Income Effects in the Theory of Monopolistic Competition and International Trade

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Abstract

We present a model of monopolistic competition and international trade in which income effects play a crucial role. It is assumed that goods are indivisible and consumers decide whether or not to purchase a given variety. This provides us with a simple and tractable framework in which prices and mark-ups of monopolistic producers are determined by consumers' income levels. Our model generates two interesting results. First, we find that all goods are traded when countries have very similar per-capita incomes, whereas countries remain in autarky when they are very dissimilar. For intermediate income differences only a subset of goods is internationally traded. This is consistent with the "Linder hypothesis" according to which trade intensity is inversely related to differences in trading partners' per-capita incomes. Second, we find that the gains from trade liberalization (a reduction of transport costs) may be divided very unequally between (rich and poor) countries. When transportation costs are relatively high, rich and poor country gain from trade liberalization. However, when transportation costs are below a certain threshold, the poor country may lose and oppose further trade liberalization.

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1 Introduction

This paper presents a model of monopolistic competition and international trade in which income effects play a crucial role. The potential importance of income effects has been emphasized by many previous writers, most notably by Staffan Burenstam Linder (1961). In his influential and frequently quoted essay on "*Trade and Transformation*" he argues "*... the more similar the demand structures of two countries, the more intensive, potentially, is the trade between these two countries.*" He then adds "*... the similarity of average income levels could be used as an index of similarity of demand structures.*"

While the relevance of income effects is undisputed and supported by a number of empirical studies, "new trade theory" models provide little room for such effects. To illustrate the point consider two countries, A and B. Country A has 100 million inhabitants and a per-capita income of 10; country B has 10 million inhabitants and a per-capita income of 100, hence aggregate income of the two countries is the same. Assume there are no differences in any other respect. In the canonical model of "new trade theory" these two countries are essentially identical. Due to the assumption of homothetic preferences, it is the level of *aggregate* income that is relevant for the determination of (aggregate) equilibrium variables. There is no separate role for *per-capita* income. In this sense, the standard model rules out income effects and cannot appropriately address the Linder hypothesis – which stresses the relevance of similarities in per-capita incomes for the intensity of trade.

In the present model consumers have "0/1 preferences". Due to indivisible products, consumers either purchase one unit of a certain good or do not purchase it at all. Under this assumption, the households choose the optimal number of consumed goods while there is no choice about the quantity per consumed variety.[1] This seemingly minor change in assumptions has major implications for general equilibrium outcomes. *First*, the existence and the composition of international trade depends on the relative per-capita income between the two countries. When countries are very dissimilar no trade will take place. In the autarky equilibrium firms supply a broad range of products in the country with a high per-capita income and a narrow range in the country with a low per-capita income. In contrast, when countries are very similar, trade emerges and all goods produced in the world economy will be consumed in both countries. Both, home and foreign consumers will be better off vis-à-vis

[1] One way to look at the implied differences in consumer behavior between the model proposed here and the standard (new trade theory) model is this: In the standard model consumers choose the quantity consumed per variety but have no choice about the number of goods. (Homothetic preferences force them to purchase *all* supplied varieties). In contrast, consumers in our model choose the number of goods, but have no choice about the quantity per consumed variety. In this sense, the assumption on consumer preferences adopted in this paper is equally general (or special) than the assumption of homothetic preferences in new trade theory models.

autarky. For intermediate differences in per-capita incomes, the equilibrium outcome features a situation where the range of available products in the poor country is narrow and broad in the rich country. This is due to the fact, that only a subset of the goods produced worldwide is internationally traded.

A *second* main result that emerges from our analysis relates to the gains from trade and the distribution of welfare between countries. When countries are sufficiently similar so that all goods are traded, then the poorer country gains more than the rich country. The reason is that richer consumers have a higher willingness to pay for the various products so prices and mark-ups are higher. As a result, consumers in the rich country bear a relatively larger share in the fixed cost generating a bias in the gains from trade in favor of the poor country. However, both countries gain in absolute terms and a reduction in transportation costs (e.g. a trade liberalization) is beneficial for both home and foreign consumers.

When countries are more dissimilar (but not too dissimilar to rule out trade at all), a different situation emerges. Both countries are still better off under openness than under autarky but the gains from trade may be quite differently distributed. When trade occurs between a very rich and a very poor country, producers can no longer take full advantage of the higher willingness to pay of rich-country consumers. The reason is a threat of parallel imports which puts a pressure on prices in the richer country,[2] and benefits rich-country consumers. In such a situation it turns out that the rich country gains disproportionately from a reduction in transportation costs, whereas the poor country is worse off. As a result, the poor country may oppose further trade liberalization.

In sum, our paper shows that allowing for income effects may have quite strong implications for general equilibrium outcome. Of course, whether such effects are relevant or not is an empirical question. There are at least three pieces of empirical evidence that underline the potential importance of income effects for international trade flows. First, Hunter and Markusen (1988) and Hunter (1991) find that demand systems that allow for varying expenditure shares perform significantly better in explaining the composition of bilateral trade flows. Second, there is the empirical fact of "zeros" in bilateral trade statistics. Helpman, Melitz, and Rubinstein (2006) highlight that for only about 50 percent of all possible bilateral trade relations in their 161 country sample trade actually occurs. While these authors focus on fixed import costs as a possible explanation, in our view, income effects is at least as plausible as a cause for the zeros. A third fact is the explanatory power of income distribution in predicting trade flows. Francois and Kaplan (1996) and Dalgin, Mitra, and Trindade (2006) investigate this

[2] When US firms charge high prices at home and sell the same product cheaply in Brasil, an arbitrageur could purchase goods in Brasil, ship it back to the US and sell it cheaply there. Such parallel imports discipline price setting for US producers.

issue empirically. The latter for example estimate that the US being as equal as Canada would lead to 9-13% lower luxury imports and 13-19% higher imports of necessities. If elasticities were constant, distribution did not matter for the aggregate outcome. In contrast, our 0/1 preferences imply that income levels affect firms' pricing behavior and hence the incentives to trade goods internationally.

There are various theoretical papers to which the present work is related. In his seminal paper Markusen (1986) combines differences in factor endowments, monopolistic competition, and quasihomothetic preferences in order to explain North-South and East-West trade. Sauré (2006) incorporates quasi-homothetic (Stone-Geary) preferences into Krugman's (1980) workhorse model[3]. Neary (2003a) considers quadratic utility in a general oligopolistic equilibrium (GOLE). He uses the GOLE model in Neary (2003b) to study various aspects of globalization. Melitz and Ottaviano (2005) consider heterogenous firms and quasilinear preferences to analyze the effect of different liberalization policies. Chung (2005) used quasihomothetic preferences to address Trefler's (1995) missing trade puzzle. Mitra and Trindade (2005) use nonhomothetic preferences over the industry aggregates to explain the role of the demand side - and related with that inequality - in determining the trade patterns. Their model has been incorporated into a gravity equation by Bohman and Nilsson (2006). Flam and Helpman (1987) consider qualitative product differentiation in a North-South model. This model has been extended by Choi, Hummels, and Xiang (2006), who focus on the role of income distribution in determining the trade patterns. In the empirical part of their work they find that income distribution plays an important role in shaping a country's import demand. Mountford (2006) uses quasihomothetic preferences in a dynamic Heckscher-Ohlin model to address the issue of the East-Asian growth miracles. Nonhomothetic preferences with indivisibilities were used by Matsuyama (2000) in a Ricardian context. Krishna and Yavas (2005) used consumption indivisibilities in combination with labor market imperfection to explain possible losses from trade in transition economies.

The remainder of this paper is organized as follows. In the next section we present the basic assumptions and solve the model under autarky. Section 3 turns to the case of international trade between equal countries. Section 4 then will allow for dissimilar countries. Section 5 concludes.

[3] Other important contributions related to the Krugman (1980) model include Krugman (1979), Helpman and Krugman (1985), and Davis (1998).

2 The Model

This section introduces a simple model of monopolistic competition with nonhomothetic preferences. We first present our assumptions of these preferences and then briefly present our (standard) assumptions on endowments and technology. We then work out the monopolistically competitive equilibrium under autarky which serves as a benchmark for the trade equilibria we will be discussing in the later sections.

Preferences Consumers spend their income on a continuum of indivisible goods, indexed by j. Only the first unit of a good yields positive utility, no additional utility is derived from consuming more than one unit. Hence consumption is a binary choice: either you buy or you don't buy. Denote by $c(j)$ an indicator that takes value 1 if good j is purchased and value 0 if is not purchased. The consumer's utility takes the simple form

$$U = \int_0^\infty c(j)dj, \quad \text{where } c(j) \in \{0, 1\}. \tag{1}$$

This formulation implies that utility is additively separable in the various goods and each good contributes in the same way to the consumer's utility which is simply given by the number of consumed goods.

Suppose a measure of N different goods are supplied at prices $\{p(j)\}$ and that the consumer has income y. The problem is to choose $\{c(j)\}$ to maximize the objective function (1) subject to the budget constraint $\int_0^N p(j)c(j) = y$. Denoting by λ the marginal utility of income, the first order condition can be written as

$$\begin{aligned} c(j) &= 1 \text{ if } 1 \geq \lambda p(j) \\ c(j) &= 0 \text{ if } 1 < \lambda p(j) \end{aligned} \tag{2}$$

Rewriting this condition as $1/\lambda \geq p(j)$ yields the simple rule that the consumer's willingness to pay $1/\lambda$ has to be at least as large as the price $p(j)$.[4] The resulting demand curve, depicted in Figure 1, is a step function which coincides with the vertical axis for $p(j) > 1/\lambda$ and equals unity for prices $p(j) \leq 1/\lambda$.

Figure 1

Notice that, by symmetry of utility function (1), the consumer's willingness to pay is the same for all goods and equal to the inverse of λ which itself is determined by consumer's income

[4] Strictly speaking the condition $1 \leq \lambda p(j)$ is necessary but not sufficient for $c(j) = 1$ and the condition $1 > \lambda p(j)$ is sufficient but not necessary for $c(j) = 0$. The reason is that purchasing all goods for which $1 = \lambda p(j)$ may not be feasible given the consumer's budget. For when all N different goods are supplied at the same price p but $y < pN$ the consumer picks at random which particluar good will be purchased or not purchased.

and the prices of the various goods. Intuitively, the demand curve shifts up when the income of the consumer increases (λ falls) and shifts down when the price level of all other goods increases (λ rises).

Notice the difference between consumption choices with 0-1 preferences and the standard CES-case. With 0-1 preferences consumers have a choice about how many goods to buy but there is no choice about consumed quantities.[5] Under CES preferences, the consumer purchases all goods (because the marginal utility of the first unit is infinitely large) and choose consumed quantities. In other words, with 0-1 preferences the consumer chooses along the *extensive* margin (but have no choice along the intensive margin), whereas under CES-preferences the consumer chooses along the *intensive* margin (but there is – trivially – no choice along the extensive margin). In this sense 0-1 preferences are no less restrictive (and no less un/realistic) than CES-preferences.

Endowments, technology and price setting The economy is populated by identical households and total population size $\mathcal{P}$. Each household is endowed with L units of labor, the only production factor. The labor market is competitive and the wage is W. Hence the households income is $y = WL$. Production requires a fixed labor input of F to set up a new firm and variable labor input of $1/a$ per unit of output, the same for all firms[6]. To produce good j in quantity $x(j)$ thus needs a total labor input of $F + x(j)/a$.

Due to the setup costs, the various producers have a natural monopoly for their products. As all monopolists have the same cost and demand curves, we can omit indices. Assuming a representative consumer, the monopolistic producer faces a demand curve as depicted in Figure 1 and hence will charge a price $p = 1/\lambda$ and sell output 1 (provided this covers total costs – which will be the case in equilibrium).

Decentralized equilibrium under autarky It is straightforward to characterize the autarky equilibrium. Without loss of generality we choose labor as the numéraire and set $W = 1$. The *first* equilibrium condition is a zero-profit condition ensuring that operating profits cover the entry costs (but not exceed them to deter further entry). Entry costs are $FW = F$ and operating profits are $[p - W/a]\mathcal{P} = [p - 1/a]\mathcal{P}$. The zero-profit condition can be written as $p = (aF + \mathcal{P})/a\mathcal{P}$.[7] This implies a mark-up μ - the ratio of price over marginal cost – given

[5] The discussion here rules out the case that incomes could be larger than pN meaning that the consumer is rationed (would want to purchase more goods than are acutally available at the available prices). While this could be a problem in pinciple, it will never occur in the equilibrium of the model.

[6] In contrast to "New New Trade Theory" model à la Melitz (2003) we assume homogenous firms.

[7] Notice that we have argued that $p = 1/\lambda$ and $p = (aF + P)/aP$ so it seems that p is overdetermined, unless we have $\lambda = aP/(aF + P)$. To see that this is in fact the case notice that increasing income by one unit is just like an increase in L (as income $y = WL$ and the normalization $W = 1$). Hence we can write

by

$$\mu = \frac{aF + \mathcal{P}}{\mathcal{P}}. \tag{3}$$

which is determined by technology parameters a and F and the market size parameter $\mathcal{P}$. The *second* equilibrium condition is a resource constraint ensuring that there is full employment $\mathcal{P}L = FN + \mathcal{P}N/a$. From this equation, equilibrium product diversity in the decentralized equilibrium can be calculated[8]

$$N = \frac{a\mathcal{P}}{aF + \mathcal{P}} L. \tag{4}$$

3 Costly international trade between similar countries

Let us now consider the case when the differentiated products can be traded internationally. It is assumed that international trade is costly. We assume iceberg trade costs so $\tau \geq 1$ units have to be shipped to the other country to make sure that 1 unit arrives at the destination. Moreover, we stick to the simple case where there are two countries, home and foreign (the with foreign-country variables indexed by an asterix). In what follows, we denote by $p_H(j)$ and $p_H^*(j)$ the prices of the home producer in the home country and in the foreign country, respectively. $p_F(j)$, and $p_F^*(j)$ are the corresponding prices for foreign producers. Similarly, we denote by $c_H(j)$ and $c_H^*(j)$ the (binary) consumption indicators of home and foreign consumers of a good produced in the home country; and by $c_F(j)$, and $c_F^*(j)$ are the corresponding indicators for a good produced in the foreign country.

Let us first consider the special case of two identical countries. In particular, they have the same population size, the same labor endowment, access to the same technologies and face the same transportation cost. (The case of heterogenous countries will be discussed in the next section.) In equilibrium, $N + N^*$ producers are active worldwide. A suspect equilibrium is one in which all producers sell on both markets, so let us consider this case first. As we have seen in the last section, the prices charged by monopolistic firms are equal to the willingnesses to pay of the respective consumers. Hence optimal prices charged on home country markets are equal to the willingness to pay of the home consumer, $p_H(j) = p_F(j) = p = 1/\lambda$. Similarly, $p_H^*(j) = p_F^*(j) = p^* = 1/\lambda^*$ for prices charged on foreign country markets. Since the countries

$\lambda = dU/dL = (\partial U/\partial N) \cdot (\partial N/\partial L)$. Since we have $U = N$, $\partial U/\partial N = 1$, and from equilibrium product diversity we have $\partial N/\partial L = aP/\left(aF + P\right)$ which confirms the claim.

[8] Notice the difference between the 0-1 outcome and the standard CES-case. With CES, the mark-up is determined by the elasticity of substitution between differentiated goods and independent of technology and market size. In fact, the variability of the mark-up with 0-1 preferences will drive mayny of our results below. Moreover, with CES, equilibrium product diversity is independent of productivity a and proportional to set-up costs F and inversely proportional to market size P. See Appendix 1 for the details. We notice that with 0-1 preferences product diversity in the decentralized equilibrium is equal to the socially optimal product diversity.

are identical, consumers in both countries are equally rich and we have $\lambda = \lambda^*$. This means there is one price, p, charged worldwide, the same for each product.[9]

When all goods are traded, the resource constraint is $\mathcal{P}L = NF + N\mathcal{P}(1+\tau)/a$, the same for both countries. This lets us determine the number of active firms

$$N = N^* = \frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}} L. \tag{5}$$

From the zero-profit condition we can calculate the prices and mark-ups that will be charged in equilibrium. Using labor as the numéraire good, we have $W = W^* = 1$ and the zero-profit condition is $\mathcal{P}[p - 1/a] + \mathcal{P}[p - (1+\tau)/a] = F$, the same in both countries. This lets us calculate the price charged worldwide[10]

$$p_H = p_F = p_H^* = p_F^* = \frac{aF + (1+\tau)\mathcal{P}}{2a\mathcal{P}} \tag{6}$$

and the mark-ups, respectively on locally produced goods (μ_H and μ_F^*) and imported goods (μ_F and μ_H^*) are given by

$$\mu_H = \mu_F^* = \frac{aF + (1+\tau)\mathcal{P}}{2\mathcal{P}}, \text{ and} \tag{7}$$

$$\mu_H^* = \mu_F = \frac{1}{\tau} \cdot \frac{aF + a(1+\tau)\mathcal{P}}{2\mathcal{P}}. \tag{8}$$

As prices are the same irrespective of whether they are produced at home or abroad, imported goods generate a lower mark-up than locally produced goods. Importers have to fully bear the transportation costs in terms of a lower mark-up.[11]

So far we have implicitly assumed that producers in both countries have an incentive to trade their products internationally. However, this need not to be the case. Intuitively, if trade costs are too high and consumers' willingnesses to pay are too low, it does not pay to ship output to the foreign country. We state this result in the following

Proposition 1 *Consider two identical countries. a) Trade in the decentralized equilibrium will emerge if $\tau \leq (aF + \mathcal{P})/\mathcal{P}$, otherwise countries remain autarkic. b) In a decentralized trade equilibrium consumers are always better off than under autarky. c) The decentralized equilibrium coincides with the socially optimal solution.*

[9] The full set of equilibrium conditions is stated explicitely in Appendix 1.

[10] Since $p = 1/\lambda$ we mus thave $\lambda = 2/[aF/P + (1+\tau)/a]$. To see that this is in fact the case we note that increasing home income by one unit is just like a (unilateral) increase in L (as income $y = WL$ and the normalization $W = 1$). Hence we can write $\lambda = dU/dL = [\partial U/\partial(N+N^*)] \cdot [\partial(N+N^*)/\partial L]$. Since we have $U = N + N^*$, $\partial U/\partial(N+N^*) = 1$, and from equilibrium product diversity we have $\partial(N+N^*)/\partial L = 2aP/(aF + P(1+\tau))$ which confirms the claim.

[11] Notice that this result is consistent with the fact the costs are not passed through to prices. A number of empirical studies document that marginal cost shocks are not fully passed through to prices at the firm level and that prices are substantially less volatile than costs. See Incomplete Cost Pass-Through Under Deep Habits Ravn, Schmitt-Grohe, and Uribe (2007) for relevant literature.

Proof. a) To give firms and incentive to trade the price they get abroad has to cover at least their variable cost which includes the marginal cost of production and transportation cost. Prices abroad under trade are $p^* = [aF + (1+\tau)\mathcal{P}]/2a\mathcal{P}$, hence $p^* < \tau/a$ implies the condition stated in the Proposition. b) The utility of a home consumer in autarky is $U^a = L/(F + 1/a)$. If trade made him worse off it must be that $N^a > N + N^*$. This can be rewritten as $aL\mathcal{P}/(aF + \mathcal{P}) > 2a\mathcal{P}L/[aF + \mathcal{P}(1+\tau)]$. Rearranging this condition yields $\tau > (aF + \mathcal{P})/\mathcal{P}$, the trade condition. c) The social planner maximizes $V = U + U^*$ subject to the countries' resource constraints. The solution is that it is socially optimal to trade if $N^a \leq N + N^*$ which pins down to the trade condition. Hence decentralized equilibrium and social optimum coincide. ■

4 Trade between unequal countries

Consider next the more interesting case when the countries are heterogenous. Rather than letting all parameters vary across countries it is more illuminating to proceed in steps. Perhaps the most interesting and most relevant are differences in per-capita incomes.

4.1 Differences in per-capita incomes

An obvious source of differences in per-capita incomes are unequal endowments with labor resources. Differences in labor endowments could, for instance, result from differences in labor supply across countries (differences in hours worked and/or labor force participation) but in present context we can also think of differences in effective labor units which arise from differences in human capital endowments.[12] From now on we assume that the home country is better endowed with labor resources, $L > L^*$, and that countries are identical in all other dimensions.

Full trade equilibrium In a full trade equilibrium all goods are traded and consumed in both countries, despite differences in per-capita endowments. In that case there are $N + N^*$ producers worldwide and consumers in both countries purchase all goods. This leads to an equilibrium very similar to the one discussed in the last section except that the number of firms active in the two countries differs to the extent of their unequal labor endowments. From

[12] Notice that the case where the home country has an endowment k times as much as the foreign country, $L = kL^*$ is isomorphic to the case where productivity parameters are such that $1/F = k/F^*$ *and* $a = ka$.

the resource constraints we calculate

$$N = \frac{a\mathcal{P}}{aF + (1+\tau)\,\mathcal{P}} L, \text{ and} \tag{9}$$

$$N^* = \frac{a\mathcal{P}}{aF + (1+\tau)\,\mathcal{P}} L^*. \tag{10}$$

Just like before, local producers and importers charge prices that are equal to the respective consumers' willingnesses to pay hence we have $p_H = p_F$ and $p_H^* = p_F^*$. From the zero profit conditions and the consumers' budget constraints it is straightforward to calculate these prices as

$$p_H = p_F = \frac{L}{L+L^*}\frac{aF + (1+\tau)\,\mathcal{P}}{a\mathcal{P}} \text{ and} \tag{11}$$

$$p_H^* = p_F^* = \frac{L^*}{L+L^*}\frac{aF + (1+\tau)\,\mathcal{P}}{a\mathcal{P}}. \tag{12}$$

The corresponding mark-ups are $\mu_H = ap_H$, and $\mu_F = (a/\tau)\,p_F < \mu_H$ which differ between local producers and importers because the latter have also to cover transportations costs but cannot pass through these costs to prices. Similarly, for the foreign country $\mu_F^* = ap_F^*$, and $\mu_H^* = (a/\tau)\,p_H^* < \mu_F^*$.

Notice that differences in per-capita endowments translate one-to-one into differences in nominal per-capita incomes. This can be easily seen from the zero-profit conditions. Since we have $p_H = p_F$ and $p_H^* = p_F^*$ worldwide sales are identical between countries. Because technology and population sizes are also the same, it follows that $W = W^* = 1$ and $y^*/y = (W^*L^*)\,/\,(WL) = L^*/L$. However, real per-capita incomes are identical. Differences in per-capita incomes translate one-to-one into prices differences so we have $(y^*/p_H^*)\,/\,(y/p_H) = 1$. In sum, the full trade equilibrium has a simple structure: the number of active firms at home relative to abroad, as well as the prices and mark-ups at home relative to abroad differ to the extent that there are differences in relative endowments, i.e. $N^*/N = p_H^*/p_H = p_F^*/p_F = \mu_H^*/\mu_H = \mu_F^*/\mu_F = L^*/L$. However, real incomes and welfare are identical between the two countries despite per-capita endowment-differences.

Partial trade equilibrium A quite different equilibrium outcome arises when not all goods are traded and consumed in both countries. Intuitively, the (poor) foreign consumers may not be able to afford all goods that are produced worldwide. In that case, a partial trade equilibrium emerges. In such an equilibrium, firms face a constraint their on price setting behaviors. In the (poor) foreign country (home and foreign) producers still charge a price that is equal to the foreign consumers' willingnesses to pay, hence we still have $p_F^*(j) = p_H^*(j) = 1/\lambda^*$. However, the situation is different in the (rich) home country. With sufficiently large income differences the willingness to pay in the home country is much higher than in the foreign country. This leads to a situation where firms face a constrained scope of price setting due arbitrage incentives. When firms charge prices in the home country that are equal to the home consumers' willingnesses to pay, trading firms could purchase goods cheaply abroad ship it back home and sell it just below the high price on the home market. To prevent such arbitrage home producers have to set their price not larger than the price in the foreign country *plus* the transportation costs. In other words the threat of parallel imports discipline the price setting behaviors of home firms[13]. For similar reasons, the scope of price setting of foreign firms is limited by the threat of parallel exports.

This constraint on price setting behaviors leads to an equilibrium where some goods are traded but other goods are not traded. To see why, consider an equilibrium where all goods are traded. Were all prices in the home country below the home consumers' willingnesses to pay, they would have left-over income generating an infinitely large willingness to pay for additional products. This induces some home producers to sell their product only on the home market. By not trading exporting their goods to the foreign country these firms are not affected by the threat of parallel imports and hence can exploit the home consumers' high willingnesses to pay. In sum, a partial trade equilibrium is characterized by a situation where firms located in the (poor) foreign country trade all their goods but only a subset of firms located in the (rich) home country trade whereas the remaining home firms sell their product only on the local market. Trading home firms face a price constraint but profit from the large world market. Non-trading home firms have a smaller market but profit from higher prices. In equilibrium both types earn the same operating profits (covering the set-up costs).

We now denote by $p_T(j)$ the price of a home-produced good that is traded and by $p_N(j)$ the price when it is not traded, we have $p_N(j) = 1/\lambda$, $p_T(j) = p_F(j) = \tau/\lambda^*$, and $p_H^*(j) = p_F^*(j) = 1/\lambda^*$. Using the zero-profit conditions for traded goods it is straightforward to see that we still have $W = W^* = 1$. Hence also in a partial trade equilibrium, differences in per-capita endowments translate one-to-one into nominal per-capita income differences. From the zero profit conditions (taking account of price setting constraints) we calculate prices of traded goods as

$$p_T = p_F = \frac{\tau}{1+\tau}\frac{aF + (1+\tau)\mathcal{P}}{a\mathcal{P}} \quad \text{and} \tag{13}$$

$$p_F^* = p_H^* = \frac{1}{1+\tau}\frac{aF + (1+\tau)\mathcal{P}}{a\mathcal{P}}, \tag{14}$$

[13] Note that due to the static setting we do not need to introduce patents - however, we implicitely assume international exhaustion. In a dynamic setting the design of patents is crucial for the outcomes. Grossman and Lai (2004) and Grossman and Lai (2006) discuss such models. For a general overview on parallel imports see for example Maskus (2000).

whereas the prices of non-traded goods are

$$p_N = \frac{aF + \mathcal{P}}{a\mathcal{P}}. \tag{15}$$

In equilibrium the (poor) foreign country produces N^* goods all of which are traded whereas the (rich) home country produces N goods of which only N_T are traded and N_N are not traded. In the foreign country the resource constraint is $\mathcal{P}L^* = N^*\left(F + (1+\tau)\mathcal{P}/a\right)$ from which we calculate

$$N^* = \frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}} L^*. \tag{16}$$

In the home country the resource constraint is $\mathcal{P}L = N_T\left(F + (1+\tau)\mathcal{P}/a\right) + N_N\left(F + \mathcal{P}/a\right)$. Together the with trade balance condition $N_T p_H^* \mathcal{P} = N^* p_F \mathcal{P}$ this allows us to calculate

$$N_T = \frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}} \tau L^*, \quad \text{and} \tag{17}$$

$$N_N = \frac{a\mathcal{P}}{aF + \mathcal{P}} \left(L - \tau L^*\right). \tag{18}$$

Full trade, partial trade, and autarky It remains to determine the conditions under which either full trade, partial trade, or autarky emerges. A full rather than partial trade regime will prevail as long as the pricing constraint $p_H \leq \tau p_H^*$ is not violated. From equations (11) and (12) we see that the *FP-boundary* (full trade versus partial trade) is given by

$$\tau = \frac{L}{L^*}. \tag{19}$$

When $\tau > L/L^*$ partial trade cannot be an equilibrium and when $\tau < L/L^*$ full trade cannot be an equilibrium.

Full trade rather than autarky will prevail if trade is not too costly. This is the case when export prices have to be sufficiently large to make it worthwhile to trade, $p_H^* \geq \tau/a$.[14] Using equation (12) the *FA-boundary* (full trade versus autarky) can be stated as

$$\tau = \frac{L^*}{L} \frac{aF + \mathcal{P}}{\mathcal{P}}. \tag{20}$$

When $\tau < \left(L^*/L\right)\left(aF + \mathcal{P}\right)/\mathcal{P}$ autarky cannot be an equilibrium and when $\tau > \left(L^*/L\right)\left(aF + \mathcal{P}\right)/\mathcal{P}$ full trade cannot be an equilibrium.

Finally, a partial trade equilibrium rather than autarky will prevail if it is worthwhile to trade. This is the case as long as home producers can realize export prices that are sufficiently

[14] Notice that – when the pricing constraint and the trade condition are satisfied for home firm – the corresponding constraints are also satisfied for the foreign firms. Because home consumers are richer they are willing to pay higher prices than foreign consumers. Hence $p_F^* \leq \tau p_F$ and $p_F \leq \tau/a$ hold when $p_H \leq \tau p_H^*$ and $p_H^* \geq \tau/a$.

large to cover (production and transportation) costs $p_T/\tau \geq \tau/a$. Using equation (13) it is straightforward to determine the *PA-boundary* (partial trade versus autarky) as

$$\tau = \sqrt{aF/\mathcal{P} + 1}. \tag{21}$$

When $\tau < \sqrt{aF/\mathcal{P} + 1}$ autarky cannot be an equilibrium and when $\tau > \sqrt{aF/\mathcal{P} + 1}$ partial trade cannot be an equilibrium.

The three conditions (19), (20), and (21) fully characterize the possible equilibria that may emerge under the different parameter values. We are now able to state the following proposition

Proposition 2 *a) When $L^*/L > 1/\sqrt{aF/\mathcal{P} + 1}$, the general equilibrium will be characterized by full trade if $L/L^* \leq \tau < (L^*/L)(aF/\mathcal{P} + 1)$; by partial trade if $\tau > L/L^*$; and by autarky if $\tau \geq (L^*/L)(aF/\mathcal{P} + 1)$. b) When $L^*/L \leq 1/\sqrt{aF/\mathcal{P} + 1}$, a full trade equilibrium is not feasible. A partial trade equilibrium emerges if $\tau < \sqrt{aF/\mathcal{P} + 1}$ and there is autarky if $\tau \geq \sqrt{aF/\mathcal{P} + 1}$.*

Proposition can be most easily seen from Figure 2 which summarizes the various conditions in a diagram in $(L^*/L, \tau)$ space. Region **F** indicates parameter constellations for a full trade equilibrium, region **P** indicates a partial trade equilibrium and region **A** shows the autarky equilibrium. (Note that both the FP-boundary and the AP-boundary shift up when $aF/\mathcal{P}$ increases leaving a smaller area for region **A** and larger areas **F** and **P**. Hence, unsurprisingly, our model predicts that a higher productivity a, a larger fixed cost F and a lower population size $\mathcal{P}$ foster international trade.[15])

Figure 2

In region **F**, characterized by high values of L^*/L and intermediate values of τ, a full trade regime prevails. Higher values of τ have to be associated with more equality between countries. This is because higher trade costs have to be compensated by a higher willingness to pay of consumers in the poorer country. More surprisingly, also lower values of τ may lead to a situation where free trade is no longer feasible. The reason is that a very low τ limits the scope of price setting for home producers. Only if consumers of the two countries have very similar incomes (so that differences in their willingnesses to pay are minor), the price setting constraint for home producers becomes binding if τ becomes small. Notice also that a full trade equilibrium is only possible if income differences between the two countries

[15] A larger F fosters international trade because there is an incentive to share fixed costs on an international market. A lower population $\mathcal{P}$ reduces the incentive to trade because a large internal market makes it less necessary to share the fixed costs. A higher productivity a reduces production costs and increases the propensity to sell abroad. Notice that the two former predictions are also relevant in the standard CES framework of new trade theory. However, the latter result does not show up.

are sufficiently small, i.e. when level, $L^*/L \geq 1/\sqrt{aF/\mathcal{P}+1}$. If income differences are larger the economies either remains autarkic or trade only a subset of the goods that are produced worldwide.

In region **P**, characterized by low trade costs and high differences in average incomes, a partial trade equilibrium emerges. Why is there international trade even when income differences become extremely large? To see the intuition consider a home firm's incentive to export under autarky. A firm active on the home market could produce additional $\mathcal{P}$ units of its product and sell it on the foreign market yielding a revenue $\mathcal{P}/\lambda^*$; use this revenue to purchase $\mathcal{P}$ units of some foreign good; and resell it on the home market at price at price $\mathcal{P}/\lambda$. The extra costs of this strategy consist of the cost of production for additional $\mathcal{P}$ units of output, the transportation costs of exporting the own product and re-importing a foreign product which adds up to $(W/a)\,\tau^2\mathcal{P}$. The additional revenue from selling the foreign product on the home market is $\mathcal{P}/\lambda$ which, in an autarky equilibrium, equals $(W/a)\,(aF+\mathcal{P})$. Notice that neither the additional revenue nor the additional cost depend on the income differences between countries. The former are larger than the latter if $\tau < \sqrt{aF/\mathcal{P}+1}$. In that case, autarky cannot be an equilibrium. When income differences are large, the constraints on pricing behaviors becomes binding and internationally active home firms get low prices on the home market whereas all remaining home firms sell only on the local market and do not trade internationally.

In region **A**, characterized by high trade costs and high differences in endowments, the two economies remain autarkic. Transportation costs are too high to make international trade worthwhile. The critical level of τ above which there is no incentive to trade depends on the differences in average incomes between countries. With low differences in average incomes between countries, $L^*/L \geq 1/\sqrt{aF/\mathcal{P}+1}$, there will be full trade equilibrium at moderate trade costs. The critical level of trade costs above which the economies remain autarkic is higher the smaller the international income differences. The reason is that smaller income differences mean higher export prices p_H^* for home firms so that the full trade condition $p_H^* \geq \tau/a$ calls for higher transportation costs to become binding. In contrast, when income differences between countries are high, $L^*/L < 1/\sqrt{aF/\mathcal{P}+1}$, this critical level of transportation costs is independent of income differences (because switching to trade results in a partial trade equilibrium where pricing constraints are independent of differences in consumers' willingnesses to pay and hence independent of endowment differences).

Per-capita incomes and the intensity of trade An interesting feature of our analysis is that our model predicts are positive relationship between per-capita incomes and the intensity of trade. In others words, our model fits the Linder hypothesis. Linder (1961) emphasized the similarity between countries, in particular the importance of differences in average incomes, as an important determinant of the intensity of international trade. This is exactly what our model predicts.

Proposition 3 *Assume that $\tau < \sqrt{aF/\mathcal{P}+1}$. The intensity of trade increases with relative per-capita endowments if $L^*/L < 1/\tau$; reaches its maximum level at $L^*/L = 1/\tau$; and stays at that level for $L^*/L \in [1/\tau, 1]$.*

To see why proposition 3 holds true it is interesting to look at "trade intensity", the fraction of traded goods in total goods produced worldwide. It is straightforward to calculate

$$\phi = \frac{N^* + N_T}{N^* + N_T + N_N} = \frac{(1+\tau)(1+aF/\mathcal{P})}{1 + aF/\mathcal{P} - \tau^2 + (1+\tau+aF/\mathcal{P})\, L/L^*}. \tag{22}$$

Equation (22) reveals that a higher L^*/L is associated with a lower trade intensity ϕ. In Figure 3 we draw ϕ (vertical axis) against relative labor endowments L^*/L (horizontal axis) holding worldwide resources $\mathcal{P}(L + L^*)$ constant. (A decrease in L^*/L is a mean-preserving spread in world endowments.) At low values of L^*/L, $L^*/L < 1/\sqrt{aF/\mathcal{P}+1}$, the general equilibrium is characterized by partial trade. In that case a reduction in L^*/L leads to a lower intensity of trade: a decreasing range of traded goods $N^* + N_T$ is associated with an increasing range of non-traded goods N_N, the result stated in Proposition 3. At high values of L^*/L, $L^*/L \geq 1/\tau$, the general equilibrium is characterized by full trade. In other words when countries are sufficiently similar all produced goods are traded and consumed in both countries. Trade intensity reaches its highest possible level.

Figure 3

There is a subtle difference between this proposition and the hypothesis put forth by Linder. Linder emphasized the role of differences in per-capita *incomes* between countries. In contrast Proposition 3 is based on differences in per-capita *endowments*. In our framework, endowments are exogenously given whereas real per-capita incomes are endogenously determined (because wages and prices are endogenous). Recall that $W = W^* = 1$ so the ratio of (foreign to home) real per-capita incomes are can be written as $(y^*/p^*)/(y/p) = (L^*/L)/(p^*/p)$. Here p and p^* denote the price indices for a home consumer and a foreign consumer, respectively. Notice that in a full trade equilibrium $L^*/L = p^*/p$, see equations (11) and (12). Hence, despite differences in per capita endowments, real per-capita incomes are identical. Changes in L^*/L are fully accommodated by corresponding changes in p^*/p leaving the income ratio unchanged.

In a partial trade equilibrium we have $p = p_T\phi + p_N(1-\phi)$ and $p^* = p_T/\tau$. From (13), (15) and (14) we see that p_T and p_N, and p^* are not affected by L^*/L. However, trade intensity ϕ and hence also p are decreasing in L^*/L, see (22). This implies that also in a partial trade equilibrium p^*/p and L^*/L are positively related. However, the effect of L^*/L on ϕ is less than proportional so diverging endowments (a reduction in L^*/L) are not fully compensated by the fall in p^*/p.[16] As a result, per-capita incomes diverge. In sum, our model fits the Linder hypothesis in the sense that it generates a positive relationship between two endogenous variables: trade intensity and differences in real per-capita incomes.

Gains from trade Let us look in more detail at the distribution of the gains from trade. In a *full trade* equilibrium all goods that are produced worldwide are purchased by consumers in both countries. Hence the welfare levels of consumers are identical in both countries despite their unequal endowment with economic resources

$$U^f = U^{f*} = \frac{a\mathcal{P}}{aF + (1+\tau)\,\mathcal{P}}\,(L + L^*)\,.$$

This results is driven by the price setting behaviors of firms. Home consumers are willing to pay higher prices than foreign consumers because their nominal income is higher. As costs are identical between countries it must be that home consumers bear a larger share in total cost. To see the mechanism that drives this result consider the average markups paid by the consumers.[17] In equilibrium zero profits prevail. This implies that the markups are fully used to cover fixed costs and iceberg losses during transportation. Since home consumers pays the higher markups they bears a larger part of the costs that do not directly originate from production. As a result, the gains from trade are smaller for the home consumer than for the foreign consumer. This can be immediately seen from the home and foreign welfare levels under autarky which are given by $U^a = L/\,(F + 1/a) > U^{a*} = L^*/\,(F + 1/a)$.

In a *partial trade* equilibrium welfare levels of the home and foreign consumers diverge. In the foreign country consumers purchase N_T goods whereas home consumers purchase $N^* +$

[16] This is evident from equation (22) and the condition $\tau < \sqrt{aF/\mathcal{P} + 1}$.

[17] The rich country consumer pays on average higher markups than the poor country consumer. The markup is defined as the price charged on a specific market divided by the marginal costs of supplying that market. Therefore, the markup charged by a home country producer in his local market is $\mu_H = a/\lambda = aL/\,(L + L^*)\,(F + (1+\tau)\,/a)$. The markup he charges abroad is $\mu_H^* = a/\,(\tau\lambda^*) = a/\tau L^*/\,(L + L^*)\,(F + (1+\tau)\,/a)$. For a foreign country producer's markups we get $\mu_F = a/\,(\tau\lambda) = a/\tau L^*/\,(L + L^*)\,(F + (1+\tau)\,/a)$ and $\mu_F^* = a/\,(\lambda^*) = aL^*/\,(L + L^*)\,(F + (1+\tau)\,/a)$. Thus, a home country consumer pays on average a markup $\mu = \mu_H N/\,(N + N^*) + \mu_F N^*/\,(N + N^*)$, i.e. the two producers' markups weighted with their relative importance in the consumption bundle. The respective average markup that the foreign country producer pays is $\mu^* = \mu_H^* N/\,(N + N^*) + \mu_F^* N^*/\,(N + N^*)$. Dividing these two average markups by each other and substituting for the endogenous variables yields

$$\frac{\mu}{\mu^*} = \frac{\frac{L}{L^*} + \frac{1}{\tau}}{\frac{L^*}{L} + \frac{1}{\tau}},$$

which implies that the home country agent pays on average higher markups as long as $L > L^*$, i.e. as long as it is the richer country.

$N_T + N_N$ goods. This gives welfare levels

$$U^{p*} = \frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}} (1+\tau) L^* \quad \text{and}$$
$$U^{p} = \frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}} (1+\tau) L^* + \frac{aF + \mathcal{P}}{\mathcal{P}} (L - \tau L)$$

Notice that welfare in the home country decreases in τ (lower transportation costs or trade liberalization increases welfare) but the opposite is true for foreign welfare. We are now able to state the following proposition.

Proposition 4 *Home consumers favor free trade, i.e.* $\tau = 1$, *whereas foreign consumers derive their highest utility when there are trade barriers such that* $\tau = \min\left[\sqrt{aF/\mathcal{P}+1}, L/L^*\right]$.

The proposition can be readily demonstrated using Figure 4. Panel a) is drawn for the case when $L^*/L \geq 1/\sqrt{aF/\mathcal{P}+1}$ so that a full trade equilibrium emerges with moderate transportation costs. Panel b) is drawn for the case when $L^*/L < 1/\sqrt{aF/\mathcal{P}+1}$ so that a full trade equilibrium is not feasible. In both panels of Figure 4 home welfare (the bold graph) is monotonically decreasing in τ. Hence the home consumer reaches it maximum welfare when trade costs have reached their lowest possible level, at $\tau = 1$. However, in both panels of Figure 4, foreign welfare (the dotted graph) *increases* in τ when transportations costs are sufficiently low, i.e. when a partial trade emerges. In panel a) when $\tau \in [L/L^*, aF/\mathcal{P}+1]$ a full trade regime emerges where welfare decreases in τ and for even higher $\tau > aF/\mathcal{P}+1$ the economies remain autarkic where welfare obviously becomes independent of τ. Figure 4 also shows that the highest welfare for foreign consumers occurs at $\tau = L/L^*$ when $L^*/L \geq 1/\sqrt{aF/\mathcal{P}+1}$ and at $\tau = \sqrt{aF/\mathcal{P}+1}$ when $L^*/L < 1/\sqrt{aF/\mathcal{P}+1}$. Taken together, this yields the result in Proposition 4.

Figures 4a, 4b

Proposition 4 shows the crucial role of transportation costs for welfare. Unequal countries have different preferred trade barriers (or different preferred degrees of trade liberalizations). Consumers in the (rich) home country are essentially free-traders whereas consumers in the (poor) foreign country's only want liberalization up to a positive level of transportation costs. Foreign consumers do only benefit from liberalization as long as producers are able to freely discriminate prices. In that case a reduction of transportation costs also results in lower prices. However, transportation costs are sufficiently low, however, prices in the foreign country are increasing in the level of transportations costs. Lower transportation costs induces some home firms to take advantage of the home consumers' higher willingnesses to pay by removing their product from the international market and selling only on the home market. The lower range of available goods in the foreign country allows suppliers in the foreign country to charge higher prices which harms foreign consumers.

World welfare and social optimum In both panels of Figure 4 the foreign welfare levels exhibit discrete jumps at the autarky boundary. This suggests that it should be possible for a social planner to achieve an improvement in world welfare - at least around these jumps. In the upper panel of Figure 4 we assume that $L/L^* < 1/\sqrt{aF/\mathcal{P}+1}$, so the decentral solution is partial trade for very low τ, full trade for intermediate values of τ and autarky for high levels of τ. (When $L/L^* > 1/\sqrt{aF/\mathcal{P}+1}$, so that full trade is not possible the analysis is very similar. This case is depicted in the lower panel of Figure 4). We also assume that transportation costs are sufficiently low so that in the decentral equilibrium partial trade is a feasible solution.

We first need to specify a social welfare function. Let us start by assuming the social planner's objective is to *maximize aggregate world welfare* $V = U + U^*$. In that case, the planner's problem is to maximize the number of products available worldwide and let both representative agents consume one unit of each variety. Notice that with utilitarian utility (and equal weights) the social planner will never implement a partial trade allocation. This would be suboptimal as maximum fixed costs dispersion requires production for the largest possible market. This means the social welfare function is $V = 2(N + N^*)$. Maximizing V subject to the economies' resource constraints. Inserting the resource constraints into the welfare function yields aggregate world welfare when all produced goods are distributed to both markets

$$V = 2\frac{a\mathcal{P}}{aF + (1+\tau)\mathcal{P}}(L + L^*). \tag{23}$$

Notice that for sufficiently high transportation costs even the social planner favors autarky over free trade. World welfare under autarky is

$$V^a = \frac{a\mathcal{P}}{aF + \mathcal{P}}(L + L^*). \tag{24}$$

From comparing equations (23) and (24) we see that for sufficiently low transportation costs aggregate world welfare is higher when producers serve both markets rather than when they stay autarkic. The critical level of transportation costs below which the social planner favors openness rather than autarky is

$$\tilde{\tau} = aF/\mathcal{P} + 1,$$

which is identical to the trade condition between equal countries (see Proposition 1).

Panel a) of Figure 5 plots world welfare attained by the social planner (the bold graph) and world welfare attained in the decentral equilibrium (the dotted graph). We see that the two graphs coincide when the decentral solution features full trade, but higher levels of welfare can be attained when the decentral solution features either partial trade or autarky. For low transportation costs, $\tau < L/L^*$, the social planner can increase world welfare by implementing full trade rather than partial trade. This increases world welfare because it reduces average costs of production (fixed costs are spread among the largest possible number of consumers for each product). For high transportation costs $\tau \in [(L^*/L)(aF/\mathcal{P}+1), aF/\mathcal{P}+1]$ the social planner increases world welfare by implementing full trade rather than autarky. In the decentralized solution the trade condition is $\tau < (L^*/L)(aF/\mathcal{P}+1)$ (which implies that prices abroad have to be larger than marginal costs of production at home), whereas socially optimal trade condition is $\tau < aF/\mathcal{P}+1$ (which implies that world welfare under autarky becomes smaller than world welfare under full trade). One possibility to implement the socially optimal solution is an subsidy for exports to the foreign (poor) country. This gives home producers an incentive to export although the foreign consumer's willingness to pay is lower than the marginal costs of production and transportation.

Figure 5

A second possible objective of a social planner is world welfare subject to the constraint that only *Pareto-improving* allocations (relative to the decentral solution) are feasible. This means no welfare improvement can be achieved for low trade costs when the world economy is in a decentralized partial trade equilibrium. Starting from such an equilibrium, any other allocation would make (rich) home consumers strictly worse off than under the decentralized solution. However, a Pareto-improving allocations are still possible for high transportation costs when the world economy is in a decentralized autarky equilibrium. Formally, the social planner maximizes $V = U + U^*$ subject to the additional constraints $U \geq U^a = La\mathcal{P}/(aF+\mathcal{P})$ and $U^* \geq U^{a*} = L^*a\mathcal{P}/(aF+\mathcal{P})$ where U^a and U^{a*} are the countries' welfare levels under autarky. Let us first assume that $\tau = (L^*/L)(aF/\mathcal{P}+1)$ so that the home producer is exactly indifferent between trading and autarky in the decentralized equilibrium. If the transportation costs are now slightly higher the decentral equilibrium is autarky. Nevertheless it should be possible for a social planner to let almost all firms produce for both markets. To guarantee a welfare level of at least N^a to the (rich) home consumer, the social planner assigns γL units of the home endowment to produce solely for the home market. The problem is then to choose γ such that $N^a = N^* + \tilde{N}_T(\gamma) + \tilde{N}_N(\gamma)$, where $\tilde{N}_N(\gamma) = \gamma La\mathcal{P}/(aF+\mathcal{P})$ and $\tilde{N}_T(\gamma) = (1-\gamma)La\mathcal{P}/(aF+(1+\tau)\mathcal{P})$. Solving for γ yields

$$\gamma = 1 - \frac{1}{\tau}\frac{L^*}{L}\left(\frac{aF+\mathcal{P}}{\mathcal{P}}\right). \tag{25}$$

Note that for $\gamma = 0$ we are exactly in the case where decentral case just emerges, i.e. $\tau = (L^*/L)(aF/\mathcal{P}+1)$. Of course, we need as well that the foreign consumer is always at least as well off as in autarky, i.e. $N^{a*} \leq N^* + \tilde{N}_T(\gamma)$. Solving for the critical γ yields

$$\gamma = 1 - \tau\frac{L^*}{L}\frac{\mathcal{P}}{aF+\mathcal{P}}. \tag{26}$$

As γ is strictly rising in τ in equation (25) whereas γ is strictly falling in τ in equation (26) there must be a unique level of transportation costs that induces the social planner to switch from full trade to autarky. By equalizing (25) and (26) we find the critical level $\tilde{\tau} = aF/\mathcal{P} + 1$. Note that this critical level is the same one that induces the unconstrained social planner to switch from full trade to autarky.

Panel b) of Figure 5 plots world welfare attained by the social planner and world welfare attained in the decentral equilibrium when the social planners is constrained to Pareto-improving allocations. We see that with transportation costs in the range $\tau \in [(L^*/L)(aF/\mathcal{P} + 1), aF/\mathcal{P} + 1]$ a Pareto-improving allocation is possible. Just like before, a consumption tax to subsidize exports in the rich country could be used to implement the social planner's Pareto-improving solution.

5 Conclusions

In this paper we have presented a model of monopolistic competition and international trade in which income effects play a crucial role. The argument that average income levels are potentially important determinants international trade has a long tradition in the theoretical debate and dates back at least to Linder (1961) who has argued that per-capita incomes are an important determinant for the intensity of trade between countries. Moreover, numerous empirical studies have unequivocally supported the relevance of income levels as a determinant of the volume and the patterns of international trade.

We have argued that, due to the homotheticity of preferences assumed in the canonical model of new trade theory, the notion of income effects remains unclear in this framework of analysis. In contrast, income effects have a precise meaning in the present context. Rather than sticking to CES-preferences we have assumed have "0/1 preferences". This specification of preferences is meaningful when consumer goods are indivisible and households face a 0/1 choice: either one unit of a good is consumed or it is not consumed at all. In such a context the consumer's problem is to choose the number of goods, while there is no choice about the quantity per consumed variety. This is different from the standard model where consumers choose the quantity consumed per variety but have essentially no choice about the number of goods (because homothetic preferences force them to purchase *all* supplied varieties). In this sense, the assumption on consumer preferences adopted in this paper is equally general (or special) as the assumption of homothetic preferences in the standard model.

Two main results emerge from our analysis. The *first* result is that our model provides a precise formulation of the Linder hypothesis in the context of an otherwise standard new trade theory model. We find that, when countries are very dissimilar, no trade will take place. In contrast, when countries are very similar, trade emerges and all goods that are produced in the world economy will be traded and consumed in both countries. For an intermediate degree of similarity, the equilibrium outcome features a situation where product variety is narrow in the poor country; broad in the rich country; and only a subset of the goods produced worldwide will be internationally traded.

A *second* main result that emerges from our analysis relates to the gains from trade and the distribution of welfare between countries. We find that, when countries are sufficiently similar, so that all goods are traded the poorer country gains more than the rich country. The reason is that consumers in the rich country bear a relatively larger share in the fixed cost in production. This result is driven by the fact that richer consumers are willing to pay more for the various goods which allows firms to charge high prices and mark-ups. When countries are more dissimilar (but not too dissimilar to rule out trade at all), producers in the rich country can no longer take full advantage of the higher willingness to pay of rich-country consumers. The reason is a threat of parallel imports which disciplines firms' price-setting behavior. We show that, in such a situation the rich country gains disproportionately from a reduction in transportation costs whereas poor country will be harmed. As a result, the poor country may oppose a trade liberalization.

Our model could be extended along various lines. One obvious extension is to allow for income inequality within countries. This would generate further interesting insights as the non-homotheticity of "0/1-preferences" leads to a situation where price-setting behavior is not only affected by between-country inequality but also by the distribution of income within countries. A second potentially interesting direction for future research concerns political economy issues of international trade. Whether trade liberalization policies can be implemented will crucially depend on the distribution of trade gains between countries. A detailed analysis of the involved conflicts of interest implied by income effects may yield potentially important insight into the political economy of international trade negotiations.

References

[1] Bohman, Helena and Désirée Nilsson (2006) "Income Inequality as a Determinant of Trade Flows", CESIS Electronic Working Paper Series, Paper No. 73.

[2] Choi, Yo Chul, David Hummels, and Chong Xiang (2006) "Explaining Export Variety and Quality: The Role of the Income Distribution", NBER Working Paper No. 12531.

[3] Chung, Chul (2005) "Nonhomothetic Preferences as a Cause of Missing Trade and Other Mysteries", mimeo.

[4] Dalgin, Muhammed, Devashish Mitra, and Vitor Trindade (2006) "Inequality, Nonhomothetic Preferences, and Trade: A Gravity Approach", mimeo.

[5] Davis, Donald R. (1998) "The Home Market, Trade, and Industrial Structure", *American Economic Review*, Vol. 88(5), 1264-1276.

[6] Flam, Harry and Elhanan Helpman (1987) "Vertical Product Differentiation and North-South Trade", *American Economic Review*, Vol. 77(5), 810-822.

[7] Francois, Joseph F. and Seth Kaplan (1996) "Aggregate Demand Shifts, Income Distribution, and the Linder Hypothesis", *Review of Economics and Statistics*, Vol. 78(2), 244-250.

[8] Grossman, Gene M. and Edwin L.-C. Lai (2004) "International Protection of Intellectual Property", *American Economic Review*, Vol. 94(5), 1635-1653.

[9] Grossman, Gene M. and Edwin L.-C. Lai (2004) "Parallel Imports and Price Controls", NBER Working Paper No. 12432.

[10] Helpman, Elhanan and Paul R. Krugman (1985) *Market Structure and Foreign Trade: Increasing Return, Imperfect Competition, and the International Economy*, MIT Press, Cambridge MA and London.

[11] Helpman, Elhanan, Marc Melitz, and Yona Rubinstein (2007) "Trading Partners and Trading Volumes", NBER Working Paper No. 12927.

[12] Hunter, Linda C. (1991) "The Contribution of Nonhomothetic Preferences to Trade", *Journal of International Economics*, Vol. 30(3-4), 345-358.

[13] Hunter, Linda C. and James R. Markusen (1988) "Per Capita Income as a Basis for Trade", in Robert Feenstra, ed., *Empirical Methods for International Trade*, MIT Press, Cambridge MA and London.

[14] Krishna, Kala and Cemile Yavas (2005) "When Trade Hurts: Consumption Indivisibilities and Labor Market Distrotions", *Journal of International Economics*, Vol. 67(2), 413-427.

[15] Krugman, Paul R. (1980) "Scale Economies, Product Differentiation, and the Pattern of Trade", *American Economic Review*, Vol. 70(5), 950-959.

[16] Krugman, Paul R. (1979) "Increasing Returns, Monopolistic Competition, and International Trade", *Journal of International Economics*, Vol. 9(4), 469-79.

[17] Linder, Staffan B. (1961) *An Essay on Trade and Transformation*, Almqvist and Wiksells, Uppsala.

[18] Markusen, James R. (1986) "Explaining the Volume of Trade: An Eclectic Approach", *American Economic Review*, Vol. 76(5), 1002-1011.

[19] Maskus, Keith E. (2000) "Parallel Imports", *The World Economy*, Vol. 23(9), 1269-1284.

[20] Matsuyama, Kiminori (2000) "A Ricardian Model with a Continuum of Goods under Nonhomothetic Preferences: Demand Complementarities, Income Distribution, and North-South Trade", *Journal of Political Economy*, Vol. 108(6), 1093-1120.

[21] Melitz, Marc J. (2003) "The Impact of Trade on Intra-Industry Allocation and Aggregate Industry Productivity", *Econometrica*, Vol. 71(6), 1695-1725.

[22] Melitz, Marc J. and Gianmarco I.P. Ottaviano (2005) "Market Size, Trade, and Productivity", NBER Workingpaper No. 11393.

[23] Mitra, Devashish and Vitor Trindade (2005) "Inequality and Trade", *Canadian Journal of Economics*, Vol. 38(4), 1253-1271.

[24] Mountford, Andrew (2006) "International Trade and Growth Miracles: the Implications of Nonhomothetic Preferences", *Review of International Economics*, Vol. 14(4), 645-657.

[25] Neary, Peter J. (2003a) "International Trade in General Oligopolistic Equilibrium", mimeo.

[26] Neary, Peter J. (2003b) "Globalization and Market Structure", *Journal of the European Economic Association*, Vol. 1(2-3), 245-271.

[27] Ravn Morten, Stephanie Schmitt-Grohe, and Martin Uribe (2007) "Incomplete Cost Pass-Through Under Deep Habits", NBER Working Paper No. 12961.

[28] Sauré, Philip (2006) "Productivity Growth, Bounded Marginal Utility, and Patterns of Trade", mimeo.

[29] Trefler, Daniel (1995) "The Case of the Missing Trade and Other Mysteries", *American Economic Review*, Vol. 85(5), 1029-1046.

A Equilibrium conditions for the 0-1 case

In this section we provide the full set of equilibrium conditions for the full trade and the partial trade eqilibrium. Note that in contrast to the main text we allow the per-capita labor endowments as well as population size to differ.

A.1 Full Trade Equilibrium

From the Lagrangian

$$\mathcal{L} = \left(\int c_H(j)\, dj + \int c_F(j)\, dj \right) + \lambda \left(WL - \int p_H(j)\, c_H(j)\, dj + \int p_F(j)\, c_F(j)\, dj \right).$$

we get the first-order conditions

$$\begin{aligned} c_H(j) &= 1, \text{ if } 1 \geq \lambda p_H(j), \ \ 0 \text{ else,} \\ c_F(j) &= 1, \text{ if } 1 \geq \lambda p_F(j), \ \ 0 \text{ else,} \\ c_H^*(j) &= 1, \text{ if } 1 \geq \lambda^* p_H^*(j), \ \ 0 \text{ else and} \\ c_F^*(j) &= 1, \text{ if } 1 \geq \lambda^* p_F^*(j), \ \ 0 \text{ else,} \end{aligned}$$

These conditions yield the step-demand curves of Figure 1. On the basis of these conditions, firms set prices

$$\begin{aligned} p_H(j) &= 1/\lambda, && (27) \\ p_F(j) &= 1/\lambda, && (28) \\ p_H^*(j) &= 1/\lambda^* \text{ and} && (29) \\ p_F^*(j) &= 1/\lambda^*. && (30) \end{aligned}$$

The resource constraints are

$$\begin{aligned} \mathcal{P}L &= N\left(F + \frac{\mathcal{P} + \tau \mathcal{P}^*}{a}\right) \text{ and} && (31) \\ \mathcal{P}^* L^* &= N^*\left(F^* + \frac{\mathcal{P}^* + \tau^* \mathcal{P}}{a^*}\right), && (32) \end{aligned}$$

and the zero profit conditions are

$$\begin{aligned} p_H \mathcal{P} + p_H^* \mathcal{P}^* &= W\left(F + \frac{\mathcal{P} + \tau \mathcal{P}^*}{a}\right) \text{ and} && (33) \\ p_F \mathcal{P} + p_F^* \mathcal{P}^* &= W^*\left(F^* + \frac{\mathcal{P}^* + \tau^* \mathcal{P}}{a^*}\right). && (34) \end{aligned}$$

The balance of payments requires

$$N p_H^* \mathcal{P}^* = N^* p_F \mathcal{P}. \quad (35)$$

Equations (27)-(33) are nine equations in ten unknowns: p_H, p_H^*, p_F, p_F^*, λ, λ^*, N, N^*, W, and W^*.[18] We get the tenth equation by choice of a numeraire (home labor)

$$W = 1. \tag{36}$$

A.2 Partial Trade Equilibrium

In a partial trade equilibrium, the same Lagrangian and the same first order conditions apply. However, price determination is now different. Assuming home is the richer country, home-producers are of two types: type T who is internationally active but has limited scope in price setting on the local market (by the threat of parallel imports); or type N who sells only on the local market and who can charge the price that local consumers are willing to pay. Price setting on the home market is also limited by foreign producers (by the threat of parallel exports). Firms set prices

$$p_T(j) = \tau/\lambda^*, \quad \text{for } j \in [0, N_T] \tag{37}$$

$$p_N(j) = 1/\lambda, \quad \text{for } j \in (N_T, N_T + N_N] \tag{38}$$

$$p_F(j) = \tau/\lambda^* \tag{39}$$

$$p_H^*(j) = 1/\lambda^* \text{ and} \tag{40}$$

$$p_F^*(j) = 1/\lambda^*. \tag{41}$$

The resource constraints are

$$\mathcal{P}L = N_T\left(F + \frac{\mathcal{P} + \tau\mathcal{P}^*}{a}\right) + N_N\left(F + \frac{\mathcal{P}}{a}\right) \text{ and} \tag{42}$$

$$\mathcal{P}^*L^* = N^*\left(F^* + \frac{\mathcal{P}^* + \tau^*\mathcal{P}}{a^*}\right), \tag{43}$$

and the zero profit conditions are

$$p_N\mathcal{P} = W\left(F + \frac{\mathcal{P}}{a}\right), \tag{44}$$

$$p_T\mathcal{P} + p_H^*\mathcal{P}^* = W\left(F + \frac{\mathcal{P} + \tau\mathcal{P}^*}{a}\right) \text{ and} \tag{45}$$

$$p_F\mathcal{P} + p_F^*\mathcal{P}^* = W^*\left(F^* + \frac{\mathcal{P}^* + \tau^*\mathcal{P}}{a^*}\right). \tag{46}$$

The balance of payments requires

$$N_T p_H^* \mathcal{P}^* = N^* p_F \mathcal{P}. \tag{47}$$

[18] Notice that the budget constraints $Np_H + N^*p_F = WL$ and $Np_H^* + N^*p_F^* = W^*L^*$ are implied by the resource constraint, the zero-profit condition and the trade balance condition. To see this write the resource constraint as $WL = WN[F + (1+\tau)/a]$, replace the term in $[]'s$ by to get $WL = N\left[p_H + p_H^*\right]$. Using the trade balance condition we can replace Np_H^* by N^*p_F which yields the consumer's budget constraint.

Equations (37)-(47) are eleven equations in twelfe unknowns: p_T, p_N, p_H^*, p_F, p_F^*, λ, λ^*, N_T, N_N, N^*, W, and W^*. We get the twelfth equation by choice of a numeraire (home labor)

$$W = 1. \tag{48}$$

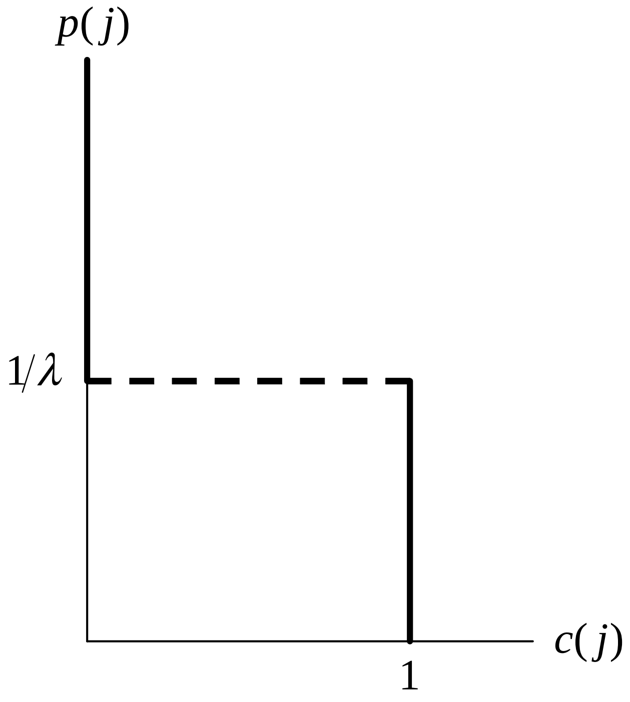

Figure 1: The microeconomic demand function with 0/1-preferences

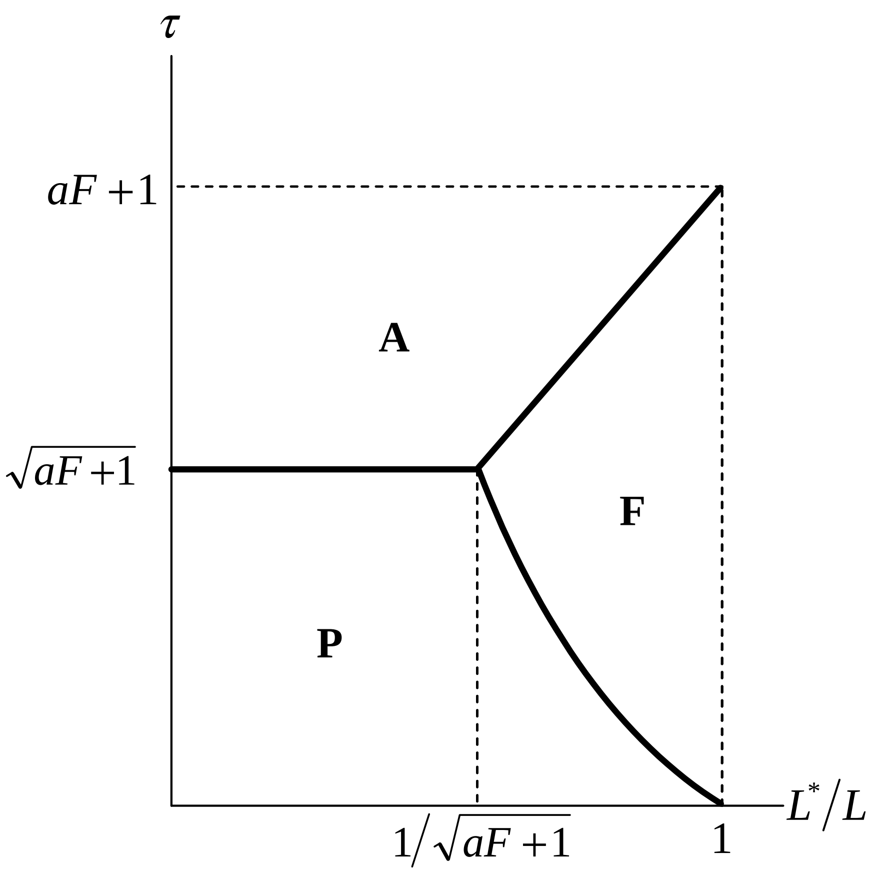

Figure 2: Depending on the level of the iceberg costs and the relative labor endowment full trade (F), a partial trade (P), or autarky (A) is the equililbrium outcome.

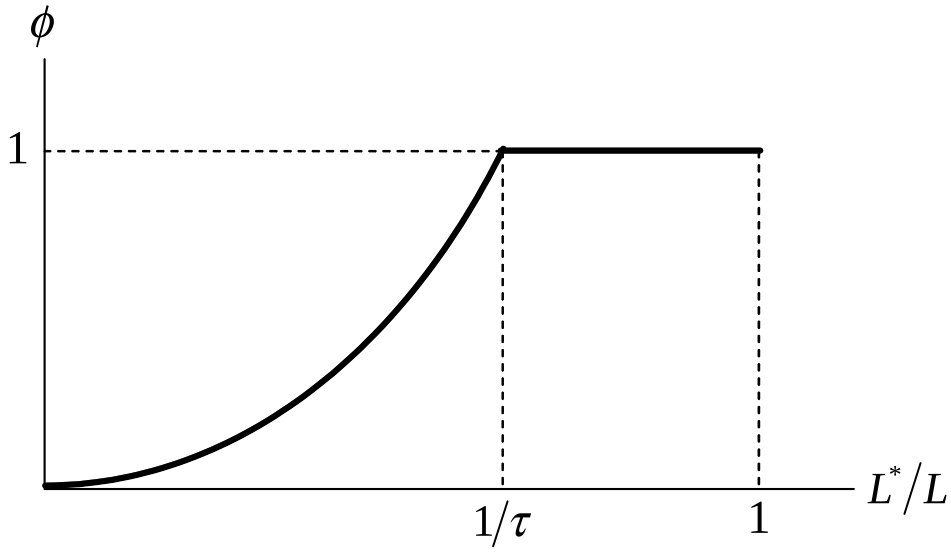

Figure 3: The more similar two countries the larger is the share of traded varieties ϕ.

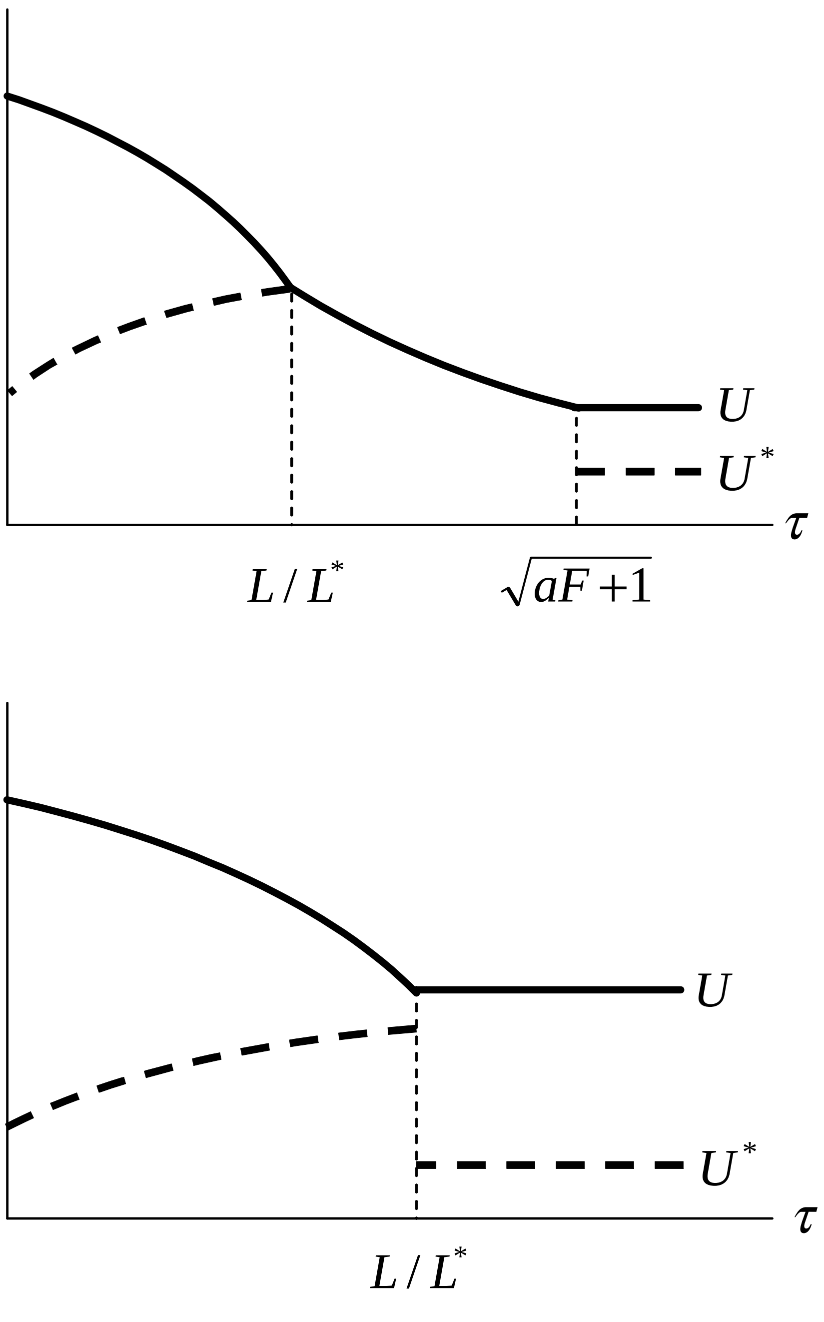

Figure 4: The equilibrium utility levels of representative home agent (U) and of a foreign agent (U^*) as a function of the iceberg costs. (a) The upper graph displays a situation where a full trade equilibrium emerges for some τ, where (b) in the lower graph only partial trade or autarky is possible.

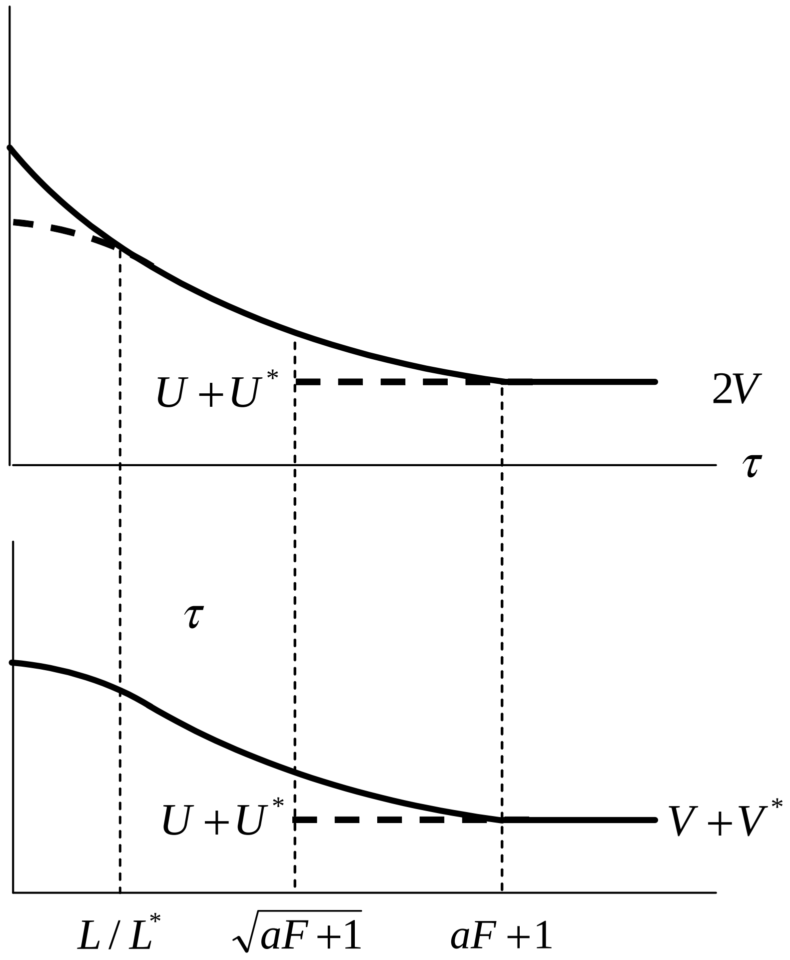

Figure 5: Aggregate welfare in the decentral equilibrium (dotted line, $U + U^{*}$) vs. the social planner solution ($V + V^{*}$). (a) in the upper graph the planner has a utilitarian welfare function, where in the lower graph (b) the social planner only considers pareto improvement vis-à-vis the decentral equilibrium