{K_i}{S_i} + \beta_{18}t_{zij}\frac{K_i}{S_i} + \beta_{19}t_{xji}E_i + \beta_{20}t_{xij}E_i + \beta_{21}t_{xji}\frac{K_i}{L_i} + \beta_{22}t_{xij}\frac{K_i}{L_i} + \beta_{23}t_{xji}\frac{K_i}{S_i} + \beta_{24}t_{xij}\frac{K_i}{S_i} + \epsilon_i$. We assume that the error (ϵ) is approximately normally distributed. Looking at a kernel density plot, we found a pattern typical for micro-data sets with a high pick (in our case around zero) and smaller tails as compared to a normal distribution.

K_i/L_i and S_i/L_i to be highly correlated, which is empirically justified[9]). This enables us to study the different welfare consequences of trade and investment liberalization for *small* (25 percentile of E_i) versus *large* (75 percentile of E_i) and *poor* (25 percentile of K_i/L_i) versus *rich* (75 percentile of K_i/L_i) economies. Table 3 summarizes the results for country i.

– Table 3 –

Second, we set up an analysis of variance to assess the relevance of different plant configurations for the impact of trade and investment liberalization on the welfare of each country and the whole world. To give the analysis more focus, we have to relax the distinction between the two cases of differences in K_i/L_i (K_j/L_j) and K_i/S_i (K_j/S_j). On the one hand, we discuss situations, where firm regimes do *not change* according to liberalization. Therefore, we construct dummy variables for each type of firms active: n_i, n_j, h_i, h_j, v_i, v_j. For instance, the h_i dummy is set at 1, if country i headquarters horizontal MNEs in one cell of the two ($K \times L$ and $K \times S$) endowment boxes in both the baseline scenario *and* the counterfactual post-liberalization case. This implies to look only at a sub-sample of the 19602 cells of each experiment, where liberalization did not cause any change in the plant configuration.[10]

Additionally, we analyze the cases, where liberalization *changes* the plant configuration. Then, it is of special interest, whether h or v firms come into existence or are shut down in one of the economies because of liberalization. Since there are two countries, we have to consider eight combinations, namely $h_{i0,1}$, $v_{i0,1}$, $h_{j0,1}$, $v_{j0,1}$, if the respective type of firms does not exist initially (the first period subscript is 0) and $h_{i1,0}$, $v_{i1,0}$, $h_{j1,0}$, $v_{j1,0}$, if such firms do not further exist after

[9]For example, in the largest possible cross-section of 57 countries in the 80s, their correlation amounts to 0.58 and is significant at 1%. Data sources are the Barro and Lee data-set and the Penn World Table.

[10]The estimated regression equation is given by: $EV_i = \beta_0 + \beta_1 n_i + \beta_2 n_j + \beta_3 h_i + \beta_4 h_j + \beta_5 v_i + \beta_6 v_j + \epsilon_i$, with ϵ denoting the disturbance term (i.e., the approximation error).

liberalization (the second period subscript is 0).[11]

– Tables 4 and 5 –

Figures 3-8 illustrate some of our findings graphically. Noteworthy, we do not distinguish between own and foreign unilateral policies in the figures for simplicity. Some of the figures address the question of which considered liberalization strategy is preferable at the individual country level (Figure 3) or from a social planner's (i.e., the whole world's) perspective (Figure 5). The black areas in these figures indicate cases in the endowment box, where neither policy induces a positive welfare effect. The dark gray areas refer to cases, where investment liberalization leads to the highest welfare gain among the considered alternatives. In the medium gray (light gray) areas, Z-sector (X-sector) tariffs should be liberalized. The white area indicates that a combined trade and investment liberalization is the preferred considered policy. These figures abstract from whether individual countries or the social planner would be in favor of an unilateral or a bilateral reduction of barriers to trade and/or investment. This is illustrated by the second set of figures for individual countries (Figures 4 and 7) and the social planner (Figures 6 and 8), where white areas indicate a preferred bilateral liberalization, gray ones a preferred unilateral liberalization, and black ones again capture non-positive welfare effects from liberalization. Noteworthy, we do not distinguish between *domestic* and *foreign* unilateral policies in these figures. Rather we ask, which of the undertaken unilateral and bilateral, domestic and foreign liberalization policies a country would chose according to the associated welfare effects.[12] In other words we are interested in which of the considered policies would a planner chose, who only cares about the welfare effects in a *single* economy.

– Figures 3 - 8 –

[11] In this experiment, we run the following regression: $EV_i = \beta_0 + \beta_1 h_{i0,1} + \beta_2 h_{j0,1} + \beta_3 v_{i0,1} + \beta_4 v_{j0,1} + \beta_5 h_{i1,0} + \beta_6 h_{j1,0} + \beta_7 v_{i1,0} + \beta_8 v_{j1,0} + \epsilon_i$, with ϵ as the disturbance term.

[12] However, if we restrict a country's choice to *own* unilateral and bilateral policies, a bilateral, combined liberalization is more likely chosen on average.

3.2 When is Pure Investment Liberalization (Especially) Beneficial and When Harmful?

Result 1: *Pure investment liberalization is likely beneficial for a country, irrespective of whether it is unilateral or bilateral.* [See rows 1, 7, 13 and 15 and the means and columns A-D of Table 4.]

A reduction in investment costs always reduces the factor waste through fixed foreign plant set-up costs. Since there is no associated rent (like tariff revenues associated with trade policy), the welfare effect is positive on average. If a country *headquarters* horizontal or vertical MNEs, its gains from a pure investment liberalization may even be higher than those of a combined trade and investment liberalization. [See the small dark gray areas in Figure 3.] This holds true irrespective of whether an unilateral or a bilateral policy is considered. If two countries exhibit relatively similar factor endowments and horizontal inward investment takes place, a pure trade liberalization and a combined trade and investment liberalization policy is likely to result in a smaller positive or even a negative welfare effect, since the policy changes the proximity-concentration trade-off in favor of exporters.

However, if trade is already fully liberalized in the initial equilibrium [see rows 13 and 15 of Table 4], a pure investment liberalization is unlikely detrimental, if a country headquarters or hosts vertical MNEs. This result is consistent with Figure 7. Especially, an unilateral foreign investment liberalization raises welfare at home, if new (horizontal or vertical) multinationals are founded abroad and it likely reduces welfare, if there is divestment in horizontal or vertical multinationals from either country. Foreign investment liberalization encourages foreign plant set-up, and it is especially beneficial, if it leads to entry of new firms. For the home country, this allocation of factor resources mitigates the resource waste from investment barriers. From studying several graphs (not all presented here), it is evident that the biggest welfare effects are often associated with a regime shift. Then, foreign investment liberalization makes it economically worth to go

abroad. This opens up the market for MNEs headquartered in the home country, and makes it possible to gain from a bigger market. The welfare gain of investment liberalization is likely smaller, if it leads to a displacement of its horizontal MNEs by vertical ones. In this case, welfare may even decline after liberalization.

Result 1 qualifies the conclusion of Markusen for the knowledge-capital model (2002, p. 188), namely that "the parent countries ... could lose from investment liberalization." According to our simulations, parent countries are relatively unlikely to lose from a pure investment cost reduction, though cases exist, where negative parent economy welfare effects occur.[13]

One source of the difference between Markusen's (2002) and our approach regarding the home and host country welfare effects is due to our choice of a three factor model. In a two factor world, investment liberalization directly reduces the demand for capital, whereas labor demand is not directly influenced. In our model, both skilled and unskilled labor are only indirectly affected. Investment liberalization only leads to a decline in the home market advantage in the X-sector of the capital *and* skilled labor-abundant country, if investment liberalization leads to such a plant reconfiguration that the other country is able to robe the capital *and* skilled labor abundant country of its home market advantage. This is only possible, if the capital and skilled labor scarcity in the other country gets relatively less severe. However, this is unlikely, since investment liberalization exerts a direct factor market effect on capital but not on skilled labor.[14] Parent countries with a large (small) pre-liberalization home market effect are likely to gain (lose) from investment liberalization.

[13] *Average* marginal welfare effects are significantly positive in the majority of cases, as reported in the pure investment liberalization experiments (1,2 and 7) in Table 4.

[14] If the *relative* capital to skilled labor endowment difference were large, but *absolute* skilled labor endowment difference were small between countries, investment liberalization would in our model likely reduce welfare in the parent country, which is similar to the effect described in Markusen (2002). Then, the pre-liberalization home market effect is relatively small as compared to a situation with a large difference in both the relative capital to unskilled labor and the relative skilled to unskilled labor endowments (remember the stylized fact of a high positive correlation between the two).

Unbundling of activities is facilitated by investment liberalization, but in our framework it is for two reasons not as important for the welfare effects as in Markusen (2002). First, we only gradually reduce the (finite and moderate) level of investment barriers. Second, the consideration of a third factor, skilled labor, matters. In our case, investment liberalization lowers the capital requirement. Therefore, the demand for skilled labor rises as well, and this effect is likely larger than the relative decline in the capital rental.

Helpman and Razin (1983) showed in a monopolistic competition model that foreign investment may flow in the wrong direction thereby harming the host as well as the home country. The difference between their approach and ours is twofold: (i) they assume that factor movements do not change relative prices of the traded good (the small country assumption in commodity markets), and (ii) the differentiated good is non-tradeable in their model. This assumption enables them to ignore the effects of factor movements on the number of varieties supplied on world markets. Both, the terms-of-trade effect and the variety effect are present in our analysis. Therefore, FDI does not harm home and host countries in our setting.

Summing up, investment liberalization is likely to raise welfare in both the host and the parent countries. The welfare gain is likely larger in the host as compared to the parent economies.

Result 2: *Pure investment liberalization is harmful, if MNEs are shut down in the course of liberalization* [see Table 5].

If a pure investment liberalization policy change leads to foreign divestment, where vertical, horizontal or both types of MNEs are shut down in one economy, host countries face a decline in factor demand. Then, domestic MNEs are most likely replaced by exporters or foreign owned vertical MNEs. However, exporters face a home market bias due to transportation costs, and they are not free to choose the country of production. The associated change in factor rewards is likely to be that strong that the corresponding increase in exports is too low to outweigh the detrimental effects on world welfare, especially so, if domestic

vertical MNEs are shut down. As far as the termination of horizontal MNE activity is concerned, a combined policy may make the typical world consumer better off, since the positive impact of an accompanying trade liberalization is strong enough, where the proximity-concentration trade-off changes in favor of (partly non-multinational) trading firms. Generally, a change in the equilibrium plant configuration induced by policy measures is relatively unlikely (confer the number of observations in Table 4 as compared to Table 5) and it only occurs, if relative factor endowments are sufficiently different.

Result 3: *Small countries gain more from pure (domestic or foreign) investment liberalization than large ones.*[15] [Compare rows 1 and 2 in columns A and B with rows 1 and 2 in columns C and D of Table 3.]

This finding is fully in line with the results in Markusen (2002, pp. 179-181). Of course, foreign investment liberalization ($\Delta\gamma_{ij}$) rises country i's welfare more than domestic investment liberalization ($\Delta\gamma_{ji}$). Through investment liberalization, less capital is lost by foreign plant set-up. Since for small countries' horizontal MNEs a large foreign market is attractive, they gain especially from foreign investment liberalization. Similarly, an unskilled labor-abundant country's welfare is highly sensitive to the level of γ_{ij}, since capital is relatively scarce, there. On the other hand, this country's welfare is also sensitive to the level of γ_{ji}, since it affects vertical direct inward investment. As already Markusen (2002) notes, one important reason behind the effect of investment liberalization is that it facilitates unbundling of headquarter services and production activities.

Confronting this result with the stylized facts in Table 1, we may conclude that there is still room and an incentive for smaller countries to further liberalize investment. Over the last decades, it has been mainly the larger countries, which have signed bilateral investment agreements.

Result 4: *Unskilled labor-abundant countries gain more (less) from pure do-*

[15]For country i, Experiment 1 refers to domestic investment liberalization and Experiment 2 means foreign investment liberalization. In contrast, for country j Experiment 1 implies foreign investment liberalization and Experiment 2 reflects domestic investment liberalization.

mestic (foreign) investment liberalization than unskilled labor-scarce countries. [Compare rows 1 and 2 in columns A and C with rows 1 and 2 in columns B and D of Table 3.]

Domestic investment liberalization attracts multinationals from abroad. Production of the foreign affiliates is less capital-intensive than setting up a domestic firm, and, therefore, domestic investment liberalization leads to rising factor prices and higher income in the unskilled labor-abundant country. Foreign investment liberalization favors the capital-abundant country even more, because it can take advantage of cheaper variable production costs abroad by unbundling headquarter services and production facilities within vertically organized MNEs.

Result 5: *If trade between two countries is already fully liberalized, they can only gain from investment liberalization, if the relative endowment of capital to skilled labor is not too different* [see Figure 7.]

If capital is very abundant compared to skilled labor, investment liberalization shows no positive effect on welfare. The reason is that skilled labor is scarce but important to set-up a headquarter and run a multinational network.[16] If capital is very scarce, a country does not engage in FDI at all, and investment liberalization is not able to reduce the capital rental to induce FDI. Then, investment liberalization is an irrelevant policy.[17]

3.3 Pure Investment Liberalization or Combined Trade and Investment Liberalization?

Result 6: *Pure investment liberalization is unlikely the preferred policy. If the difference in the capital to skilled labor endowment ratio is not too large, economies tend to prefer a bilateral, combined trade and investment liberalization to maximize welfare. This holds true irrespective of whether trade is already fully liberalized or not* [see Figures 3, 4 and 7].

[16] See the black areas above the main diagonal in the mentioned figures.

[17] These are the black areas below the main diagonal in the mentioned figures.

Investment liberalization reduces the factor waste of capital. As the relative endowment with capital and skilled labor is very similar across countries in the described cases, *bilateral* investment liberalization does not exert large distributional consequences at the international level. By contrast, both countries should gain because of the reduction of factor waste. Tariff reduction in the X-sector favors exporters, that is national firms and vertical MNEs. In all our experiments and in contrast to Markusen (2002), there are national firms in both countries, if relative endowment differences are small. The large country (associated with the north-east region in Figure 3), mainly runs national firms, and the other one vertical MNEs. By and large, either country gains from bilateral trade liberalization in these cases.

Result 7: *The social planner would never choose a pure investment liberalization strategy in either or both countries. By and large, this is independent of whether countries have similar relative factor endowments and horizontal MNEs are active, or if factor endowment differences are large and vertical MNEs exist* [see Figures 5 and 6].

On average, the social planner prefers a combined investment and trade policy over the other considered policies. The reason is that an additional reduction in tariffs enforces the stimulus to produce abroad (i.e., to exploit specialization gains due to factor cost differences). A bilateral reduction of tariffs works in favor of both national firms and vertical MNEs. The combined liberalization effect is likely to outweigh the loss in world tariff incomes. Similar to Markusen (1997), we may conclude that trade and investment liberalization are complements in welfare terms. However, if capital endowments differ to some extent, differentiated goods trade liberalization may be superior as compared to a (marginal) combined trade and investment liberalization strategy, since the latter is irrelevant and, thus, does not induce additional welfare gains.

If liberalization leads to a change in the equilibrium plant configuration and MNEs come into existence, the social planner would choose a bilateral combined trade and investment policy. A bilateral combined policy seems especially rec-

ommended, if horizontal MNE activity is induced. The associated welfare gains are smaller with vertical MNEs coming into existence. The reason is that vertical MNEs arise, where previously (only) horizontal MNEs were active. This may generate strong effects on factor markets, since production plants are shut down in the country, where the headquarters are located, and production is concentrated in the low-wage country. The associated decline in the demand for unskilled labor in the high-wage economy may be strong enough, so that the net welfare effect is negative. However, this only happens, if countries are sufficiently dissimilar in terms of relative factor endowments.

Hence, whether trade and investment liberalization are really complementary depends on the initial equilibrium plant configuration (and, in turn, on the exogenous absolute and relative factor endowments behind) and on whether a marginal liberalization is relevant (and effective) or not. At least, we may conclude that trade and investment liberalization are not substitutive in welfare terms.

3.4 Either or Neither Kind of Liberalization?

Result 8: *Countries with both a moderate to high capital to skilled labor and a high capital to unskilled labor endowment ratio tend to lose (or at least do not gain) from any liberalization policy* [see the black areas in Figure 3].

If capital is abundant relative to both skilled and unskilled labor, any tariff reduction is unlikely to raise welfare. First, such a country does not export Z-goods, due to its comparative advantage. Second, also X-sector trade liberalization is not able to produce welfare gains. The main reason is that predominantly horizontal MNEs are headquartered by such an economy, and these do not engage in trade, so that a (marginal) trade liberalization is an irrelevant policy in this case. Even pure investment liberalization does not induce welfare gains for a capital abundant country, if skilled labor is relatively scarce.[18]

[18] According to relative factor endowments, we found two further interesting results concerning trade liberalization: (i) Countries with a relatively high skilled to unskilled labor endowment ratio prefer trade liberalization in the differentiated goods sector, whereas economies with a

Result 9: *A country is likely to gain from any kind of liberalization, if it hosts (either horizontal or vertical) MNEs.* [See columns B and D as compared to columns A and C in Table 4.]

On average, it gains more, if it hosts vertical MNEs and if it is relatively well-endowed with unskilled labor. In this case, (large) differences in relative factor endowments motivate vertical MNEs headquartered abroad to exploit factor price differentials, which are large enough to concentrate production at a single low-wage location. Since vertical MNEs by definition engage in trade, welfare is positively affected by both trade and investment liberalization (*complementarity* between trade and vertical MNE activity). The associated gains from trade liberalization tend to be smaller, if a country hosts horizontal MNEs. The reason is that part of the welfare raising stimulus is offset by the proximity-concentration trade-off, which results in a replacement of horizontal MNE activity by trade (*substitution* between trade and horizontal MNE activity). Note that this result is in line with the conclusion of Markusen (2002, p. 188) that "it is generally the host economies that are ensured of gains ... from investment liberalization."

A combined trade and investment liberalization is especially preferable for a country, which hosts MNEs. [See Experiments 10-12 and columns B and D as compared to columns A and C in Table 4.] Particularly, there is large scope for welfare gains, if foreign vertical multinationals are active. In this case, an economy gains considerably from a simultaneous reduction of investment costs and X-sector tariffs, since both measures positively affect specialization gains and foreign direct investment and trade volumes, respectively.

However, there is an exception to the general result that host countries gain more from liberalization. Pure foreign investment liberalization can negatively

low skilled to unskilled labor endowment ratio are in favor of homogeneous goods trade liberalization, and (ii) Large/capital-abundant countries lose more from domestic trade liberalization and they gain less from foreign trade liberalization than small/unskilled labor-abundant ones. However, large countries lose less than small ones from domestic trade liberalization in the X-sector. More details on these results are provided in the supplement to this paper, following page 39.

affect a FDI-sending country's welfare, if there are relatively large factor cost differences between country i and j in the baseline scenario due to their heterogeneous sizes. [See Experiment 2 and column A in Table 4.] Assume that the proximity-concentration trade-off is initially in favor of country i's national firms and investment liberalization changes the trade-off in favor of MNEs. Since factor cost differences are still large, country i-based vertical MNEs come into existence to exploit specialization gains. Consequently, h_i firms are to some extent replaced by v_i firms, which reduces the welfare gain. Eventually, this crowding out effect even dominates the specialization gain due to the set-up of v_i firms, so that welfare declines. [See the black areas in Figures 3 and 4.][19]

3.5 Robustness of the Findings

We address the robustness of our results in several respects. For this purpose, we construct Table 3 and Figures 3 and 4 for different parameter/endowment values and technology assumptions than in the previous section. Under these alternative parameter, endowment and technology domains, we simulate all scenarios, where trade is not fully liberalized in the initial equilibrium (i.e., Experiments 1-12).[20]

First, we investigate the sensitivity with respect to changes in the elasticity of substitution between varieties. This is done by using $\epsilon = 3$ and $\epsilon = 5$, alternatively. It turns out that an increase in ϵ tends to reduce the marginal effects of trade and investment liberalization in absolute values. Further, Results 4, 6 and 8 are robust in general terms with respect to different levels of ϵ. Only Result 3 must be modified to some extent: small countries gain more from foreign investment liberalization than large ones, however, they gain less from domestic pure investment liberalization as ϵ gets larger. At higher levels of ϵ, it is more likely that neither policy is welfare increasing. Also, a combined trade and investment

[19] As pointed out in Result 2, the world consumer will nevertheless be better off in this case.

[20] Additionally, we have considered asymmetric policy parameters configurations in the base case and found that the results prove robust in this respect. All the results of the robustness section and figures for capital to unskilled labor slices through the factor cube, holding skilled labor endowments fixed, are available in the supplementary material (following page 39).

liberalization is less likely the preferred considered policy, and countries tend to be in favor of trade liberalization. The likelihood of pure investment liberalization (in either of the countries) being a preferred policy remains small and does not significantly change with ϵ. In sum, a country tends to be the more in favor of an unilateral policy, the higher ϵ. Concerning the likelihood of multinational firms, our results are ambiguous, which squares with the conclusion in Markusen (2002, p. 116), who finds that the likelihood of multinational firms rises with the elasticity of substitution.

Second, we check the robustness of the welfare effects of trade and investment liberalization with respect to different values of the technical rate of substitution between X-sector production factors (ρ). Though a higher substitutability between production factors raises the welfare effects of liberalization in absolute terms, the results in the paper are not affected qualitatively. If firms may substitute production factors more elastically, there is likely at least one liberalization strategy, which may rise welfare. Then, a capital- *and* labor-abundant economy tends to be in favor of pure investment liberalization. Again, the scope for a combined trade and investment liberalization is large. At a high rate of technical substitution between X-sector production factors, a country would strongly gain from a foreign unilateral policy, but a bilateral liberalization strategy is the most likely feasible outcome.

As mentioned in the previous section, we have looked at specific slices of the factor cube for the ease of presentation. To illustrate the robustness of our findings in this respect, we investigate the EV-responses after liberalization for the capital to skilled labor boxes at a country i's share of world unskilled labor of 25%, 50% (as above), and of 75%. Similarly, we set country i's endowment with skilled labor at 25%, at 50% (as above), and at 75%. In sum, this gives six slices, which we evaluate altogether. Of course, the parameters and the marginal effects are then estimated from triple as much observations as in the original Table 3. The results are very similar to those in Table 3 both in quantitative and in qualitative terms. Hence, looking at only two slices of the factor cube seems not associated with a

serious reduction in information as compared to looking at the whole factor cube. Also, there are only proportional changes in the respective areas of Figures 3 and 4.

So far, we have assumed that the necessary capital to set-up a foreign plant stems only from the MNE's home country. Now, we relax this condition and assume that capital from both countries is used according to a CES technology:

$$a_{Khi} = 1 + 2^{\frac{1-\kappa}{\kappa}}(1+\gamma_{ij})w_{Ki}^{\frac{1}{\kappa-1}}\left(w_{Ki}^{\frac{\kappa}{\kappa-1}} + w_{Kj}^{\frac{\kappa}{\kappa-1}}\right)^{-\frac{1}{\kappa}} \tag{20}$$

$$a_{Kvi} = a_{Khi} - 1, \tag{21}$$

where $2^{\frac{1-\kappa}{\kappa}}$ is a scaling factor, which guarantees that each country contributes the same amount of capital to the overall (domestic and foreign) real capital provision of a horizontal (a vertical) MNE of $2+\gamma_{ij}$ (of $1+\gamma_{ij}$) at equalized capital rewards. We always set $\kappa = -1$, which implies a technical rate of substitution between domestic and foreign capital of 0.5.[21]

The corresponding capital constraint reads:

$$\begin{aligned} K_i \;\geq\; & a_{Kxi}\left(\left(n_i + h_i + h_j + v_j\right)x_{ii} + \left(n_i + v_j\right)x_{ij}\right) + a_{Kni}n_i \\ & + a_{Khi}h_i + a_{Kvi}v_i + (a_{Khj} - 1)h_j + a_{Kvj}v_j. \end{aligned} \tag{22}$$

Under these assumptions, the marginal effects on welfare are larger in absolute value. Also, the previous results regarding the role of size and factor endowments for the marginal effects of trade and investment liberalization change. (i) Small countries always gain less from both foreign and domestic investment liberalization than large ones, and (ii) unskilled labor-abundant countries gain more from both foreign and domestic investment liberalization than unskilled labor scarce ones. There is a larger scope for combined trade and investment liberalization than in the original experiments, once both foreign and domestic capital can be used for setting up plants. Moreover, there is likely at least one liberalization strategy, which is able to produce welfare gains. Further, small, skilled

[21] However, in this case we have to slightly reduce the size of the factor box to establish stable numerical solutions.

labor-abundant economies tend to prefer a pure investment liberalization strategy, since their small capital endowment is not a binding constraint, but they may also use foreign capital to set-up plants abroad. However, what matters is a relative large endowment of that factor, which is used to generate the firm specific assets, namely skilled labor. Under the assumed high substitution between domestic and foreign capital, this pure investment liberalization is preferably bilateral from both a single economy's and the whole world's point of view. However, at different endowment constellations, a country tends to be in favor of an unilateral, combined liberalization strategy.

From this exercise, we may conclude that our results are robust, as long as we do not fundamentally change the technology of setting up foreign plants.

4 Conclusions

This paper provides a thorough welfare analysis of trade and investment liberalization in the knowledge-capital model with three factors of production and monopolistically competitive firms. So far, results on the welfare effects in general equilibrium are scarce, and Markusen (1997, 2002) is an exception. Following the previous literature, we set-up up a comprehensive set of numerical simulation exercises. Thereby, we focus on several aspects of liberalization, which have not been explicitly considered yet.

In particular, our simulation exercises suggest that pure investment liberalization is unlikely the preferred policy from both an individual country's and the world's perspective. A country prefers a simultaneous trade and investment liberalization, if the capital to skilled labor endowment ratios are not too different across countries. The social planner is in favor of a combined trade and investment liberalization almost everywhere in the endowment space, and never opts for a pure investment liberalization strategy.

So far, welfare results are available for bilateral and symmetric liberalization. We find that bilateral liberalization is mostly preferable for individual countries with

similar capital to skilled labor ratios, irrespective of their relative endowment with unskilled labor. In this case, the social planner is also in favor of bilateral liberalization.

We consider the simulated knowledge-capital model as the data-generating process and analyze the welfare effects of liberalization graphically and by means of regression and analysis of variance methods. This allows us to quantitatively compare different liberalization policies and to assess the marginal welfare effects of country size, factor endowments and plant configurations. The latter, we refer to as home and host country effects. Although a pure investment liberalization is rarely the preferred policy, we find that it is unlikely detrimental. The associated welfare gain declines with country size and the capital to unskilled labor endowment ratio. Further, a country is likely to gain from any liberalization strategy, if it hosts MNEs. Finally, parent countries are unlikely to lose from a pure investment liberalization, though the welfare gains for host countries are larger.

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A Appendix

A.1 Parameter Values for the Base Symmetric Case

Values for the fixed costs: δ=0.01; γ_{ji}=0.3; γ_{ij}=0.3; a_{Sni}=1; a_{Snj}=1; a_{Kni}=1; a_{Knj}=1;

Transport costs: τ=0.15;

Tariffs: t_{xji}=0.2; t_{xij}=0.2; t_{zji}=0.2; t_{zij}=0.2;

World Endowment: L=100; K=60; S=40;

Parameters for the CES X-sector technology: ρ=-1000; a=0.3; b=0.5;

Parameters for the demand function: α=0.8; ϵ=2;

In all experiments, we evaluate the welfare effects of liberalization considering factor endowment shares of the countries in between 0.0005 and 0.9995 of world factor endowments.

A.2 Discussion of the Parametrization

We assume expenditure share parameters for capital, skilled and unskilled labor in the production function of X-goods (a, b, (1-a-b)) in accordance with the empirical stylized facts.

Assuming $\alpha = 0.8$ means that consumers spend more on X-goods (due to the fact that we imposed a Cobb-Douglas production function as the outer nest of our utility function).

For the X-sector CES production function, we choose $\rho = -1000$, implying a low TRS 0.001 between production factors to avoid factor intensity reversals, which

would make interpretation of the results much harder, if not impossible.

Transport costs are set equal to $\tau = 1.15$. This is on the upper bound of the empirical findings (see Harrigan, 1993; Rauch, 1996; Baier and Bergstrand, 2001).

An elasticity of substitution between varieties of $\epsilon = 2$, which corresponds to a markup of 100% over marginal costs, is at the lower bound of the empirical findings (see Feenstra, 1994; Baier and Bergstrand, 2001).

Size	Observed policy change	Secondary school attainment share		
		Below median	Above median	All countries
Small countries	Δ in BITs	2.6	5.6	3.2
	Δ in tariffs	-0.1	-3.2	-1.0
Large countries	Δ in BITs	13.0	23.3	20.4
	Δ in tariffs	-5.2	-7.9	-7.2
All countries	Δ in BITs	6.0	20.4	13.2
	Δ in tariffs	-2.4	-7.2	-5.4

Note: Data sources are WTO for BITs, the World Bank's World Development Indicators for tariffs and GDP, and the Barro and Lee (1993) database for secondary school attainment

Table 1: Change in bilateral investment treaties (BITs) and tariffs (70s-90s)

#	Policy change	Short description[1]
	Unilateral single policy	
1	γ_{ji} reduced by 30 %	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$
2	γ_{ij} reduced by 30 %	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$
3	t_{zji} reduced by 30 %	Δt_{zji}; $\Delta t_{zij} = 0$
4	t_{zij} reduced by 30 %	$\Delta t_{zji} = 0$; Δt_{zij}
5	t_{xji} reduced by 30 %	Δt_{xji}; $\Delta t_{xij} = 0$
6	t_{xij} reduced by 30 %	$\Delta t_{xji} = 0$; Δt_{xij}
	Bilateral single policy	
7	γ_{ji} and γ_{ij} reduced by 30 %	$\Delta\gamma_{ji} = \Delta\gamma_{ij}$
8	t_{zji} and t_{zij} reduced by 30 %	$\Delta t_{zji} = \Delta t_{zij}$
9	t_{xji} and t_{xij} reduced by 30 %	$\Delta t_{xji} = \Delta t_{xij}$
	Unilateral combined policy	
10	γ_{ji}, t_{zji} and t_{xji} reduced by 30 %	Δ_{ji}; $\Delta_{ij} = 0$
11	γ_{ij}, t_{zij} and t_{xij} reduced by 30 %	$\Delta_{ji} = 0$; Δ_{ij}
	Bilateral combined policy	
12	γ_{ji}, γ_{ij}, t_{zji}, t_{zij}, t_{xji} and t_{xij} reduced by 30 %	$\Delta_{ji} = \Delta_{ij}$
	Unilateral single policy - full trade liberalization policy	
13	γ_{ji} reduced by 30 %	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$
14	γ_{ij} reduced by 30 %	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$
	Bilateral single policy - full trade liberalization policy	
15	γ_{ji} and γ_{ij} reduced by 30 %	$\Delta\gamma_{ji} = \Delta\gamma_{ij} = 0$

[1] $\Delta\gamma$ indicates investment liberalization, Δt_z refers to trade liberalization in the Z-sector, Δt_x stands for trade liberalization in the X-sector, and Δ alone captures a combined policy of $\Delta\gamma$, Δt_z and Δt_x simultaneously.

Table 2: Overview of policy experiments

Policy change		Associated $EV_i * 10^2$ for 1 % liberalization	$EV_i * 10^2$ evaluated at				
			variable means	low E_i low $\frac{K_i}{L_i}$	low E_i high $\frac{K_i}{L_i}$	high E_i low $\frac{K_i}{L_i}$	high E_i high $\frac{K_i}{L_i}$
				A	B	C	D
1	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$	1.212 − 0.002 E_i − 0.051 $\frac{K_i}{L_i}$ − 0.019 $\frac{K_i}{S_i}$	0.724	0.898	0.864	0.689	0.655
		(0.134) (0.001) (0.016) (0.006)	[243.09]	[218.22]	[211.18]	[147.52]	[138.76]
2	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$	2.771 − 0.011 E_i + 0.399 $\frac{K_i}{L_i}$ − 0.045 $\frac{K_i}{S_i}$	0.944	1.317	1.583	0.149	0.415
		(0.134) (0.001) (0.016) (0.006)	[413.68]	[468.75]	[708.41]	[6.87]	[55.64]
3	Δt_{zji}; $\Delta t_{zij} = 0$	0.608 − 0.008 E_i − 0.297 $\frac{K_i}{L_i}$ + 0.014 $\frac{K_i}{S_i}$	-1.218	-0.550	-0.749	-1.396	-1.594
		(0.200) (0.001) (0.024) (0.009)	[305.60]	[36.41]	[70.43]	[268.75]	[364.98]
4	$\Delta t_{zji} = 0$; Δt_{zij}	38.458 − 0.147 E_i − 1.127 $\frac{K_i}{L_i}$ + 0.820 $\frac{K_i}{S_i}$	10.388	18.836	18.085	2.936	2.184
		(0.200) (0.001) (0.024) (0.009)	[22247.13]	[42634.75]	[41098.61]	[1189.22]	[685.36]
5	Δt_{xji}; $\Delta t_{xij} = 0$	-2.404 + 0.004 E_i − 0.202 $\frac{K_i}{L_i}$ − 0.464 $\frac{K_i}{S_i}$	-3.186	-2.637	-2.836	-2.21	-2.408
		(0.200) (0.001) (0.024) (0.009)	[1548.39]	[788.39]	[840.17]	[633.97]	[688.30]
6	$\Delta t_{xji} = 0$; Δt_{xij}	28.262 − 0.067 E_i − 0.869 $\frac{K_i}{L_i}$ − 0.547 $\frac{K_i}{S_i}$	12.214	17.665	16.913	10.349	9.597
		(0.200) (0.001) (0.024) (0.009)	[22752.27]	[35368.44]	[29889.90]	[13901.87]	[10931.08]

Standard errors in parenthesis and t-statistics in brackets. 235224 observations.

Table 3: Calculating the marginal effect of policy changes in country i by policy

Policy change		Mean	h_i	h_j	v_i	v_j	Obs.	R^2
			A	B	C	D		
Unilateral single policy								
1	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$	0.040	++	++	++	++	18787	0.14
2	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$	0.091	−−	−	++	++	18787	0.30
3	Δt_{zji}; $\Delta t_{zij} = 0$	-0.075	−−	++	−−	++	19475	0.23
4	$\Delta t_{zji} = 0$; Δt_{zij}	0.625	−−	++	−−	++	19475	0.21
5	Δt_{xji}; $\Delta t_{xij} = 0$	-0.197	−−	++	++	++	18808	0.30
6	$\Delta t_{xji} = 0$; Δt_{xij}	0.778	−−	++	−−	++	18808	0.61
Bilateral single policy								
7	$\Delta\gamma_{ji} = \Delta\gamma_{ij}$	0.120	−	+	++	++	18138	0.32
8	$\Delta t_{zji} = \Delta t_{zij}$	0.553	−−	++	−−	++	19348	0.22
9	$\Delta t_{xji} = \Delta t_{xij}$	0.575	−−	++	−	++	19144	0.68
Unilateral combined policy								
10	Δ_{ji}; $\Delta_{ij} = 0$	-0.225	−−	++	++	++	18615	0.28
11	$\Delta_{ji} = 0$; Δ_{ij}	1.489	−−	++	++	++	18615	0.47
Bilateral combined policy								
12	$\Delta_{ji} = \Delta_{ij}$	1.269	−−	++	++	++	18170	0.56
Unilateral single policy - full trade liberalization policy								
13	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$	0.041	−−	++	++	++	18907	0.30
14	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$	0.036	−−	−−	++	−−	18907	0.28
Bilateral single policy - full trade liberalization policy								
15	$\Delta\gamma_{ji} = \Delta\gamma_{ij}$	0.075	−−	−−	++	++	18264	0.37

Double signs are significant at 1 %.

Table 4: Regression of firm type dummies on EV of country i

Policy change		Mean	$h_{i1,0}$	$h_{j1,0}$	$v_{i1,0}$	$v_{j1,0}$	Obs.	R^2
			E	F	G	H		
Unilateral singular policy								
1	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$	0.330	−−	0	−−	−−	815	0.11
2	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$	0.330	0	−−	−−	−−	815	0.11
Bilateral singular policy								
9	$\Delta t_{xji} = \Delta t_{xij}$	0.402	++	++	+	+	458	0.30
Unilateral single policy – full trade liberalization policy								
13	$\Delta\gamma_{ji}$; $\Delta\gamma_{ij} = 0$	0.142	−	−−	−	−	695	0.70
14	$\Delta\gamma_{ji} = 0$; $\Delta\gamma_{ij}$	0.142	−−	−	−	−	695	0.70
Bilateral single policy – full trade liberalization policy								
15	$\Delta\gamma_{ji} = \Delta\gamma_{ij}$	0.201	−−	−−	−	−	1338	0.56

Double signs are significant at 10 %.

Table 5: Regression of firm type change dummies on EV of country i and j

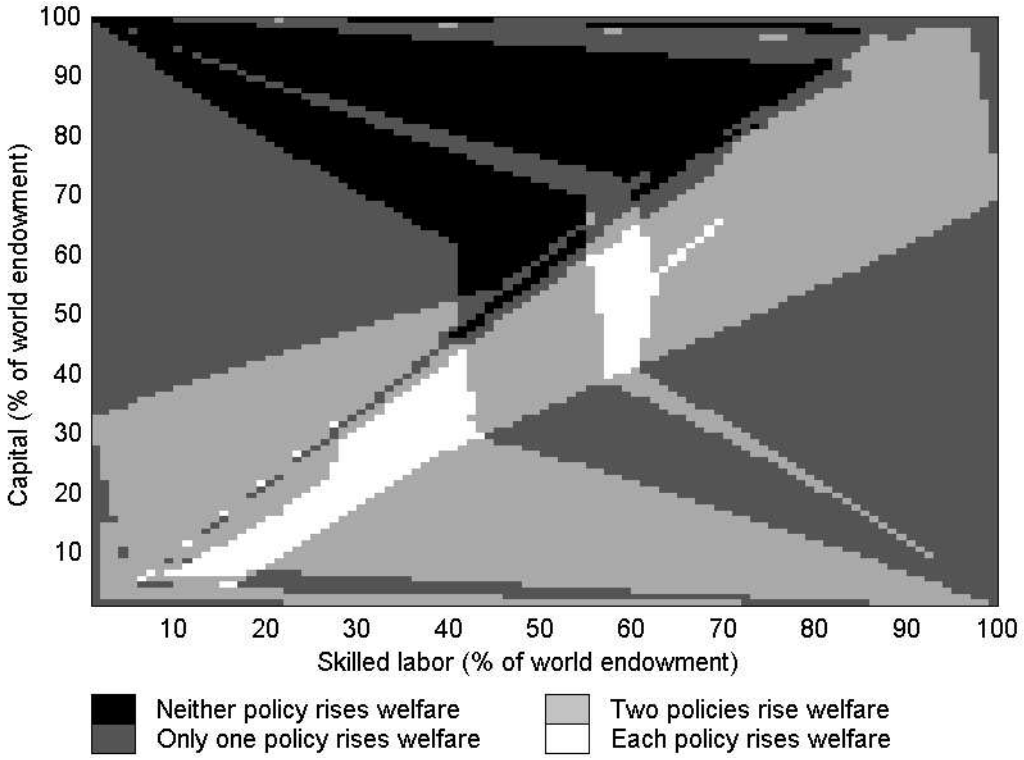

Figure 1: Consequences of different bilateral, symmetric liberalization policies on country i's welfare

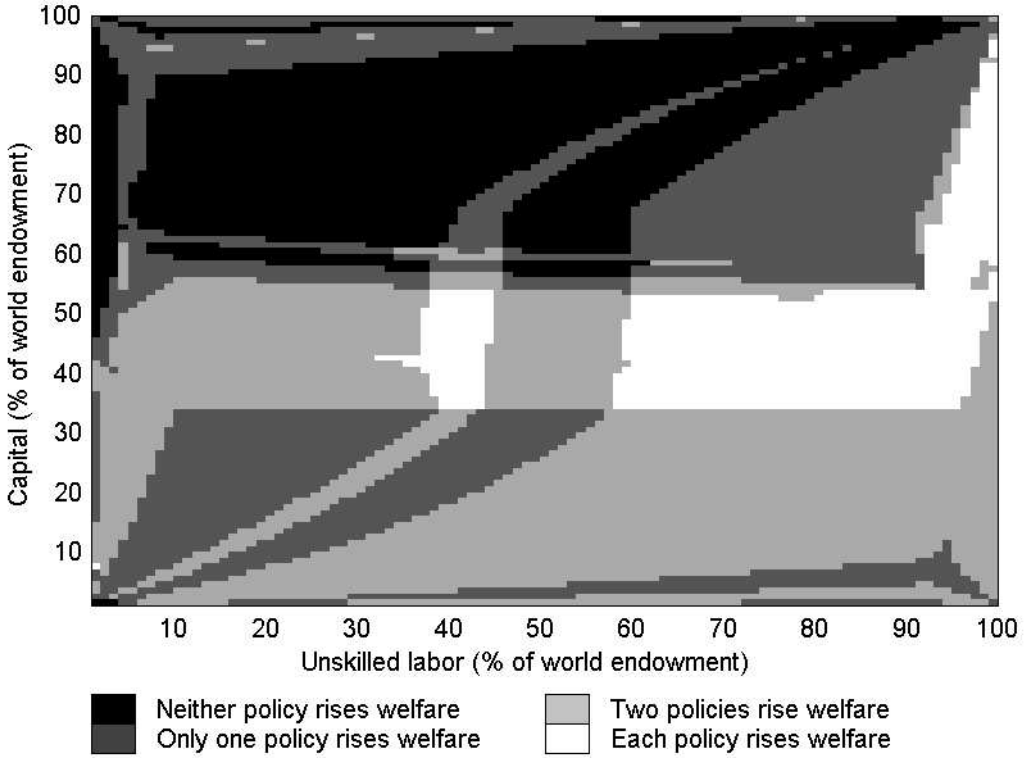

Figure 2: Consequences of different bilateral, symmetric liberalization policies on country i's welfare

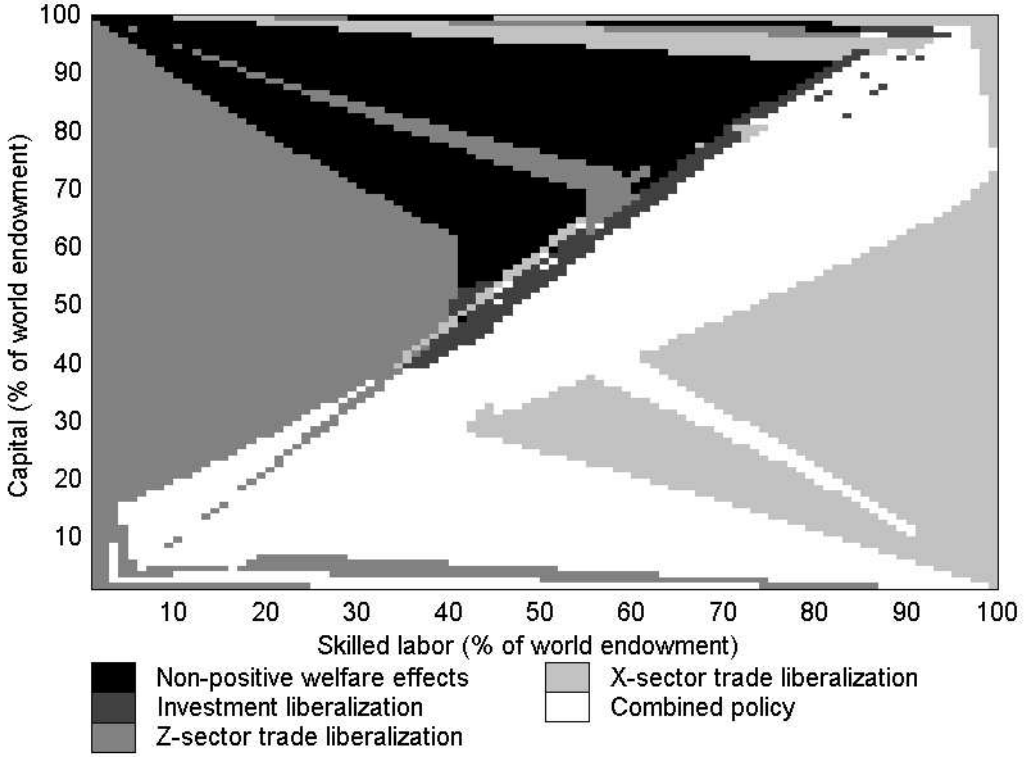

Figure 3: Preferred choice of considered policies to maximize welfare in country i

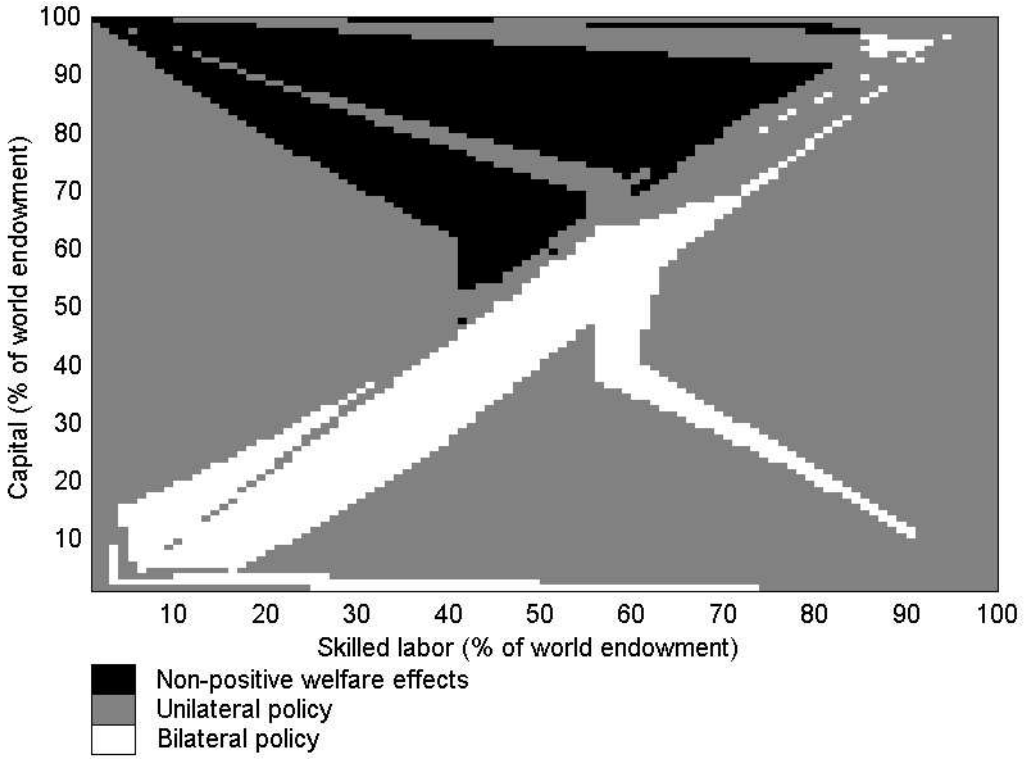

Figure 4: Preferred unilateral versus bilateral liberalization for country i

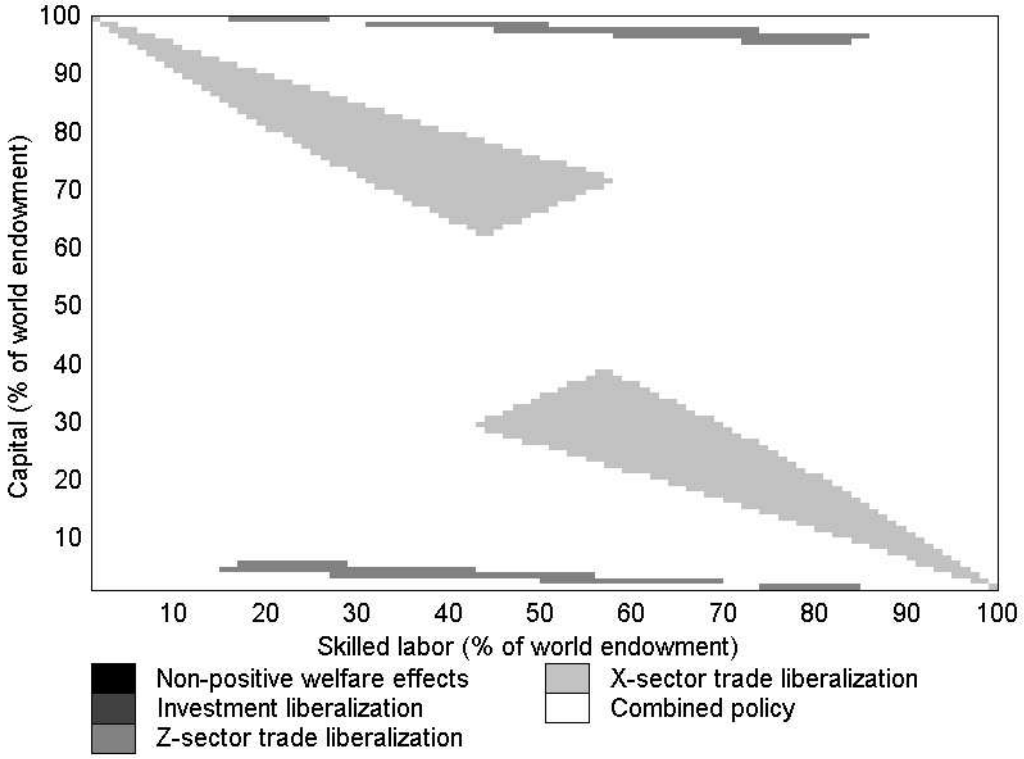

Figure 5: Preferred choice of considered policies to maximize world welfare (social planner)

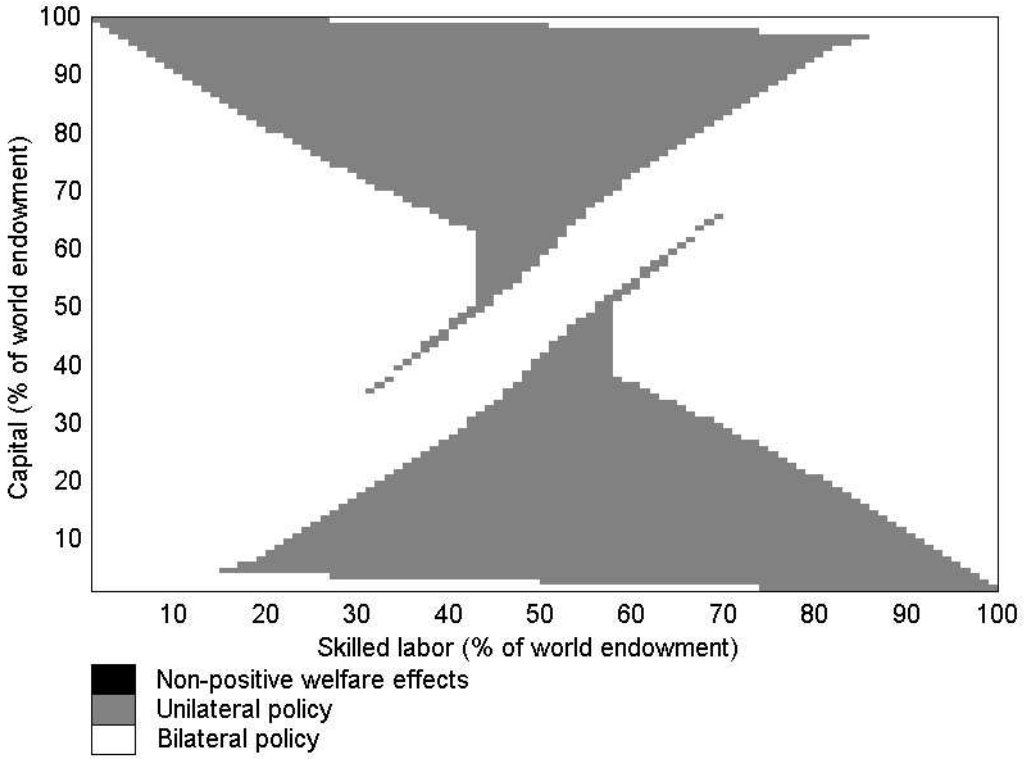

Figure 6: Preferred unilateral versus bilateral liberalization (social planner)

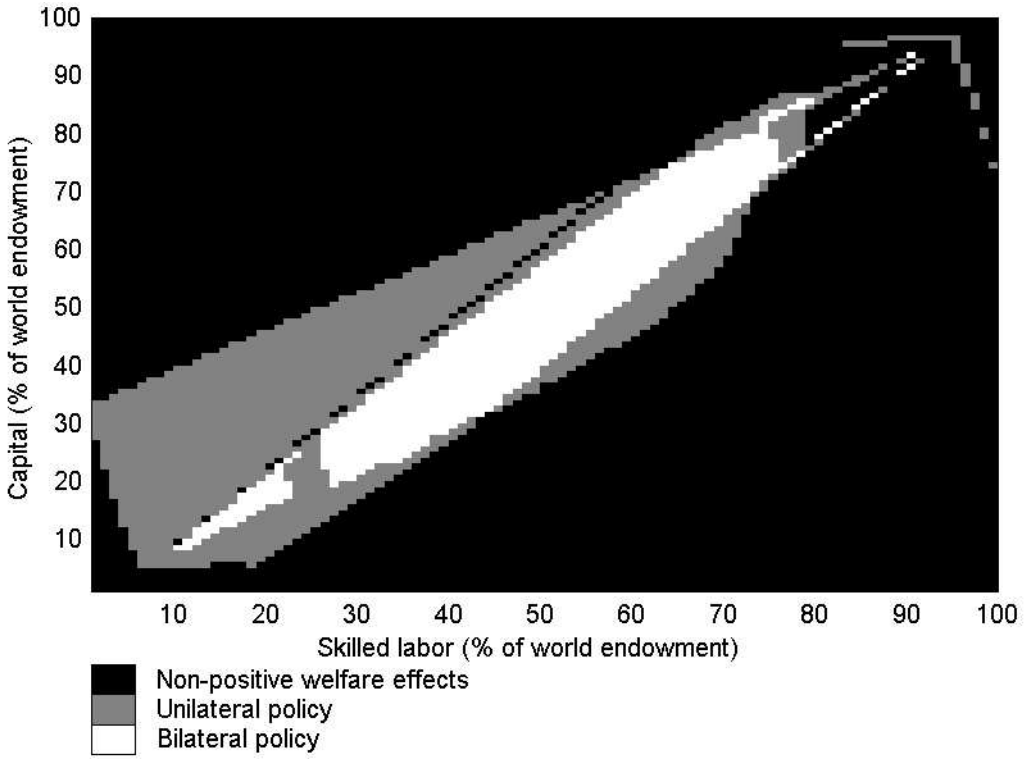

Figure 7: Preferred unilateral versus bilateral liberalization for country i at zero tariffs

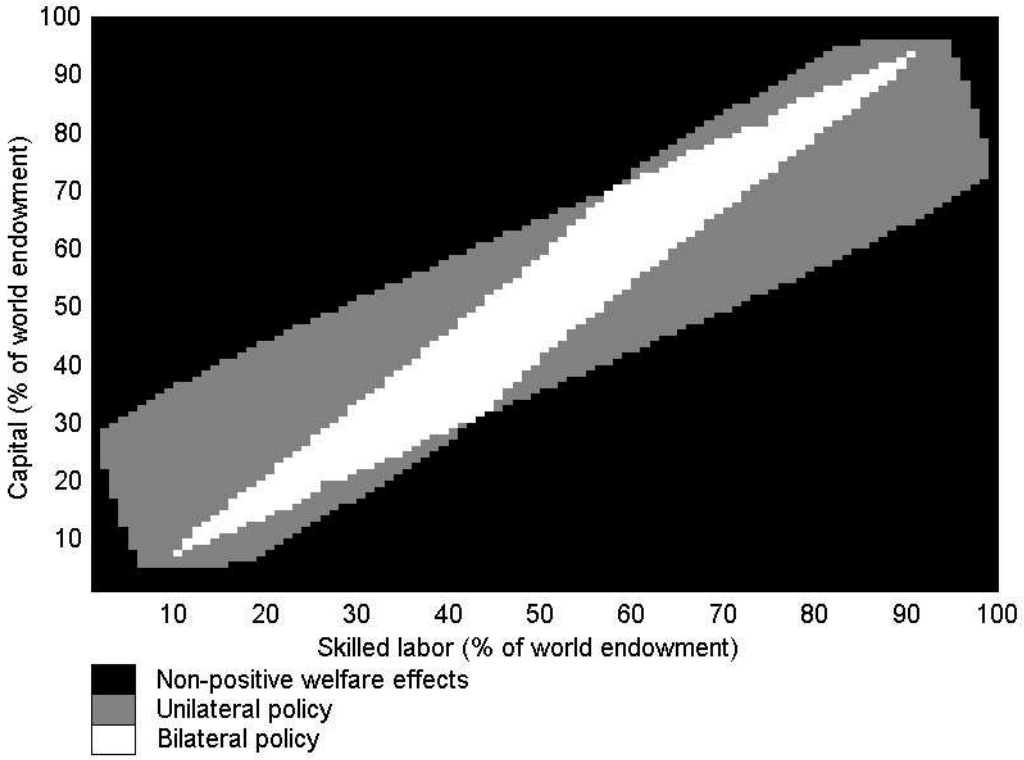

Figure 8: Preferred unilateral versus bilateral liberalization at zero tariffs (social planner)