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Consumer Heterogeneity and the Impact of Trade Liberalization: How Representative is the Representative Agent Framework?*

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Abstract

While it is well established that across-country taste differences are associated with "home market effects", there is very limited analysis of how such preference heterogeneity impacts the aggregate volume of trade and the welfare gains from liberalization. I develop a structural model of aggregate demand featuring products with heterogeneous attributes, consumers with heterogeneous tastes for attributes, and across-country differences in the distribution of tastes. The impact of across-country taste differences depends on whether the domestic industry can adjust to the mismatch between the attribute composition of imports and the domestic distribution of tastes. For the case of a large degree of across-country taste differences, countries specialize completely and the model supports notions along the lines of Linder (1961) that taste diversity impedes the volume of trade and leads to group-specific gains from trade. In contrast, if specialization is incomplete, free firm entry implies that the relative toughness of competition across different market segments must be invariant to liberalization. It is shown that therefore, both trade volume and welfare gains are entirely unaffected by the distribution of foreign tastes and coincide with those in a representative agent framework.

Keywords: Intra-Industry Trade, Monopolistic Competition, Heterogeneous Agents, Industrial Structure, Firm Dynamics

JEL: F12, F15, L15, L16

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Starting with Krugman (1979) and Lancaster (1980), international trade theory has overwhelmingly been based on increasing returns and monopolistic competition. The property that distinguishes this "new" trade theory most clearly from supply-sided motives for trade is the "home market effect" of Krugman (1980) relating across-country differences in the distribution of consumer tastes to bilateral net trade flows.[1]

While there now exists ample empirical evidence for the home market effect and thus also for the existence of across-country taste heterogeneity (Davis and Weinstein (1999 and 2003), Feenstra et al. (2001), Head and Ries (2001), Weder (2003), Hanson and Xiang (2004), Crozet and Trionfetti (2008), and Brülhart and Trionfetti (2009)), most analysis in the theory of international trade is based upon preference frameworks that assume the existence of a globally representative consumer. This discrepancy is even more striking against the backdrop of recent empirical studies finding direct evidence against the notion that consumers can be typified by such a representative agent (Bills and Klenow (2001), Atkin (2009), and Broda and Romalis (2009)).

What is the relevant metric for the gains from trade when consumers have heterogeneous tastes? How do across-country differences in the distribution of tastes impact the volume of trade and the welfare gains from liberalization? In this paper, I demonstrate that, owing to the way in which the domestic industrial composition adjusts to trade, the effects of trade liberalization in a structural model of across-country demand heterogeneity may actually coincide with those in a representative agent framework.

The basic preference framework, presented in section 1, is one in which consumers are heterogeneous in their valuation of attributes, goods are heterogeneous in the level of the attribute they deliver, and in equilibrium, good attributes and consumer valuations tend to be matched assortively. A key assumption of the model is that firms can decide with what kind of good to enter the market and that therefore, attribute-entry is directed towards the distribution of consumer tastes.[2]

Section 3 nests these preferences in a model of the international economy featuring iceberg transportation costs and two countries that differ in the distribution of consumer valuations. The model comprises the standard representative agent framework of Dixit and Stiglitz (1977) as a special case, thus allowing to directly evaluate the impact of taste heterogeneity on trade flows, industrial composition dynamics, and the welfare gains from trade. The latter impact is shown to depend crucially on the degree to which the domestic industry composition can adjust to counteract the mismatch between the attribute composition of imports and the domestic distribution of tastes, i.e. on whether countries are completely specialized or not.

For the case of incomplete specialization, I find that the class of increasing returns models with constant markups gives rise to a result on the invariance of relative ideal price indices to trade that is akin to the factor price equalization theorem in the classical theory of trade. In the latter constant returns economy analyzed by Samuelson (1949), costless trade equates good prices and any equilibrium featuring incomplete specialization requires that factors of production receive exactly the same reward across countries. In the increasing returns economy analyzed

[1] This home market effect within the manufacturing sector is not to be confused with the home market effect analyzed in Krugman (1991), where sectors differ in their returns to scale and transportation costs, large countries specialize into the increasing returns manufacturing sector, and smaller nations specialize into the constant returns agricultural sector.

[2] This paper analyses the case where consumers are characterized by heterogeneous preference parameters over good attributes and homothetic preferences. Countries may also choose different consumption bundles in the presence of a representative agent with non-homothetic preferences and income heterogeneity (see Foellmi et al. (2008), Fieler (2009), and Fajgelbaum et al (2009)).

in this paper, the adjustment of firm profits is attained via relative firm scale. Irrespective of whether markets are open or not, the free firm "attribute-entry" condition requires that the set of competitors (adjusted for trade costs) producing a certain type of good is proportional to the number of consumers with a preference for the type of good in question. It is then shown that the interplay of the free attribute-entry conditions at Home and in Foreign requires that with symmetric trade costs, the domestic industry structure must adjust such as to *exactly* counteract the mismatch between the attribute composition of imports and the domestic distribution of tastes, in turn leaving the relative "toughness" of competition – summarized by ideal price indices – unaffected by trade.

A major implication of this finding is that the recent quantifications of the gains from trade based on the representative agent framework (see Broda and Weinstein (2004), Broda et al. (2006), and Akorlakis et al. (2008)), hold exactly even if the representative agent is actually not the correct description of the underlying consumption decisions. For example, if there are two goods wine and beer, assume that the French population consists mostly of wine lovers, while the opposite is true for Germany. German exports are then too "beer-intensive" for the typical French consumer, but this is offset by the French industry specializing into the wine segment. On the consumer side, this implies that while the group of French beer lovers gains relatively more from the imported German varieties, the domestic industry responses favors French wine lovers. In equilibrium these two effects exactly offset each other and all consumers benefit from trade in the same proportion irrespective of the distribution of tastes abroad and in the exact same proportion as in the large class of representative agent models surveyed in Akorlakis et al. (2009).

Second, this finding also reemphasizes the challenge that trade theory faces in reconciling the observed volume of trade with measured trade costs (see, for example, Anderson and Van Wincoop (2003) and the literature on the "missing globalization puzzle"). Starting with Linder (1961) and Armington (1969), there is ample informal notion in the literature that differences between theoretical predictions and empirical estimates of trade volume can be explained by unmeasured across-country differences in consumer tastes. These notions disregard the fact that demand for imports is not determined by preferences alone, but also, by how well these preferences are served by the domestic industry. With trade, the home market effect implies that a lower domestic valuation for an attribute is associated with an over-proportional reduction in domestic production of goods embodying the attribute and the equilibrium therefore features a high import volume of goods that are in low demand. Overall, this implies that the aggregate volume of trade is equal to the level one would observe in a representative agent economy.

Taste heterogeneity can matter for trade if the degree of across-country taste differences is large so that both countries are completely specialized (each in a different sector). In the above introduced example, Germany then exports only beer, for which demand in France is so low that even in the absence of any French beer producer there is still little demand for beer; German exports are thus not "appropriate" for the tastes of the average French consumer. Then, across-country taste differences are associated with a "consumption home-bias" in the Armington (1969) sense that the volume of trade is lower than what would be expected on the basis of transportation costs and the elasticity of demand and the model confirms Linder's (1961, p. 94) conjecture that "[t]he more similar is the demand structure of two countries, the more intensive, potentially, is the trade between these two countries."

Is complete specialization a relevant case? The pervasiveness of zero trade flows (see the survey in Helpman et al. (2008)) suggests that at least in some industries, some countries are completely specialized.[3] It is noteworthy, however, that the analysis also implies that taste heterogeneity may matter only little for the effect of liberalization even if specialization is complete. For example, if parameters are such that specialization is complete but only marginally so, the volume of trade and the welfare gains from trade are still equal to the one prevailing in a representative agent framework.

Before concluding, I show that also a small degree of across-country taste differences can affect the volume of and the gains from trade in the transition from autarky to liberalization if industry composition reacts with a lag to liberalization. In section 5, I show in a extension of the model that in the short run after liberalization, the welfare gains from trade occur disproportionately to the comparatively smaller group of consumers, since this group gains access to a comparatively large set of new imported varieties. Moreover, in the short run after liberalization, differences in the distributions of tastes across countries are associated with lower trade volume. In autarky, the composition of the domestic industry adjusts to the distribution of consumer valuations such that all firms have equal sales. Second, in the presence of across-country taste differences, the foreign industry is not composed proportional to the home distribution of tastes and consequently, imports tend to increase the toughness of competition more in some segments than in others. Third, because foreign firms tend to concentrate in precisely the relatively tough market segment (in fact: in the segment they make tough by their exports), their sales are low compared to the domestic firms. Thus, across-country taste differences diminish the short run volume of trade if the exporter's industry is non-negligible in size.

The structure of this paper is the following. Section 1 develops the preferences and section 2 analyzes the equilibrium of the closed economy. In next open markets to trade and analyze the impact of trade liberalization between two symmetric countries in section 3. These results are next generalized in section 4 to the case of asymmetric entry costs in the two industry segments, asymmetric preference parameters, and also, to the case of asymmetric countries that trade with the rest of the world. The static impact of liberalization is analyzed in section 5 and section 6 concludes.

1 A Model of the Demand for Heterogeneous Products

In this section, I develop a model of consumer preferences combining two motives of consumption decisions: the love of variety motive from Dixit and Stiglitz (1977) and the two-sided heterogeneity of good attributes a and consumer valuations v in the spirit of Mussa and Rosen (1978). Consumers with a high taste for an attribute tend to buy from firms with a high-attribute good. The key implication of this assortative matching is that firms with similar goods tend to sell to consumers with similar tastes, i.e., that the industry is endogenously segmented by product attributes. Consequently, with trade, the composition of imports matters for the composition of the domestic industry.

Differences in attributes a can be seen as differences in good quality, but may also reflect more trivial product characteristics such as the good's color or the language used to label a product. Similarly, differences in valuations v reflect differences in people's tastes for the attribute. For example, some consumers might have a preference for cars painted in Ferrari Red, while others prefer British Racing Green.

[3] Indeed, Bernasconi (2009) finds evidence that the degree of country similarity is a predictor for zero trade flows while Hallak (forthcoming) finds empirical support for the Linder hypothesis along the intensive margin.

Consumers also value variety, i.e., they prefer an economy featuring many different varieties of cars painted in British Racing Green to an economy featuring only one such variety. This love for variety motive is derived from a discrete choice setting in the spirit of McFadden (1981), Anderson et. al. (1987 and 1992), and Gabaix et al. (2009). Each consumer is endowed with consumer-firm specific utility draws x. Since having a larger number of such draws raises the expected maximum draw, consumer welfare rises with the number of available varieties.

I next lay out the functional forms used in this paper to model these intuitions, derive a firm's demand, and then describe the supply side of the economy.

1.1 Preferences

The world is composed of two countries named Home and Foreign, which are populated by a mass of L and L^* consumers respectively. Each consumer has preferences over a homogenous $\mathcal{O}$ (outside) good and over a finite set of differentiated $\mathcal{M}$ (manufacturing) varieties. Each $\mathcal{M}$ firm produces exactly one differentiated variety that is characterized by its attribute a. Each consumer has a valuation v for the attribute a and is also characterized by an idiosyncratic and consumer-firm specific utility draw x.

Throughout the analysis, let $i \epsilon I$ index consumers (individuals) and $j \epsilon J$ index manufacturing firms. Each consumer i is endowed with income $\theta_i = \theta$[4] in terms of labor and a valuation draw v_i. Each consumer is also endowed with a consumer-firm specific draw $x_{i,j}$ for each firm in $j \epsilon J$.

Consumers care about the valuation- and idiosyncratic draw- adjusted effective quantity of the manufacturing $\mathcal{M}$ good and the absolute quantity of the outside good O. Denoting the quantity consumer i consumes of the O good by o_i and the quantity she consumes from manufacturing firm j by $q_{i,j}$, consumer i's utility U_i is given by

$$U_i = (o_i)^{1-\alpha} \left(\sum_{j \epsilon J} q_{i,j} e^{x_{i,j} + a_j v_i} \right)^{\alpha}. \tag{1}$$

Her consumption decision is subject to non-negativity $o_i > 0$ and for all j, $q_{i,j} \geq 0$, as well as to her budget constraint

$$o_i p_O + \sum_{i \epsilon I} q_{i,j} p_j \leq \theta_i. \tag{2}$$

The utility function (1) implies that for all consumers, all manufacturing goods are perfectly substitutable. However, different consumers have different rates of substitution between different varieties; in equilibrium, therefore, certain types of consumers are more or less likely to buy certain types of goods.

Consider first only the term $e^{a_j v_i}$ in (1).[5] The key feature of this term in the preferences is that the rate at which consumers value (or dislike) the attribute differs between consumers with different v_i. Assume that two otherwise identical consumers of valuations v_L and $v_H > v_L$ are offered to buy a certain good a_L at price p_L or a good a_H at price p_H where $a_H > a_L$. What

[4] The preferences of the model developed below are homothetic so that the model's predictions with L equal workers who supply θ units of effective labor each are exactly equal to the predictions in a model with heterogeneous workers satisfying $\theta L = \sum_{i \epsilon I} \theta_i$.

[5] Both a_j and v_i are a scalars. It is straightforward to extend the model at hand to the case of multiple attributes. For example, if each consumer is characterized by independent valuations over K attribute dimensions, the predictions developed below continue to hold exactly.

is the maximum price difference between p_L and p_H at which each consumer would prefer the high a good? For the $H - valuation$ consumer, this would be price ratio $p_H/p_L = e^{v_H(a_H - a_L)}$, while it would be $p_H/p_L = e^{v_L(a_H - a_L)}$ for the $L - valuation$ consumer. Because higher valuation consumers value the attribute more, in equilibrium, they constitute the relatively larger group of consumers of $H - attribute$ goods. For expositional clarity, a large part of the analysis below assumes that v_i can take only one of two possible values (v_L, v_H). However, in general, this assumption is not necessary to derive a firm's demand and valuations can take any positive value, i.e.,

$$v_i \sim F_v(v) \text{ where } f_v(v) \geq 0 \tag{3}$$

Next, consider only the term $e^{x_{i,j}}$ in (1). $x_{i,j}$ is a consumer-firm specific shock, reflecting the fact that some consumers like or dislike the variety of a specific firm irrespective of the variety's attribute. In (1), the idiosyncratic taste shock introduces market power to the model: although firms cannot observe $x_{i,j}$, they can engage in first degree price discrimination by charging a higher price and only attracting consumers with high $x_{i,j}$ draws. Throughout the analysis, I assume that $x_{i,j}$ is distributed maximum Gumbel (or Type I extreme value distribution) with scale and shape parameters 0 and $1/\sigma$ respectively.

$$G_x(x_{i,j}) = \exp\left[-\exp\left[-x_{i,j}\sigma\right]\right] \tag{4}$$

The consumer-firm specific shocks are orthogonal to firm attribute or consumer valuation and are independent across firms and consumers: $x_{i,j} \perp x_{i,n}$ for $n \neq j$. Gabaix et al. (2006 and 2009) demonstrate that these assumptions, in combination with a utility function similar to (1) yield an ideal-variety micro foundation for the constant elasticity of substitution (CES) demand system of Dixit and Stiglitz (1977). It is note worthy that the closed-form assumption on the consumer-firm specific taste shocks (4) is not very restrictive, since in equilibrium consumers buy only from the attribute-adjusted maximum realization of $x_{i,j}$. Since the economy features a large number of firms, the distribution of this maxima converges to the Type I extreme value distribution for a wide set of underlying distributions.[6]

1.2 Demand and Consumer Welfare

I next solve for a firm's demand and consumer welfare using the general distribution of valuations $F_v(v)$. Consumer i consumes the agricultural $\mathcal{O}$ good and the manufacturing composite $M_i \equiv \sum_{j \epsilon J} q_{i,j} e^{x_{i,j} + a_j v_i}$. Before considering the choice among the single manufactured goods, consider first the decision of how much of the $\mathcal{O}$ good to consume. The first order conditions of the utility function (1) with respect to these two quantities and the budget constraint (2) imply that an agent with income 1 consumes

$$M_i = (1 - \alpha)/p_{M,i} \text{ and } O_i = \alpha/p_O ,$$

where $p_{M,i}$ is the price of the manufacturing composite for consumer i (which is NOT the same for all i). Irrespective of this price, the consumer always spends a fraction α of her income on the $\mathcal{O}$ good.

[6] The preference structure at hand makes the model's results highly comparable to the work of Bernard et al. (2003), who extend the Eaton and Kortum (2002) model of trade to allow for positive markups. In Bernard et al. the realization of productivities is common knowledge and firms thus engage in Bertrand competition. In the framework developed here, firms only know the distribution of taste shocks and, therefore, engage in first degree price discrimination.

Thus, the consumer spends the remainder fraction of $(1-\alpha)$ on the manufacturing composite. Within the manufacturing composite, since all goods are perfect substitutes, each consumer then chooses the variety that yields the highest ratio of effective quantity per unit divided by the price of the variety. Since consumers with different valuation v_i differ in their average rate at which they substitute goods of different attributes a, demand is of a different shape for each v.

Proposition 1 (Demand) *The demand $D(a_j, p_j)$ of a firm with attribute a_j and price p_j is equal to*

$$D(a_j, p_j) = (1-\alpha)\,\theta L \Gamma(1-\sigma)\, p_j^{-(1+\sigma)} \int_{v \epsilon V} f_v(v) \frac{\exp[\sigma v a_j]}{\overline{P(v)}^{-\sigma}} dv, \tag{5}$$

where $\Gamma(...)$ is the beta function and $\overline{P(v)}$ denotes the ideal price index for all consumers with $v_i = \widetilde{v}$, which is given by

$$\overline{P(v)} \equiv \left(\sum_{n \epsilon J} \left(\frac{p_n}{\exp[v a_n]} \right)^{-\sigma} \right)^{-1/\sigma}. \tag{6}$$

Proof. *See Appendix* ■

The proof of Proposition 1 follows previous research demonstrating how the love of variety motive can arise in a discrete choice setting: each consumer has a consumer-variety specific taste shock $x_{i,j}$. For equal prizes and good attributes, the consumer chooses the maximum of all the realizations of the taste shocks $x_{i,j}$, i.e., she chooses $j = \arg\max_{j \epsilon J} x_{i,j}$. Owing to the functional form assumption that the idiosyncratic taste shocks are distributed Gumbel with shape parameter $1/\sigma$, all firms face a constant elasticity of demand equal to $-(1+\sigma)$.

Compared to the existing literature, the novel ingredient in the derivation of firm demand (5) is that the probability of consumer i with valuation $v_i = v$ buying from firm j with attribute $a_j = a$ depends on the match of v and a, as well as on how well the other goods in the economy match with the consumer's taste, i.e., the ideal price index of consumers with $v_i = v$. First, sales are shifted by the match between the consumer's valuation and the firm's attribute, i.e., in (5), demand is shifted by $\exp[\sigma v_i a_j]$. Second, it is not only the match between firm j and consumer i with $v_i = v$ that determines sales, but also how well the competition's output matches with the consumers preferences, i.e., the ideal price index of each consumer valuation is a function of the attribute composition of the economy. The latter average match is summarized in the ideal price index $\overline{P(v)}$.

Since sales to each consumer are inversely proportional to $\overline{P(v)}^{-\sigma}$, I will below refer to $\overline{P(v)}^{-\sigma}$ as a measure of the "toughness" of competition for consumers of this type.

Last, there is not one type of consumer, but a distribution of consumers with varying valuations. Total demand for a firm is equal to the sum of demand from all possible valuations, hence explaining the outer integral over the possible realizations of v in (5).

Since the expected maximum draw is increasing in the number of draws, consumers prefer having a larger number of varieties to choose from, i.e., they love variety. A key feature of the preferences developed here is that consumer welfare is highly comparable to the one in Dixit and Stiglitz (1977).

Corollary 1 (Consumer Welfare) *Denote the* expected *welfare of consumer i with* $v_i = v$ *and income* θ_i *by* $E(U_i(v,\theta_i))$. *If* $p_O = 1$,

$$E(U_i(v,\theta_i)) = (1-\alpha)^{1-\alpha}\alpha^{\alpha}\Gamma\left(1-\frac{\sigma}{\alpha}\right)\left(\overline{P(v)}\right)^{-\alpha}\theta_i$$

where the ideal price index $\overline{P(v)}$ *is as defined in (6) and* $\Gamma(..)$ *is the gamma function.*

Proof. *see Appendix* ■

Corollary 1 documents an important property of the developed preference structure. Changes in the toughness of competition for consumers with $v_i = v$ can be mapped directly into welfare changes for this group of consumers. As I document below, with open markets, the interplay of the free entry conditions at Home and abroad pins down the ideal relative price indices for different v's uniquely, hence leading to very sharp predictions regarding the welfare effects of trade.

Moreover, one can directly relate the findings of this paper to the existing literature. In the case where all firms produce the same good ($a_n = a_j = a$), the valuation-attribute match in (5) cancels out and the demand curve is the same as in Dixit and Stiglitz (1977). The model at hand, therefore, is a generalization of the Dixit and Stiglitz (1977) framework.

Another special case is where there are two goods $a_L < a_H$ and the degree of taste heterogeneity is extreme such that consumers buy only one type of good: $\exp[\sigma v_H a_L] \approx 0$ and $\exp[\sigma v_L a_H] \approx 0$. In this case, the economy resembles that of Krugman (1980).

1.3 Supply

For expositional clarity, I restrict the universe of potential levels the attribute can take and assume that $a_j \epsilon \{a_L, a_H\}$, where $0 < a_L < a_H$. I refer to the two attribute levels as the $H - attribute$ or $L - attribute$ "good", "firm", or "variety" in the remainder of the paper.

In each country and at each moment in time, a large set of potential entrepreneurs can enter the $\mathcal{M}$ industry by paying a fixed flow cost of $f_j \epsilon [f_L; f_H]$ labor units. Each entrepreneur can leave the industry at any point of time.

While alive, each firm can produce any quantity of its good at constant marginal costs (in units of labor) equal to

$$c_j = e^{ca_j} \tag{7}$$

$\frac{\partial c(a_j)}{\partial a_j}$ can be positive, zero, or negative. For example, if a_j measures the wavelength of the good's color, it may be cheaper to produce red lacquer than violet lacquer and $c < 0$. If the lowest possible valuation $v_{\min}$ is larger than 0, it is reasonable to assume that higher a_j (higher quality) goods are more expensive and that $c > 0$.

The outside good $\mathcal{O}$ is produced in a competitive sector at a marginal cost of one unit of labor. In total, the Home economy thus has to satisfy the resource constraint that domestic production of the $\mathcal{O}$ and $\mathcal{M}$ sector and entry into the $\mathcal{M}$ sector do not use more than θL units of Home labor.

If markets are opened to trade, manufacturing firms can sell abroad at a cost $c_j^* = \tau c_j$, where $\tau > 1$. In contrast, the outside $\mathcal{O}$ good can be freely traded.

2 Autarky Equilibrium

I next solve the closed economy equilibrium focusing on the two attribute - two valuation case and assume that $v_i \epsilon \{\widetilde{v_L}, \widetilde{v_H}\}$, where $\widetilde{v_L} < \widetilde{v_H}$. A starting observation is that demand (5) is such that firms face a constant price elasticity of $(1+\sigma)$ and thus charge a price of $p_j = \frac{1+\sigma}{\sigma} c_j = \frac{1+\sigma}{\sigma} e^{c a_j}$. For each type of consumer, demand (5) thus simplifies to $e^{\sigma(v_i - c)a_j} / \sum_{n \epsilon J} e^{\sigma(v_i - c)a_n}$, i.e., valuations v_i can simply be adjusted by costs.

The analysis below derives most of its results insights based on the notion that consumers with different valuations are different enough so that they prefer, on average, different types of attributes. Formally, this notion is equivalent to the following parameter restriction.

Assumption 1: The valuation pair $\widetilde{v_L}$ and $\widetilde{v_H}$ satisfies

$$\widetilde{v_L} < c < \widetilde{v_H}$$

Assumption 1 implies that when valuations are adjusted for costs, there exists both a group of consumers that prefers $L - attribute$ goods as well as a group that prefers $H - attribute$ ones, which is a necessary condition for an equilibrium with positive entry of both type of firms. In the remainder of the analysis, I will only evaluate the cost-adjusted $H - valuation$ v_H and $L - valuation$ v_L defined as

$$v_L \equiv (\widetilde{v_L} - c) \quad \text{and} \quad v_H \equiv (\widetilde{v_H} - c) \ ,$$

where by Assumption 1 $v_L < 0 < v_H$.

It is noteworthy that even with this assumption, the described preferences also comprise the case of vertical differentiation: when $\widetilde{v_L} > 0$, all consumers value higher attribute goods and one can speak of good "quality" as in Flam and Helpman (1987), Auer and Chaney (2009), or Fajgelbaum et al. (2009). The fact that $\widetilde{v_L} > 0$ but $v_L < 0$ merely implies that although consumers agree on the ranking of goods, they differ in their ranking of price-good pairs since for some consumers, the increase in quality is not worth the increase in price. If, on the contrary, $\widetilde{v_L} < 0$, the analysis is about product characteristics such as good color that are not strictly preferred by all consumers.

I denote the fraction of the population that has a valuation draw of $v_i = \widetilde{v_H}$ by $\pi_H \ \epsilon \ [0,1]$. Also, let N denote the total number of active firms in the industry and let n_H denote the fraction of these firms producing a good with $a_j = a_H$. Normalizing $\Gamma(1-\sigma)\,\theta(1-\alpha) \equiv 1$, revenue $\Pi(a_j)$ is equal to

$$\Pi(a_j) = \pi_H L \frac{e^{\sigma v_H a_j}}{P(v_H)^{-\sigma}} + (1-\pi_H) L \frac{e^{\sigma v_L a_j}}{P(v_L)^{-\sigma}} \tag{8}$$

where

$$\begin{aligned} P(v_H) &= \left[N\left(n_H e^{\sigma v_H a_H} + (1-n_H)\, e^{\sigma v_H a_L}\right)\right]^{-1/\sigma} \text{ and} \\ P(v_L) &= \left[N\left(n_H e^{\sigma v_L a_H} + (1-n_H)\, e^{\sigma v_L a_L}\right)\right]^{-1/\sigma}. \end{aligned}$$

are the ideal price indices for the two groups of consumers. Since valuations are separating, $e^{\sigma v_H a_H} > e^{\sigma v_H a_L}$, and $H - attribute$ firms sell more to $H - valuation$ consumers than do $L - valuation$ firms. Similarly, $e^{\sigma v_L a_L} > e^{\sigma v_L a_H}$ and L firms sell more to $L - valuation$ consumers. Sales to each group are proportional to the number of consumers (there are $L\pi_H$ $H - valuation$ consumers) and increasing in the ideal price indices $P(v_H)$ and $P(v_L)$.

Given constant markup-pricing, firm profits are proportional to revenue. In the closed economy, this revenue depends on the distribution of consumer valuations. For any given attribute, a higher proportion of $H - valuation$ consumers implies a larger market size for $H - attribute$ firms.

In the existing literature that is based on Dixit and Stiglitz (1977), due to the constant elasticity demand structure, entry of new competitors hurts the sales of all existing firms in the same proportion. In the preferences at hand, the effect of such an increase in competition on a firm's sales is different for different types of firms. The revenue (8) of a firm reacts more to entry of firms producing a similar good than to entry of firms producing a dissimilar good, i.e., $\left|\frac{\partial\Pi(a_H)}{\partial N_H}\right| > \left|\frac{\partial\Pi(a_L)}{\partial N_H}\right|$ and $\left|\frac{\partial\Pi(a_H)}{\partial N_L}\right| < \left|\frac{\partial\Pi(a_L)}{\partial N_L}\right|$. The latter feature implies that industries are partially segmented: for example, the sales of BMW depend much more on the product strategy of Mercedes rather than on the one of Toyota, which caters to a slightly different set of consumers. Similarly, Armani's sales depend more on the success of the latest collections by Prada than they do depend on the success of the collections by Benetton.

With demand being pinned down, it is straightforward to derive entry in the closed economy. Denoting the value that a variable takes in the autarky steady state by an ^{A} superscript, the following holds.

Proposition 2 (Autarky Equilibrium) *Denote by N^A the autarky equilibrium number of firms and by $n_H^A \epsilon\ [0,1]$ the autarky equilibrium fraction of entrepreneurs producing the $H-attribute$ good. There exists a unique autarky equilibrium featuring $N^A = \frac{L}{\sigma f}$ and*

$$n_H^A = \begin{cases} 0 \text{ if } \pi_H < e^{\sigma v_L a_H} \frac{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}{e^{\sigma v_H a_H} e^{\sigma v_L a_L} - e^{\sigma v_H a_L} e^{\sigma v_L a_H}} \\ 1 \text{ if } \pi_H > e^{\sigma v_H a_H} \frac{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}{e^{\sigma v_H a_H} e^{\sigma v_L a_L} - e^{\sigma v_H a_L} e^{\sigma v_L a_H}} \\ \frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}} \pi_H - (1-\pi_H) \frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} \text{ otherwise} \end{cases}. \tag{9}$$

Proof. *Since firms are free to enter with an H or the L good, an equilibrium with positive entry of both types of firms requires that the flow of revenues are equal for both $H-attribute$ and $L-attribute$ firms, it has to be true that*

$$\Pi(a_H) = \Pi(a_L), \tag{10}$$

where $\Pi(a_H)$ and $\Pi(a_L)$ are given by (8). Reformulating (10) as the difference in sales to $H-valuation$ and $L-valuation$ consumers yields

$$\frac{\pi_H}{1-\pi_H} \frac{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}{n_H e^{\sigma v_H a_H} + (1-n_H) e^{\sigma v_H a_L}} = \frac{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}{n_H e^{\sigma v_L a_H} + (1-n_H) e^{\sigma v_L a_L}}. \tag{11}$$

Since $e^{\sigma v_H a_H} > e^{\sigma v_H a_L}$, the LHS of (11) is increasing in relative entry of H firms n_H. Since $e^{\sigma v_L a_L} > e^{\sigma v_L a_H}$ the RHS is decreasing in n_H. Thus, n_H is uniquely determined. N^A is pinned down by the free entry condition $f\sigma = \frac{L}{N^A}$. ■

It is noteworthy that in general equilibrium, as long as $n_H^A \epsilon [0,1]$, n_H^A is increasing in the number of $H-valuation$ consumers ($\frac{\partial n_H^A}{\partial \pi_H} > 0$) and also that n_H^A is increasing in both valuations v_L and v_H ($\frac{\partial n_H^A}{\partial v_L} > 0$, $\frac{\partial n_H^A}{\partial v_H} > 0$). Furthermore, denoting the autarky equilibrium ideal price indices by $P^A(v_j)$, it is true that whenever n_H^A is interior[7]

$$P^A(v_H) = \left(\pi_H \frac{\phi L/f\sigma}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}\right)^{-1/\sigma} \quad \text{and} \quad P^A(v_L) = \left((1-\pi_H) \frac{\phi L/f\sigma}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}\right)^{-1/\sigma} \tag{12}$$

[7] Note that in the preferences developed below – much in contrast to the ones that are used by Krugman (1980) – complete specialization in autarky may occur also if there are nontrivial masses of both types of consumers in both Home and Foreign.

where $\phi \equiv e^{\sigma v_H a_H} e^{\sigma v_L a_L} - e^{\sigma v_H a_L} e^{\sigma v_L a_H} > 0$. The fact that the toughness of competition is linear in π_H and $(1-\pi_H)$ respectively is a direct consequence of the fact that firms can decide with what kind of product to enter the industry. Therefore, a higher π_H has to be offset exactly by an increase in n_H so that firms with different attributes operate at the same level of profits, i.e. in the closed economy, the level of competition for $H-$ and $L-valuation$ consumers is proportional to the number of customers π_H respectively $(1-\pi_H)$.

Summarizing, the equilibrium in the closed economy has the following properties. First, a necessary condition for an equilibrium featuring both kinds of firms is that there exists both a group of consumers that prefers L goods as well as a group that prefers H goods. Second, in an equilibrium featuring positive entry of both types of firms, the fraction of $H - attribute$ firms is increasing in the number of $H - valuation$ consumers. The fraction of such firms is also increasing in v_H and v_L, since an increase in either valuation leads to higher relative expenditures on $H - attribute$ goods. Third, in equilibrium, owing to the free entry condition, all firms have the same revenue.

3 Tastes and Trade Liberalization Between Symmetric Countries

I next examine the impact of a one-time trade liberalization between two countries that differ in the fraction of $H-$ and $L - valuation$ consumers.[8]

This section focuses on a special case of the model with equally sized countries $(L = L^*)$ symmetric preference parameters $(a_L v_L = a_H v_H > a_L v_H = a_H v_L)$, and a symmetric distribution of preferences $\pi_H = 1 - \pi_H^* > 0.5$. Assuming that countries are each other's "mirror images" is convenient to highlight the mechanisms at work because it implies that either both or none of the countries specialize completely, whereas with asymmetric countries also either Home of Foreign might specialize completely. I extend the analysis to the case of asymmetric countries, asymmetric preference parameters, and also allow for trade with the rest of the world in the next section 4.

International trade is subject to "iceberg" transportation costs $\tau > 1$. Since there are no fixed costs to access a foreign market all firms export.

The main insights are best explained adopting the following notation. Denote by $\Pi^T(a_j)$ the domestic revenue of a Home firm of type a_j and by $\Pi^{T*}(a_j)$ the domestic revenue of a Foreign. Denoting the value that a variable takes in the equilibrium with open market by a ^{T} superscript, the following holds

$$\Pi^T(a_j) \equiv L\pi_H \frac{e^{\sigma v_H a_j}}{P^T(v_H)^{-\sigma}} + L(1-\pi_H)\frac{e^{\sigma v_L a_j}}{P^T(v_L)^{-\sigma}}. \tag{13}$$

As in the closed economy (see (8)), domestic revenue of a Home firm is equal to the sales to $\pi_H L$ domestic $H - valuation$ and $(1-\pi_H) L$ $L - valuation$ consumers. With trade, however, the set of competitors – and hence $P^T(v_H)$ and $P^T(v_L)$ – now includes foreign firms. The ideal price indices are given by

$$P^T(v_H)^{-\sigma} = \left(N^T n_H^T + \tau^{-\sigma} N^{T*} n_H^{T*}\right) e^{\sigma v_H a_H} + \left(N^T\left(1-n_H^T\right) + \tau^{-\sigma} N^{T*}\left(1-n_H^{T*}\right)\right) e^{\sigma v_H a_L} \tag{14}$$
$$P^T(v_L)^{-\sigma} = \left(N^T n_H^T + \tau^{-\sigma} N^{T*} n_H^{T*}\right) e^{\sigma v_L a_H} + \left(N^T\left(1-n_H^T\right) + \tau^{-\sigma} N^{T*}\left(1-n_H^{T*}\right)\right) e^{\sigma v_L a_L} \tag{15}$$

[8] Throughout the analysis, the distributions of consumer valuations in Home and Foreign are assumed to be different for exogenous reasons. Atkin (2009) shows how such taste differences can be an equilibrium outcome of a model featuring habit formation and comparative advantage. I here assume that such differences in tastes are present for exogenous reasons, thus enabling me to highlight the pure effect of taste heterogeneity rather than the interplay of comparative advantage and endogenously acquired taste differences in Atkin's work.

The symmetric conditions hold in Foreign.

How high is each firm's export revenue? Firms charge constant markups and production costs are the same across countries; thus, in the Foreign market, firms from Home charge a price that is τ times as high as the price of Foreign firms. With the demand elasticity being equal to -$(\sigma+1)$, each Home firm thus has export revenue that equals a fraction $\tau^{-\sigma}<1$ of the domestic sales of a Foreign firm producing the same attribute output, implying that export revenue per Home firm of type a_j is equal to $\tau^{-\sigma}\Pi^{T*}(a_j)$.

With this easy relation between domestic revenue of a Foreign firm and the export revenue of a Home firm in mind, it is straightforward to show how the interplay of the free attribute-entry conditions in Home and Foreign pins down the relative level of competition for $H-$ compared to $L-attribute$ producers.

Lemma 1 (Relative Competition and Liberalization) *Assume that Home and Foreign are each other's mirror image and that $\pi_H > 0.5$. Then, the relative ideal price indices satisfy*

$$P^T(v_H)^{-\sigma} = \begin{cases} (1+\tau^{-\sigma})P^A(v_H) & \text{if } \pi_H < \Theta \\ (e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_H a_L}) L/f\sigma & \text{otherwise} \end{cases} \tag{16}$$

$$P^T(v_L)^{-\sigma} = \begin{cases} (1+\tau^{-\sigma})P^A(v_L) & \text{if } \pi_H < \Theta \\ (e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L}) L/f\sigma & \text{otherwise} \end{cases} \tag{17}$$

where $\pi_H < \Theta \equiv \left((1-\tau^{-\sigma}) - \frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}\right) / \left(\frac{e^{\sigma v_L a_L}}{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}} + \frac{e^{\sigma v_H a_L}}{e^{\sigma a_H v_H} - e^{\sigma a_L v_H}}\right)$ corresponds to the parameter region where countries are not completely specialized.

Proof. *Consider first the case of incomplete specialization. Since all firms export, face a constant elasticity of demand, and are subject to iceberg transportation costs, the export revenue of a Home firm is equal to $\tau^{-\sigma}\Pi^*(a_j)$ so that total revenue of a home firm is equal to $\Pi(a_j) + \tau^{-\sigma}\Pi^*(a_j)$. Similarly, the total revenue of a Foreign firm equals $\tau^{-\sigma}\Pi(a_j) + \Pi^*(a_j)$. With constant markups, an equilibrium without complete specialization requires that the revenue of an $H-attribute$ and an $L-attribute$ firm are equal in Home and in Foreign so that*

$$\Pi^T(a_H) + \tau^{-\sigma}\Pi^{T*}(a_H) = \tau^{-\sigma}\Pi^T(a_H) + \Pi^{T*}(a_H) \tag{18}$$

$$\Pi^T(a_L) + \tau^{-\sigma}\Pi^{T*}(a_L) = \tau^{-\sigma}\Pi^T(a_L) + \Pi^{T*}(a_L). \tag{19}$$

(19) and (18) can be reduced to $\Pi(a_H) = \Pi(a_L)$ and $\Pi^*(a_H) = \Pi^*(a_L)$. Recalling the definitions of $\Pi(a_j)$ and $\Pi^*(a_j)$ yields

$$\frac{P^T(v_H)^{-\sigma}}{P^T(v_L)^{-\sigma}} = \frac{e^{\sigma a_H v_H} - e^{\sigma a_L v_H}}{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}}\frac{\pi_H}{1-\pi_H} \text{ and } \frac{P^{T*}(v_H)^{-\sigma}}{P^{T*}(v_L)^{-\sigma}} = \frac{e^{\sigma a_H v_H} - e^{\sigma a_L v_H}}{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}}\frac{\pi_H^*}{1-\pi_H^*}.$$

Last, noting that profits equal a fraction $1/\sigma$ of revenue, free entry implies $\Pi^T(a_j)+\tau^{-\sigma}\Pi^{T*}(a_j) = \sigma f$, which yields (16) and (17) for the case of complete specialization.

Second, consider the case of complete specialization. With $\pi_H > 0.5 > \pi_H^*$, there are only $H-attribute$ firms at Home and only $L-attribute$ firms in Foreign. The free entry condition still holds (although $\Pi^{T*}(a_H)$ and $\Pi^T(a_L)$ are hypothetical concepts since no such firms exist) so that

$$\Pi^T(a_H) + \tau^{-\sigma}\Pi^{T*}(a_H) = f\sigma \text{ and } \tau^{-\sigma}\Pi^T(a_L) + \Pi^{T*}(a_L) = f\sigma$$

Since $n_L^T = n_H^{*T} = 0$ the four ideal price indices simplify to

$$P^T(v_H)^{-\sigma} = N^T e^{\sigma v_H a_H} + \tau^{-\sigma} N^{T*} e^{\sigma v_H a_L} \text{ and } P(v_L)^{-\sigma} = N^T e^{\sigma v_L a_H} + \tau^{-\sigma} N^{T*} e^{\sigma v_L a_L},$$

$$P^{T*}(v_H)^{-\sigma} = \tau^{-\sigma} N^T e^{\sigma v_H a_H} + N^{T*} e^{\sigma v_H a_L} \text{ and } P^*(v_L)^{-\sigma} = \tau^{-\sigma} N^T e^{\sigma v_L a_H} + N^{T*} e^{\sigma v_L a_L}$$

thus yielding the second case of (16) and (17). ∎

The most important implication of Lemma 1 is that under incomplete specialization, the distribution of tastes abroad has no impact on the relative toughness of competition for firms of type a_H and a_L. Comparison of the ideal prices indices in the autarky equilibrium (see (12)) to the ones prevailing under trade (see (16) and (17)) reveals that

$$P^T(v_H)/P^A(v_H) = P^T(v_L)/P^A(v_L)^{-\sigma} = \left(1+\tau^{-\sigma}\right)^{-1/\sigma} \tag{20}$$

The underlying intuition for this result is best highlighted in a two-step argument. The first step of this argument is that any equilibrium with incomplete specialization can only arise if it is true that in both markets, both types of firms have the exact same revenue. Since markets are separated by trade costs, the Home market is relatively more important for Home firms, while the Foreign market is relatively more important for Foreign firms.

With this in mind, could it ever be the case that $H - attribute$ producers are somewhat more profitable than $L - attribute$ producers in Home, while the reverse is true in Foreign? For example, lets denote this difference in domestic sales at home between a $H - attribute$ firm and a $L - attribute$ firm by Z $(Z = \Pi^T(a_H) - \Pi^T(a_L))$. Due to the existence of transportation costs, the Home market matters relatively less than the domestic market and the free attribute entry condition in Home requires that the offsetting advantage for $L - attribute$ firms in Foreign must be larger than the advantage for $H - attribute$ firms at i.e. that $Z + \tau^{-\beta}Z^* = 0$. However, defining the analogue difference in Foreign by Z^* $(Z^* = \Pi^{T*}(a_H) - \Pi^{T*}(a_L))$, the free attribute entry condition in Foreign requires that $\tau^{-\beta}Z + Z^* = 0$. Since the free entry condition in Home requires $-Z^* > Z$ while the one in Foreign implies that $-Z^* < Z$ only $Z = Z^* = 0$ can satisfy both free attribute-entry conditions.

The second step of the intuition underlying Lemma 1 is that since domestic revenue is equalized across countries, the domestic industry composition must adjust such as to offset the mismatch between the composition of imports and domestic tastes exactly, leaving the relative ideal price indices undistorted by trade. The non-specialization condition under trade $\Pi^T(a_H) = \Pi^T(a_L)$ is the exact same one as the free entry condition $\Pi^A(a_H) = \Pi^A(a_L)$ in autarky. Thus, if the composition of imports is such that after trade liberalization, some market segments are relatively more crowded than others, domestic entry of firms is directed towards the less crowded market segments and the entry response of domestic firms must be such that the initial imbalance is offset *exactly*, since only equally crowded market segments are in accordance with the non-specialization conditions (18) and (19) not being violated.

Last, for the case of complete specialization, Lemma 1 implies that trade makes competition tougher in the market segment that the country is *not* specialized in, i.e. that

$$P^T(v_H)/P^A(v_H) > \left(1+\tau^{-\sigma}\right)^{-1/\sigma} > P^T(v_L)/P^A(v_L)^{-\sigma}$$

If there were some $L - attribute$ producers in autarky, they get crowded out by imports. The domestic industry reshuffling towards $H - attribute$ producers however is not strong enough (since the country specializes completely) to offset the fact that the import composition is composed entirely of $L - attribute$ goods.

After trade liberalization, the industrial structure of the two countries diverges in order to restore the free attribute-entry conditions. Whether specialization is complete or not, the response of domestic industry is associated with the home market effect of Krugman (1980).

Lemma 2 (Specialization and the Home Market Effect) *Denote Home and Foreign's H-attribute exports by* X_H *and* X_H^* *respectively. For any* $\tau^{-\sigma} > 0$*, the economy is at least as specialized as in autarky and*

$$n_H^T \geq n_H^A \geq n_H^{*A} \geq n_H^{*T}.$$

Moreover, Home is a net exporter of $H-$ *attribute manufactured goods and a net importer of* $L-$ *attribute manufactured goods or*

$$X_H - X_H^* > 0 \text{ and } X_L - X_L^* < 0.$$

Proof. see Appendix ■

With the equilibrium industry structure solved for, it is straightforward to calculate the volume of trade and the gains from liberalization. Before describing the latter, it noteworthy to point out the effects of liberalization in a representative agent economy (corresponding to either $\pi_H = \pi_H^* = 1$ or $\pi_H = \pi_H^* = 0$). In both these benchmarks, it is true that the volume of trade is equal to $\frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}L$ and that the gains from trade in relative terms satisfy $\frac{E^T(U(\theta_i))}{E^A(U(\theta_i))} = (1+\tau^{-\sigma})^{\alpha/\sigma}$. With this clear benchmark in mind, it is straightforward to highlight the impact of liberalization in the presence of taste differences.

Proposition 3 (Taste Differences and the Effect of Liberalization) *Assume that* $\pi_H = 1 - \pi_H^*$*,* $L^* = L$*,* $a_L v_L = a_H v_H$*, and* $a_L v_H = a_H v_L$ *and define average welfare in Home by*

$$E\left(U\left(\theta_i\right)\right) \equiv \pi_H E\left(U_i\left(v=v_H,\theta_i\right)\right) + \left(1-\pi_H\right) E\left(U_i\left(v=v_L,\theta_i\right)\right).$$

The following holds.

- If $\pi_H < \Theta$ *specialization is incomplete and the volume of trade is the same as in the representative agent economy. Moreover, the welfare gains from trade occur to all groups equi-proprotionally and in the same percentage as in the representative agent economy. That is*

$$X = X^* = \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}L$$

and

$$\frac{E^T\left(U\left(\theta_i\right)\right)}{E^A\left(U\left(\theta_i\right)\right)} = \frac{E^T\left(U_i\left(v=v_H,\theta_i\right)\right)}{E^A\left(U_i\left(v=v_H,\theta_i\right)\right)} = \frac{E^T\left(U_i\left(v=v_L,\theta_i\right)\right)}{E^A\left(U_i\left(v=v_L,\theta_i\right)\right)} = \left(1+\tau^{-\sigma}\right)^{\alpha/\sigma}.$$

- If $\pi_H > \Theta$*, specialization is complete and the volume of trade smaller than in the representative agent economy. Moreover, the welfare gains from trade are group-specific and at Home, the relatively smaller group* $v = v_L$ *gains relatively the most from trade. The average welfare gains from trade are smaller than in the representative agent economy. That is*

$$X = X^* = \left(\frac{\pi_H^* e^{\sigma v_H a_H}}{\tau^{-\sigma} e^{\sigma v_H a_H} + e^{\sigma v_H a_L}} + \frac{\left(1-\pi_H^*\right) e^{\sigma v_L a_H}}{\tau^{-\sigma} e^{\sigma v_L a_H} + e^{\sigma v_L a_L}}\right) \tau^{-\sigma} L < \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}L$$

and

$$\frac{E^T\left(U_i\left(v=v_L,\theta_i\right)\right)}{E^A\left(U_i\left(v=v_L,\theta_i\right)\right)} > \left(1+\tau^{-\sigma}\right)^{\alpha/\sigma} > \frac{E^T\left(U\left(v_i\right)\right)}{E^A\left(U\left(v_i\right)\right)} > \frac{E^T\left(U_i\left(v=v_H,\theta_i\right)\right)}{E^A\left(U_i\left(v=v_H,\theta_i\right)\right)} > 1.$$

Proof. *First, consider total trade volume, which can be expressed as the sum of* $H-$ *and* $L-$ *attribute imports* $X = X_H^T + X_L^T$*. For the case of incomplete specialization, noting that also exports per* $L-$ *attribute firm equal* $\frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}\sigma f$ *implies*

$$X_H^T + X_L^T = \left(n_H^T + \left(1-n_H^T\right)\right) \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}} N^T L = \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}L$$

If, instead, specialization is complete, $n_H^T = 1$, $X_L^T = 0$ and total exports equal

$$X = N^T \left(L^* \pi_H^* \frac{\tau^{-\sigma} e^{\sigma v_H a_H}}{P^{T*}(v_H)^{-\sigma}} + L^* (1 - \pi_H^*) \frac{\tau^{-\sigma} e^{\sigma v_L a_H}}{P^{T*}(v_L)^{-\sigma}} \right)$$

Where the ideal price indices in Foreign under specialization include $L/f\sigma$ $H-$attribute producers from Home and $L/f\sigma$ $L-$ attribute producers from Foreign.
Second, consider the welfare effect of liberalization. Corollary 1 relates group-specific welfare to ideal price indices. Consequently, also the relative welfare gains depend exclusively on relative price indices before and after liberalization.

$$\frac{E^T(U_i(v = v_H, \theta_i))}{E^A(U_i(v = v_H, \theta_i))} = \left(\frac{\overline{P^T(v_H)}}{\overline{P^A(v_H)}} \right)^{-\alpha} \quad \textit{and} \quad \frac{E^T(U_i(v = v_L, \theta_i))}{E^A(U_i(v = v_L, \theta_i))} = \left(\frac{\overline{P^T(v_L)}}{\overline{P^A(v_L)}} \right)^{-\alpha}$$

Solving for the relative price indices under trade yields

$$\frac{E^T(U_i(v = v_H, \theta_i))}{E^A(U_i(v = v_H, \theta_i))} = \begin{cases} (1 + \tau^{-\sigma})^{\alpha/\sigma} & \textit{if } \pi_H < \Theta \\ \left(\frac{e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}} \right)^{\alpha/\sigma} & \textit{otherwise} \end{cases}$$

$$\frac{E^T(U_i(v = v_L, \theta_i))}{E^A(U_i(v = v_L, \theta_i))} = \begin{cases} (1 + \tau^{-\sigma})^{\alpha/\sigma} & \textit{if } \pi_H < \Theta \\ \left(\frac{e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}} \right)^{\alpha/\sigma} & \textit{otherwise} \end{cases}$$

where, for the case of average welfare, it is true that

$$\frac{E^T(U(\theta_i))}{E^A(U(\theta_i))} = \begin{cases} (1 + \tau^{-\sigma})^{\alpha/\sigma} & \textit{if no } \pi_H < \Theta \\ \frac{\pi_H \left(e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_H a_L} \right)^{\alpha/\sigma} + (1 - \pi_H) \left(e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L} \right)^{\alpha/\sigma}}{\left(\pi_H^{1+\alpha/\sigma} + (1 - \pi_H)^{1+\alpha/\sigma} \right)} & \textit{otherwise} \end{cases}.$$

It is straightforward to check that these expressions satisfy the stated inequalities. ■

The main takeaway from Proposition 3 is that under incomplete specialization, taste heterogeneity does give rise to effects of liberalization that are the same as in a representative agent framework. In addition, taste heterogeneity may matter only little even if countries in specialize completely. For example, when $\pi_H = \frac{1-\tau^{-\sigma}}{1+\tau^{-\sigma}} \frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} \Lambda^{-1} + \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}}$ i.e. when parameters are such that specialization is complete but only marginally so, the volume of trade and the welfare gains from trade are still equal to the one prevailing in a representative agent framework. When π_H is higher, the volume of trade is decreasing in the degree of across country taste heterogeneity and welfare gains are group-specific.

Why is complete specialization associated with low trade volume? Specialization at Home only happens if $\Pi^T(a_H) > \Pi^T(a_L)$ so that

no Home firm finds it profitable to enter as a $L-$*attribute* producer. But Foreign is specialized in exactly this market segment and each foreign firm exports $\tau^{-\sigma}\Pi^T(a_L)$ which is smaller than what they a Foreign H-type producer would export; tastes are so different across countries that each other's production is simply not "appropriate" for the export market.

Corollary 1 implies that the ideal price index of each type of consumer can be mapped one-to-one into welfare changes. Proposition 3 thus implies that when countries are completely specialized, it is the relatively smaller group of consumers that gains relatively more from trade at the moment of trade liberalization. This result if intuitive: if markets are opened to trade, a French consumer with a preference for beer suddenly gains access to many German beer varieties. In contrast, a French consumer with a preference for wine gains relatively little, since Germany offers few of these varieties compared to the French industry.[9]

For the case of incomplete specialization, however, equilibrium trade flows are not affected by the underlying taste differences across nations. Since the import competition is biased towards one sector, the domestic industry concentrates into the other sector. With equally sized countries, this adjustment continues until $\pi_H \,/P^T \left(v_H\right)^{-\sigma} = \pi_H^* \,/P^{T*} \left(v_H\right)^{-\sigma}$, hence implying that exports and domestic revenue per firm are the same for $H-$ and $L-attribute$ firms. Hence, the distribution of tastes abroad does not matter for the volume of trade.

4 Asymmetric Countries: A Generalization

The previous section has demonstrated a peculiar result: domestic industry composition adjusts to exactly counteract the mismatch between the attribute composition of imports and the domestic distribution of tastes.

The latter result, however, has been derived based on the very strong assumption of perfectly symmetric countries. I next generalize this analysis, hence yielding the main finding of the paper that there is a nontrivial parameter region in which across-country taste differences are of no consequences for the effect that trade liberalization has. These generalizations include asymmetric preferences ($a_L v_L \neq a_H v_H$ and $a_L v_H \neq a_H v_L$, and π_H and π_H^* being free parameters), asymmetric entry costs ($f_L \neq f_H$), varying country size, and I also analyze the 3-country case. In particular the latter introduction of the rest of the world is of importance, since it introduces an asymmetry in the degree to which trade liberalization affects the country's industry structure.[10]

The following proposition summarizes the importance of across-country taste differences for the effects of trade liberalization.

Proposition 4 (Invariance of Relative Ideal Price Indices to Trade) *Assume that the world consists of* 3 *countries* 1, 2, *and* 3 *that are separated by bilateral transportation costs* $\tau_{1,2}$, $\tau_{1,3}$ *and* $\tau_{2,3}$. *If parameters are such that no country specializes completely, it is true for* $c = 1, 2, 3$ *that*

$$\frac{P^{c,A}\left(v_H\right)^{-\sigma}}{P^{c,A}\left(v_L\right)^{-\sigma}} = \frac{P^{c,T}\left(v_H\right)^{-\sigma}}{P^{c,T}\left(v_L\right)^{-\sigma}}$$

and that therefore, the welfare gains from trade are equal for all groups and satisfy

$$\frac{E^{c,T}\left(U\left(\theta_i\right)\right)}{E^{c,A}\left(U\left(\theta_i\right)\right)} = \frac{E^{c,T}\left(U_i\left(v = v_H, \theta_i\right)\right)}{E^{c,A}\left(U_i\left(v = v_H, \theta_i\right)\right)} = \frac{E^{c,T}\left(U_i\left(v = v_L, \theta_i\right)\right)}{E^{c,A}\left(U_i\left(v = v_L, \theta_i\right)\right)} = \left(T^c\right)^{\alpha/\sigma}$$

[9] This notion of the "appropriateness" of the domestic industry relates well to the notion of appropriate technology in the endogenous growth literature. For example, Acemoglu and Zilibotti (2001) show how even when technology is freely adoptable, skill scarce countries may be less productive because technologies can be adapted to the skill endowment of rich nations and are can only be used sub-optimally in poor nations. In this paper each country develops an industry that is suited best to the tastes of the local consumer. The country's export bundle is thus inappropriate for the taste distribution of Foreign consumers.

[10] A generalization I do not analyze in this paper is the one where transportation costs are sector specific, i.e. $\tau_H = \tau_L$. As Hanson and Xiang (2004) have documented, such asymmetry gives rise to a home market effect where larger economies (or, in a multi-country world those countries that are close to economic activity) specialize into producing low transportation goods.

where T^c is country c's multilateral resistance, for example equal to

$$T^1 \equiv \frac{\left(1-\tau_{2,3}^{-\sigma}\right)\left(1+\tau_{2,3}^{-\sigma}-\tau_{1,2}^{-\sigma}-\tau_{1,3}^{-\sigma}\right)}{1+2\tau_{2,3}^{-\sigma}\tau_{1,2}^{-\sigma}\tau_{1,3}^{-\sigma}-\left(\tau_{1,3}^{-\sigma}\right)^2-\left(\tau_{1,2}^{-\sigma}\right)^2-\left(\tau_{2,3}^{-\sigma}\right)^2}$$

for country 1.

Proof. *For $c = 1, 2,$ and 3 define the "domestic revenue" in each country as $\Pi^{c,T}$ in the same way as for the two country case in (13). Denoting the fixed entry cost is attribute-specific by $f(a_j)$, the free entry conditions in the three countries are thus*

$$\begin{aligned}
\Pi^{1,T}(a_j)+\tau_{1,2}^{-\sigma}\Pi^{2,T}(a_j)+\tau_{1,3}^{-\sigma}\Pi^{3,T}(a_j) &= \sigma \\
\tau_{1,2}^{-\sigma}\Pi^{1,T}(a_j)+\Pi^{2,T}(a_j)+\tau_{2,3}^{-\sigma}\Pi^{3,T}(a_j) &= \sigma f(a_j) \\
\tau_{1,3}^{-\sigma}\Pi^{1,T}(a_j)+\tau_{2,3}^{-\sigma}\Pi^{2,T}(a_j)+\Pi^{3,T}(a_j) &= \sigma f(a_j)
\end{aligned}$$

solving to a relation

$$\Pi^{c,T}(a_j) = T^c \sigma f(a_j)$$

where T^c is the country's multilateral resistance as defined above. Next, recall the definition of domestic revenue (13) for an $H-$ and a $L-$attribute firm

$$\begin{aligned}
L^c\pi_H^c\frac{e^{v_H a_H}}{P^{c,T}(v_H)^{-\sigma}}+L^c(1-\pi_H^c)\frac{e^{v_L a_H}}{P^{c,T}(v_L)^{-\sigma}} &= \Pi^{c,T}(a_H) \\
L^c\pi_H^c\frac{e^{v_H a_L}}{P^{c,T}(v_H)^{-\sigma}}+L^c(1-\pi_H^c)\frac{e^{v_L a_L}}{P^{c,T}(v_L)^{-\sigma}} &= \Pi^{c,T}(a_L)
\end{aligned}$$

Together, this uniquely solves for the ideal price indices $P^{c,T}(v_H)^{-\sigma} = P^{c,A}(v_H)^{-\sigma}/T^c$, which satisfies the above-state equalities. The statements about welfare then derive from Corollary 1. The underlying parameter conditions for incomplete specialization are derived in the appendix. ■

The main intuition of Proposition is that trade may affect different countries differentially, but that in an non-specialized equilibrium, it must always be true that trade leave relative revenue flows unchanged, i.e. that $\frac{\Pi^{c,T}(a_H)}{\Pi^{c,T}(a_L)} = \frac{f(a_H)}{f(a_L)} = \frac{\Pi^{c,A}(a_H)}{\Pi^{c,A}(a_L)}$. From this, it follows that also the volume of trade is unaffected by taste heterogeneity.

Corollary 2 (The Volume of Trade Between Asymmetric Countries) *Assume that parameters are such that no country specializes completely. Then, the volume of country 1's exports is unaffected by the distribution of tastes in either country 1, 2, or 3 and equal to*

$$\begin{aligned}
X^1 &= X^{1,2}+X^{1,3} \\
&= \left(\frac{\frac{L^1}{T^1}\left(1-\left(\tau_{23}^{-\sigma}\right)^2\right)-\frac{L^2}{T^2}\left(\tau_{12}^{-\sigma}-\tau_{23}^{-\sigma}\tau_{13}^{-\sigma}\right)-\frac{L^3}{T^3}\left(\tau_{13}^{-\sigma}-\tau_{12}^{-\sigma}\tau_{23}^{-\sigma}\right)}{1+2\tau_{23}^{-\sigma}\tau_{12}^{-\sigma}\tau_{13}^{-\sigma}-\left(\tau_{23}^{-\sigma}\right)^2-\left(\tau_{13}^{-\sigma}\right)^2-\left(\tau_{12}^{-\sigma}\right)^2}\right)\left(\tau_{12}^{-\sigma}T^2+\tau_{13}^{-\sigma}T^3\right)
\end{aligned}$$

Proof. *See Appendix.* ■

Corollary 2 documents that Linder's (1961) hypothesis neglects an important insight about how trade affects a nation's industrial structure. The key insight that demand for imports is not determined by preferences alone, but also, by how well these preferences are served by the domestic industry. His hypothesis hinges on the (intuitive) notion that low domestic taste for an attribute is associated with a low volume of imports of goods embodying this attribute. This insight indeed holds if industry structure did not respond to tastes. However, in general equilibrium, the country in question looses firms that produce the type of good for which domestic demand is low, and thus the country becomes a net importer of the good. In general equilibrium, a low taste for an attribute is thus associated with a large amount of imports embodying the attribute.

Finally, the most important consequence of Proposition 4 and the associated corollary 2 regards the welfare effects of liberalization. Opening markets to trade does not affect the relative welfare of $H-$ and $L-valuation$ consumers at Home: although the group which is relatively smaller gains from having access to a large set of Home firms that produce a fitting good, this is exactly offset by the exit of domestic firms from this sector.[11]

Proposition 4 and the associated Corollary 2 document the main result of this paper. They demonstrate that across-country taste heterogeneity and departures from the representative agent framework may matter much less for the effects of trade liberalization than a superficial intuition suggests.

5 The Static Impact of Trade Liberalization

Before concluding, I also analyze the short run impact of trade since it gives rise to another case when taste heterogeneity matters for trade. I examine the short run impact of an unanticipated trade liberalization when the industry structure is still determined by autarky demand conditions. The direct relevance of this case lies in the fact that firms generally take more time to exit and enter an industry than to start exporting and, that therefore, the direction and volume of, as well as the welfare gains from, trade are dependent on the composition of industry in autarky. In addition, the analysis of the current section is also of use since some of the developed intuitions hold true in general equilibrium when countries are dissimilar and specialize completely.

The analysis unveils two facts: first, consumption is home-biased in the sense that trade volume is lower than what would be expected on the basis of transportation costs and the elasticity of demand. At the moment of opening markets to trade, each country's industry is optimized for the tastes of domestic consumers. The typical domestic exporter will, therefore, on average sell less on the export market than would be expected for a given level of trade costs since the typical Home consumer is different than what the industry is optimized for: while the few German producers of fuel-efficient cars experience high demand in France, this is more than offset by the many producers of fast cars that experience low demand in France. Overall, the volume of trade is small since the German industry, which is optimized for the fast-car loving German consumer, is inappropriate for the average French consumer, who is characterized by a love for fuel efficiency.

I analyze how liberalization impacts the economy in the short run if the two countries differ in the fraction of $H-$ and $L-valuation$ consumers and contrast this to the static effects of liberalization without such taste heterogeneity, where the economy resembles the one in Krugman (1980). I also allow for the countries to differ in size L and L^*.

[11] The welfare gains from trade in the model of this paper are also comparable to the ones in the literature on firm heterogeneity. Arkolakis et al. (2009) evaluate the welfare effects of trade for several such models with heterogeneous firms, demonstrating that one can calculate the gains from trade on the basis of knowing only the share of expenditure on domestic goods and the elasticity of demand. In this paper, the same holds true in the long run equilibrium, but not in the immediate aftermath of trade liberalization.

At the instant of opening markets to trade, the number of firms is at its autarky level (9). Since accessing the export market is not subject to any fixed cost, all firms export and there are $N^A n_H^A$ $H - attribute$ producers exporting from Home to Foreign and $N^{A*} n_H^{A*}$ $H - attribute$ producers exporting from Home to Foreign. Each Home $H - attribute$ firm sells to $\pi_H^* L^*$ $H - valuation$ consumers and to $(1 - \pi_H^*) L^*$ $L - valuation$ consumers in Foreign. Denoting the values that variables take immediately at the moment of opening to trade by ^{S} and ^{S*} superscripts, the aggregate volume of $H - attribute$ exports (denoted by X_H^S) is thus equal to

$$X_H^S = N^A n_H^A \left[\pi_H^* L^* \frac{\tau^{-\sigma} e^{\sigma v_H a_H}}{P^{S*}(v_H)} + (1 - \pi_H^*) L^* \frac{\tau^{-\sigma} e^{\sigma v_L a_H}}{P^{S*}(v_L)} \right].$$

Similarly, the volume of Foreign's $H - attribute$ exports is equal to

$$X_H^{S*} = N^{A*} n_H^{A*} \left[\pi_H L \frac{\tau^{-\sigma} e^{\sigma v_H a_H}}{P^S(v_H)} + (1 - \pi_H) L \frac{\tau^{-\sigma} e^{\sigma v_L a_H}}{P^S(v_L)} \right]$$

In each country, the price indices now include the import competition. Since all firms export, Home's exports are more $H - attribute$ intensive than is the domestic production in Foreign. Trade, therefore, intensifies competition more in the sector where Foreign has relatively fewer consumers.

Lemma 3 (Liberalization and Short Run Relative Competition) *Assume that $\pi_H > \pi_H^*$ and $n_H^A, n_H^{A*} \epsilon]0,1[$. When opening markets to trade, competition in Home intensifies more in the $L - attribute$ segment of the industry than in the $H - attribute$ segment, while competition in Foreign intensifies more in the $H - attribute$ segment of the industry than the $L - attribute$ segment. I.e., it is true that*

$$\frac{P^S(v_H)}{P^A(v_H)} < \frac{P^S(v_L)}{P^A(v_L)} \text{ and } \frac{P^{S*}(v_H)}{P^{A*}(v_H)} > \frac{P^{S*}(v_L)}{P^{A*}(v_L)}.$$

Proof. *Since accessing the export market is free, all firms export. With entry given by the autarky equilibrium values $P^S(v_H)^{-\sigma} = \left(\tau^{-\sigma} N^A n_H^A + N^{A*} n_H^{A*}\right) e^{\sigma v_H a_H} +$ $\left(\tau^{-\sigma} N^A \left(1 - n_H^A\right) + N^{A*}\left(1 - n_H^{A*}\right)\right) e^{\sigma v_H a_L} = (\sigma f)^{-1} \frac{\tau^{-\sigma}\pi_H L + L^* \pi_H^*}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}$, $P^{S*}(v_H) =$ $\left((\sigma f)^{-1} \frac{\tau^{-\sigma}\pi_H L + L^*\pi_H^*}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}} \phi\right)^{-1/\sigma}$, $P^S(v_L) = \left((\sigma f)^{-1} \frac{L(1-\pi_H) + \tau^{-\sigma} L^*\left(1-\pi_H^*\right)}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} \phi\right)^{-1/\sigma}$, and $P^{S*}(v_L) =$ $\left((\sigma f)^{-1} \frac{\tau^{-\sigma} L(1-\pi_H) + L^*\left(1-\pi_H^*\right)}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} \phi\right)^{-1/\sigma}$, which satisfy the stated inequalities.* ■

Corollary 1 implies that the ideal price index of each type of consumer can be mapped one-to-one into welfare changes. Lemma 3 thus implies that when countries differ in their distributions of tastes, it is the relatively smaller group of consumers that gains relatively more from trade at the moment of trade liberalization. This result if intuitive: if markets are opened to trade, a French consumer with a preference for large cars suddenly gains access to many German large car varieties. In contrast, a French consumer with a preference for small and fuel efficient cars gains relatively little, since Germany offers few of these varieties compared to the French industry.

What is the direction of trade in the short run after liberalization? The following proposition summarizes the prevailing patterns of trade.

Proposition 5 (Within- and Across-Industry Home Market Effects) *Assume that parameters are such that* $n_H^A, n_H^{A*} \epsilon]0,1[$. *At the moment after trade liberalization, if* $L = L^*$, *Home is a net exporter of* $H - attribute$ *goods iff* $\pi_H > \pi_H^*$. *If* $L \neq L^*$ *Home's manufacturing exports contain a larger fraction of* $H - attribute$ *goods than do Foreign's exports, but Home can be a net-importer of such goods if* $L^* > L$. *If* $\pi_H^* = \pi_H$, *Home is a net exporter of the* $\mathcal{M}$ *good* iff $L > L^*$.

Proof. *see Appendix* ■

Proposition 5 presents two home market effects. In models following Krugman (1980), a country with a larger home market for certain types of goods has more entry of firms producing for the domestic market. Thus, with open markets, this nation is a net exporter of industrial output.[12]

The model also includes Krugman's (1991) aggregate home market effect as a special case when Home and Foreign share the distribution of consumer tastes.[13] For the strength of the home bias, the share of $H-$ and $L - valuation$ consumers is not important, since the returns to scale are equally strong in the L and H segment of the market. Moreover, as I demonstrate in the appendix, the model also predicts that net exports of the manufacturing $\mathcal{M}$ good can be nonzero even in the case of equal country sizes. In this case, the direction of net exports is the following: if $\pi_H + \pi_H^* > 1$, i.e., if the global market for the type of good that Home's exports are concentrated in is large, Home is a net importer of manufacturing goods. If $\pi_H + \pi_H^* > 1$ there are in more $H - valuation$ consumers than $L - valuation$ consumers in the world (since $L = L*$) and accordingly, there are also more $H - attribute$ firms in the world than $L - attribute$ good ones. Global competition is thus tougher in the H segment of the industry, which happens to be the segment were Home's exports are concentrated in. Similarly, competition is less tough in the market segment were Home exports are concentrated in. Thus, Home's overall exports are smaller than its imports from Home if its exports tend to be concentrated in the more competitive industry, which is the case if $\pi_H + \pi_H^* > 1$.

Lemma 3 is also indicative of why differences in the distribution of tastes across Home and Foreign reduce the short run aggregate volume of trade. The aggregate volume of Home's exports is equal to the number of $H - attribute$ firms times exports per such firm plus the number of $L - attribute$ firms times exports per such firm. Since trade intensifies competition in Foreign relatively more in the H sector, each Home $H - attribute$ exporter sells a smaller amount that she would in an economy without product heterogeneity. In contrast, each Home L-exporter sells a larger amount that she would in an economy without product heterogeneity.

Next, I turn to the volume of trade (measured in terms of the numeraire),

Proposition 6 (Short Run Trade Volume) *Assume that parameters are such that* $n_H^A, n_H^{A*} \epsilon]0,1[$. *At the moment after trade liberalization, the following holds. If* $\pi_H^* = \pi_H$, *the volume of trade is the same as in the absence of consumer heterogeneity and Home is a net exporter of the* $\mathcal{M}$

[12] In the model at hand, the intuition of the within-industry home market effect is closely related to Hanson and Chen's (2004) notion of the relative across-industry home market effect. The within-industry home market effect is also reminiscent of Fajgelbaum et al.'s (2009) prediction that richer countries tend to export high-quality goods and import low-quality one's. Fajgelbaum et al.'s model features non-homogenous preferences which result in richer consumers tending to buy higher quality goods. Since a larger fraction of high income consumers is associated with a larger domestic market for high quality goods, richer nations have a larger number of high quality producers. When markets are opened to trade, richer nations thus become net exporters of high quality goods.

[13] As demonstrated by Davis (1998), the aggregate home market effect does not necessarily arise once one allows for the possibility that trade in the $\mathcal{O}$ sector is also subject to trade costs.

good iff $L > L^*$. If $\pi_H \neq \pi_H^*$, the volume of trade is lower than in the absence of consumer heterogeneity and the lower the higher is $|\pi_H - \pi_H^*|$.

Proof. *See Appendix* ■

The short run volume of trade is composed of $H-$ and $L-$*attribute* goods and equals

$$X^S = X_H^S + X_L^S = \frac{\tau^{-\sigma} L L^* \pi_H \pi_H^*}{L\pi_H + \tau^{-\sigma} L^* \pi_H^*} + \frac{\tau^{-\sigma} L L^* (1-\pi_H)(1-\pi_H^*)}{L(1-\pi_H) + \tau^{-\sigma} L^* \left(1-\pi_H^*\right)}.$$

It is easily verified that if there are no differences in the distribution of valuations in Home and Foreign ($\pi_H^* = \pi_H = \pi$), the volume of Home's exports is equal to $\frac{\tau^{-\sigma} L L^*}{L + \tau^{-\sigma} L^*}$ for any value of π. It is easily verified that the latter expression corresponds exactly to the volume of trade one would observe immediately after liberalization in Krugman (1980). The latter volume is decreasing in trade costs, increasing in the size of the domestic labor force (because a larger domestic labor force is associated with more domestic firms) and also in the size of the Home labor force (since a larger Home labor force consumes more). The volume of trade is less than proportionally increasing in $\tau^{-\sigma}$ since the global toughness of competition is increasing in the inverse of trade costs.

Moreover, it is also straightforward to check that for any level of π_H^*, in the above equation is indeed maximized when $\pi_H = \pi_H^*$, i.e., the volume of trade is lower than in the presence of across-country taste differences. Consider the impact of taste heterogeneity and assume that $\pi_H > \pi_H^*$. With such preferences, each Home firm faces relatively more demand from $L-$*valuation* consumers, and sales per firm equal $\frac{\left(1-\pi_H^*\right)L^*}{\tau^{-\sigma} L(1-\pi_H) + L^*\left(1-\pi_H^*\right)} > \frac{L^*}{\tau^{-\sigma} L + L^*}$. $H-$*valuation* consumers face less demand and each have sales of $\frac{\pi_H^* L^*}{\tau^{-\sigma} L\pi_H + L^* \pi_H^*} < \frac{L^*}{\tau^{-\sigma} L + L^*}$. Compared to the benchmark economy without product heterogeneity, there is thus one sub-sector with larger export volume and one with smaller export volume per firm. The overall effect of such product heterogeneity on the volume of trade is still unambiguously negative on Home's export volume, since the losses in the large $H-$*attribute* segment are not fully outweighed by gains in the comparatively small $L-$*attribute* segment. In autarky, the demand structure of the domestic industry adjusts to the distribution of consumer valuations such that all firms have equal sales. Second, in the presence of across-country taste differences, the Home industry is not composed proportional to the Home distribution of tastes and consequently, imports tend to increase the toughness of competition more in some segments than in others. Third, because Home firms tend to concentrate in precisely the relatively tough market segments (in fact: in those segments they *make* tough by their exports), their sales are low compared to the domestic firms. Thus, across country taste differences diminish the short run volume of trade if the exporter's industry is non-negligible in size.

In the short run, the composition of the domestic industry is thus not "appropriate" for the average Home consumer. This notion of the "appropriateness" of the domestic industry relates well to the notion of appropriate technology in the endogenous growth literature. For example, Acemoglu and Zilibotti (2001) show how even when technology is freely adoptable, skill scarce countries may be less productive because technologies are adapted to the skill endowment of rich nations and are can only be used sub-optimally in poor nations. In this paper, in autarky, each country develops an industry that is suited best to the tastes of the local consumer. In the short run after opening to trade, the country's export bundle is inappropriate for the taste distribution of Foreign consumers.

Summarizing, three major trade patterns arise in the short run opening markets to trade. First, if countries are of unequal size, the Home market effect applies and the larger country becomes the net exporter of manufactured goods, while the other country becomes the net exporter of agricultural goods. Second, even if countries are of equal size, there can be net exports in each segment of the industry. Third, owing to the differences in countries' average tastes, trade volume is lower than what one would observe in Krugman's (1980) model. I next examine whether and to what extent these predictions hold when the industry structure is allowed to adjust to the changed demand patterns after a trade liberalization.

Overall, my findings thus highlight that endogenizing how a nation's industrial composition responds to trade liberalization is of first order importance for understanding trade patterns and the welfare gains from open markets. For example, Linder's (1961) often-cited hypothesis hinges on the intuitive idea that a lower fraction of consumers who value a certain attribute is associated with a lower volume of imports embodying the attribute. While the latter statement is true for a given domestic industry structure, the reverse holds true in general equilibrium: with trade, lower domestic valuation for an attribute is associated with an over-proportional reduction in domestic production of goods embodying the attribute, and consequently, higher import volume of such goods.

Modeling the dynamic response of industrial composition to trade liberalization and the subsequent increase in trade volumes can also contribute to our understanding of why trade grows very sluggish after liberalization as for example documented by see Yi (2003), Ruhl (2008), and Hummels (2007). After such liberalization, each country's industrial composition has to adapt, which requires firm exit and entry and, therefore, time. It is also noteworthy that the model predicts a substantial amount of new trade due to the extensive margin. In contrast to the existing literature, this is not driven by the trade-induced shift towards ex-ante more profitable entities, but rather, by the adaptation of a country's industrial composition to the taste structure of a globalized economy. Modeling the dynamic response of industrial composition to trade liberalization and the subsequent increase in trade volumes can also contribute to our understanding of why trade grows very sluggish after liberalization (see Yi (2003), Ruhl (2008), and Hummels (2007)). After such liberalization, each country's industrial composition has to adapt, which requires firm exit and entry and, therefore, time. It is also noteworthy that the model predicts a substantial amount of new trade due to the extensive margin (see Kehoe and Ruhl (2008)). In contrast to the existing literature that derives from Melitz (2003), this is not driven by the trade-induced shift towards ex-ante more profitable entities, but rather, by the adaptation of a country's industrial composition to the taste structure of a globalized economy.[14]

6 Conclusion

The home market effect analyzed in Krugman (1980) relates across-country taste differences to bilateral net trade flows. Given that there is now strong empirical evidence for the home market effect and therefore, also for the existence of across-country taste differences, it is striking that most analysis in the theory of international trade is based upon preference frameworks that assume the existence of a globally representative consumer.

In this paper, I thus analyze how differences of tastes across countries impact the volume of trade and the welfare gains from liberalization. The paper's main finding is that for any parameter region that is consistent with incomplete specialization, the class of increasing returns

[14] Cunat and Maffezzoli (2007) model a similar structural transition process in which trade-induced factor accumulation slowly transforms a country's industrial structure, leading to a sluggish response of trade volume to liberalization.

models based on constantly elastic preference frameworks gives rise to a result on the invariance of relative ideal price indices to trade that is akin to the factor price equalization theorem in the classical theory of trade. In the latter constant returns economy analyzed by Samuelson (1949), costless trade equates good prices and any equilibrium featuring incomplete specialization requires that factors of production receive exactly the same reward across countries.

In the increasing returns economy analyzed in this paper, the adjustment of firm profits works via relative firm scale across different types of goods. Since production costs and markups are equal across countries, an equilibrium featuring incomplete specialization requires firms of the same type to have the same revenue in Home and Foreign. This, in turn, implies that the domestic industry composition must adjust such as to offset the mismatch between the composition of imports and domestic tastes exactly, leaving the relative ideal price indices (which measure the "toughness" of competition) undistorted by trade.

It is shown that therefore, both trade volume and welfare gains are entirely unaffected by the distribution of foreign tastes and exactly equal to what they would be in a representative agent framework. This, for example, implies that the recent quantifications of the gains from trade based on the representative agent framework (see Broda and Weinstein (2004), Broda et al. (2006), and Akorlakis et al. (2008)) hold exactly even if the representative agent is not the accurate description of underlying consumption decisions.

In this sense, the analysis of hand documents that the Linder (1961) conjecture that taste differences between countries may impede trade only holds true under the special case that countries are completely specialized. Linder's (1961) often-cited hypothesis hinges on the intuitive idea that a lower fraction of consumers who value a certain attribute is associated with a lower volume of imports embodying the attribute. While the latter statement is true for a given domestic industry structure, the reverse holds true in general equilibrium: with trade, lower domestic valuation for an attribute is associated with an over-proportional reduction in domestic production of goods embodying the attribute, and consequently, higher import volume of such goods.[15]

Overall, the results at hand implies that the representative agent framework is much better approximating of the welfare as might seem on first sight, hence supporting Krugmans (2008, p. 341) conjecture that the

> "detailed pattern of trade [...] does not matter as long as aggregate measures like the volume of trade and the welfare effects of trade can be derived from the model. In effect, one had to step back from the blackboard and unfocus one's eyes a bit, so as to grasp the broad pattern rather than the irrelevant details."

[15] I also analyze two cases where across-country taste differences impact the volume of trade and the welfare gains from liberalization. The first case is the one where countries specialize completely. The second case is the short run after liberalization when industry structure has not yet reacted to the changed demand structure of the open economy. In these cases, the instantaneous welfare gains from trade occur disproportionately to the comparatively smaller group of consumers, since this group gains access to a comparatively large set of new imported varieties. Moreover, in these cases, differences in the distributions of taste across countries are associated with lower trade volume.

References

[1] Acemoglu, Daron, and Fabrizio Zilibotti. (2001). "Productivity Differences." *The Quarterly Journal of Economics*, 116 (2): 563–606.

[2] Atkin, David G. (2009). "Trade, Tastes and Nutrition in India." Mimeo, Yale University.

[3] Anderson, James E., and Eric van Wincoop. (2003). "Gravity with Gravitas: a Solution to the Border Puzzle." *The American Economic Review*, 93 (1): 170–92.

[4] Anderson, Simon P., André De Palma, and Jacques-François Thisse. (1987). "The CES is a discrete choice model?" *Economics Letters*, 24 (2): 139–140.

[5] Anderson, Simon P., André de Palma, and Jacques-François Thisse. (1992). "Discrete Choice Theory of Product Differentiation." Cambidge: MIT Press.

[6] Arkolakis, Costas, Pete Klenow, Svetlana Demidova, and Andres Rodriguez-Clare. (2008). "The Gains from Trade with Endogenous Variety." *The American Economic Review Papers and Proceedings*, 98 (4): 444–450.

[7] Arkolakis, Costas, Arnaud Costinot, and Andres Rodriguez-Clare. (2009). "New Theories, Same Old Gains?" Mimeo, Yale University.

[8] Armington, Paul S. (1969). "A theory of demand for products distinguished by place of production." IMF Staff Papers 16: 159–76.

[9] Auer, Raphael and Thomas Chaney (2009). "Exchange Rate Pass-Through in a Competitive Model of Pricing-to-Market." *Journal of Money, Credit and Banking*, 41 (s1): 151–175.

[10] Baier, Scott L., and Bergstrand, Jeffrey H. (2001). "The growth of world trade: tariffs, transport costs, and income similarity." *The Journal of International Economics*, 53 (1): 1–27.

[11] Bergstrand, Jeffrey H. (1990). "The Heckscher-Ohlin-Samuelson Model, The Linder Hypothesis and the Determinants of Bilateral Intra-Industry Trade." *The Economic Journal*, 100 (403):1216–1229.

[12] Bernasconi Claudia. (2009) "New Evidence for the Linder Hypothesis and the two Extensive Margins of Trade. Mimeo University of Zurich.

[13] Bernard, Andrew B., Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum. (2003). "Plants and productivity in international trade." *The American Economic Review,* 93(4): 1268–1290.

[14] Bernard, Andrew B., J. Bradford Jensen, Stephen J. Redding, and Peter K. Schott. (2007). "Firms in International Trade." *The Journal of Economic Perspectives*, 21 (3): 105–130.

[15] Bernard Andrew B., Stephen J. Redding, and Peter K. Schott. (2009). "Multi-product firms and trade liberalization." Mimeo, revised version of NBER Working Paper No. 12782.

[16] Bils, Mark and Pete Klenow. (2001) "Quantifying Quality Growth" with , American Economic Review 91, September 2001, 1006-1030.

[17] Blonigen, Bruce A., and Wesley W. Wilson. (1999). "Explaining Armington: What Determines Substitutability between Home and Foreign Goods?" *The Canadian Journal of Economics / Revue canadienne d'Economique*, 32 (1): 1–21.

[18] Broda, Christian, and John Romalis (2009) "The Welfare Implications of Rising Price Dispersion ", Mimeo University of Chicago Booth. July 2009.

[19] Broda, Christian, and David Weinstein. (2006). "Globalization and the Gains from Variety." *The Quarterly Journal of Economics*, 121 (2): 541–585.

[20] Broda, Christian, Josh Greenfield and David Weinstein. (2006) "From Groundnuts to Globalization: A Structural Estimate of Trade and Growth" National Bureau of Economic Research, Working Paper No. 12512. September 2006

[21] Bruelhart M. & Trionfetti F. (2009). A Test of Trade Theories When Expenditure is Home Biased. Working Paper 2009-01 GREQAM

[22] Choi, Yo Chul, David Hummels, and Chong Xiang. (Forthcoming). "Explaining Import Quality: the Role of the Income Distribution." *The Journal of International Economics.*

[23] Crozet, Mathieu, Keith Head, and Thierry Mayer. (2008). "Quality Sorting and Trade: Firm-level Evidence for French Wine." Mimeo.

[24] Crozet, Matthieu and Trionfetti, Federico, 2008. "Trade costs and the Home Market Effect," Journal of International Economics, Elsevier, vol. 76(2), pages 309-321, December

[25] Cunat, Alejandro, and Marco Maffezzoli. (2007). "Can Comparative Advantage Explain the Growth of US Trade." *The Economic Journal.* Royal Economic Society, 117(04): 583-602.

[26] Davis, Don R. (1998). "The home market, trade, and industrial structure." *The American Economic Review*, 88 (5): 1264–1276.

[27] Davis, Don R. and David Weinstein. (1999)."Economic Geography and Regional Production Structure: An Empirical

[28] Investigation." *European Economic Review*, 43 (2). February 1999.

[29] Davis, Don R. and David Weinstein. (2003). "Market Access, Economic Geography and Comparative Advantage: An

[30] Empirical Assessment." *Journal of International Economics.* 59 (1). January 2003.

[31] Dixit, Avinash V., and Joseph E. Stiglitz. (1977). "Monopolistic Competition and Optimum Product Diversity." *The American Economic Review*, 67 (3): 297–308.

[32] Eaton, Jonathan and Samuel Kortum. (2002). "Technology, Geography, and Trade." *Econometrica.* 70(5): 1741-1779. September 2002.

[33] Fajgelbaum, Pablo, Gene Grossman, and Elhanan Helpman. (2009). "Income Distribution, Product Quality and International Trade." National Bureau of Economic Research, Working Paper No. 15329. September 2009.

[34] Feenstra, R.C., J.A. Markusen and A.K. Rose. 2001. Using the gravity equation to differentiate among alternative theories of trade, Canadian Journal of Economics 34 (2001), pp. 430–447

[35] Fieler, Ana Cecilia (2009). "Non-Homotheticity and Bilateral Trade: Evidence and a Quantitative Explanation", Mimeo, Department of Economics, University of Pennsylvania.

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

[37] Foellmi, Reto, Christian Hepenstrick, and Josef Zweimueller. (2008). "Income Effects in the Theory of Monopolistic Competition and International Trade." Mimeo, University of Zurich.

[38] Gabaix, Xavier, David Laibson, Deyuan Li, Hongyi Li, and Caspar G. de Vries. (2006). "On Extreme Value Theory and Market Demand." Mimeo, MIT.

[39] Gabaix, Xavier, David Laibson, Deyuan Li, Hongyi Li, Sidney Resnick, and Caspar G. de Vries. (2009). "Competition and Prices: Insights from Extreme Value Theory." Mimeo, NYU Stern.

[40] Goldberg, Pinelopi K., and Frank Verboven. (2001). "The Evolution of Price Dispersion in the European Car Market." *Review of Economic Studies*, 68 (4): 811–848.

[41] __ (2005). "Market Integration and Convergence to the Law of One Price: Evidence from the European Car Market." *The Journal of International Economics*, 65 (1): 49–73.

[42] Hallak, Juan Carlos. (forthcoming). "A Product-Quality View of the Linder Hypothesis." *Review of Economics and Statistics.*

[43] Hanson, Gordon and Chong Xiang (2004). "The Home-Market Effect and Bilateral Trade Patterns" *The American Economic Review*, 2004, 94, (4): 1108-1129.

[44] Helpman, Elhanan, Marc Melitz and Yona Rubinstein. 2008. "Estimating Trade Flows: Trading Partners and Trading Volumes." *The Quarterly Journal of Economics.* 123(2): 441-487. May 2005.

[45] Hummels, David. 2007. "Transportation Costs and International Trade in the Second Era of Globalization," *Journal of Economic Perspectives.* 21(3): 131-154. 2007.

[46] Keith, Head and John Ries. 2001. "Increasing Returns versus National Product Differentiation as an Explanation for the Pattern of U.S.-Canada Trade," *The American Economic Review.* 91(4): 858-876, September 2001.

[47] Kehoe, Timothy J. and Kim J. Ruhl. (2008). "How Important is the New Goods Margin in International Trade? Mimeo, University of Minnesota

[48] Krugman, Paul R. (1979). "A Model of Innovation, Technology Transfer, and the World Distribution of Income." *The Journal of Political Economy*, 87 (2): 253–266.

[49] __ (1980). "Scale Economies, Product Differentiation, and the Pattern of Trade." *The American Economic Review*, 70 (5): 950–959.

[50] __ (1981). "Intraindustry Specialization and the Gains from Trade." *The Journal of Political Economy*, 89 (5): 959–973.

[51] __ (2008). "The Increasing Returns Revolution in trade and Geography". Nobel Prize Lecture, December 2008.

[52] Lancaster, Kelvin. 1980. "Intra-industry trade under perfect monopolistic competition". Journal of International Economics 10(1): 151 175.

[53] Linder, Staffan B. (1961). *An Essay on Trade and Transformation*. New York: John Wiley & Sons.

[54] McFadden, Daniel L. (1981). "Econometric Models of Probabilistic Choice." In Charles F. Manski and Daniel L. McFadden (eds.): *Structural Analysis of Discrete Data with Econometric Applications (* pp. 198-242). Cambidge: MIT Press.

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

[56] Mussa, Michael, and Sherwin Rosen. (1978). "Monopoly and Product Quality." *The Journal of Economic Theory*, 18 (2): 301–317.

[57] Ruhl, K. (2008). "The International Elasticity Puzzle." Mimeo, NYU Stern.

[58] Samuelson, Paul A. 1949. "International Factor-Price Equalisation Once Again." *Economic Journal.* 59, pp. 181-197. June 1949.

[59] Schott, Peter K. (2004). "Across-product versus within-product specialization in international trade." *The Quarterly Journal of Economics*, 119 (2): 647–678.

[60] Weder Rolf. 2003. "Comparative home-market advantage: An empirical analysis of British and American exports," *Review of World Economics (Weltwirtschaftliches Archiv).* 139(2): 220-247. June 2003.

[61] Yi, Kei-Mu. (2003). "Can vertical specialization explain the growth of world trade?" *The Journal of Political Economy*, 111 (1): 52–102.

7 Appendix: Proofs

Proposition 1 (reminded) Denote the demand function of a firm with attribute a_j and charging price p_j by $D(a_j, p_j)$. Demand is determined by

$$D(a_j, p_j) = (1-\alpha)\,\theta L \Gamma(1-\sigma)\, p_j^{-(1+\sigma)} \int\limits_{v \epsilon V} f_v(v) \frac{\exp[\sigma v a_j]}{\overline{P(v)}^{-\sigma}} dv, \tag{21}$$

where $\Gamma(...)$ is the beta function and $\overline{P(v)}$ denotes the ideal price index for all consumers with $v_i = \widetilde{v}$ and is equal to

$$\overline{P(v)} = \left(\sum_{n \epsilon J} \left(\frac{p_n}{\exp[v a_n]} \right)^{-\sigma} \right)^{-1/\sigma}. \tag{22}$$

Proof. A consumer with valuation $\widetilde{v}$ buys only from the firm the firm offering the cheapest per unit good, adjusted for the idiosyncratic shock and the taste-attribute match, i.e., each consumer chooses $\widetilde{j}$=arg $\max\limits_{i \epsilon J} \frac{e^{a_j \widetilde{v} + x_{i,j}}}{p_j}$. Since the distribution of $x_{i,j}$is continuous the probability of ties is 0. From the firm side, (expected) demand from consumer $\widetilde{v}$ with an unknown realization of $x_{i,j}$ is then equal to the probability that the firm's draw $x_{i,j}$, adjusted for the firms' price and the match of a_j and $\widetilde{v}$ is the maximum of all adjusted draws. Since each consumer spends $(1-\alpha)\,\theta_i$ on the manufacturing composite, spends it all on one variety only, sales are then equal to

$$\begin{aligned} & D_j(a_j, p_j, v_i = \widetilde{v}) \\ = \; & \frac{(1-\alpha)\,\theta_i}{p_j} \int\limits_{x_{i,j} \epsilon X} j_x(x_{i,j}) \Pr\left(\frac{e^{a_j \widetilde{v} + x_{i,j}}}{p_j} = \max_{n \epsilon J} \frac{e^{a_n \widetilde{v} + x_{i,n}}}{p_n} \right) dx_{i,j} \\ = \; & \Pr\left(x_{i,n} < \ln(p_n) - \ln(p_j) + (a_j - a_n)\,\widetilde{v} + x_{i,j}\right) dx_{i,j} \end{aligned}$$

If all x are distributed Gumbel with scale parameter 0 and shape parameter $1/\sigma$, the following holds

$$g_x(x) = \frac{1}{\sigma} \exp[-x\sigma] \exp[-\exp[-x\sigma]]$$

and thus

$$\begin{aligned} & \Pr\left(x_{i,n} < \ln(p_n) - \ln(p_j) + (a_j - a_n)\,\widetilde{v} + x_{i,j}\right) \\ = \; & \exp\left[-p_j^{\sigma} p_n^{-\sigma} \exp\left[-\sigma\left(a_j \widetilde{v} + x_{i,j}\right)\right] \exp\left[\widetilde{v} \sigma a_n\right]\right] \end{aligned}$$

so that

$$\begin{aligned} & \prod_{n \neq j} \Pr\left(x_{i,n} < \ln(p_n) - \ln(p_j) + (a_j - a_n)\, v + x_{i,j}\right) \\ = \; & \exp\left[-p_j^{1/\sigma} \exp\left[-\sigma\left(a_j v + x_{i,j}\right)\right] \sum_{J \neq j} \left(p_n^{-\sigma} \exp[v \sigma a_n] \right) \right] \end{aligned}$$

and Demand from group $\widetilde{v}$ can be conveniently be expressed as

$$D_j(a_j,p_j,\widetilde{v}) = \frac{(1-\alpha)\,\theta_i}{p_j}\frac{1}{\sigma}\int\limits_{x_{i,j}\epsilon X} \exp[-\sigma x_{i,j}]\exp$$

$$\left[-\exp[-\exp -\sigma x_{i,j}]\left(1+p_j^{\sigma}\exp[-\sigma\widetilde{v}a_j]\sum_{J\neq j}\left(p_n^{-\sigma}\exp[\widetilde{v}\sigma a_n]\right)\right)\right]dx_{i,j}$$

Note that : $\left(1+p_j^{\sigma}\exp[-\widetilde{v}\sigma a_j]\sum_{J\neq j}(p_n^{-\sigma}\exp[\widetilde{v}\sigma a_n])\right) = \sum_{J\neq j}(p_n^{-\sigma}\exp[\widetilde{v}\sigma a_n])$. Now, one can substitute: $z_{i,j} = p_j^{\sigma}\exp[-\widetilde{v}\sigma a_j]\sum_{j\epsilon J}(p_n^{-\sigma}\exp[\widetilde{v}\sigma a_n])\,x_{i,j}$ leading to

$$\begin{aligned} D_j(a_j,p_j,\widetilde{v}) &= \frac{(1-\alpha)\,\theta_i}{p_j}\frac{1}{\sigma}\left(p_j^{\sigma}\exp[-v\sigma a_j]\sum_{j\epsilon J}\left(p_n^{-\sigma}\exp[v\sigma a_n]\right)\right)^{-1} \\ &\quad \int\limits_{z_{i,j}\epsilon X}\exp[-z_{i,j}\sigma]\exp[-\exp[-\sigma z_{i,j}]]\,dzx_{i,j}. \end{aligned}$$

Since the latter part can be expressed as the CDF of a Gumbel shock, we get demand per from a mass 1 of consumers with valuation $\widetilde{v}$

$$D_j(a_j,p_j,\widetilde{v}) = \Gamma(1-\sigma)\,\frac{w}{p_j}\frac{p_j^{-\sigma}\exp[\sigma\widetilde{v}a_j]}{\sum_{n\epsilon J}\left(p_n^{-\sigma}\exp[\sigma\widetilde{v}a_n]\right)}. \tag{23}$$

To get a firm's total demand $D_j(a_j,p_j)$, one has to integrate over all possible valuations v. ■

Corollary 1 **(reminded).** Denote the *expected* welfare of consumer i with $v_i = v$ and income θ_i by $E(U_i\,|v,\theta_i)$. If $p_O = 1$,

$$E(U_i) = (1-\alpha)^{1-\alpha}\alpha^{\alpha}\Gamma\left(1-\frac{\sigma}{\alpha}\right)\left(\overline{P(v)}\right)^{-\alpha}\theta_i$$

where the ideal price index $\overline{P(v)}$ is as defined in (6) and $\Gamma(..)$ is the gamma function.

Proof. The consumer only buys from the draw and match-adjusted cheapest firm. Define $j^*(i) \equiv \arg\max_{j\epsilon J}\left(\frac{\exp[v_i a_j + x_{i,j}]}{p_j}\right)$. Conditional on this $j^*(i)$, consumer i maximizes

$$U_i = \max_{O_i,q_{i,j^*(i)}} O_i^{1-\alpha}\left(q_{i,j^*(i)}e^{x_{i,j^*(i)}+a_{j^*(i)}v_i}\right)^{\alpha} - \lambda_i\left[O_i\underset{i\epsilon I}{p_O}+q_{i,j^*(i)}p_{j^*(i)} - \theta_i\right]$$

Implying that the value of the Langragian multiplier, or the marginal utility with respect to increasing income θ_i, equals $\lambda_i = (1-\alpha)^{1-\alpha}\alpha^{\alpha}p_O^{-(1-\alpha)}\left(\frac{p_{j^*(i)}}{e^{x_{i,j^*(i)}+a_{j^*(i)}v_i}}\right)^{-\alpha}$. With p_O normalized to 1, the utility for a given maximum realization of $x_{i,j^*(i)} + a_{j^*(i)}v_i$ is thus

$$U_i = (1-\alpha)^{1-\alpha}\alpha^{\alpha}\theta_i\left(\frac{e^{x_{i,j^*(i)}+a_{j^*(i)}v_i}}{p_{j^*(i)}}\right)^{\alpha}.$$

How is the expectation of the maximized utility distributed? Let $F\left(\widetilde{U}_i\right)$ denote the cdf of $\widetilde{U}_i = U_i \Big/ (1-\alpha)^{1-\alpha}\alpha^{\alpha}\theta_i$, which is distributed

$$\begin{aligned} F\left(\widetilde{U}_i\right) &= \Pr\left[\max_{j\epsilon J}\left(\frac{e^{x_{i,j}+a_j v_i}}{p_j}\right)^{\alpha} < \widetilde{U}_i\right] \\ &= \exp - \left[\left(\frac{\widetilde{U}_i}{\left(\sum_{j\epsilon J} p_j^{-\sigma} e^{\sigma a_j v_i}\right)^{\frac{\alpha}{\sigma}}}\right)^{-\frac{\sigma}{\alpha}}\right] \end{aligned}$$

$\widetilde{U}_i$ is distributed Frechet with scale parameter $\left(\sum_{j\epsilon J} p_j^{-\sigma} e^{\sigma a_j v_i}\right)^{\frac{\alpha}{\sigma}}$ and shape parameter $\frac{\sigma}{\alpha}$.

$$\begin{aligned} E\left(U_i\right) &= (1-\alpha)^{1-\alpha}\alpha^{\alpha}\theta_i E\left(\widetilde{U}_i\right) \\ &= (1-\alpha)^{1-\alpha}\alpha^{\alpha}\theta_i \Gamma\left(1-\frac{\sigma}{\alpha}\right)\overline{P\left(v_i\right)}^{-\alpha} \end{aligned}$$

■

Lemma 2 (reminded) (Specialization and the Home Market Effect) Denoting Home and Foreign's H-attribute goods by X_H and X_H^* respectively. For any $\tau^{-\sigma} > 0$, the economy is at least as specialized as in autarky and

$$n_H^T \geq n_H^A \geq n_H^{*A} \geq n_H^{*T}.$$

Moreover, Home is a net exporter of $H-$*attribute* manufactured goods and a net importer of $L-$*attribute* manufactured goods i.e.

$$X_H - X_H^* > 0 \text{ and } X_L - X_L^* < 0$$

Proof. Under incomplete specialization the ideal price indices with two types of firms equal (14) (15) and the symmetric conditions hold in Foreign

$$\begin{aligned} P^{*T}\left(v_H\right)^{-\sigma} &= \left(\tau^{-\sigma}N^T n_H^T + N^{*T}n_H^{*T}\right)e^{v_H a_H} + \left(\tau^{-\sigma}N^T\left(1-n_H^T\right) + N^{*T}\left(1-n_H^{*T}\right)\right)e^{v_H a_L} \\ P^{*T}\left(v_L\right)^{-\sigma} &= \left(\tau^{-\sigma}N^T n_H^T + N^{*T}n_H^{*T}\right)e^{v_L a_H} + \left(\tau^{-\sigma}N^T\left(1-n_H^T\right) + N^{*T}\left(1-n_H^{*T}\right)\right)e^{v_L a_L} \end{aligned}$$

, thus yielding a linear system of four equations with four unknowns N^T, N^{*T}, n_H^{*T}, and n_H^T. Lemma (1) pins down the ideal price indices, thus yielding

$$n_H^T = \begin{cases} n_H^A + \left(\pi_H - \pi_H^*\right)\frac{\tau^{-\sigma}}{1-\tau^{-\sigma}}\Lambda \text{ if } \pi_H < \Theta \\ 1 \text{ otherwise} \end{cases} \tag{24}$$

where $\Lambda = \frac{e^{\sigma v_L a_L}}{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}} + \frac{e^{\sigma v_H a_L}}{e^{\sigma a_H v_H} - e^{\sigma a_L v_H}}$ and $N^T = L/f\sigma$. Home's exports of $H-$*attribute* goods are equal to the number of such exporters times the exports per firm, which, as shown above equal $\tau^{-\sigma}\Pi^{T*}\left(a_j\right)$ and thus

$$X_H^T = N^T n_H^T \tau^{-\sigma}\Pi^{T*}\left(a_H\right)$$

With the total number of firms equal in Home and Foreign ($N^T = N^{*T} = L/\sigma f$), $H - attribute$ exports equal $X_H^T = n_H^T \frac{\tau^{-\sigma}}{1+\tau^{-\sigma}} L$ and the symmetric condition for Foreign implies

$$X_H - X_H^* = \left(n_H^T - n_H^{*T}\right) \frac{\tau^{-\sigma}}{1 + \tau^{-\sigma}} L > 0.$$

For the case of complete specialization, $X_H^* = 0$ so that $X_H - X_H^* > 0$ is trivially true. ■

Proposition 3 **(reminded)** (Invariance of Relative Ideal Price Indices to Trade)
Proof. (continued from main text) First note that

$$\begin{aligned}
T^2 &\equiv \frac{1 - \tau_{1,2}^{-\sigma} - \tau_{2,3}^{-\sigma} + \tau_{1,3}^{-\sigma}\left(\tau_{2,3}^{-\sigma} + \tau_{1,2}^{-\sigma} - \tau_{1,3}^{-\sigma}\right)}{1 + 2\tau_{1,2}^{-\sigma}\tau_{1,3}^{-\sigma}\tau_{2,3}^{-\sigma} - \left(\tau_{2,3}^{-\sigma}\right)^2 - \left(\tau_{1,2}^{-\sigma}\right)^2 - \left(\tau_{1,3}^{-\sigma}\right)^2} \\
T^3 &\equiv \frac{1 - \tau_{2,3}^{-\sigma} - \tau_{1,3}^{-\sigma} + \tau_{1,2}^{-\sigma}\left(\tau_{2,3}^{-\sigma} + \tau_{1,3}^{-\sigma} - \tau_{1,2}^{-\sigma}\right)}{1 + 2\tau_{2,3}^{-\sigma}\tau_{1,2}^{-\sigma}\tau_{1,3}^{-\sigma} - \left(\tau_{1,3}^{-\sigma}\right)^2 - \left(\tau_{1,2}^{-\sigma}\right)^2 - \left(\tau_{2,3}^{-\sigma}\right)^2}
\end{aligned}$$

Finding the explicit solution for the underlying condition for non-specialization. This expressed for the N levels of the attribute:

$$\begin{aligned}
P^1(v_H)^{-\sigma} &= e^{v_H a_H}\left(N^1(a_H) + \tau_{12}^{\sigma} N^2(a_H) + \tau_{13}^{\sigma} N^2(a_H)\right) \\
&\quad + e^{v_H a_L}\left(N^1(a_L) + \tau_{12}^{\sigma} N^2(a_L) + \tau_{13}^{\sigma} N^c(a_L)\right) \\
P^1(v_L)^{-\sigma} &= e^{v_L a_H}\left(N^1(a_H) + \tau_{12}^{\sigma} N^2(a_H) + \tau_{13}^{\sigma} N^2(a_H)\right) \\
&\quad + e^{v_L a_L}\left(N^1(a_L) + \tau_{12}^{\sigma} N^2(a_L) + \tau_{13}^{\sigma} N^c(a_L)\right)
\end{aligned}$$

This, combined with the reduced free entry condition $\Pi^{c,T}(a_j) = T^c \sigma f(a_j)$ and the definition of domestic revenue implies

$$\begin{aligned}
N^1(a_H) &= \frac{M^1(a_H)\left(1 - (\tau_{23}^{\sigma})^2\right) - M^3(a_H)(\tau_{12}^{\sigma} - \tau_{23}^{\sigma}\tau_{13}^{\sigma}) - M^2(a_H)(\tau_{13}^{\sigma} - \tau_{12}^{\sigma}\tau_{23}^{\sigma})}{1 + 2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma} - (\tau_{23}^{\sigma})^2 - (\tau_{13}^{\sigma})^2 - (\tau_{12}^{\sigma})^2} \\
N^2(a_H) &= \frac{M^2(a_H)\left(1 - (\tau_{13}^{\sigma})^2\right) - M^1(a_H)(\tau_{12}^{\sigma} - \tau_{23}^{\sigma}\tau_{13}^{\sigma}) - M^3(a_H)(\tau_{23}^{\sigma} - \tau_{12}^{\sigma}\tau_{13}^{\sigma})}{1 + 2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma} - (\tau_{23}^{\sigma})^2 - (\tau_{13}^{\sigma})^2 - (\tau_{12}^{\sigma})^2} \\
N^3(a_H) &= \frac{M^3(a_H)\left(1 - (\tau_{12}^{\sigma})^2\right) - M^1(a_H)(\tau_{13}^{\sigma} - \tau_{23}^{\sigma}\tau_{12}^{\sigma}) - M^2(a_H)(\tau_{23}^{\sigma} - \tau_{13}^{\sigma}\tau_{12}^{\sigma})}{1 + 2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma} - (\tau_{23}^{\sigma})^2 - (\tau_{13}^{\sigma})^2 - (\tau_{12}^{\sigma})^2}
\end{aligned}$$

Solving, for example for $N^1(a_H)$ in parameters yields:

$$\begin{aligned}
N^1(a_H) &= \frac{1-(\tau_{23}^{\sigma})^2}{1-\tau_{1,2}^{-\sigma}-\tau_{1,3}^{-\sigma}+\tau_{2,3}^{-\sigma}\left(\tau_{1,2}^{-\sigma}+\tau_{1,3}^{-\sigma}-\tau_{2,3}^{-\sigma}\right)} \\
&\quad \left(\pi_H^1\frac{e^{v_La_L}}{f(a_H)e^{v_La_L}-f(a_L)e^{v_La_H}}-(1-\pi_H^1)\frac{e^{v_Ha_L}}{f(a_L)e^{v_Ha_H}-f(a_H)e^{v_Ha_L}}\right)\frac{L^1}{\sigma} \\
&\quad -\frac{\tau_{12}^{\sigma}-\tau_{23}^{\sigma}\tau_{13}^{\sigma}}{1-\tau_{2,3}^{-\sigma}-\tau_{1,3}^{-\sigma}+\tau_{1,2}^{-\sigma}\left(\tau_{2,3}^{-\sigma}+\tau_{1,3}^{-\sigma}-\tau_{1,2}^{-\sigma}\right)} \\
&\quad \left(\pi_H^3\frac{e^{v_La_L}}{f(a_H)e^{v_La_L}-f(a_L)e^{v_La_H}}-(1-\pi_H^3)\frac{e^{v_Ha_L}}{f(a_L)e^{v_Ha_H}-f(a_H)e^{v_Ha_L}}\right)\frac{L^3}{\sigma} \\
&\quad -\frac{\tau_{13}^{\sigma}-\tau_{12}^{\sigma}\tau_{23}^{\sigma}}{1-\tau_{2,3}^{-\sigma}-\tau_{1,3}^{-\sigma}+\tau_{1,2}^{-\sigma}\left(\tau_{2,3}^{-\sigma}+\tau_{1,3}^{-\sigma}-\tau_{1,2}^{-\sigma}\right)} \\
&\quad \left(\pi_H^2\frac{e^{v_La_L}}{f(a_H)e^{v_La_L}-f(a_L)e^{v_La_H}}-(1-\pi_H^2)\frac{e^{v_Ha_L}}{f(a_L)e^{v_Ha_H}-f(a_H)e^{v_Ha_L}}\right)\frac{L^2}{\sigma}.
\end{aligned}$$

■

Corollary 2 **(reminded).** The Volume of Trade Between Asymmetric Countries. As long as no country specializes, the volume of country 1's exports is unaffected by the distribution of tastes abroad and equal to

$$\begin{aligned}
X^1 &= X^{1,2}+X^{1,3} \\
&= \left(\frac{\frac{L^1}{T^1}\left(1-(\tau_{23}^{1-\sigma})^2\right)-\frac{L^3}{T^3}\left(\tau_{12}^{-\sigma}-\tau_{23}^{-\sigma}\tau_{13}^{-\sigma}\right)-\frac{L^2}{T^2}\left(\tau_{13}^{-\sigma}-\tau_{12}^{-\sigma}\tau_{23}^{-\sigma}\right)}{1+2\tau_{23}^{-\sigma}\tau_{12}^{-\sigma}\tau_{13}^{-\sigma}-(\tau_{23}^{-\sigma})^2-(\tau_{13}^{-\sigma})^2-(\tau_{12}^{-\sigma})^2}\right)\left(\tau_{12}^{-\sigma}T^2+\tau_{13}^{-\sigma}T^3\right)
\end{aligned}$$

Proof. In the open economy, the total number of firms satisfies

$$\begin{aligned}
N^1+\tau_{1,2}^{-\sigma}N^2+\tau_{1,3}^{-\sigma}N^3 &= \frac{L^1}{f\sigma T^1} \\
\tau_{1,2}^{-\sigma}N^1+N^2+\tau_{2,3}^{-\sigma}N^3 &= \frac{L^2}{f\sigma T^2} \\
\tau_{1,3}^{-\sigma}N^1+\tau_{2,3}^{-\sigma}N^2+N^3 &= \frac{L^3}{f\sigma T^3}
\end{aligned}$$

leading to

$$\begin{aligned}
N^1 &= (f\sigma)^{-1}\frac{\frac{L^1}{T^1}\left(1-(\tau_{23}^{\sigma})^2\right)-\frac{L^3}{T^3}\left(\tau_{12}^{\sigma}-\tau_{23}^{\sigma}\tau_{13}^{\sigma}\right)-\frac{L^2}{T^2}\left(\tau_{13}^{\sigma}-\tau_{12}^{\sigma}\tau_{23}^{\sigma}\right)}{1+2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma}-(\tau_{23}^{\sigma})^2-(\tau_{13}^{\sigma})^2-(\tau_{12}^{\sigma})^2} \\
N^2 &= (f\sigma)^{-1}\frac{\frac{L^2}{T^2}\left(1-(\tau_{13}^{\sigma})^2\right)-\frac{L^1}{T^1}\left(\tau_{12}^{\sigma}-\tau_{23}^{\sigma}\tau_{13}^{\sigma}\right)-\frac{L^3}{T^3}\left(\tau_{23}^{\sigma}-\tau_{12}^{\sigma}\tau_{13}^{\sigma}\right)}{1+2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma}-(\tau_{23}^{\sigma})^2-(\tau_{13}^{\sigma})^2-(\tau_{12}^{\sigma})^2} \\
N^3 &= (f\sigma)^{-1}\frac{\frac{L^3}{T^3}\left(1-(\tau_{12}^{\sigma})^2\right)-\frac{L^1}{T^1}\left(\tau_{13}^{\sigma}-\tau_{23}^{\sigma}\tau_{12}^{\sigma}\right)-\frac{L^2}{T^2}\left(\tau_{23}^{\sigma}-\tau_{13}^{\sigma}\tau_{12}^{\sigma}\right)}{1+2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma}-(\tau_{23}^{\sigma})^2-(\tau_{13}^{\sigma})^2-(\tau_{12}^{\sigma})^2}
\end{aligned}$$

Last, solving for the number of $N^1(a_H)$ and $N^1(a_L)$ firms (see Proposition 3)

$$X^1 == \left(\frac{\frac{L^1}{T^1}\left(1-(\tau_{23}^{\sigma})^2\right)-\frac{L^3}{T^3}\left(\tau_{12}^{\sigma}-\tau_{23}^{\sigma}\tau_{13}^{\sigma}\right)-\frac{L^2}{T^2}\left(\tau_{13}^{\sigma}-\tau_{12}^{\sigma}\tau_{23}^{\sigma}\right)}{1+2\tau_{23}^{\sigma}\tau_{12}^{\sigma}\tau_{13}^{\sigma}-(\tau_{23}^{\sigma})^2-(\tau_{13}^{\sigma})^2-(\tau_{12}^{\sigma})^2}\right)\left(\tau_{12}^{\sigma}T^2+\tau_{13}^{\sigma}T^3\right)$$

■

Proposition 5 (Short Run Within-industry Home Market Effect) Assume that parameters are such that $n_H^A, n_H^{A*}\epsilon\,]0,1[$. At the moment after trade liberalization, if $L=L^*$, Home is a net exporter of $H-attribute$ goods iff $\pi_H>\pi_H^*$. If $L\neq L^*$ Home's manufacturing exports contain a larger fraction of $H-attribute$ goods than do Foreign's exports.

Proof. Home's net exports of $H-attribute$ goods are equal to the number of $H-attribute$ Home firms times exports per such firm minus the same multiplicative in Foreign

$$\begin{aligned} X_H^S-X_H^{S*} &= N^A n_H^A\left(\pi_H^* L^*\frac{\tau^{-\sigma}e^{\sigma v_H a_H}}{P^{*S}(v_H)^{-\sigma}}+(1-\pi_H^*)\,L^*\frac{\tau^{-\sigma}e^{\sigma v_L a_H}}{P^{*S}(v_L)^{-\sigma}})\right) \\ &\quad -N^{A*}n_H^{*A}\left(\pi_H L\frac{\tau^{-\sigma}e^{\sigma v_H a_H}}{P^S(v_H)^{-\sigma}}+(1-\pi_H)\,L\frac{\tau^{-\sigma}e^{\sigma v_L a_H}}{P^S(v_L)^{-\sigma}}\right)\end{aligned}$$

For the case of $L=L^*$, taking into account the toughness of competition in Foreign as well as at Home yields

$$\begin{aligned} & X_H^S-X_H^{S*} \\ = \ & (\pi_H-(1-\pi_H))\,\tau^{-\sigma}L\frac{(1-\pi_H)\,\pi_H\,(1-\tau^{-\sigma})}{(\tau^{-\sigma}\pi_H+(1-\pi_H))\,(\tau^{-\sigma}(1-\pi_H)+\pi_H)} \\ & +\Omega\tau^{-\sigma}L^*\left(\frac{\pi_H}{\tau^{-\sigma}\frac{1-\pi_H}{\pi_H}+1}-\frac{(1-\pi_H)}{\tau^{-\sigma}\frac{\pi_H}{1-\pi_H}+1}\right)\end{aligned}$$

where $\Omega=\frac{e^{\sigma v_H a_H}e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}e^{\sigma v_L a_L}-e^{\sigma v_L a_H}e^{\sigma v_H a_L}}\frac{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}+\frac{e^{\sigma v_L a_L}e^{\sigma v_L a_H}}{e^{\sigma v_H a_H}e^{\sigma v_L a_L}-e^{\sigma v_H a_L}e^{\sigma v_L a_H}}\cdot\frac{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}>0$. Since both $\pi_H-(1-\pi_H)$ and $\frac{\pi_H}{\tau^{-\sigma}\frac{1-\pi_H}{\pi_H}+1}-\frac{(1-\pi_H)}{\tau^{-\sigma}\frac{\pi_H}{1-\pi_H}+1}$ are larger than 0, $X_H-X_H^*>0$ for $\pi_H>\pi_H^*$.

Next, for the case of $L \neq L^*$, to show that $\frac{X_H^S}{X_H^S+X_L^S} > \frac{X_H^{S*}}{X_H^{S*}+X_L^{S*}}$ it suffices to show that $\frac{X_H^S}{X_L^S} > \frac{X_H^{S*}}{X_L^{S*}}$.

$$\begin{aligned}
\frac{X_H^S}{X_L^S} &= \frac{n_H^A\left(\pi_H^* \frac{e^{\sigma v_H a_H}}{P^{*S}(v_H)^{-\sigma}} + (1-\pi_H^*)\frac{e^{\sigma v_L a_H}}{P^{*S}(v_L)^{-\sigma}}\right)}{(1-n_H^A)\left(\pi_H^* \frac{e^{\sigma v_H a_L}}{P^{*S}(v_H)^{-\sigma}} + (1-\pi_H^*)\frac{e^{\sigma v_L a_L}}{P^{*S}(v_L)^{-\sigma}}\right)} \\
&= \frac{\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}\pi_H^* - (1-\pi_H^*)\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}}{\frac{\pi_H^*}{\tau^{-\sigma}\pi_H L + L^*\pi_H^*}\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} + \frac{(1-\pi_H^*)}{\tau^{-\sigma}L(1-\pi_H)+L^*(1-\pi_H^*)}\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}} \\
&\quad \cdot \frac{\frac{\pi_H^*}{\tau^{-\sigma}\pi_H L + L^*\pi_H^*}\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} + \frac{(1-\pi_H^*)}{\tau^{-\sigma}L(1-\pi_H)+L^*(1-\pi_H^*)}\frac{e^{\sigma v_L a_H}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}}{(1-n_H^A)} \\
\frac{X_H^{S*}}{X_L^{S*}} &= \frac{n_H^{*A}\left(\pi_H \frac{e^{\sigma v_H a_H}}{P^{S}(v_H)^{-\sigma}} + (1-\pi_H)\frac{e^{\sigma v_L a_H}}{P^{S}(v_L)^{-\sigma}}\right)}{(1-n_H^{*A})\left(\pi_H \frac{e^{\sigma v_H a_L}}{P^{S}(v_H)^{-\sigma}} + (1-\pi_H)\frac{e^{\sigma v_L a_L}}{P^{S}(v_L)^{-\sigma}}\right)} \\
&= \frac{\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}\pi_H^* - (1-\pi_H^*)\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}}{\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} - \pi_H^*\left(\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}} + \frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}\right)} \\
&\quad \frac{\frac{\pi_H}{\pi_H L+\tau^{-\sigma}L^*\pi_H^*}\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} + \frac{(1-\pi_H)}{L(1-\pi_H)+\tau^{-\sigma}L^*(1-\pi_H^*)}\frac{e^{\sigma v_L a_H}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}}{\frac{\pi_H}{\pi_H L+\tau^{-\sigma}L^*\pi_H^*}\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} + \frac{(1-\pi_H)}{L(1-\pi_H)+\tau^{-\sigma}L^*(1-\pi_H^*)}\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}}
\end{aligned}$$

Since both $\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}\pi_H - (1-\pi_H)\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}}$ and $\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L}-e^{\sigma v_L a_H}}\pi_H^* - (1-\pi_H^*)\frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H}-e^{\sigma v_H a_L}} \epsilon 0, 1$, it is true that $\frac{X_H^S}{X_L^S} > \frac{X_H^{S*}}{X_L^{S*}}$ for $\pi_H > \pi_H^*$ ■

Proposition 6 (reminded) (Short Run Trade Volume) Assume that parameters are such that $n_H^A, n_H^{*A} \epsilon]0,1[$. At the moment after trade liberalization, the following holds. If $\pi_H^* = \pi_H$, the volume of trade is the same as in the absence of consumer heterogeneity and Home is a net exporter of the $\mathcal{M}$ good $iff\ L > L^*$. If $\pi_H \neq \pi_H^*$, the volume of trade is lower than in the absence of consumer heterogeneity and decreasing in $|\pi_H - \pi_H^*|$.

Proof. Denote the total value of exports at the moment after opening markets to trade by X^S and X^{S*} and the attribute specific trade flows by an additional H or L subscript. For each type of good, the value of trade is proportional to the number of firms of each type and the sales per such firm, i.e., Home's export volume equals

$$\begin{aligned}
X_H^S &= N^{A*} n_H^A \left(\pi_H^* L^* \frac{\tau^{-\sigma} e^{\sigma v_H a_H}}{P^{*S}(v_H)^{-\sigma}} + (1-\pi_H^*) L^* \frac{\tau^{-\sigma} e^{\sigma v_L a_H}}{P^{*S}(v_L)^{-\sigma}}\right) \text{ and} \\
X_L^S &= N^{A*}\left(1-n_h^A\right)\left(\pi_H^* L^* \frac{\tau^{-\sigma} e^{\sigma v_H a_L}}{P^{*S}(v_H)^{-\sigma}} + (1-\pi_H^*) L^* \frac{\tau^{-\sigma} e^{\sigma v_L a_L}}{P^{*S}(v_L)^{-\sigma}}\right).
\end{aligned}$$

The two ideal price indices for Home H- and $L-valuation$ consumers are given by Lemma (3) thus yielding

$$X^S = \frac{\tau^{-\sigma} L L^* \pi_H \pi_H^*}{L\pi_H + \tau^{-\sigma} L^* \pi_H^*} + \frac{\tau^{-\sigma} L L^* (1-\pi_H)(1-\pi_H^*)}{L(1-\pi_H) + \tau^{-\sigma} L^* \left(1-\pi_H^*\right)} \quad (25)$$

$$X^{S*} = \frac{\tau^{-\sigma} L L^* \pi_H^* \pi_H}{\tau^{-\sigma} L\pi_H + L^* \pi_H^*} + \frac{\tau^{-\sigma} L L^* (1-\pi_H^*)(1-\pi_H)}{\tau^{-\sigma} L(1-\pi_H) + L^* \left(1-\pi_H^*\right)} \quad (26)$$

Next, note that $\pi_H \frac{\pi_H^*}{\tau^{-\sigma} L\pi_H + L^*\pi_H^*} + (1-\pi_H) \frac{\left(1-\pi_H^*\right)}{\tau^{-\sigma} L(1-\pi_H) + L^*\left(1-\pi_H^*\right)} \Big|_{\pi_H^*=\pi_H} = \frac{1}{\tau^{-\sigma} L + L^*}$ and that

$$\frac{\partial X^S}{\partial \pi_H} \begin{cases} < 0 \text{ if } \pi_H > \pi_H^* \\ = 0 \text{ if } \pi_H^* = \pi_H \\ > 0 \text{ if } \pi_H < \pi_H^* \end{cases}$$

so that $\tau^{-\sigma} LL^* \left(\frac{\pi_H \pi_H^*}{\tau^{-\sigma} L\pi_H + L^*\pi_H^*} + \frac{(1-\pi_H)\left(1-\pi_H^*\right)}{\tau^{-\sigma} L(1-\pi_H) + L^*\left(1-\pi_H^*\right)} \right) <$ if $\pi_H^* \neq \pi_H$ and it holds that

$$X^S \begin{cases} = \frac{\tau^{-\sigma} LL^*}{N^A + \tau^{-\sigma} N^{A*}} \text{ if } \pi_H^* = \pi_H \\ < \frac{\tau^{-\sigma} LL^*}{N^A + \tau^{-\sigma} N^{A*}} \text{ if } \pi_H \neq \pi_H^* \end{cases},$$

which verifies the first two claims of proposition 6 . Next, setting $\pi_H = \pi_H^*$ in (26) and (25) yields $X - X^* = \frac{\tau^{-\sigma} LL^*}{L + \tau^{-\sigma} L^*} - \frac{\tau^{-\sigma} LL^*}{\tau^{-\sigma} L + L^*}$, which has the described sings depending on L, L^*. For the second part of the claim, note that at $L = L^*$, $X - X^* = \frac{\left(\pi_H^2 + \pi_H^{*2}\right)(1-\pi_H)\left(1-\pi_H^*\right) - \left((1-\pi_H)^2 + \left(1-\pi_H^*\right)^2\right)\pi_H \pi_H^*}{\left(\tau^{-\sigma}\pi_H + \pi_H^*\right)\left(\pi_H + \tau^{-\sigma}\pi_H^*\right)\left(\tau^{-\sigma}(1-\pi_H) + \left(1-\pi_H^*\right)\right)\left((1-\pi_H) + \tau^{-\sigma}\left(1-\pi_H^*\right)\right)}$ $\left(\pi_H - \pi_H^*\right)\tau^{-\sigma}\left(1 + \tau^{-\sigma}\right)$. The latter expression is 0 whenever $\pi_H + \pi_H^* = 1$, positive if $\pi_H + \pi_H^* < 1$ and $\pi_H \geq \pi_H^*$, and negative if $\pi_H + \pi_H^* < 1$ and $\pi_H \geq \pi_H^*$. The latter sign is reversed if $\pi_H < \pi_H^*$. A similar calculation for Home yields (26). Thus, if $L = L^*$ and $\pi_H \neq \pi_H^*$ net trade flows satisfy

$$X^S - X^{S*} \Big|_{L=L^*;\pi_H \geq \pi_H^*} = \begin{cases} > 0 \text{ if } \pi_H + \pi_H^* < 1 \\ = 0 \text{ if } \pi_H + \pi_H^* = 1 \\ < 0 \text{ if } \pi_H + \pi_H^* < 1 \end{cases}.$$

It is noteworthy that due to the presence of the O sector, wages are equal across the two countries and thus a net trade flow in labor units is equal to a net trade flow in Dollars. ■

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