Reaping the Gains: Specialization and Capital Flows

Christina Ortseifer* Jakob Schwab†

December 2015

Abstract

This paper gives a new answer to the old question of whether international trade and capital flows are substitutes or complements. In contrast to conventional intuition, we show that Heckscher-Ohlin trade that takes place in high-skill and low-skill intensive goods creates incentives for capital flows into countries that partly specialize along their abundant skill factor. Technically, we incorporate capital as a composite factor in a tractable 3-factor neoclassical trade model. It shows that countries for whom trade induces greater trade specialization should observe larger capital inflows. By using data on revealed comparative advantage while controlling for common factors, we provide emprical evidence for this result.

Keywords: Trade and Capital Flows, Specialization, Three-factor models
JEL: F11, F21

*Johannes Gutenberg University Mainz, E-Mail: christina.ortseifer@uni-mainz.de

†GSEFM and Johannes Gutenberg University Mainz, E-Mail: jakob.schwab@uni-mainz.de. We thank Peter Egger, Philipp Harms, Florian Hett, Sebastian Krautheim, Karlhans Sauernheimer and Klaus Waelde, as well as participants of the 16th ETSG Conference 2014 in Munich, the 7th FIW Conference on International Economics 2014 in Vienna, the SMYE 2015 in Gent, and the Meeting of the Verein für Socialpolitik 2015 in Münster for valuable comments and discussions. Jakob Schwab gratefully acknowledges financial support by the Gutenberg Academy.

1 Introduction

Differences in factor endowments between countries are relevant drivers of international trade flows (Romalis, 2004; Morrow, 2010). The classical and prominent Heckscher-Ohlin-Mundell paradigm states that the indirect trade of factors through commodities would replace incentives for international capital flows.[1] Still, we observe both, international trade in goods and capital flows, and both in rapidly increasing volume over the past 50 years. At the same time, it shows that specialization patterns go along the lines of high-skill and low-skill labor, rather than in terms of capital endowments. Theories that extend the standard Heckscher-Ohlin setting to incorporate these three factors allow for the endurance of factor price differences and hence capital flows. Nevertheless, they still do not point at a clear direction regarding the question of whether trade and capital flows are substitutes or complements in the sense that one tends to increase or decrease the volume of the other.

We in this study identify an effect in this type of analysis that makes trade and capital flows complementary. The intuition behind it is that advantegeous allocation of the respective skill factors enabled by trade raises the return of the third, composite factor capital and hence leads to capital inflows. We then test whether this mechanism can be observed in the data by constructing an index of skill level specialization and testing whether increased specialization in either direction (high-skill or low-skill) induces capital inflows.

In our model, both high-skill and low-skill labor, as well as capital are involved in production. When countries open up to trade, they increase their real income by producing for the world market those goods that use the *skill class* intensively that they are endowed with abundantly, and import the other goods for a lower price from the world market. If now production additionally requires capital, which obtains a share of the production value as returns, then the increased real return also affects the rewards for capital and hence creates incentives for capital flows. Capital reaps part of the gains from using the skill level that a country is abundantly endowed with for production for world markets.

For symmetric specialization patterns, the efficiency increasing effect of trade liberalization raises rental rates in both countries and hence does not imply a certain direction of capital flows, or any flows at all. It only implies symmetric worldwide gains for capital, in contrast to the asymmetric ones for labor skill classes between trading countries.[2]. However, given

[1] As treated formally in Mundell (1957).

[2] For these, Stolper-Samuelson type effects prevail, even in the presence of capital mobility (see Ethier and Svensson, 1986)

any differences in the relative intensity that bilateral trade induces for the participating countries, it implies differentiated effects on capital returns in the sense that a higher degree of specialization also implies larger potential gains for capital and hence capital inflows into the more strongly specializing country.

We conjecture from our anlysis that whenever countries make use of their abundant factor in order to export, the gains from increased Heckscher-Ohlin-type trade, arising from the potential to use certain skill classes as demanded by the world market, should attract capital, and trade liberalizing countries should also experience capital inflows. When testing this empirically, we want to delineate this mechanism from others that might possibly relate trade and capital flows. We therefore construct a measure of particularly Heckscher-Ohlin specialization for countries. By using data on skill embodied in goods classes and countries' trade data, we can analyze how skill intensive a country's overall exports are (also relative to imports). From this, we generate a comparable measure of both high-skill and low-skill intensive specialization which is postitive in both directions of deviation from no visible factor emphasis in exports. Furthermore, we control for the level of capital market integration and general investment climate to isolate the effect of intensified trade specialization on capital flows only, not concurrent integration into world goods and factor markets. The results strongly support our hypothesis that countries which show a higher factor intensity in exports, i.e. more Heckscher-Ohlin type specialization, also experience increased capital inflows.

The remainder of the paper is structured as follows. The following section 2 relates our study to earlier literature. In section 3, the theoretical analysis is presented. Section 3.1 lays out the basic structure of the model and section 3.2 presents the autarky equilibrium. In section 3.3, the structure of the international capital market is described. Section 3.4 then shows how an opening up to goods trade affects the real rental rate in a small opening economy. Because when trade is bilateral, capital returns increase in all participating countries due to an increase in general efficiency of production, section 3.5 discusses how the world equilibrium is determined and in which direction capital will flow accordingly. Section 4 then presents the empirical test and results on the derived hypothesis on the complementarity between (factor endowment) trade and capital flows. Section 5 concludes and gives an outlook.

2 Related Literature

Technically, our theoretical analysis implements a 2-sector, 3-factor model. In this type of model, trade does not necessarily induce full factor price equalization between countries.[3] There are always two 'extreme' factors which drive (incomplete) specialization patterns, and one 'middle' factor (Ruffin, 1981). If this middle factor is the mobile factor, which we consider the empirically relevant case, the question of whether trade specialization induces capital flows is isomorphic to the question of how the return to the middle factor in countries is affected by trade. Jones and Easton (1983) show that the effect of trade on the middle factor's return depends on how complementary it is to either of the extreme factors in production, i.e. how relatively important it is for production of the comparative advantage good in a country. In the present study, we abstract from this complementarity-effect to isolate a further effect of trade liberalization: Even if capital is equally important in the production of both high- and low-skill-intensive goods, this does affect the real return to the middle factor capital, and it unambiguously increases it. We shut down the factor-compementarity effect to show that a second force, namely that of increased factor allocation efficiency, always works in favor of composite capital. This effect does not depend on whether a country exports high-skill or low-skill intensive goods, i.e. the direction, but rather only on the degree of specialization.[4]

Despite the long-held assertion that complementarity between trade and capital flows can only be found in other reasons for trade than differences in factor endowments (Markusen, 1983), there is other, more specific, literature that incorporates factor endowment driven trade and capital flows. This usually focuses on trade specialization in the mobile factors themselves, which are then subject to some type of friction. In Jin (2012), capital investment underlies adjustment costs, which allows capital abundant countries to specialize in capital intensive goods and still attract capital flows out of savings from the world. Antràs and Caballero (2009), in turn, allow for different affectedness by financial restrictions between sectors that interact with the level of financial frictions in countries such that countries

[3] See e.g. Woodland (1982) for a treatment of models where N(factors)>M(goods).

[4] Our analysis focusses on incomplete specialization patterns only, because these yield tractable solutions and convey the basic intuition. Also, this shows the contrasting effect to the standard 2x2-model, where trade equalizes factor prices if countries still produce both types of goods in equilibrium. Full specialization along abundant factor endowments also then implies a deviation from factor price equalization and hence perfect substitutability between trade and capital flows, but does not necessarily imply complementarity either, as capital returns are likely to have diverged strongly before trade liberalization as well, if endowments are so different as to lead to full specialization. This is also pointed out by Jones (1956).

specialize in the goods that their financial development supports, and hence create higher returns for capital in unrestricted sectors in capital scarce countries. Technically, this resembles an endogenous Ricardo-Viner structure with internationally mobile sector-specific capital. This is also the approach of Neary (1995), who finds that sector-specificity generally should be the more appropriate view. However, general sector-specificity of capital, as in his model, seems more relevant for the short-, but not the long-run. Abstracting from any type of frictions, our model thereby attempts to capture a more general relationship, both in scope, and in time dimension.

Trade theories that explicitly account for the firm level also rather predict a tendency for substitutability of trade and capital flows. As discussed by Buckley and Casson (1981), individual firms face the decision to either incur higher fixed costs of setting up a subsidiary in a foreign country or to incur higher variable transport costs when directly exporting (proximitiy-concentration trade-off). Helpman et al. (2004) show that when firms are heterogeneous, the more productive firms will choose the former and less productive firms the latter. This can explain the coexistence of both, FDI and trade flows, in aggregate. It still makes both types of supplying foreign market substitutes, in the sense that falling trade costs should make more firms choose concentrated home production and direct exporting, and less foreign investment, as Neary (2009) points out. He then argues that instead when trade costs fall, firms would set up subsidiaries in single countries to serve complete trade blocs, thereby generating capital flows and trade (export-platform-FDI). Other extensions, such as that of Krautheim (2013) go in the same direction, arguing that serving foreign markets via goods trade may require or favor the aquisition of wholesale and retail trading firms, such that also FDI works export-supporting.

Whereas these arguments concern horizontal internationalization by firms, vertical integration may also lead to within-company trade, and possibilities to trade may encourage FDI. Helpman (1985) develops a factor endowment model where the trade of headquarter services and intermediate products goes into opposing directions, where the aquisition of production sites can be interpreted as a capital flow. Markusen (2004) advances this idea for multinational corporations that pursue both, horizontal, and vertical integration.

Our general equilibrium model is much less specific and could generally include all these cases, as long as the reason for trade are factor endowment differences. Given the importance and extent of the comovement of trade and capital flows, we hence attempt to identify an underlying force behind the strong positive relationship between the two.

3 Model

3.1 Setup

The model is constructed such as to most conveniently transfer the intuition from Heckscher-Ohlin-Samuelson models of trade with high-skill and low-skill intensive goods, to a setting where capital is involved in production.

We consider that there are two goods $i \in 1, 2$ which are produced by constant returns to scale production technologies. Both goods are produced by three factors F: capital (K), high-skill labor (H) and low-skill labor (L). The distributive shares of capital and labor are the same in both sectors, whereas those of the two types of labor differ between the sectors. The production functions for the sectors are:

$$\begin{aligned} Y_1 &= K_1^{\alpha} H_1^{\beta} L_1^{1-\alpha-\beta}, \\ Y_2 &= K_2^{\alpha} H_2^{\gamma} L_1^{1-\alpha-\gamma}, \end{aligned} \tag{1}$$

respectively, where $\alpha, \beta, \gamma > 0$, $\alpha + \beta < 1$, and $\alpha + \gamma < 1$.

Factor markets are competetive. Firms take factor prices r, s and w as given and minimize costs. The production functions (1) then correspond to unit cost functions of

$$\begin{aligned} C_1 &= r^{\alpha} s^{\beta} w^{1-\alpha-\beta} \Delta_1 \\ C_2 &= r^{\alpha} s^{\gamma} w^{1-\alpha-\gamma} \Delta_2 \end{aligned} \tag{2}$$

where $\Delta_1 = \alpha^{-\alpha}\beta^{-\beta}(1-\alpha-\beta)^{-(1-\alpha-\beta)}$ and $\Delta_2 = \alpha^{-\alpha}\gamma^{-\gamma}(1-\alpha-\gamma)^{-(1-\alpha-\gamma)}$.

Without loss of generality we assume that $\beta > \gamma$. By Shephard's Lemma, taking the derivative of (2) yields the unit input coefficients of factors F, denoted by $a_{iF} \equiv \frac{F_i}{Y_i}$, and shown explicitly in appendix A. Relative skill intensities are then given by

$$\begin{aligned} \frac{a_{1H}}{a_{1L}} &= \frac{w}{s}\left(\frac{\beta}{1-\alpha-\beta}\right) \\ \frac{a_{2H}}{a_{2L}} &= \frac{w}{s}\left(\frac{\gamma}{1-\alpha-\gamma}\right) \end{aligned} \tag{3}$$

This implies that sector 1 is the high-skill intensive sector (defined by $\frac{a_{1H}}{a_{1L}} > \frac{a_{2H}}{a_{2L}}$).
Note that this holds independent of the factor price of capital. This simplification will greatly facilitate the analysis and lead to results of relative production that are closely related to standard 2-sector-2-factor production patterns with only high-skill and low-skill labor. The assumption of strict equality in capital-labor shares in production between the two goods implies that capital is not particularly complementary to either type of labor. This shuts down the effect of capital being a 'friend' of one of the two other factors and hence of one of the sectors. By doing so, we will be able to isolate a further effect of trade liberalization that holds for specialization in either sector, not only the one that capital is complementary to. In reality, both effects should be present. By abstracting from one, we will be able to concentrate on the other that is of interest for us here.
We will also assume that countries always produce both goods in equilibrium, such that there will be no full specialization, even under free trade. This is to stay close to Heckscher-Ohlin intuition and it also is the analytically most interesting case. Extending the analysis to full specialization would require extensive taxonomical exposition and not generate much insight beyond that from standard 2x2 models in this case (see e.g. Jones, 1956), and the one provided here.
The solution of the model thus closely follows 2-sector general equilibrium models with only 2 factors of production, only with one additional equilibrium condition.
Free entry implies that firms make zero profits. Hence, goods prices have to equal unit costs, such that $p_i = C_i(r, s, w)$. Solving this together with (2) gives a simple expression for the relation between the relative goods price and the relative wages of high-skill and low-skill workers, given by

$$\frac{w}{s} = \left(\phi \frac{p_2}{p_1}\right)^{\frac{1}{\beta-\gamma}}, \tag{4}$$

where $\phi = \frac{\gamma^\gamma}{\beta^\beta} \frac{(1-\alpha-\gamma)^{1-\alpha-\gamma}}{(1-\alpha-\beta)^{1-\alpha-\beta}} = \frac{\Delta_1}{\Delta_2}$.
The rental rate for capital, r, does not depend on the relative price of the two goods because its price enters unit costs symmetrically.
Full employment conditions of factors F read $F = a_{1F}Y_1 + a_{2F}Y_2$. Solving the system of full employment conditions of L & H yields production volumes of the respective sectors as

functions of r, s, w, and factor endowments L & H:

$$Y_1 = \left(\frac{w}{r}\right)^{\alpha}\left(\frac{w}{s}\right)^{\beta}\frac{1}{\Delta_1(1-\alpha)(\beta-\gamma)}\left[\frac{s}{w}(1-\alpha-\gamma)H-\gamma L\right]$$
$$Y_2 = \left(\frac{w}{r}\right)^{\alpha}\left(\frac{w}{s}\right)^{\gamma}\frac{1}{\Delta_2(1-\alpha)(\beta-\gamma)}\left[\beta L-\frac{s}{w}(1-\alpha-\beta)H\right] \tag{5}$$

Because, again, r enters symmetrically, and using (4), relative production only depends on aggregate supplies of H and L and the relative price of the two goods, and is given by

$$\begin{aligned}\frac{Y_1}{Y_2} &= \frac{p_2}{p_1}\frac{\left(\frac{p_2}{p_1}\right)^{\frac{1}{\gamma-\beta}}\phi^{\frac{1}{\gamma-\beta}}(1-\alpha-\gamma)H-\gamma L}{\beta L-\left(\frac{p_2}{p_1}\right)^{\frac{1}{\gamma-\beta}}\phi^{\frac{1}{\gamma-\beta}}(1-\alpha-\beta)H} \\ &\equiv \frac{p_2}{p_1}\Gamma(H,L,p_2/p_1)\end{aligned} \tag{6}$$

$\Gamma(H,L,p_2/p_1)$ is the relative value produced of good 1, as a function of the relative price of good 2.

Proposition 1 *The relative production value,* $\frac{p_1Y_1}{p_2Y_2} \equiv \Gamma$*, is decreasing in the relative price* $\frac{p_2}{p_1}$*, such that* $\frac{\partial\Gamma(H,L,p_2/p_1)}{\partial\frac{p_2}{p_1}} < 0$.

Proof. For a positive value of $\frac{Y_1}{Y_2}$, both numerator and denominator of Γ, as given in (6) are necessarily of equal sign. Therefore, for $\beta > \gamma$, and all else equal the numerator being the negative of the denominator, both need to be positive. The numerator is hence decreasing, the denominator increasing in $\frac{p_2}{p_1}$. Note that in autarky, the demand structure will ensure postitive values of both Y_1 and Y_2. ■

Capital now accrues a constant share α of production, which can be shown by solving the full employment condition of K for r, which yields:

$$r = \frac{\alpha}{1-\alpha}\cdot\frac{wL+sH}{K} \tag{7}$$

For given prices p_2/p_1 and a numeraire chosen, the production side can be solved for r, s, w, Y_1, Y_2. Endowments, relative production, firms optimization and factor market clearing conditions yield unique solutions. The intuition behind these closely resembles that of

standard 2-good, 2-factor models, except for that the capital endowment K scales production and hence incomes.[5] The following relations hold for the division of factors between the two sectors:

$$\frac{K_1}{K_2} = \Gamma(H, L, p_2/p_1)$$

$$\frac{H_1}{H_2} = \frac{\beta}{\gamma}\Gamma(H, L, p_2/p_1) \tag{8}$$

$$\frac{L_1}{L_2} = \frac{1-\alpha-\beta}{1-\alpha-\gamma}\Gamma(H, L, p_2/p_1)$$

Thogether with the full employment conditions and proposition 1, this implies that not only the produced relative value, but also the produced absolute quantity of good 1, Y_1, is decreasing, and that of good 2, Y_2, is increasing in the relative goods price $\frac{p_2}{p_1}$, as all factors are shifted to the sector whose good's relative price increases.

The demand side is characterized by standard, homothetic, Cobb-Douglas preferences over the two goods which will be identical across countries. The consumers' utility function is given by

$$U = X_1^{\theta} X_2^{1-\theta}. \tag{9}$$

Consumers take goods prices as given and optimize their expenditure to maximize utility. Their resulting relative consumption of the two goods is

$$\frac{X_1}{X_2} = \frac{\theta}{1-\theta}\frac{p_2}{p_1}. \tag{10}$$

The price to obtain 1 unit of utility is thus given by the standard Cobb-Douglas price index

$$P = \left(\frac{p_1}{\theta}\right)^{\theta}\left(\frac{p_2}{1-\theta}\right)^{(1-\theta)}. \tag{11}$$

[5]The additional factor market clearing condition for capital, or (7), solves for one additional unknown, r.

3.2 Autarky

In autarky, capital supply K is given by domestic endowment, and consumption of both goods must equal production. Equilibrium is determined by equalizing relative demand $\frac{X_1}{X_2}$ as given in (10) and relative supply $\frac{Y_1}{Y_2}$ as in (6). This yields the resulting relative autarky equilibrium price

$$\left(\frac{p_2}{p_1}\right)_a = \frac{1}{\phi}\left[\lambda\frac{H}{L}\right]^{(\beta-\gamma)}, \tag{12}$$

where $\lambda = \frac{\theta(1-\alpha-\beta)+(1-\theta)(1-\alpha-\gamma)}{\theta\beta+(1-\theta)\gamma}$.

From this, the autarky equilibrium is obtained. Countries that have a larger relative endowment in low-skill labor produce relatively more of the low-skill intensive good 2, which then has a lower relative price. Capital does not affect relative production, but only overall production of the two goods.

The rental rate is higher in countries that are endowed with less capital, but both wage income and salary are smaller, as is overall income.[6]

We now want to analyze the effect of trade liberalization on capital flows in an economy which is described by the above system. We will henceforth keep the level of capital market openness constant while considering a movement towards free trade.

3.3 Open capital markets and international investment

(Somehow) open capital markets imply that the stock of capital, K, need not be exogenously given by the domestic endowment. Instead, capital will flow such as to maximize effective returns. We assume that capital returns have to be consumed where they occur. Hence, the real return r/P to capital is decisive for the decision to invest in a country.[7] There may be barriers to international investment that translate to proportional investment costs $\delta \geq 1$. Full capital mobility is given when $\delta = 1$. Investors choose to invest in a country as long as

$$\frac{r}{P} \geq \delta\frac{r^*}{P^*} \tag{13}$$

[6] Consider equation (7) together with (1) and (8) to see that an increase in capital will increase both wage and salary incomes and reduce the rental.

[7] Alternatively, P/P^* can be interpreted as an exchange rate between the home and a foreign country, or the world market, respectively.

where an asterisk denotes world market variables, or those in the foreign investors' home country, respectively.
Solving the zero profit conditions, (4) and (7), and using (11), for any given capital stock, the real rental in a country reads

$$\frac{r}{P} = \Theta \left[\left(\frac{p_2}{p_1} \right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}} L + \phi^{\frac{1}{(\gamma-\beta)}} \left(\frac{p_2}{p_1} \right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}} H \right]^{(1-\alpha)} \left(\frac{p_2}{p_1} \right)^{\theta} K^{\alpha-1}, \tag{14}$$

where

$$\Theta = \theta^{\theta}(1-\theta)^{(1-\theta)} \frac{\Delta_1^{\frac{\gamma}{(\beta-\gamma)}}}{\Delta_2^{\frac{\beta}{(\beta-\gamma)}}} \left(\frac{(1-\alpha)}{\alpha} \right)^{(\alpha-1)}.$$

The relative price of the two goods may either be determined by home demand and supply (no free trade) or world market conditions (trade).
We can see from equation (14) that the real return to capital depends negatively on the current capital stock. When returns are low, capital will flow into the country such that (13) will hold with equality. Also, if the rental rate in a country increases, more capital will move in, until respective returns equal again. This does not influence goods market relative prices (as given by (12), or by world market conditions, respectively). With capital mobility, hence, capital stocks adjusts such that

$$\frac{r}{P} = \delta \frac{r^*}{P^*} \tag{15}$$

holds.

3.4 Small open economy

Now we look at how trade liberalization in this setting affects capital flows. We can interpret the situation of no trade as one of prohibitively high trade costs. We assume iceberg trade costs, such that for one unit to arrive in the destination country, τ units have to be shipped in the source country. This implies with the type of barter trade here, that in order to trade good l for one unit of good m in another country ($l, m \in 1, 2$), τ^2 units of good l have to be shipped from the domestic country. Thus, a country will trade with another if either one of

the two following conditions hold:

$$\tau^2 \left(\frac{p_2}{p_1}\right)_a < \left(\frac{p_2^*}{p_1^*}\right)_a \tag{16a}$$

or

$$\left(\frac{p_2}{p_1}\right)_a > \tau^2 \left(\frac{p_2^*}{p_1^*}\right)_a \tag{16b}$$

Which one will possibly hold depends on the ratio of autarky prices (remember that these are not influenced by possible capital inflows). It is then more likely to hold, the lower trade costs τ are. If (16a) holds, the home country will export good 2 and import good 1, and vice versa if (16b) holds. By trade, goods prices will converge to make the respective condition hold with equality. For a small open economy, a decrease of τ will hence lead to an adjustment in the relative goods price, then given by $\frac{p_2}{p_1} = \tau^2 \frac{p_2^*}{p_1^*}$ or $\frac{p_2}{p_1} = \frac{1}{\tau^2}\frac{p_2^*}{p_1^*}$.
We can hence interpret a trade liberalization as a change in the relative goods prices. Production patterns will adapt accordingly, shifting ressources to the sector whose relative price has increased.[8] What does this imply for the real return to capital? With a change in relative prices, the real rental changes according to

$$\begin{aligned}\frac{\partial(\frac{r}{P})}{\partial(\frac{p_2}{p_1})} =& \Theta K^{\alpha-1}\left[\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}} L + \phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}} H\right]^{-\alpha}\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}-(1-\theta)} \\ & \left[\frac{\gamma+(\beta-\gamma)\theta}{(\beta-\gamma)}L - \frac{(1-\alpha-\gamma)-(\beta-\gamma)\theta}{(\beta-\gamma)}\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{1}{(\gamma-\beta)}} H\right].\end{aligned} \tag{17}$$

Proposition 2 *The rental rate has its minimum at the autarky price level and increases with any change in the relative goods price* $\frac{p_2}{p_1}$ *from that level.*

Proof. $\frac{r}{P}(\frac{p_2}{p_1})$ has an extremum where (25) is zero. This is only the case if the second bracket of (25) is zero, which is true only at

$$\frac{p_2}{p_1} = \frac{1}{\phi}\left[\lambda\frac{H}{L}\right]^{(\beta-\gamma)}, \tag{18}$$

[8] From (4) we can also understand that Stolper-Samuelson effects will occur for high- and low-skill laborers. The analysis of real gains and losses for the skill classes is skipped here as not being our primary interest, but goes along the usual lines, as presented in e.g. Feenstra (2003), pp. 13ff.

which is exactly the autarky price level. Appendix B shows that it is indeed a minimum ($\frac{\partial^2(\frac{r}{P})}{\partial(\frac{p_2}{p_1})^2} > 0$ at the autarky relative price level given by (12)). ■

Hence, the real rental is lowest at the autarky price and increases monotonously for both increasing and decreasing relative goods prices from the autarky level. Figure 1 depicts the real rental r/P as a function of the relative goods price.

Hence, if relative goods prices change due to opening up for goods trade, the real rental

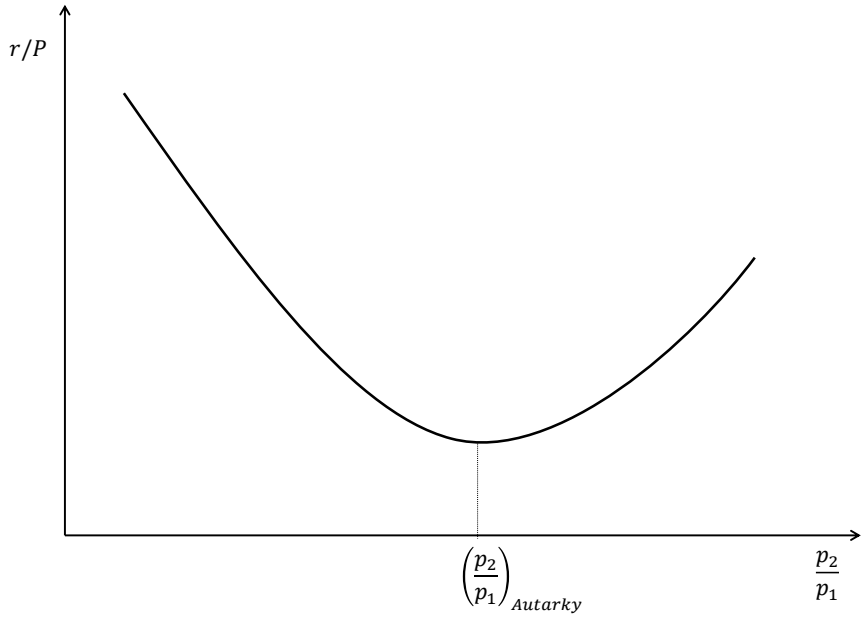


Figure 1: The real rental rate and world market goods prices

rate will increase and capital will flow into the country. This does not depend on whether a country specializes in one good or the other. Both, if the relative price increases or decreases, the real rental rate will always increase. The reason is that specialization always entails efficiency gains, as one good can be bought cheaper on the world market, which frees ressources for production of the other good, which is now worth more. When capital is involved in production, it participates in these changes and profits from an increased real marginal product. It hence partly reaps the gains from specialization. In different words, capital flows in when labor can be allocated more efficiently to produce for the world market.

Only the inflow of capital can hold the real rental rate at its equilibrium level given by (15).[9] Hence, for a small open economy, opening up for trade, and specializing in one good or the other to produce for the world market along its relatively abundant factor, will lead to capital inflows.

3.5 Two and many Countries

When opening up to trade in a two- or more-country setting, goods prices change in both countries, only in different directions. Thus, also the real rental will increase in both countries. It is not per se clear in which direction capital will flow. The question is, for whom the price changes relatively more and for whom this is more influential when together reaching a new world market price equilibrium.
Whereas in a 2-immobile-factor setting, worldwide free trade equilibrium prices and production of the two goods is the same as for one, large country with the combined endowments of both countries, and hence international trade yields the same result as complete international integration, here this is different. Because capital endowments additionally scale production of the two goods, it depends on the division of the worldwide stock of capital onto the two countries to determine how much of the goods in which they specialize in can be produced. The capital stocks in turn depend on the relative goods price, trade and investment costs. World market equilibrium is reached when goods markets clear and equality of real rentals (15) holds. Then, that country for which the real rental rate increases stronger, will experience additional capital flows due to the opposingly directed common goods price changes from international trade. In general terms, which country this will be can only be answered numerically. But before doing so, we can gain some intuition on what determines whose country's production becomes more attractive to capital.

Graphical analysis

From (7), we see that, for a given capital stock, the nominal rental rate is a direct monotone function of overall income, I, in a country, given by $r = \frac{\alpha}{K} I$. Hence, r/P is also a direct monotone function of I/P, which is by definition equal to the level of utility $U = I/P$, such

[9] See again (14) for how an inflow of capital reduces the real rental rate back to its exogenous equilibrium level.

that

$$\frac{r}{P} = \frac{\alpha}{K}\frac{I}{P} = \frac{\alpha}{K}U. \tag{19}$$

Hence, the real rental rises linearly in the level of utility. The question of which country's real rental rises more due to trade integration, and hence will experience larger capital inflows, is isomorphic to the question of which country gains more from bilateral trade.[10] By Heckscher-Ohlin logic, utility rises in the degree of specialization. Figure 2 depicts how the level of utility increases with the difference in trade prices to autarky prices. If two or more

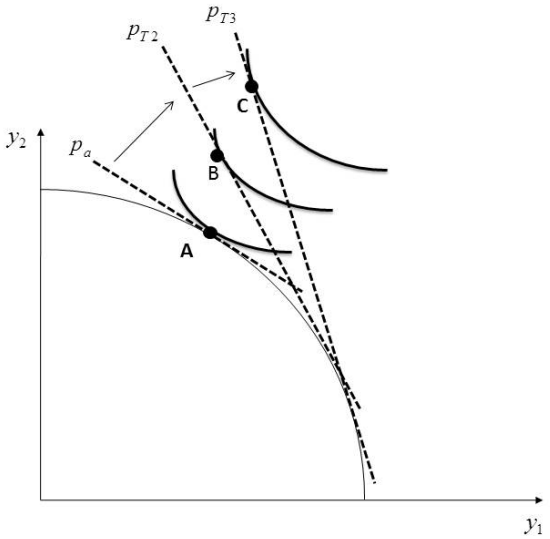


Figure 2: Prices and Utility

countries simultaneously open up for bilateral trade with each other, this price effect will differ between the countries. The direction of capital flows induced by trade only depends on for whom the price change is more pronounced. The more a country accordingly specializes in the production of one type of good, the more capital will it see flowing in compared to other countries (which may experience increased outflows despite, or because of, trade liberalization), because capital is attracted by the increase in efficiency due to production for the world market. It is the relative degree of specialization, that follows an opening up to a new world market price, which decides which country will experience capital inflows.

[10]Note that this only concerns utility increases *without* those that a following capital inflow entails.

For the case of capital flows and frictionless free trade, the world market price after capital flows can be derived in closed-form solution, which we analyze in the following.

Full world market equilibrium

In the absence of trade costs, the world market equilibirum can be solved explicitly. Combining worldwide production of the two goods given in (5), to determine relative world supply Y_1/Y_2, and equalizing with relative world demand, making use of the price-rental relationship (4) yields the following implicit solution for the world market relative price in open markets:

$$\left(\frac{p_2}{p_1}\right)_o = \phi \left[\lambda \frac{H + H^* \left(\frac{r}{r^*}\right)^\alpha}{L + L^* \left(\frac{r}{r^*}\right)^\alpha}\right]^{\beta-\gamma} \tag{20}$$

Comparing this to the expression for autarky prices (12), the relative price change depends on the importance of the own country's endowment in overall prices. Ceteris paribus, and regarding the conjectures from the graphical analysis before, an initially smaller country gains more from trade, because its own relative endowment of high-skill and low-skill labor has less effect on the world market relative price, which hence differs more from its own autarky price. Small here, however, also means in terms of capital before capital flows, not only absolute endowments of H and L, hence economically small. This is captured by the weighting of respective labor endowments by the rental rates. $\frac{r}{r^*}$ here represents the ratio of the real rentals, beacuse with free trade, also price levels P and P^* equal across countries. Also, the more extreme a country's relative skill endowments are, the more it will specialize in the production of the good that uses the abundant factor intensively, and hence diverge from the production pattern of autarky.
Generally, equation (20) could have multiple solutions, because r and r^* depend on the world market price themselves. However, $\frac{r}{r^*}$ is uniquely determined when capital flows are taking place between the two countries, and is given by δ, or $1/\delta$, respectively. With full capital mobility ($\delta = 1$), equation (20) reduces to:

$$\left(\frac{p_2}{p_1}\right)_o = \phi \left[\lambda \frac{H + H^*}{L + L^*}\right]^{\beta-\gamma} \tag{20'}$$

Which is again the same world market price as if the world was one large country.

α	0.33	β	0.44
γ	0.22	θ	0.5
δ	1		
K	250	K^*	1000
H	200	H^*	1000
L	800	L^*	1000

Table 1: Parameters for trade cost decrease

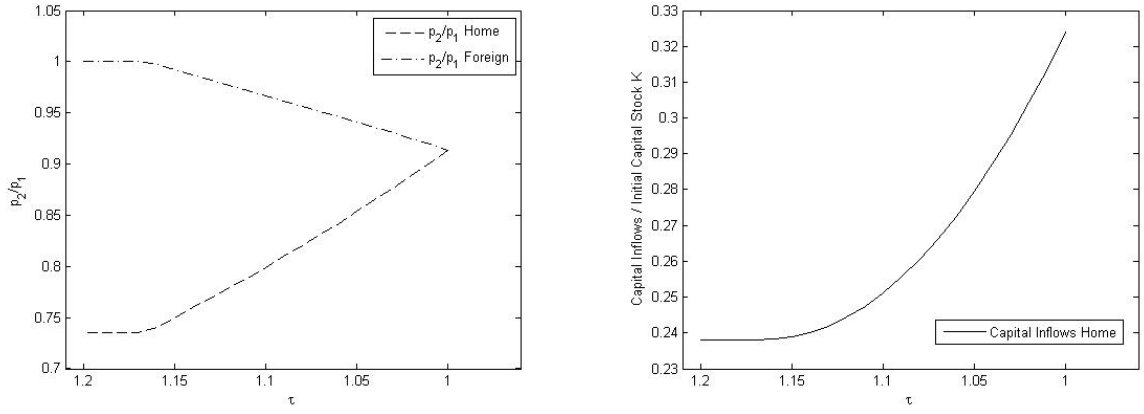
Numerical solution

The following simulation exercise exemplarily illustrates the effect in the home economy of bilateral trade liberalization in the model described. We will assume that the home country is relatively smaller than the foreign country, but has an effect on world market prices.
First, consider that the home economy is relatively abundant in low-skill labor. Table 1 shows the parameters underlying the analysis. We consider a steady reduction in trade costs τ, and its effect on the level of capital inflows. Equilibrium is determined by jointly solving (15), and a) autarky prices when (16a) does not hold, or b) world goods market clearing when it holds.[11] The world market clearing condtions are given by:

$$Y_1^* = X_1^* + \tau(X_1 - Y_1)$$
$$Y_2 = X_2 + \tau(X_2^* - Y_2^*)$$

where Y_i and Y_i^* are given by (5), and X_i and X_i^* are determined by consumers' expenditure minimization.
Figure 3 shows the simulation results for a decrease of τ from 1.2 to 1. In figure 3(a), we see the relative goods prices in both economies, home and foreign, as a function of trade costs τ. Next to it, in figure 3(b), the corresponding capital flows from foreign to home relative to the initial capital stock K are depicted. It shows that for high levels of trade costs, no trade is taking place and neither the relative goods price nor the real rental is affected by the decrease in trade costs. Still, there are positive capital flows into the capital scarce home country. From some point on, trade costs are low enough such that prices in the two countries converge. Although prices change for both countries, this is particularly

[11] (16b) will not hold in this constellation.



(a) (b)

Figure 3: Simulation: Trade cost decrease

pronounced for the home country. Accordingly, due to trade, additional capital flows from foreign to home. These capital inflows increase with the level of trade liberalization.

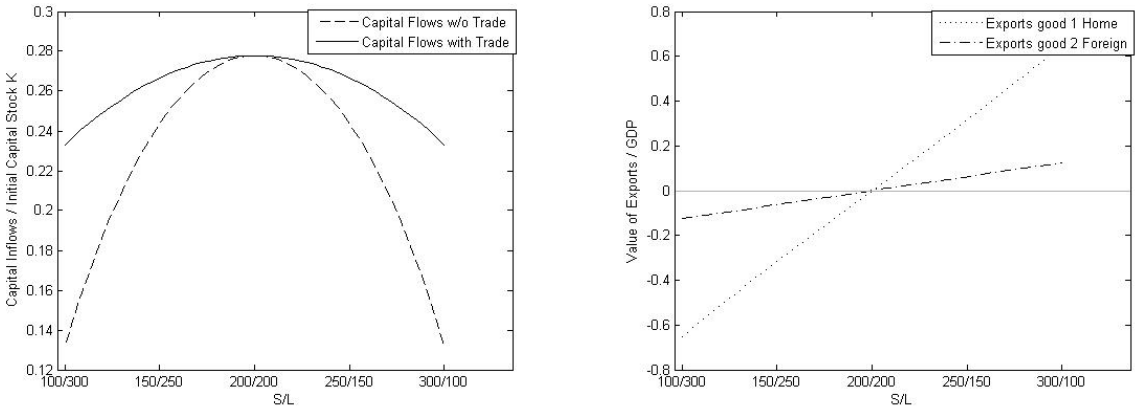
Whereas this illustration has shown the example of a relatively low-skill abundant economy, we can also analyze changes in the level of relative initial skill endowment. We will therefore consider the case of complete free trade ($\tau = 1$), but vary the relative home endowment with skills. We therefore jointly solve for relative real return equality (13) and the free trade world market price (20′). We compare this to the level of capital flows without free trade, i.e. solving rental rate equality (13) with autarky prices given by (12). Table 2 lists the parameters used in this exercise. The results are shown in figure 4. Figure 4(a)

α	0.33	β	0.44
γ	0.22	θ	0.5
δ	1	τ	1
K	250	K^*	1000
L^*	1000	H^*	1000

Table 2: Parameters for endowment variation

plots capital flows from foreign to home relative to the initial capital stock without free trade ($\tau \to \infty$) and those with free trade ($\tau = 1$) for varying relative values of H and L,

keeping the relative endowments in foreign constant. When the relative endowments equal



(a) (b)

Figure 4: Simulation: varying skill endowments

(at 1), no trade is taking place, and there are consequently no additional capital flows due to trade taking place. When relative endowments differ, capital flows do decrease overall in both cases, because then the home endowment is not as "fitting" anymore for the symmetric model constellation in production technologies and preferences. But the opportunity to trade still raises the resulting level of capital flows from the large to the smaller country. This is true for both directions of specialization, low-skill and high-skill. Because trade is balanced, being smaller also implies a greater relative dependence on trade and hence greater specialization in production relative to overall production. Figure 4(b) depicts the according export values of goods 1 and 2 for the two countries relative to GDP, which is calculated as the value of overall production in terms of good 1. Both export values equal in absolute terms but are greater in relative terms for the (home) country that consequently experiences additional capital inflows.

The numerical exercises illustrate the scope of the effect that the opportunity to trade influences incentives for capital flows and the direction that these take: The country for which trade induces greater specialization in factor endowment driven trade will also experience more capital inflows.[12]

[12]Note that a country that is larger in terms of capital than the ones illustrated here, may experience capital outflows in general. But trade – if specializing stronger than the other country – will by the same

4 Empirical Test

Data and approach

It follows from the theoretical analysis that for an individual country, relatively more Heckscher-Ohlin-trade specialization in high- or low-skill intensive goods should also lead to increased capital inflows. Both are likely to be correlated in the data for other reasons than the one that our theory puts forward, as trade and capital flows may both be the common result of greater overall political and economic integration into world markets. To test our hypothesis, we therefore have to seperate the two effects. We do so by constructing a measure for relative overall trade specialization in either skill class and at the same time controlling for the degree of financial account liberalization and overall investment risk in a country in a given year. We then run a panel regression including country and time fixed effects. Our baseline regression thus looks like the following:

$$CapInflows_{c;t} = \beta_0 + \beta_1 * HOS_{c;t} + \beta_2 * CapOpen_{c;t}^{dejure} + \beta_3 * InvSec_{c;t} + \alpha_t + \alpha_c + \epsilon_{ct} \quad (21)$$

Our dependent variable are the net capital inflows in country c in year t. Our interest is in the coefficient β_1 on the measure of Heckscher-Ohlin skill specialization (HOS, as explicated below). From our theory, we would expect it to have a positive sign. We then control for the degree of *de jure* capital market openness ($CapOpen$), and the (absence of) overall investment risk in the country at that time ($InvSec$). We use time fixed effects in order to control for a time trend in both trade and capital flows and country fixed effects to single out peculiar characterisitcs such as geographical or cultural proximitiy to other countries. We therefore only exploit the within-variation in Heckscher-Ohlin specialization.

The measure of capital openness needs to be a de jure measure because de facto measures are by definition constructed out of capital inflows themselves and would thus make our test pointless. A measure of de jure capital market openness is provided by Chinn and Ito (2006). It is constructed as to measure the extent of capital controls that are enforced in a country and hinder capital inflows regardless of the general attractiveness of the country to capital flows. A higher value of $CapOpen$ implies more de jure financial account openness.

Investment risk is measured by an index provided by the International Country Risk Guide on the investment risk profile in a country. It is constructed to measure the risk of pri-

mechanism then reduce its capital outflows.

vate investment in a country and captures the level of and danger associated with viability/expropriation, profits repatriation, and payment delays for international investment. Unfortunately, this index is only available from 1984 on, but for a wide range of countries. The index runs from 0 to 12, where a higher number indicates less risk, which is why we denote the measure by $InvSec$.

As our dependent variable, we use *net* capital inflows in a country in a given year. We restrict the analysis to equity investment only, since this should be most directly affected by the increased possibilities to use the abundant factor efficiently for production for the world market. We therefore for once report the effect on FDI flows only, because this is the most intuitive application of the idea of productive foreign investment. Since investment can also be on a smaller scale when direct investment is profitable, we then also use the sum of FDI and portfolio equity investment as overall investment. We divide the respective level of (positive or negative) net capital inflows by GDP. This not only makes numbers comparable, but also excludes valuation and growth effects. Net inflows yield a positive value of $CapInflows$, net outflows a negative one. All data on capital flows is taken from the IFS Financial Statistics. GDP data is taken from the World Bank WDI.

Our independent variable of interest is the degree of specialization in either high-skill or low-skill labor. There is however no direct data on the skill content of countries exports available, and calculation is problematic. For example, the measure of skill intensities used most regularly in the trade literature is the number of production and non-production workers in a particular industry as provided by the US census for manufactures. However, an assignment of this industry-level data to bilateral trade data, which is only available in product classification, is only reliably feasible at the 3-digit level, which implies roughly 20 different product classes. At this highly aggregated level, there is first of all not much variation in skill itensities between product classes, and second, this will partially miss specialization patterns, since these will go along the product chain within industries, as e.g. pointed out by Krugman (2008).[13]

We therefore construct a more refined measure of countries' actual specialization patterns along skill levels. The UNCTAD RFI database (documented in Shirotori et al., 2010) reports

[13] Our results do still hold for applying this measure on the 3-digit level, but tend to be less pronounced. More importantly, they then seem to be driven by exports of few, relatively skill intensive product classes, such as machinery and chemical products, but not by variation between other product classes. This raw approach hence is likely to particularly miss specialzation patterns in rather low-skill intensive industries, or that in low-skill intensive sections of the production chain.

skill intensities in production on the SITC2 4-digit product level. hence on a much more differentiated scale. This measure is constructed by taking data on factor endowments of exporting countries (for skill abundance, the authors use data on schooling obtained from Barro and Lee (2001)) and relating these to factual exports to gather from this the skill intensity embodied in product classes. For our purpose, this has the advantage that this measure is directly drawn from actual trade data, and thus reveals factual specialization patterns. At the same time, it is computed from worldwide observations, so that we can directly apply it on individual country-level observations without being tautological. On the SITC2 4-digit level, there are 651 different product classes for which we have data on skill intensities. These are available for each year in our sample, even though the variation over time within product classes is small. $H_{i;t}$ represents the skill level embodied per value of exports of the respective product class i in year t.[14] For exposition, table 3 shows the 13 least and most skill intensive product classes from the RFI Database for the year 2000, the last year in our sample. Less skill intensive goods are mostly particular textiles and basic agricultural exports, whereas the most skill intensive goods tend to be chemical products.[15]

Most skill intensive Product classes	$H_{i;2000}$	Least skill intensive Product classes	$H_{i;2000}$
Ores and concentrates of uranium and thorium	11.03811	Oils,animal & vegetable,boiled,oxidized, etc.	2.625086
Mechanical wood pulp	10.79112	Cotton,carded or combed	2.703924
Sawlogs in the rough,whether/not stripped of bark	10.32102	Tea	2.759669
Barley,unmilled	10.24047	Jute & other textile bast fibres,nes,raw/processed	2.792496
Other phenols and phenol-alcohols	10.22291	Copra	2.96619
Cresols,n.e.s,and their salts	10.22291	Carpets of other textile materials	2.97924
Halogenated,sulphonated,etc.derivatives of phenol	10.22291	Carpets of wool or fine animal hair	2.97924
Phenol(hydroxybenzene),chemically pure,& its salts	10.22291	Groundnuts (peanuts),green,whether or not shelled	3.106773
Other phenols and phenol-alcohols	10.22291	Cotton seeds & Cotton seed oil	3.109285
Organo-mercury compounds	10.21946	Sheep and lamb skin leather	3.669646
Seep's or lambs' wool,greasy or fleece-washed	10.16085	Groundnut (peanut) oil	3.711931
Horses, asses, mules and hinnies, live	10.13878	Tin ores and concentrates	3.713806

Table 3: Skill intensities of product classes

[14]Note that the relative skill intensity is – in line with our theory – equal for all countries (by (3)). Because our theory also abstracts from changing technologies, we for robustness also use constant values $H_{i,2000}$, applying the measured skill intensities from 2000 for all years in the sample. The results do not change.

[15]But also, some agricultural goods that are produced on large scales, such as barley, have relatively high-skill intensity measures. This may be true, as the production of these is highly automated, but it may also reflect one weakness of using actual trade data, namely that export subsidies for low-skill intensive goods in high-skill abundant countries lead to these as being measured relatively high-skill intensive. Apart from crops, however, we consider this problem to be rather small.

Since we want to know about a country's overall specialization level, we take this product-level data and combine it with trade flows in these product classes in order to construct aggregate country-year observations of factor intensity in trade patterns. Countries' exports and imports on the SITC2 4-digit product level are taken from the NBER-United Nations Trade Data, as documented in Feenstra et al. (2005). We then assign these trade flow volumes the respective skill intensity of the exported products and aggregate these. We thus obtain the overall skill embodied in a country's exports (and imports) in year t. The average skill intensity in exports is then given by this sum of all skill embodied in product level exports, divided by the value of overall exports. This average skill embodied in export value will be our measure of skill intensity in exports, denoted H1. We then also relate this to the average skill intensity of imports, calculated accordingly, to obtain a measure of relative skill intensity of exports over that of imports, denoted H2. The formulas for the two indicators hence read:

$$H1_{c;t} = \frac{\sum_i H_{i;t} * EX_{c;i;t}}{\sum_i EX_{c;i;t}} \tag{22a}$$

and

$$H2_{c;t} = \frac{\sum_i H_{i;t} * EX_{c;i;t}}{\sum_i EX_{c;i;t}} \Big/ \frac{\sum_i H_{i;t} * IM_{c;i;t}}{\sum_i IM_{c;i;t}}, \tag{22b}$$

where $EX_{c;i;t}$ and $M_{c;i;t}$ are the exported and imported values of country c in product class i at time t. H1 and H2 are highly correlated (0.90).

Both measures, and particularly H1, are measures of (relative) skill intensity of exports. From this, we aim at identifying specialization patterns in *either*, low-skill or high-skill intensive goods. Thus, those countries that have a relatively low level of high-skill embodied in exports should be seen as specializing strongly (in low-skill intensive goods), as well as those that show a rather high level (specializing in high-skill intensive goods). We therefore use as a natural reference point the median level of high-skill specialization, as measured by H1 and H2, in a certain year. We can then interpret any deviation from this reference point in both directions as a stronger relative specialization in a skill level. Our respective measures of Heckscher-Ohlin-specialization then read:

$$HOS1_{c;t} = |ln\left(\frac{H1_{c;t}}{H1_{MED;t}}\right)| \tag{23a}$$

$$HOS2_{c;t} = |ln\left(\frac{H2_{c;t}}{H2_{MED;t}}\right)| \tag{23b}$$

By taking the absolute value of logs of a fraction, both measures are always positive and increase, the more distant the fraction is from 1. Thus, we interpret a higher value in both measures as a greater level of specialization, as compared to the median worldwide pattern in a given year.[16] Furthermore, the use of logs implies that a relative specialization pattern of e.g. average skill embodied in exports of $1/x$ times the median country in that year receives the same value as one of x times the median.

The measures constructed for HO-trade have no direct representation in the theoretical model above. By Proposition 1 and equations (8), the the type of good of which the relative price increases will be produced more, whereas production of the other type of good will decrease. By equation (10), relative consumption reacts exactly in the opposite way. Hence, countries will export more of these goods, that they can sell at a higher price at the world market than in autarky. The empirical measures used here show the degree of high- or low-skill specialization per exported value, which would be equal for two countries exporting the respective factor-intensive good in the model (because there are only two goods, i.e. only one to export), independent of how much of it. We therefore here test for the importance of HO-trade in overall trade, assuming that there are other reasons for trade as well.

We have hence created measures for countries' revealed relative specialization in skill levels based on a very refined definition of product classes that we can use to test whether it has an influence on net capital inflows.

The data on investment risk is only available from 1984 on and our trade data only goes until 2000, such that including all variables, the regressions cover a sample over the time span from 1984 to 2000. Summary statistics of the variables used in the analysis over the respective period are given in table 11 in appendix C. For some countries there are no observations in some years, so that we are left with around 1500 country-year observations in our sample, coming from 119 countries.

Results

We run regressions of type (21) with both dependent variables, net FDI and overall equity investment inflows, each on both measures of skill specialization in a country. Standard errors are clustered on the country level. The results are presented in table 4.

[16] Using the median, instead of e.g. the average skill level embodied in all exports for H1, and no adaption for H2, has the advantage that we obtain relative measures of specialization, and furthermore, that we can keep samples comparable in terms of high-and low-skill specializing countries for both measures.

VARIABLES	(1) Net FDI	(2) Net FDI	(3) Net Inv.	(4) Net Inv
HOS1	0.0197*		0.0349**	
	(0.0100)		(0.0154)	
HOS2		0.0204**		0.0364**
		(0.0100)		(0.0164)
CapOpen	0.00151	0.00141	0.00128	0.00105
	(0.00156)	(0.00158)	(0.00265)	(0.00264)
InvSec	0.000749	0.000751	0.000717	0.000730
	(0.000642)	(0.000642)	(0.000765)	(0.000775)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	0.0133**	0.0134**	0.0125	0.0127
	(0.00559)	(0.00561)	(0.00831)	(0.00830)
Observations	1,533	1,532	1,369	1,368
R2	0.069	0.070	0.054	0.055
Number of Countries	119	119	118	118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4: Results

The estimated coefficients are indeed positive and statistically significant for the entire sample. Heckscher-Ohlin specialization does generally go along with net capital inflows. All other coefficients also go in the direction as expected, even though capital market openness is not statistically significant in any specification.[17]

These findings could also result from theoretical considerations on complementarity of capital with either one skill class, and an unbalanced sample. If capital were e.g. high-skill complementing, then relative specialization in high-skill intensive goods would create incentives for capital inflows. The mechanism that we propose here should instead lead to capital inflows whenever a country specializes relatively more in either skill class. In order to test our mechanism more precisely, we therefore split our sample in two groups. We then run the regression as in (21) once on only those countries, who have a higher relative specialization in skills, and once on those that show a lower relative specialization in skills than the median country in a respective year. These may be different groups, depending on which definition of specialization is considered, and depending on the year of the observation. For those regressions that use $HOS1$ as regressor (hence considering only specialization in exports), we

[17]Since we analyze net flows, this is not too surprising in general, as there are both countries that tend to have net in- and outflows in our sample. For the fact that the investment risk profile is not very meaningful, we take as an explanation that it is highly correlated with capital market openness, and that profitability may outweigh the absence of risk in determining (changes in) capital flow patterns.

split the sample by whether $\frac{H1_{c;t}}{H1_{MED;t}}$ is greater or smaller than 1. For those regressions that use $HOS2$ (hence relating average exported and imported skill level embodied in goods), the relevant split point is $\frac{H2_{c;t}}{H2_{MED;t}}$, and whether this is greater or smaller than 1.[18] The results are shown in table 5, columns 1-4 for the relatively high-skill exporting countries, and columns 5-8 for those that relatively specialize in low-skill intensive goods.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	high-skill Exporting Countries				low-skill Exporting Countries			
VARIABLES	Net FDI	Net FDI	Net Inv.	Net Inv	Net FDI	Net FDI	Net Inv.	Net Inv
HOS1	0.0849		0.116*		0.0170**		0.0174	
	(0.0513)		(0.0635)		(0.00772)		(0.0117)	
HOS2		0.0913**		0.142**		0.0132*		0.0123
		(0.0401)		(0.0553)		(0.00753)		(0.0112)
CapOpen	-0.000193	-0.000841	0.00281	0.00219	0.00279	0.00246	0.000639	0.000187
	(0.00307)	(0.00292)	(0.00609)	(0.00643)	(0.00175)	(0.00165)	(0.00177)	(0.00172)
InvSec	-0.000325	-0.000727	-0.000171	-0.000455	0.00149*	0.00193**	0.000849	0.00141
	(0.00113)	(0.00105)	(0.00156)	(0.00156)	(0.000750)	(0.000854)	(0.000865)	(0.000982)
Country fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Constant	0.0133**	0.0158**	-0.0226	-0.0324***	0.0104	0.0125	0.0174**	0.00818
	(0.00656)	(0.00663)	(0.0152)	(0.0117)	(0.00659)	(0.00900)	(0.00824)	(0.00727)
Observations	791	772	718	697	739	753	648	665
R2	0.062	0.066	0.040	0.047	0.134	0.146	0.166	0.178
Number of Countries	78	78	76	77	66	68	64	67

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Results by type of specialization

Even though reducing the sample size takes a little power from the model, we see that the results for either group still show the same pattern, and also the coefficients are broadly in similar dimensions for both as for the entire sample. We do see that the results overall appear slightly stronger for the relatively more high-skill specializing countries, but that also for relatively low-skill specializing countries, a stronger relative specialization in these low-skill intensive goods goes along with net capital inflows. We also see that for high-skill exporting countries (which tend to be more developed countries), capital flows including portfolio equity investment seem to react slightly stronger, whereas for low-skill exporting countries (predominantely emerging and developing economies), FDI shows the relatively

[18]Here, the definition that relates skill specialization to the median country in a year helps us to keep both samples of relevant size, in order to retrieve reliable statistical inference for both groups, those that specialize relatively more high-skill and those that specialize relatively more low-skill intensive.

more clear response to trade specialization. Overall, the above findings show that countries who specialize relatively more in goods of either skill class tend to observe larger capital inflows. Our findings hence support our theoretical predictions. When countries specialize in a skill class in their trade pattern, and hence can be said to pursue increased Heckscher-Ohlin type of trade, this also raises net capital inflows.

Robustness tests

In this section, we run a series of robusness tests. First, we explicitly compare the effect of high-skill (or low-skill) complementarity of capital with the effect of specialization in general. Second, we test whether more open countries experience higher capital inflows also due to factor trade specialization. Thirdly, we control for the effect of a country's GDP per capita, capital stock and growth, respectively.

Capital-skill-complementarity

Our theoretical model has explicitly abstracted from any type of complementarity between capital and either of the skill classes. As discussed, besides (and jointly with) the effect identified, this could also drive capital inflows. When splitting the sample in relatively high- and low-skill exporting countries, we saw that the effect of specialization was slightly stronger for high-skill exporting countries. In order to more directly test for high- or low-skill complementarity of capital and to additionally control for that this is not what drives our results, we include skill specialization in the regression as an explanatory variable by itself. To this end, we take the logs of $\frac{H1_{c;t}}{H1_{MED;t}}$ and $\frac{H2_{c;t}}{H2_{MED;t}}$, but refrain from eliminating their sign. We denote these by $H1^{Rel}_{c;t}$ and $H2^{Rel}_{c;t}$, respectively. A higher value thus indicates an increased relative specialization in high-skill intensive goods of country c in year t. As constructed, they are of equal scale as our main explanatory variables $HOS1$ and $HOS2$, which allows us to compare magnitudes of the estimates. The results are shown in table 6. It appears that there is a tendency for capital to be skill-complementary, as the sign of the coefficients for skill specialization is positive. However, these results are only significant for aggregate equity inflows. When comparing the effect with that of specialization in both directions itself, we see that the point estimates are lower for skill specialization than for any type of specialization ($HOS1$ & $HOS2$) in all specifications. We can conclude that although there might be a slight tendency for capital-skill complementarity, the general effect of trade

VARIABLES	(1) Net FDI	(2) Net FDI	(3) Net Inv.	(4) Net Inv
HOS1	0.0298*		0.0497**	
	(0.0166)		(0.0208)	
HOS2		0.0302**		0.0495**
		(0.0142)		(0.0206)
CapOpen	0.00174	0.00161	0.00166	0.00136
	(0.00155)	(0.00154)	(0.00262)	(0.00260)
InvSec	0.000611	0.000611	0.000446	0.000467
	(0.000669)	(0.000662)	(0.000781)	(0.000809)
$H1^{Rel}_{c;t}$	0.0176		0.0351*	
	(0.0158)		(0.0210)	
$H2^{Rel}_{c;t}$		0.0202		0.0388*
		(0.0125)		(0.0201)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	0.0137**	0.0143**	0.0140*	0.0154*
	(0.00561)	(0.00567)	(0.00804)	(0.00806)
Observations	1,533	1,532	1,369	1,368
R2	0.070	0.072	0.057	0.060
Number of Countries	119	119	118	118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Estimation results: control for skill specialization

specialization is relevant on its own and even stronger, regarding the amount of capital flows that it induces.

Capital openness and trade

In order for trade liberalization to have an effect on capital flows, these capital flows need to be possible at all. We therefore test whether the effect is particularly pronounced for countries that have lower legislative barriers to capital flows. We thus include interaction variables of *CapOpen* and our measures of Heckscher-Ohlin specialization in the regressions.

Table 7 shows the results. The coefficients on the interaction terms are indeed positive. They are, however, not significant for net FDI inflows, but only for net overall equity inflows. This may reflect the fact that our measure of capital controls more strongly weighs measures aiming at controlling financial capital than those on direct investment. We also see that the results for the HOS-measures are not affected by this. This indicates that even though the effect of factor-specific trade on capital inflows is slightly positively depending on the absence

VARIABLES	(1) Net FDI	(2) Net FDI	(3) Net Inv.	(4) Net Inv
HOS1	0.0206**		0.0404**	
	(0.0102)		(0.0158)	
HOS2		0.0223**		0.0448**
		(0.0103)		(0.0174)
CapOpen	0.000192	-7.14e-05	-0.00225	-0.00284
	(0.00194)	(0.00198)	(0.00257)	(0.00260)
InvSec	0.000720	0.000719	0.000557	0.000554
	(0.000658)	(0.000660)	(0.000815)	(0.000828)
HOS1 # CapOpen	0.00778		0.0202**	
	(0.00552)		(0.00927)	
HOS2 # CapOpen		0.00867		0.0220**
		(0.00559)		(0.00984)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	0.0136**	0.0136**	0.0133	0.0133
	(0.00573)	(0.00574)	(0.00859)	(0.00862)
Observations	1,533	1,532	1,369	1,368
R-squared	0.070	0.071	0.059	0.061
Number of Countries	119	119	118	118

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7: Estimation results: interaction HOS and capital market openness

of restrictions to investment, capital that enters the country in order to pursue this may find its ways around these and the effect is present independently of this. It may furthermore indicate a generally rather high level of capital market openness in the sample.

Per capita GDP

The theoretical analysis has pointed out that the capital stock in a country will for standard neoclassical reasons also play a role in determining capital flows. For the initial capital stock, this is controlled for by accounting for country fixed effects. However, also changes over time may influence incentives for capital to flow into a country. The same holds for the general level of economic development, which may attract capital flows. We therefore first jointly proxy for both, the capital stock and changes in the economic situation, by the level of GDP per capita in a country. The data on this comes from the WDI. The results are given in table 8.

We see that this has no effect on our results. The coefficient on GDP per capita has a negative sign, possibly representing that an increased capital stock does indeed rather

VARIABLES	(1) Net FDI	(2) Net FDI	(3) Net Inv.	(4) Net Inv.
HOS1	0.0208*		0.0474	
	(0.0108)		(0.0322)	
HOS2		0.0217**		0.0458*
		(0.0104)		(0.0247)
CapOpen	0.00150	0.00141	0.000927	0.000672
	(0.00154)	(0.00156)	(0.00244)	(0.00239)
InvSec	0.000595	0.000591	0.000797	0.000809
	(0.000666)	(0.000667)	(0.000820)	(0.000833)
GDP p.c.	-5.05e-07	-5.25e-07	1.00e-06	9.32e-07
	(1.55e-06)	(1.54e-06)	(4.77e-06)	(4.69e-06)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	0.00126	0.000592	-0.0186	-0.0191
	(0.0152)	(0.0150)	(0.0478)	(0.0454)
Observations	1,480	1,479	1,324	1,323
R-squared	0.065	0.066	0.051	0.052
Number of countries	116	116	115	115

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8: Estimation results: control for per capita GDP

go along with decreased incentives for capital inflows. This effect is insignificant, however. Because the expectations on the effects of level of the capital stock and economic activity point in different directions, GDP per capita as a proxy may pool the two in an inappropriate way. In order to disentangle the effect of the capital stock and GDP growth further, we thus in the following include each on their own as controls.

Capital Stock

The Penn World Tables supply data on capital stocks in a wide range of countries, although not for all that we have included in the regressions so far. The estimation results when controlling for the level of capital stock are shown in table 9. The results generally resemble those from table 8. The level of capital stock shows a negative sign, but this is insignificant. Furthermore, it is not the correlation between trade specialization and the initial capital stock, that drives our results, but the effect of trade specialization itself.

	(1)	(2)	(3)	(4)
VARIABLES	Net FDI	Net FDI	Net Inv.	Net Inv.
HOS1	0.0195*		0.0332**	
	(0.0103)		(0.0161)	
HOS2		0.0218**		0.0368**
		(0.0105)		(0.0176)
CapOpen	0.000935	0.000804	0.000809	0.000564
	(0.00163)	(0.00164)	(0.00281)	(0.00278)
InvSec	0.000579	0.000583	0.000527	0.000540
	(0.000696)	(0.000697)	(0.000832)	(0.000839)
CapStock	-1.59e-09	-1.52e-09	-1.79e-09	-1.62e-09
	(1.28e-09)	(1.25e-09)	(1.95e-09)	(1.99e-09)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	-0.00189	-0.00313	-0.00464	-0.00671
	(0.00643)	(0.00670)	(0.00769)	(0.00788)
Observations	1,453	1,452	1,303	1,302
R-squared	0.066	0.067	0.051	0.052
Number of countries	111	111	110	110

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9: Estimation results: control for capital stock

Growth

Capital inflows should be greater in relative periods of growth of a country. Although *InvSec* already partly accounts for the overall investment climate in a country, we can furthermore explicitly control for this. Here, we would expect an opposite effect to that of the capital stock, i.e. we would expect a positive sign. In the theoretical analysis, trade itself would lead to growth. Hence, this part of growth in the data is an effect that we would explicitly want to see included as an effect from trade on capital inflows. Still, there could be various other reasons for economic growth, influencing capital flows and possibly being related with trade specialization. We hence take data on growth of real per capita GDP for the respective years from the WDI and include this as a control variable in our estimations. The results are shown in table 10.

Per capita GDP growth indeed shows a positive sign, this effect is statistically insignificant, however. More importantly, the results for our measures of Heckscher-Ohlin specialization are still positive and significant, such that we can conclude that even if periods of growth and skill level specialization are correlated, we can identify a particular effect of the latter on equity capital inflows.

	(1)	(2)	(3)	(4)
VARIABLES	Net FDI	Net FDI	Net Inv.	Net Inv.
HOS1	0.0227**		0.0395**	
	(0.0104)		(0.0163)	
HOS2		0.0238**		0.0413**
		(0.0103)		(0.0170)
CapOpen	0.00136	0.00125	0.00109	0.000843
	(0.00154)	(0.00156)	(0.00262)	(0.00261)
InvSec	0.000595	0.000593	0.000505	0.000515
	(0.000704)	(0.000703)	(0.000859)	(0.000869)
Growth	0.000100	0.000104	0.000294	0.000297
	(0.000232)	(0.000231)	(0.000311)	(0.000311)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Constant	-0.00347	-0.00440	-0.00747	-0.00917
	(0.00616)	(0.00644)	(0.00768)	(0.00774)
Observations	1,500	1,499	1,341	1,340
R-squared	0.066	0.067	0.051	0.053
Number of countries	118	118	117	117

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10: Estimation results: control for per capita GDP growth

5 Conclusion and outlook

We have in this paper elaborated on a rather intuitive mechanism regarding the interdependence of globalization: as trade entails efficiency gains, capital should, as a residual factor, also profit from specialization in terms of skill intensities of immobile labor in worldwide production. Therefore, in countries that are relatively well endowed with one type of labor and that open up their goods markets to the rest of the world, production should shift towards these goods that use the abundant factor intensively. Our theoretical analysis shows that this will always increase the return to capital that is used in production of both goods and thus create incentives for capital to flow into specializing countries. Our stylized model allows us to single out this effect, that would then still be relevant when interacting with other effects, such as capital-skill complementarity, that may also shape the direction of capital flows.

This finding is in stark contrast to standard Heckscher-Ohlin trade theory, where trade replaces incentives for capital to flow across borders, if it is one of the factors of production. We here account for the fact, that indeed specialization along the lines of factor endowments

is taking place in immobile high-skill and low-skill labor, whereas capital is relatively free to cross borders. Incorporating these facts into a simple and tractable model allows us to in the logic of exactly the same determinants of trade draw diametrically opposing conclusions regarding the incentives for capital flows that trade induces.

We then test our hypothesis empirically to see whether the proposed mechanism is of empirical relevance and can be found in the data. Therefore, we construct a measure of the degree of skill-level specialization of countries and find strong support for our hypothesis. Trade specialization does lead to overall capital inflows, both for relatively high-skill and low-skill intensive specializing countries.

We believe that our framework has a very intuitive grasp, but still forcefully explains findings of concurrent trade specialization and capital flows. We have thus deliberately refrained from extending the model to account for more complex production structures to keep it tractable. However, the framework can easily be extended to incorporate different effects than the one pointed out here. Still, the effect of internationally mobile capital participating in gains that trade specialization entails is also to be considered in the discussion the many (and one) face(s) of globalization.

References

Antràs, P. and Caballero, R. J. (2009), 'Trade and capital flows: A financial frictions perspective', *Journal of Political Economy* **117**(4), 701–744.

Barro, R. J. and Lee, J.-W. (2001), 'International data on educational attainment: updates and implications', *Oxford Economic Papers* **53**(3), 541–563.

Buckley, P. J. and Casson, M. (1981), 'The optimal timing of a foreign direct investment', *The Economic Journal* pp. 75–87.

Chinn, M. D. and Ito, H. (2006), 'What matters for financial development? capital controls, institutions, and interactions', *Journal of Development Economics* **81**(1), 163 – 192.

Ethier, W. J. and Svensson, L. E. (1986), 'The theoremes of international trade with factor mobility', *Journal of International Economics* **20**(1-2), 21 – 42.

Feenstra, R. C. (2003), *Advanced international trade: theory and evidence*, Princeton University Press.

Feenstra, R. C., Lipsey, R. E., Deng, H., Ma, A. C. and Mo, H. (2005), World trade flows: 1962-2000, Working Paper 11040, National Bureau of Economic Research.

Helpman, E. (1985), 'Multinational corporations and trade structure', *The Review of Economic Studies* **52**(3), 443–457.

Helpman, E., Melitz, M. J. and Yeaple, S. R. (2004), 'Export versus fdi', *American Economic Review* **94**(1), 300–316.

Jin, K. (2012), 'Industrial structure and capital flows', *The American Economic Review* **102**(5), 2111–2146.

Jones, R. W. (1956), 'Factor proportions and the heckscher-ohlin theorem', *The Review of Economic Studies* **24**(1), pp. 1–10.

Jones, R. W. and Easton, S. T. (1983), 'Factor intensities and factor substitution in general equilibrium', *Journal of International Economics* **15**(1-2), 65–99.

Krautheim, S. (2013), 'Export-supporting fdi', *Canadian Journal of Economics/Revue Canadienne d'Economique* **46**(4), 1571–1605.

Krugman, P. R. (2008), 'Trade and wages, reconsidered', *Brookings Papers on Economic Activity* **2008**, pp. 103–137.

Markusen, J. R. (1983), 'Factor movements and commodity trade as complements', *Journal of International Economics* **14**(3-4), 341 – 356.

Markusen, J. R. (2004), *Multinational firms and the theory of international trade*, MIT press.

Morrow, P. M. (2010), 'Ricardian-heckscher-ohlin comparative advantage: Theory and evidence', *Journal of International Economics* **82**(2), 137 – 151.

Mundell, R. A. (1957), 'International trade and factor mobility', *The American Economic Review* **47**(3), 321–335.

Neary, J. P. (1995), 'Factor mobility and international trade', *The Canadian Journal of Economics / Revue canadienne d'Economique* **28**, pp. S4–S23.

Neary, J. P. (2009), 'Trade costs and foreign direct investment', *International Review of Economics and Finance* **18**(2), 207–218.

Romalis, J. (2004), 'Factor proportions and the structure of commodity trade', *The American Economic Review* **94**(1), pp. 67–97.

Ruffin, R. J. (1981), 'Trade and factor movements with three factors and two goods', *Economics Letters* **7**(2), 177 – 182.

Shirotori, M., Tumurchudur, B. and Cadot, O. (2010), Revealed factor intensity indices at the product level, UNCTAD Blue Series Papers 44, United Nations Conference on Trade and Development.

Woodland, A. (1982), *International trade and resource allocation*, Amsterdam: North-Holland.

A Factor input coefficients a_{iF}

By solving the cost minimization problem, firms in the 2 sectors choose the following optimal inputs of the 3 factors:

$$\begin{aligned}
a_{1K} &= r^{\alpha-1}s^{\beta}w^{1-\alpha-\beta}\left(\frac{\alpha}{1-\alpha-\beta}\right)^{1-\alpha}\left(\frac{\beta}{1-\alpha-\beta}\right)^{-\beta} \\
a_{1H} &= r^{\alpha}s^{\beta-1}w^{1-\alpha-\beta}\left(\frac{\alpha}{1-\alpha-\beta}\right)^{-\alpha}\left(\frac{\beta}{1-\alpha-\beta}\right)^{1-\beta} \\
a_{1L} &= r^{\alpha}s^{\beta}w^{-\alpha-\beta}\left(\frac{\alpha}{1-\alpha-\beta}\right)^{-\alpha}\left(\frac{\beta}{1-\alpha-\beta}\right)^{-\beta} \\
a_{2K} &= r^{\alpha-1}s^{\gamma}w^{1-\alpha-\gamma}\left(\frac{\alpha}{1-\alpha-\gamma}\right)^{1-\alpha}\left(\frac{\gamma}{1-\alpha-\gamma}\right)^{-\gamma} \\
a_{2H} &= r^{\alpha}s^{\gamma-1}w^{1-\alpha-\gamma}\left(\frac{\alpha}{1-\alpha-\gamma}\right)^{-\alpha}\left(\frac{\gamma}{1-\alpha-\gamma}\right)^{1-\gamma} \\
a_{2L} &= r^{\alpha}s^{\gamma}w^{-\alpha-\gamma}\left(\frac{\alpha}{1-\alpha-\gamma}\right)^{-\alpha}\left(\frac{\gamma}{1-\alpha-\gamma}\right)^{-\gamma}
\end{aligned} \tag{24}$$

B Proof of real rental minimum

The derivative of r/P, as given in (14), is by (25):

$$\begin{aligned}
\frac{\partial(\frac{r}{P})}{\partial(\frac{p_2}{p_1})} =& \Theta K^{\alpha-1}\left[\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}}L+\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}}H\right]^{-\alpha}\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}-(1-\theta)} \\
&\left[\frac{\gamma+(\beta-\gamma)\theta}{(\beta-\gamma)}L-\frac{(1-\alpha-\gamma)-(\beta-\gamma)\theta}{(\beta-\gamma)}\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{1}{(\gamma-\beta)}}H\right]
\end{aligned} \tag{25}$$

and its zero is given by the autarky price (18). At this, the second derivative of r/P with respect to $\frac{p_2}{p_1}$ reduces to

$$\begin{aligned}
\frac{\partial^2(\frac{r}{P})}{\partial(\frac{p_2}{p_1})^2} =& \Theta K^{\alpha-1}\left[\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}}L+\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{-(1-\alpha-\gamma)}{(\beta-\gamma)(1-\alpha)}}H\right]^{-\alpha}\left(\frac{p_2}{p_1}\right)^{\frac{\gamma}{(\beta-\gamma)(1-\alpha)}-(1-\theta)} \\
&\left[-\left(\frac{1}{(\gamma-\beta)}\right)\frac{(1-\alpha-\gamma)-(\beta-\gamma)\theta}{(\beta-\gamma)}\phi^{\frac{1}{(\gamma-\beta)}}\left(\frac{p_2}{p_1}\right)^{\frac{1}{(\gamma-\beta)}-1}H\right]>0
\end{aligned} \tag{26}$$

When we look at an extremum, $\frac{(1-\alpha-\gamma)-(\beta-\gamma)\theta}{(\beta-\gamma)}$ must be greater than zero, because otherwise (25) could not be zero (and there was no local extremum of r/P). Hence, (26) must be positive.

This implies that the extremum of r/P as a function of the relative goods price at the autarky price given by (18) is indeed a minimum. Since there is no other extremum, the function of (14) looks like depicted in Figure 1 and is increasing in both directions from the autarky price.

C Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
$H_{i,t}$	11119	7.121224	1.608827	0.7203289	11.2858
$H_{i,2000}$	651	7.828983	1.502626	2.625086	11.03811
$H1_{c,t}$	2781	5.982004	1.372169	1.171284	8.799596
$H2_{c,t}$	2764	0.8219775	0.1774013	0.1754505	1.513017
$H1_{c,t}$ / $H1_{MED,t}$	2781	0.9795381	0.2004088	0.2234989	1.580504
$H2_{c,t}$ / $H2_{MED,t}$	2764	0.9766633	0.2094319	0.2176675	1.904193
$HOS1_{c,t}$	2781	0.1748848	0.1503466	0	1.498349
$HOS2_{c,t}$	2764	0.1815658	0.1590568	0	1.524787
Net $FDI_{c,t}$	2000	0.0145916	0.0553066	-0.552422	1.618238
$NetInv_{c,t}$	1757	0.0140848	0.0600831	-0.552422	1.618238
$CapOpen_{c,t}$	2332	-0.0952775	1.519268	-1.863972	2.439009
Inv. $Risk_{c,t}$	2012	6.156018	2.052345	0	11.1667
GDP $p.c._{c,t}$	2699	8141.971	12496.22	50.04	72866.87
$CapStock_{c,t}$	2582	654521.1	2310451	99.79869	2.96E+07
$Growth_{c,t}$	2730	1.511087	7.329508	-65.02997	142.0705

Table 11: Summary statistics