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Product Heterogeneity, Cross-Country Taste Differences, and the Consumption Home Bias*

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Abstract

This paper starts by showing that in the European car industry, there exist cross-country taste differences along the product attribute dimension that significantly drive net trade patterns and reduce the volume of trade. Further it is shown that, after the creation of the European common market, these cross-country taste differences caused a sluggish response of trade volume to liberalization as it took time for each country's industry structure to adapt to the demand structure of the common market. To rationalize such trade patterns, a structural model of demand featuring consumers with homothetic preferences and heterogeneous tastes over attributes is developed. Allowing for international trade, the model predicts that consumption is home-biased in the immediate aftermath of trade liberalization since each country's industry structure is optimized for the preferences of domestic consumers and domestic output thus does not match well with preferences abroad. Along the transition to the open economy steady state, each country's industry specializes into market segments with comparatively large domestic demand, implying that domestic firms leave the market segments the foreign industry specializes in. This increasing specialization that underlies the "home market" effect increases the average demand for foreign goods, the volume of trade, and the average gains from liberalization.

Keywords: Intra-Industry Trade, Monopolistic Competition, Product Heterogeneity, Industrial Structure, Firm Dynamics

JEL: F12, F15, L15, L16

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1 Introduction

Cross-country differences in consumer tastes are often argued to impede the volume of international trade. Linder (1961, p. 94) conjectures that the "more similar is the demand structure of two countries, the more intensive, potentially, is the trade between these two countries." While the focus of Linder's analysis was on the dimension of similarity in income levels,[1] the underlying notion generalizes to other product attribute dimensions.[2]

Cross-country taste differences create implicit trade barriers because industries are adapted to the local taste. If, for example, German cars are designed to satisfy the German consumer's preference for driving fast on the Autobahn, while French cars are designed to fit into a narrow Parisian parking space, the volume of trade is low because the typical foreign car is not "appropriate" for the taste of the typical domestic consumer. Such adaptation of industry to the local taste potentially might offer a micro foundation of Armington's (1969) modeling assumption that goods are differentiated by the location of production, which is often needed to reconcile empirically observed and theoretically predicted trade volumes.[3]

In the first section of this paper, I document that such considerations are indeed important determinants of trade flows in the European car industry. First, cross-country taste differences along the product attribute dimension (that are uncovered following the approach of Atkin (forthcoming)) significantly drive net trade patterns, i.e. they affect the type of cars that are traded. Second, cross-country taste differences and the fact that local industries produce goods that are optimized for domestic consumers have significantly reduced within-European trade flows. Third, the reduction in the volume of trade due to taste differences initially increased in magnitude with the European Commissions' policies aimed at enhancing the integration of the European car market and successively leveled off as the industry structure adapted to the demand structure of the common European market. This timing thus caused a sluggish response of trade volume to liberalization.

To rationalize such patterns of trade, I next develop a structural model of consumers with homothetic preferences and heterogeneous tastes. The basic preference framework, presented in section 3, 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 this model is that firms can decide with what kind of good to enter the market. Therefore, attribute-entry is directed towards the distribution of consumer tastes.[4]

[1] Foellmi et al. (2008), Hallak (2010), and Fajgelbaum et al. (2011) formalize Linder's hypothesis. In these setups, preferences are non-homothetic and consumers differ in their income levels. Hallak (2010) and Fieler (2011), building on Bergstrand (1990) and Baier and Bergstrand (2001), demonstrate the empirical validity of the Linder hypothesis.

[2] Indeed, there now exists ample empirical evidence for the "home market" effect and thus also for the existence of cross-country taste differences. See, among others, 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)). Surprisingly, none of these papers investigates the importance of such cross-country taste differences for the volume of trade or the gains from liberalization. Anderson and van Wincoop (2004) sketch a preference setup featuring heterogeneous tastes and verbally analyze how differences in preferences might create implicit trade barriers, but they do not solve for the equilibrium of the sketched model.

[3] See, for example Anderson and van Wincoop (2004). In addition to cross-country differences in tastes, there could also be a simple "distrust" in foreign goods that can explain why consumption is home-biased. Evans (2001) compares the local sales of foreign affiliates of U.S. multinational enterprises to data on U.S. bilateral exports and domestic sales by host-country firms, finding that the effect of such distrust is negligible.

[4] The fact that firms can choose with what type of good to enter the industry implies that although firm's output

I nest these preferences in an otherwise standard model of the international economy featuring costly trade and two countries that differ in the distribution of consumer valuations.[5] The focus of the analysis is a) on pointing out the mechanisms by which taste differences impede trade for a given industry structure and b) on showing how industry-restructuring tends to mitigate the effect of cross-country taste differences on the volume of trade. To highlight these two separate intuitions at work, the effect of trade liberalization is modeled in two steps.

Section 4 first analyzes the short run after liberalization, defined as the industry structure still being determined by autarky demand conditions. If the foreign industry is large and liberalization is non-trivial, the volume of trade is diminished by cross-country taste differences because import competition distorts the relative toughness of competition across the different market segments: with cross-country taste differences, the foreign industry is concentrated in segments with relatively little demand in Home. Thus, the typical Foreign firm sells to a "tough" market segment when exporting, while the typical Home firm faces a relatively less tough segment when selling domestically; consumption is hence home-biased in the sense that the volume of trade is lower than what would be expected on the basis of transportation costs and the elasticity of demand.[6]

Section 5 then analyzes the resulting long-run equilibrium in which the industry structure has adapted to the need structure of the integrated market. It demonstrates that the response of the domestic industry composition to trade mitigates the impact of cross-country taste differences on the volume of trade. After opening to trade, cross-country taste differences are associated with Krugman's (1980) "home market effect." The home market effect present in the model of this paper is reminiscent of the relative notion in Hanson and Xiang (2004): even if France and Germany both have an equal domestic market size for cars, a home market effect can arise along the dimension of the kind of cars that these countries trade.

The main conceptual insight arising from this analysis is that the industrial reshuffling that underlies the home market effect also has major implications for the volume of and the gains from trade. Each country specializes into market segments with comparatively large domestic demand, implying that domestic firms leave market segments in which the foreign industry specializes in. Thus, the increasing specialization that underlies the home market effect increases the demand for foreign goods, the volume of trade, and the average gains from liberalization.

The analysis of this paper thus sheds a new light on how cross-country taste differences affect trade flows. Arguments such as the one of Linder (1961) and Armington (1969) hinge on the assumption 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

is heterogeneous, in equilibrium, firms are not heterogeneous in profitability. The model at hand, therefore, does neither feature trade-induced shifts in the distribution of firm-profitabilities as in Melitz (2003) or Bernard et al. (2003) nor does it display within-firm shifts in the composition of products as in Bernard et al. (2009) and Melitz et al. (2009).

[5] The model developed in this paper analyzes the case where consumers are characterized by exogenously given taste differences in a preference framework that otherwise resembles the class of models deriving from Krugman (1980), which uses the preference framework of Dixit and Stiglitz (1977). Countries may also choose different consumption bundles if preferences are non-homothetic and income varies across countries (see Foellmi et al. (2008), Fieler (2011), and Fajgelbaum et al. (2011)) or if tastes are formed endogenously and countries differ in their comparative advantage (see Atkin (forthcoming)).

[6] It is important to note that the consumption home bias does not arise because of cross-country tastes differences per se. Import demand is not determined by preferences alone, but also, by how well these preferences are served by the domestic industry. In autarky, the domestic industry is tailored to the taste distribution of domestic consumers. The autarky free entry condition implies that the sales of domestic firms are the same across all types of firms. Therefore, if a single foreign firm of negligible mass were to enter the home market, the type of product it has to offer would not matter for import demand.

for a fixed domestic industry structure, the reverse holds once the industry structure has adjusted to liberalization: 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.

The extent to which cross-country taste differences affect the volume of trade in the long run is determined by the degree to which the domestic industry reacts to trade liberalization. With separately additive and homothetic preferences featuring the same elasticity of substitution across all market segments and in the absence of comparative advantage, cross-country taste differences may actually not affect the volume of trade at all. They do, however, matter for the volume of trade in the presence of comparative advantage, as is documented in an extension of the model in section 7. Cross-country taste differences also do affect the volume of trade if countries specialize completely.

The analysis of the transition to the open economy steady state in Section 6 documents that since trade liberalization is generally associated with an "overshooting" of market toughness and thus a period of zero firm entry (see Chaney (2005) and Burstein and Melitz (2011)), the relative autarky industry composition (i.e. the fraction of firms producing different types of goods) is preserved for a nontrivial amount of time. Thus, the trade patterns prevailing directly after liberalization actually may persist for a non-trivial period.

Along the transition path to the open economy steady state, once entry occurs it is entirely directed towards the segment the country specializes in. With increasing specialization, the volume of trade is gradually rising. The model thus highlights a novel mechanism explaining the sluggish response of trade volume to liberalization (see also Yi (2003 and 2010), Ruhl (2008), and Hummels (2007)). After a liberalization, each country's industrial composition has to adapt to the demand structure of a globalized economy, which requires firm exit and entry and, therefore, time.[7]

The structure of this paper is the following. Section 2 documents trade patterns in the European car industry. Section 3 presents the model and also analyzes the equilibrium of the closed economy. The short run impact of liberalization are analyzed in Section 4 and the long run impact in section 5. The transition towards the long-run equilibrium with open markets is analyzed in section 6. Section 7 presents an extension of the model to comparative advantage. Section 8 concludes.

2 Attributes, Liberalization and Trade in The European Car Industry

This section demonstrates that in the European car industry, product attributes are an important determinant of the direction of trade, cross-country taste differences reduce the volume of trade, and implied a sluggish response of trade volume to liberalization as it took time for the industry structure to adapt to the demand structure of the common European market.

[7] The model predicts a substantial amount of new trade on the extensive margin (see Kehoe and Ruhl (2008)). However, in contrast to the existing literature (see, for example, Arkolakis (2010), Baldwin and Harrigan (2011), Bernard et al. (2003), Chaney (2008), Kugler and Verhoogen (2008), Johnson (2012), Melitz (2003), and Verhoogen (2008)), this is not driven by the trade-induced shift towards ex-ante more profitable entities, but rather, by the adaptation of a country's sectoral composition to the taste structure of a globalized economy. 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.

The data set examined in this section includes information on prices, sales, and characteristics of all car models sold in Belgium, France, Germany, Italy, and the UK during 1970-1999. The data has been collected by Goldberg and Verboven (2001 and 2005), who also describe it in detail (see also Verboven (1996)).

The empirical analysis focuses on the study of this industry and this period for two reasons. First, the car industry is well-suited to examine the effect of product attributes on trade since a car is a well-defined unit and information on a model's attributes is readily available. The second advantage of analyzing this data set is that the European car market has been subject to considerable trade liberalization during the 1980s and early 1990s. The European Commission had seen the car industry as a "test case" for European integration and had thus initiated a wide spectrum of policies aimed at integrating the national markets into a single one. The latter policies where focused on removing trade barriers of any form, encouraging cross-border shopping, and increasing transparency. Although these efforts were started already in the 1980s, they intensified before the launch of the European single market in 1992.[8]

Figure 1 documents that the adopted measures greatly increased the volume of intra-European trade. The three displayed lines in Figure 1 document the evolution of the number of domestically consumed cars in the five markets (i.e., German cars sold in Germany; green dashed line), imports from the respective 11 other initial European Community members (i.e., Spanish cars sold in Germany; blue solid line), and imports from other countries (dash-dotted line). Whereas domestic sales stagnated and then declined in the 90s, within-European imports grew more or less steadily and then rose substantially in the 90s. Imports from non-EC/EU countries grew substantially until 1992, but thereafter stagnated as within-European trade took over.[9]

Figure 2 documents that while trade grew substantially, the European market is still surprisingly little integrated. To make this observation requires establishing a frictionless benchmark of the volume of trade that would prevail if integration were complete. Following Deardorff (1999) and Yi (2010), the simplest possible benchmark is that in the absence of effective trade barriers of any kind – may they arise from taxes and physical transportation costs, regulatory requirements, taste differences, or cross-country price discrimination – a car model should on average sell proportionally to total sales in all markets equally.

Figure 2 documents the evolution of the median "relative sales abroad" of all car models that are both produced and sold in the five European markets. For each car model, "relative sales abroad" is defined as the ratio of the model's sales abroad compared to sales in the home market, where this ratio is adjusted for differences in total market size. For example, in 1972, the Fiat 500 model sold 180′000 units in Italy and 12′000 in Germany. Taking into account that in 1972, in total 1.4 and 1.9 million cars were sold in Italy and Germany respectively, the relative sales of the Fiat 500 in Germany were 0.05 ($\approx ((12'000/18'0000)/(1.9/1.4))$) of what they were in Italy. If the European market were truly a "common" one, this ratio should on average equal 1. However, Figure 2 documents that the relative sales abroad are surprisingly low on average (19%) and top out at 29.5% towards the end of the sample.

It is hard to explain the low degree of integration with observed trade barriers. For example, Broda and Weinstein (2006) estimate the demand elasticity in SITC Industry 782 (Motor Cars and other Motor Vehicles Principally designed for the transport of persons and excluding public

[8] See BEUC (1989 and 1992) for an outline of the policy changes aimed at increasing the speed of integration and Goldberg and Verboven (2005) and Brenkers and Verboven (2006) for an analysis of the effects of these measures on price convergence.

[9] The total declines in sales in 1992 owes to the Europe-wide recession that followed the German Re-unification boom.

transport) to equal -3.02. Using this estimate, to match even the maximum rate of 29.5% of the relative sales abroad observed in the data implies that total effective trade barriers have the same effect as an 49.5% add-valorem tax (as $1.495^{-3.02} \approx 0.295$). In 1999, the degree of price discrimination was minuscule (see Goldberg and Verboven (2005)), tariff rates were zero, and regulatory requirements should in principle have been eliminated. Physical transportation are small: a door to door delivery of a single car anywhere within these 5 markets costs less than 500 euros and bulk transport of cars is substantially cheaper.

Figure 3 and 4, as well as Table 1 next establish a second salient fact of the data: cross-country taste differences drive trade patterns. Figure 3 describes the evolution of the (volume-weighted) average engine strength in KW of cars that are produced and sold in France and Germany. The four lines correspond to cars that are produced and sold in Germany (red solid line), produced in Germany and exported to France (red dotted line), produced and sold in France (blue dashed line), and produced in France and exported to Germany (blue dash-dotted line). The first pattern emerging from this Figure is that German cars have stronger engines than French cars irrespective of where they are sold. The second pattern is that German car producers tend to sell stronger cars domestically than when exporting. The Figure 4 shows that on the flip side of this result, French cars are more fuel-efficient than German cars. Here fuel efficiency is not equal to fuel consumption (which would simply reflect the fact that cars with smaller engines consume less fuel), but it graphs "technical fuel efficiency," defined as a vehicle's fuel consumption conditional on its engine power.[10]

Table 1 next establishes that differences in domestic consumption and tastes are significant drivers of trade flows. Columns (1) to (5) of Table 1 document that domestic consumption tends to be similar to a nation's exports and imports. For these specifications, I construct the average characteristic of domestic consumption, exports, and imports. In columns (1) to (3), the dependent variable is the average engine strength of imported cars. For example for France, the latter are equal to the volume-weighted average of cars that are imported from Belgium, Germany, Italy, and the UK. If $KW_{j,Fra}$ denotes the engine strength of model j in France (and omitting time subscripts),

$$AvgImpKW_{Fra} = \frac{\sum_{C \epsilon DE,UK,IT,BE} \sum_{j \epsilon I_{Fr,C}} KW_{j,Fra} * \text{Quantity}_{j,Fra}}{\sum_{C \epsilon DE,UK,IT,BE} \sum_{j \epsilon I_{Fr,C}} \text{Quantity}_{j,Fra}} \tag{1}$$

The panel estimations of Table 1 are using aggregate bilateral trade data and the sample thus includes 20 observations per year (5 markets with 4 trading partners each).[11]

Column (1) includes the logarithm of "Domestic Avg KW" of the *exporting nation* as independent variable. Domestic average KW is equal to the volume-weighted average KW of the car models that are consumed domestically, i.e., produced and sold in France. The coefficient implies that a 1% higher engine strength of the average domestically consumed car leads to exports being composed of cars with 0.548% higher engine strength. The latter coefficient is significantly different from both 0 and 1 at the 1% level of significance.

In column (2), the independent variable is the Domestic HP Avg. of the *importing nation.* Also this coefficient is estimated positive, i.e., when consumers buy cars with strong engines from

[10] Technical fuel efficiency is constructed by first regressing fuel consumption on engine power: $FuelConsumption_j = \alpha + \beta KW_j + \epsilon_j$ Technical fuel efficiency is then equal to the negative of the model's residual ϵ_j.

[11] Owing to technological advancement, car models tend to get stronger over time and consume less gas, so all estimations in Table 1 include a trend.

domestic producers, they also tend to buy such cars from foreign producers.

The estimation of column (3) next adds both the importer and the exporter average domestic engine strength to the estimation, reproducing the finding that both exports and imports tend to be similar to a country's domestic consumption. Columns (4) and (5) repeat this finding that domestic consumption is similar to both a nation's exports and imports for two different attributes, fuel efficiency and car class. For all three attributes, domestic consumption is similar to both exports and imports (for the case of fuel efficiency, the importer domestic consumption is not significant, see (5)).

Having documented the correlation between domestic consumption and the composition of trade, I now turn to a more structural interpretation of consumption decisions as reflecting consumer's tastes: there could obviously also be reasons other than taste differences that would lead to domestic consumption being similar to a nation's imports and exports.[12]

In the appendix, I follow Atkin (forthcoming) and adjust each country's consumption basket for differences in prices and the toughness of competition for consumers with heterogeneous valuations. I am interested in the average attribute composition of cars sold in each model in the hypothetical case that the price of each car model was the same across markets. I thus generate the demand for each model adjusted for price differences and I also adjust the market "toughness" of competition for heterogeneous groups of consumers for such price differences. This results in the adjusted quantity sold of model j in each market and year.[13]

I then generate the adjusted average attribute composition of consumption, defined as the weighted average of cars sold in each market and year using the adjusted quantities as weights. For example, if $\widetilde{\text{Quantity}}_{j,Fra,t}$ denotes the adjusted quantity sold of model j in France and year t, taste for engine power in France is equal to

$$Taste\ KW_{FRA,t} = \frac{\sum_{j\epsilon I_{Fr}} KW_{j,Fra,t} * \widetilde{\text{Quantity}}_{j,Fra,t}}{\sum_{j\epsilon I_{Fr}} \widetilde{\text{Quantity}}_{j,Fra,t}}. \tag{2}$$

Columns (6) to (8) of Table 1 document that taste differences are economically important drivers of trade patterns: countries differ substantially in the type of cars they like and this has first order implications for the composition of exports and imports. Column (6) of Table 1 documents that countries tend to both export and import cars that are similar to the country's taste over car class. This specification is the same as the one in Column (3), but the independent variables are the exporter and importer tastes instead of the average attributes of domestic consumption. Both the importer's and the exporter's taste are significantly correlated with the attribute composition of imports, and the uncovered magnitudes are substantial: if a country's tastes are 1 KW higher, imports to that nation tend to be of 0.76 KW higher engine power while exports from that nation tend to be of 0.719 higher engine power.

Columns (7) and (8) document similar patterns along the taste dimensions fuel efficiency and class, where class can take any integer value between 1 and 5 and is higher for more luxurious cars.

[12] Note that the positive correlation between the importer's domestic production bundle and what is imported cannot easily be rationalized by comparative advantage. In fact, comparative advantage would imply a negative correlation between these variables.

[13] Against this backdrop, it is noteworthy that as Atkin (forthcoming), I adopt a rather loose definition of "tastes": any cross-country difference in average consumption choices that cannot be explained by the vector of prices is attributed to taste differences. I abstract from whether the identified "taste differences" are the result of national policy choices such as gasoline taxes, differences in infrastructure, acquired habits, or intrinsic differences in the preference structure of national consumers.

I again find that domestic preferences have a marked impact on the composition of trade: both imports and exports are similar to domestic tastes. For the case of importer class, the coefficient is, however, small and insignificant.

Table 2 next documents that cross-country taste differences have significantly reduced within-European trade flows. In the disaggregate analysis of Table 2, the sample includes all car models that were produced and consumed in the five markets under consideration. There are 809 car-market groups and 5926 year/car-market observations.[14]

Column (1) presents a panel regression relating the logarithm of the quantity of the car sold in an export market to the logarithm of the quantity of the same car model sold in its home market. The estimation includes fixed effects for all markets and all locations to filter out differences in market size and productivity. The specification also includes model fixed effects that absorb the average sales of each model across all markets. Furthermore, the sales of the model in its home market are included to control for sale fluctuations over the life cycle of a car model. The coefficient for the (log) quantity of the same car model sold in its home market is estimated at 0.79, i.e., if a car model sells 10% more in its home market, exports of the car model tend to be 7.9% higher.

From column (2) onwards, I analyze to what extent differences in consumption baskets and differences in "tastes" affect trade flows. To this end, I create a measure of the "distance" of the car's attribute HP_j and the country's average taste for that attribute $TasteHP_{\mathrm{Im}porter}$. The latter distance is defined in the following way:

$$Diff(HP, j, \mathrm{Im}porter) \equiv |HP_j - TasteHP_{\mathrm{Im}porter}|$$

The resulting variable is then standardized for better interpretability.

Column (2) documents that cross-country taste differences substantially diminish the volume of trade. The coefficient of $Diff(HP, j, c)$ is significant and negatively so. The magnitude of how taste differences affect trade is not only statistically, but also economically significant. $Diff(HP, j, c)$ is standardized, i.e., a car that is two standard deviations different from the average taste for horse power of the importing nation will be exported $Exp[2 * 0.062] - 1 \approx 13\%$ less than a car that has an engine power equal to the average one in the importer nation.[15]

Columns (3) and (4) examine whether finding holds true for alternative attribute measures. Column (3) documents that a one standard deviation difference of the car's fuel efficiency from the country's taste for fuel efficiency reduces trade by 4.5%. Column (4) documents that a standard deviation difference of the car's class from the importer taste reduces the volume of trade by 0.167 ln points (18%). Engine strength and car class are obviously correlated (technical fuel efficiency is orthogonal to KW by construction), so it is noteworthy to examine whether the addition of more than one "distance from taste" measures improves the model's fit. Column (5) thus includes

[14] In what follows below I neglect the extensive margin of trade, since in the sample at hand nearly all cars models are sold on all five markets.

[15] It is important to note that the regression includes Model dummies. For example, consider a 1991 Mercedes 190, which in its baseline configuration has 80 KW, higher than the average of domestically sold cars in both Italy (1991 taste 42.7 KW) and Germany (1991 taste 60.2 KW). For this car, $Diff(HP, j, c)$ is positive in both $c =$Italy and $c =$Germany, so if this variable were the only included regressor, a negative coefficient could simply reflect the fact that the market for luxury cars is smaller than the market for middle class cars in both Germany and Italy. However, the regression also includes the model dummy that absorbs the average sales of this model across all markets. Consequently, the coefficient of $Diff(HP, j, c)$ would be equal to 0 if consumers in Germany and in Italy had the same preferences over engine strength. Furthermore, the sales of the model in its home market are included to control for sale fluctuations over the life cycle of a car model.

all three distance from taste measures; both the distance of car class from the country's taste for class and engine strength from taste for KW are significant; taste for fuel efficiency is again not significant.

Columns (6) to (8) next document that the impact of differences between model attributes and importer tastes on trade has varied substantially throughout time. Based on the evolution of trade flows pictured in Figure 1, it is interesting to examine whether differences in tastes do affect trade flows to the same extent now than they did during the 1970s when the European market was less integrated compared to later periods. In Columns (6), (7) and (8) of Table 2, I thus split the sample into the 70s, 80s and 90s respectively. Taste differences seem to have mattered by far the most in the period from 80 to 89, somewhat less in the 70s, and nearly not at all in the 90s. For example, the coefficient of $Diff(CLA, j, c)$ is estimated at -0.158 in the first period, at -0.411 in the intermediate period, and at -0.167 in the last period.

Table 3 next documents the extent to which trade has been reduced by the fact that industries produce goods optimized for the local taste. The first column of Table 3 documents the reduction of trade during the entire sample. For this, I predict the specification of Column (5) in Table 2 first using the actual values of $Diff(HP, j, c)$, $Diff(CLA, j, c)$ and $Diff(LI, j, c)$. Second, I predict the model using the hypothetical values that these three measures would take if the importer nation had the same tastes as the exporter nation. That is, I predict the estimated regressions replacing the actual values of $Diff(HP, j, c)$ with $Di\widetilde{ff(HP}, j, c) \equiv |HP_j - TasteHP_{Exporter}|$. Proceeding in this way, I find that in an estimation spanning the entire sample, trade would have been a modest 3.6% higher if the importer had the same tastes as the exporter.

The effect of taste differences on the volume of trade has fluctuated strongly over time. In the next three columns of Table 3, I repeat the counterfactual of no cross-country taste differences for the three subperiods ($70-79$, $80-89$, and $90-98$) using the uncovered coefficients in the corresponding coefficients of Columns (6) to (8) in Table 2. While the impact of cross country taste difference was quite modest in the first and the last decade of the sample, it amounted to 10.6% in the $1980s$.

Figure 5 further documents that the reduction of trade due to taste differences followed a U-shaped pattern. For this Figure, I repeat the estimation of the model in Column (5) of Table 2 and the above-described counterfactual of no cross-country taste differences over a six-year rolling window from 1976 to 1999. Figure 5 then documents the resulting estimate of how taste differences have impeded trade flows over the last 30 years, documenting a pronounced U-pattern in the data: while the reduction of trade was small (around 4%) early on in the sample, it was in the range of $8-14\%$ from 1986 to 1991, and then again small in the time period thereafter.

It is interesting to note that taste differences matter less for trade flows later in the sample even though the national industries have specialized further. The blue solid line in Figure 6 plots the evolution of the standard deviation of differences in national average of cars' engine strength. For this, I first construct the average engine strength of all domestically produced cars and second, I calculate the standard deviation of $Avg\ Engine\ Strength_{Dom,Country\ A} - Avg\ Engine\ Strength_{Dom,Country\ B}$ over all bilateral combinations and for each year.

The red solid line in Figure 6 further shows that over time, also the import baskets have become more dissimilar to the domestic production basket. The latter line plots the evolution of the standard deviation of the difference in domestically national average engine strength. For this, I first construct the averages of the engine strength of domestically produced cars and of the national import baskets. Second, I calculate the standard deviation of $Avg\ Engine\ Strength_{Dom,Country\ A} - Avg\ Engine\ Strength_{\mathrm{Im}p,Country\ A}$ over all five markets and for each year.

The reduction in the volume of trade due to taste differences itself has first increased with the European Commissions' policies aimed at increasing the integration of the European car market. The reduction decreased once the industry specialized and adjusted to the demand structure of the Common European market; i.e. cross-country taste differences have led to a staggered response of trade volume to trade liberalization.

3 A Model of the Demand for Heterogeneous Products

To rationalize the above-documented patterns, I next 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 and consumer valuations developed in Mussa and Rosen (1978) and Shaked and Sutton (1982).

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.

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 Fajgelbaum et al. (2011). In particular, the model I develop is based on Gabaix et al. (2006). 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.

3.1 Preferences

The world is composed of two countries named Home and Foreign, which are populated by a mass of L and L^* consumers. 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 $\theta_i = \theta$[16] in terms of labor and a valuation draw v_i. The 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

[16] 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 $\theta L = \sum_{i \epsilon I} \theta_i$.

firm j by $q_{i,j}$, consumer i's utility U_i is given by

$$U_i = (o_i)^{1-\alpha} \left(\sum_{j \epsilon J} q_{i,j} e^{x_{i,j} + a_j v_i} \right)^{\alpha}. \tag{3}$$

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

$$o_i p_O + \sum_{i \epsilon I} q_{i,j} p_j \leq \theta_i. \tag{4}$$

The utility function (3) 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 (3).[17] 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 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 positive value, i.e.,

$$v_i \sim F_v(v) \text{ where } f_v(v) \geq 0 \tag{5}$$

Next, consider only the term $e^{x_{i,j}}$ in (3). $x_{i,j}$ 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 (3), 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.

$$G_x(x_{i,j}) = \exp[-\exp[-x_{i,j}\sigma]] \tag{6}$$

The consumer-firm specific shocks are orthogonal to firm attributes or consumer valuations and are independent across firms and consumers: $x_{i,j} \perp x_{i,n}$ for $n \neq j$. Gabaix et al. (2006) demonstrate that these assumptions, in combination with a utility function similar to (3) but without the attribute and valuation heterogeneity yield an ideal-variety micro foundation for the constant elasticity of substitution (CES) demand system of Dixit and Stiglitz (1977).[18]

[17] Both a_j and v_i are a scalars. It is straightforward to extend the model at hand to the case of multiple attributes.

[18] It is note worthy that the closed-form assumption on the consumer-firm specific taste shocks (6) 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. Gabaix et al. (2010) analyze the conditions under which a random distribution of idiosyncratic taste shocks converges to that specified in Equation (6).

3.2 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 (3) with respect to these two quantities and the budget constraint (4) 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 ($p_{M,i}$ is heterogeneous across consumers). Irrespective of this price, the consumer always spends a fraction α of her income on the $\mathcal{O}$ good.

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*

$$D(a_j, p_j) = (1-\alpha)\theta L \Gamma(1-\sigma) p_j^{-(1+\sigma)} \int_{v \epsilon V} f_v(v) \frac{\exp[\sigma v a_j]}{\overline{P(v)}^{-\sigma}} dv, \tag{7}$$

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

$$\overline{P(v)} \equiv \left(\sum_{n \epsilon J} \left(\frac{p_n}{\exp[v a_n]} \right)^{-\sigma} \right)^{-1/\sigma} . \tag{8}$$

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 (7) 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, as summarized by 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 (7), 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 $\overline{P(v)}$.

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 (7).

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 (Expected 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* $p_O = 1$,

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

where the ideal price index $\overline{P(v)}$ *is as defined in (8) and* $\Gamma(..)$ *is the gamma function.*

Proof. *see Appendix* ■

Corollary 1 is very convenient: the developed preference structure allows to directly map changes in the toughness of competition for all consumers with $v_i = v$ 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.

One can directly relate the findings regarding the gains from trade in 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 (7) 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 and, consequently, the international economy described below includes the Krugman (1980) model as a special case without product heterogeneity, which is convenient since it allows clearly highlighting the impact of such heterogeneity.[19]

3.3 Supply

In each country and at each moment in time, a large mass of potential entrepreneurs can enter the $\mathcal{M}$ industry by paying a fixed cost of F labor units. When entering the industry, each entrepreneur can choose with what type of attribute to enter the industry. After paying the entry cost F and deciding with what kind of good to enter the industry, the entrepreneur j receives the blueprint to produce a new variety of the manufacturing good with attribute a_j. While a_j can be chosen at the moment of entry, it cannot be changed thereafter. The entrepreneur has a perpetual monopoly over that specific variety from the moment of entry onwards and faces an exogenous probability of firm death of $\delta > 0$.

[19] Of course, compared to the framework of Dixit and Stiglitz (1977), a limitation of the proposed model is that it describes only average consumer welfare, i.e., all predictions that follow below hold on average but not for each consumer. Depending on the realization of idiosyncratic draws, the welfare of any single consumer may be higher or lower than predicted in Corollary 1.

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.

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

$$c_j = e^{ca_j} \tag{9}$$

$\frac{\partial c(a_j)}{\partial a_j}$ 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 addition, exporting is subject to a one time access costs T. I assume that $T < \tau^{-\sigma} F$ so that in any long run equilibrium in which firms do enter the industry, they also pay the market access cost T.[20]

In contrast, the outside $\mathcal{O}$ good can freely be traded.

Last, the interest rate $\rho \geq 0$ is given exogenously, i.e., I assume the existence of a storage technology.

3.4 Equilibrium in the Closed Economy

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 (7) is such that firms face a constant price elasticity of $(1+\sigma)$ and thus charge a price of $p_j = \frac{1+\sigma}{\sigma} c_j = \frac{1+\sigma}{\sigma} e^{ca_j}$.[21] For each type of consumer, demand (7) thus simplifies to $e^{\sigma(v_i - c)a_j} / \sum\limits_{n \epsilon J} e^{\sigma(v_i - c)a_n}$, 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.

Definition 1 (Separating Valuations) *The valuation pair $\widetilde{v_L}$ and $\widetilde{v_H}$ is said to be separating iff*

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

Separating valuations imply 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

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

[20] Due to the assumption that $T < \tau^{-\sigma} F$, the economy does not feature export selection as in Melitz (2003).

[21] This statement only holds under the assumption that each firm is small an does not take into account its influence on the ideal price index. I assume that this is the case in the entire analysis.

where I assume that valuations are separating, i.e. that

$$v_L < 0 < v_H.$$

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". However, for the analysis of good quality, the model presented here only is of limited appeal as it assumes that consumers differ in their taste over quality for exogenous reasons, whereas alternative frameworks (see, for example Foellmi et al. (2008), Auer and Chaney (2009), or Fajgelbaum et al. (2011)) analyze the effect of good quality in a setup where heterogeneous consumption decision arise endogenously as consumers have non-homothetic preferences and differ in their income levels.[22]

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 $\Gamma(1-\sigma)\,\theta(1-\alpha) \equiv 1$, domestic revenue $\Pi(a_j)$ is equal to

$$\Pi(a_j) = \frac{\pi_H L e^{\sigma v_H a_j}}{N\left(n_H e^{\sigma v_H a_H} + (1-n_H)\, e^{\sigma v_H a_L}\right)} + \frac{(1-\pi_H)\, L e^{\sigma v_L a_j}}{N\left(n_H e^{\sigma v_L a_H} + (1-n_H)\, e^{\sigma v_L a_L}\right)} \tag{10}$$

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 $P(v_L)$ (see equation (8)).

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 (10) 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 the one of Toyota, which caters to a slightly different set of consumers. Similarly, Armani's sales depend much more on the success of the latest collections by Prada than they do depend on the success of the collections by Louis Vuitton or Hermes.

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.

[22]Recent findings analyzing the systematic patterns in the quality composition of trade (Schott (2004), Hummels and Klenow (2005), Brooks (2006), Hallak (2006 and forthcoming), Baldwin and Harrigan (2007), Johnson (2007), Kugler and Verhoogen (2008), Verhogen (2008), Choi et al. (2009), Fieler (2009), Hallak and Schott (2009), Hallak and Sivadasan (2009), Manova and Zhang (2009) and Khandewal (forthcoming)).

Proposition 2 (Autarky Equilibrium) *Denote by N^A the autarky equilibrium number of firms in 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 $N = \frac{L}{\sigma(\delta+\rho)F}$ and*

$$n_H^A = \begin{cases} 0 \text{ if } \pi_H < e^{\sigma v_L a_H} \frac{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}{e^{\sigma v_H a_H} e^{\sigma v_L a_L} - e^{\sigma v_H a_L} e^{\sigma v_L a_H}} \\ \frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}} \pi_H - (1-\pi_H) \frac{e^{\sigma v_H a_L}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} \text{ otherwise} \\ 1 \text{ if } \pi_H > e^{\sigma v_H a_H} \frac{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}{e^{\sigma v_H a_H} e^{\sigma v_L a_L} - e^{\sigma v_H a_L} e^{\sigma v_L a_H}} \end{cases} . \tag{11}$$

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,*

$$L\left(\frac{\pi_H e^{\sigma v_H a_H}}{P(v_H)^{-\sigma}} + \frac{(1-\pi_H) e^{\sigma v_L a_H}}{P(v_L)^{-\sigma}}\right) = L\left(\frac{\pi_H e^{\sigma v_H a_L}}{P(v_H)^{-\sigma}} + \frac{(1-\pi_H) e^{\sigma v_L a_L}}{P(v_L)^{-\sigma}}\right), \tag{12}$$

where $P(v_H)$ and $P(v_L)$ are the ideal price indices of $H-$ and $L-$valuation consumers, equal to $P(v_H)^{-\sigma} = N(n_H e^{\sigma v_H a_H} + (1-n_H) e^{\sigma v_H a_L})$ and $P(v_L)^{-\sigma} = N(n_H e^{\sigma v_H a_H} + (1-n_H) e^{\sigma v_H a_L})$. Thus, reformulating (12) as the difference in sales to $H-$valuation and $L-$valuation consumers yields

$$\frac{\pi_H}{1-\pi_H} \frac{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}{n_H e^{\sigma v_H a_H} + (1-n_H) e^{\sigma v_H a_L}} = \frac{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}{n_H e^{\sigma v_L a_H} + (1-n_H) e^{\sigma v_L a_L}}. \tag{13}$$

Since $e^{\sigma v_H a_H} > e^{\sigma v_H a_L}$, the LHS of (13) 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 depends on the flow of instantaneous profits which have to be discounted at rate $(\delta+\rho)$ and pin down the number of firms by the free entry condition $F = \frac{L}{\sigma(\delta+\rho)N^A}$. ■

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

$$P^A(v_H)^{-\sigma} = \frac{\phi \pi_H N^A}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}} \quad \text{and} \quad P^A(v_L)^{-\sigma} = \frac{\phi (1-\pi_H) N^A}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}}$$

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 ideal price indices are 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 and $(1-\pi_H)$, respectively.

A trivial (yet crucial for explaining the volume of trade in Section 4) observation is that all firms have equal revenue ($\Pi(a_H) = \Pi(a_H) = \frac{L}{N^A}$) for any level of π_H: in equilibrium, the sales of a firm do not depend on the relative distribution of consumer tastes.

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 and profit flows.

4 The Static Impact of Trade Liberalization

I next examine the short run impact of an unanticipated trade liberalization when the industry structure is still determined by its autarky demand conditions. As will be documented below in section (6), this case is a relevant one as after trade liberalization the industry structure can be preserved for a non-trivial period.

I analyze how a 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). As in the latter work, I also allow for the countries to differ in size L and L^*.[23]

At the instant of opening markets to trade, the number of firms is at its autarky level (11). Since accessing the export market is subject only to small fixed costs ($T\tau^{-\sigma} << F$), 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 include the import competition from the other country. Since all firms export, Home's exports are more $H - attribute$ intensive than is the domestic production in Foreign. Trade, therefore, intensifies competition relatively more in the sector with relatively few Foreign consumers.

Lemma 1 (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*

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

[23] The distributions of consumer valuations in Home and Foreign are assumed to be different for exogenous reasons. Atkin (forthcoming) 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 as in Atkin's work.

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

Corollary (1) in Section 3 implies that the ideal price index of each type of consumer can be mapped one-to-one into welfare changes. Lemma (1) 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 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.

Lemma 2 (Short Run Attribute Content of Trade) *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. *see Appendix* ■

Lemma 2 documents net trade patterns after liberalization, which is not to be confused with the home market effect (which is about trade patterns *after* the industry has adjusted to trade). Lemma (1) is 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), which is composed of $H-$ and $L-attribute$ goods.

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

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 simply equal to $\frac{\tau^{-\sigma}LL^*}{L+\tau^{-\sigma}L^*}$ 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 volume of trade 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 foreign labor force (since a larger foreign 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 the volume of trade is indeed maximized when $\pi_H = \pi_H^*$, i.e., the volume of trade is lower than in Krugman (1980) if there are cross-country taste differences than if there are not. 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 $\frac{(1-\pi_H^*)L^*}{\tau^{-\sigma}L(1-\pi_H)+L^*(1-\pi_H^*)} > \frac{L^*}{\tau^{-\sigma}L+L^*}$. $H - valuation$ 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.

Proposition 3 (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. Regarding the volume of trade,*
I. For given $\tau^{-\sigma}$, *the volume of trade is decreasing in* $|\pi_H - \pi_H^*|$
II. The importance of taste heterogeneity is increasing in $\tau^{-\sigma}$. *As* $\tau^{-\sigma} \to 0$ *the volume of trade is unaffected by the distribution of tastes.*

Proof. *See Appendix* ■

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 cross-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 segments (in fact: in those segments they *make* tough by their exports), their sales are low compared to the domestic firms. Thus, cross-country taste differences diminish the short run volume of trade if the exporter's industry is non-negligible in size.

Consider an example to highlight the conditions under which the consumption home bias may arise in the immediate aftermath of trade liberalization: in France of total consumption C, 60% is spent on small cars and 40% on large cars and assume that profits of any firm are proportional to expenditures in its market segment and inversely proportional to the number competitors in its market segment. Fix the total mass of French car makers to be 1 and denote the fraction of these firms that produce large cars by n_{large}^{Fra}. If French car makers can freely choose which type of car to produce, with 60% of all expenditures being spent on small cars, also 60% of the French car industry choose to produce small cars, while the remainder produces large cars, so that producers of both types of cars have equal sales.

The presence of cross-country taste differences does not give rise to the consumption home bias in itself. Given the free entry condition, in autarky, all French car producers have equal revenue and the large and small car market segments are equally "tough" in that any newcomer would fetch the same sales irrespective of which market segment she enters. Consequently, if a lone German exporter of negligible mass were to export, the volume of trade would be the same if the producer was a large car producer or if the exporter was selling small cars, i.e., the volume of trade does not depend on the composition of German industry if it has a negligible effect on the relative toughness of competition in the two car industry segments in France.

Trade flows can depend on cross-country taste differences, however, if the foreign industry is non-negligible in size. For example, let the mass of German car exporters also be 1, of which 40% produce small and 60% produce large cars. In each of the two car market segments, the volume of German exports is equal to the number of exporters multiplied by the sales per firm. In this example, total export volume thus equals $0.6\frac{0.4C}{0.4+0.6} + 0.4\frac{0.6C}{0.6+0.4} = 0.48C$. This is lower that what trade flows would be if the German exporters were to be composed in proportion to the distribution of French tastes (in which case German firms would capture 50% of the French market since they also account for 50% of firms that are active in France).[24]

In the short run, the composition of the domestic industry is thus not "appropriate" for the average foreign 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 can only be used sub-optimally in labor-abundant 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 immediately after 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.

5 The Long Run Effects of Trade Liberalization

After trade liberalization, the industrial structure of the two countries diverges in order to restore the free entry condition. This is a direct consequence of the fact that after opening to trade, in Home, competition is relatively tougher in the market for $L-attribute$ goods than in the market for $H-attribute$ goods (see Lemma (1)). Although export possibilities are better in the market for

[24] The volume of trade in this example does *not* depend on product heterogeneity in itself. For example, it is easily verified that if the German industry is composed in the same proportion as French expenditure shares in each segment, the German exporters capture exactly 50% of the French market for *any* distribution of French expenditure shares.

H goods than in the market for $L-attribute$ goods, overall, producers of H goods make strictly higher profits because the home market is relatively more important than the foreign market. Consequently, all newly entering firms choose to enter the industry with the $H-attribute$ good until the new equilibrium is reached (see section 6 for a characterization of the transition path).

But how far does specialization go? An interesting result is that steady state sales per firm are not affected by the underlying taste differences across nations because the number of firms in each market segment adjusts such that all firms have equal sales. Denoting the value that a variables takes in the long run equilibrium with open markets by a ^{T} superscript, the following holds.

Lemma 3 (Domestic Revenue in the Open Economy) *If parameters are such that in the long run equilibrium of the open economy $n_H^T, n_H^{T*} \epsilon]0,1[$, it is true that the domestic revenue $\Pi(a_j)$ of a firm is independent of the type of the good it produces, i.e.*

$$\Pi(a_H) = \Pi(a_L) \text{ and } \Pi^*(a_H) = \Pi^*(a_L)$$

Proof. *Denote by $\Pi(a_j) \equiv L\pi_H \frac{e^{\sigma v_H a_j}}{P(v_H)^{-\sigma}} + L(1-\pi_H) \frac{e^{\sigma v_L a_j}}{P(v_L)^{-\sigma}}$ the domestic revenue of a Home firm with good a_j in the Home market and by $\Pi^*(a_j) \equiv L^* \pi_H^* \frac{e^{\sigma v_H a_j}}{P(v_H)^{-\sigma}} + L^*(1-\pi_H^*) \frac{e^{\sigma v_L a_j}}{P^*(v_L)^{-\sigma}}$ the domestic revenue of a Foreign firm with good a_j in the Foreign market. 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 $\tau^{-\sigma}\Pi(a_j) + \Pi^*(a_j)$. An equilibrium without complete specialization requires that the discounted sales of an $H-attribute$ and an $L-attribute$ firm are equal in Home and in Foreign:*

$$\int_{t=0}^{\infty} e^{-(\delta+\rho)t} \frac{1}{\sigma} \left(\Pi(a_H) + \tau^{-\sigma}\Pi^*(a_H)\right) dt = \int_{t=0}^{\infty} e^{-(\delta+\rho)t} \frac{1}{\sigma} \left(\Pi(a_L) + \tau^{-\sigma}\Pi^*(a_L)\right) dt \quad (14)$$

$$\int_{t=0}^{\infty} e^{-(\delta+\rho)t} \frac{1}{\sigma} \left(\tau^{-\sigma}\Pi(a_H) + \Pi^*(a_H)\right) dt = \int_{t=0}^{\infty} e^{-(\delta+\rho)t} \frac{1}{\sigma} \left(\tau^{-\sigma}\Pi(a_L) + \Pi^*(a_L)\right) dt \quad (15)$$

Solving the integral and subtracting $\tau^{-\sigma}$ times (15) from (14) yields $\Pi(a_H) = \Pi(a_L)$ and subtracting $\tau^{-\sigma}$ times (14) from (15) yields $\Pi^*(a_H) = \Pi^*(a_L)$. ■

Lemma (3) states a surprising result: regardless of the relative size of countries and the distribution of the preferences in the other nation – as long as there is incomplete specialization – the domestic revenue is equalized across the H and L segments in each country.

The intuition underlying Lemma (3) is trivial. If a Home $H-attribute$ firm has higher sales at Home than a Home $L-attribute$ firm, there must be some offsetting advantage for $L-attribute$ firms in the Foreign market for the free entry condition in Home to hold. Moreover, because the foreign market matters relatively less than the domestic market due to the existence of transportation costs, 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 Home. In contrast, the same argument from a Foreign perspective requires that the Home advantage for $H-attribute$ firms is relatively stronger than the $L-attribute$ advantage in Foreign. Together, the two free attribute entry conditions can only be satisfied if there is no advantage for either type of firm in either market.[25]

[25] To formalize this insight, denote the difference in domestic sales at home between a $H-attribute$ good and

The intuition for the rather stark result presented in Lemma (3) thus derives from the symmetry by which trade affects $H-$ and $L-$attribute firms alike. In section 7, I show that the result that taste heterogeneity does not matter for the sales of a specific firm sales rests on the absence of comparative advantage; the underlying intuition that low taste for an attribute in equilibrium is associated with large imports demand for goods embodying the attribute, however, is a more general one.

The sales per firm, in turn, then pin down the number of firms. If $\pi_H^* > \pi_H$, the open-economy fraction of $H-$type firms in home and foreign is equal to

$$\begin{aligned} n_H^T &= \min\left(1, n_H^A + (\pi_H - \pi_H^*)\frac{\tau^{-\sigma}\left(\tau^{-\sigma} + \frac{N^{T*}}{N^T}\right)}{1-\tau^{-2\sigma}}\Lambda\right) \text{ and} \\ n_H^{T*} &= max\left(0, n_H^{A*} - (\pi_H - \pi_H^*)\frac{\tau^{-\sigma}\left(\tau^{-\sigma} + \frac{N^T}{N^{T*}}\right)}{1-\tau^{-2\sigma}}\Lambda\right), \end{aligned}$$

where $\Lambda \equiv \frac{e^{\sigma v_L a_L}}{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}} + \frac{e^{\sigma v_H a_L}}{e^{\sigma a_H v_H} - e^{\sigma a_L v_H}}$ and it is true that

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

holds for any $\tau^{-\sigma} > 0$.

Furthermore, under incomplete specialization, which is more likely if countries are more equal in tastes (higher $|\pi_H - \pi_H^*|$) or if countries are of more unequal size,[26] the total number of entering firms is equal to

$$N^T = \frac{L - \tau^{-\sigma}L^*}{(1-\tau^{-\sigma})(T+F)\sigma(\delta+\rho)} \text{ and } N^{T*} = \frac{L^* - \tau^{-\sigma}L}{(1-\tau^{-\sigma})(T+F)\sigma(\delta+\rho)}.$$

As is summarized by the following proposition, specialization also has implications for net attribute trade patterns of trade, as well as for the way in which cross-county taste differences affect the aggregate volume of trade.

Proposition 4 (Trade and its Net Attribute Content) *Assume that $\pi_H > \pi_H^*$ and that parameters are such that $n_H^T, n_H^{T*}\epsilon\,]0,1[$. Then, the volume of Home's manufacturing exports is equal to $\frac{LL^*}{L+\tau^{-\sigma}L^*}$ for any π_H, π_H^* that satisfy the stated assumptions. If $L^* = L$, Home has 0 net exports of manufactured goods. If $L > L^*$, Home is a net exporter of manufactured goods. For any combination of L and L^* that is consistent with the stated assumptions, Home's manufacturing exports are more $H-$ attribute intensive than Foreign's manufacturing exports. Home's manufacturing exports are more $H-$ attribute intensive in the open economy equilibrium than just after trade liberalization.*

Proof. *see Appendix.* ■

a $L -$ *attribute* good firm by Z ($Z = \Pi(a_H) - \Pi(a_L)$) and the same difference in foreign by Z^* ($Z^* = \Pi^*(a_H) - \Pi^*(a_L)$). The free attribute-entry condition at home implies that $Z + \tau^{-\beta}Z^* = 0$, while the same condition in Foreign is $\tau^{-\beta}Z + Z^* = 0$. Only $Z = Z^* = 0$ can satisfy the free attribute-entry conditions both at Home and in Foreign.

[26] The parameter restrictions for incomplete specialization are that $\pi_H > \pi_H^* > e^{\sigma v_H a_L}\frac{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}}{\phi}\left(1 - \tau^{-\sigma}\frac{L}{L^*}\right) + \pi_H\tau^{-\sigma}\frac{L}{L^*}$ and that $\pi_H < e^{\sigma v_H a_H}\frac{e^{\sigma a_L v_L} - e^{\sigma a_H v_L}}{\phi}\left(1 - \tau^{-\sigma}\frac{L^*}{L}\right) + \pi_H^*\tau^{-\sigma}\frac{L^*}{L}$. Note that the condition that countries do not specialize in the $\mathcal{O}$ sector is less restrictive than the condition that n_H^T and $n_H^{T*}\epsilon\,]0,1[$ if $\pi_H \neq \pi_H^*$. If $\pi_H = \pi_H^*$ the parameter restriction $\tau^{-\sigma} < \frac{L}{L^*} < \tau^{\sigma}$ ensures the existence of manufacturing firms in both nations.

In models following Krugman (1980 and 1991), a country with a larger home market for manufacturing goods becomes the net exporter of industrial output after markets are opened to trade. In the model at hand, a within-industry home market arises that is closely related to Hanson and Chen's (2004) and Fajgelbaum et al's (2011) relative notion: a home market effect can arise in the type of manufactured products. While the insight that a "home market" effect can arise along the product attribute dimension is already well understood in the literature, a novel insight is how the "home market" effect is related to Linder's (1961) hypothesis.[27]

The main result of Proposition 4 regards how taste differences affect the volume of trade: the home bias of consumption vanishes as long as specialization is incomplete. This is intriguing: whereas in the short run, differences in the composition of industry are associated with low trade volume, in the long run, further specialization is associated with increasing trade volume.[28]

To understand why the consumption home bias vanishes, it is expedient to recall why it arises in the first place. The dollar volume of trade is equal to the number of firms times the sales per firm. At the moment after opening to trade, there are n_H^A $H-attribute$ good exporters that sell relatively less than $\tau^{-\sigma}$ times their domestic sales on the export markets because competition is relatively stronger in the foreign H sector than in the domestic H sector. This is partly offset because the $1-n_H^A$ $L-attribute$ good exporters sell more than $\tau^{-\sigma}$ times their domestic sales on the export markets. However, overall, the effect on trade volume is negative since the $H-$sector is the more important one for home firms. In contrast, steady state 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 $\pi_H \,/P^T\,(v_H)^{-\sigma} = \pi_H^* \,/P^{T*}\,(v_H)^{-\sigma}$, hence implying that exports & domestic revenue per firm are the same for $H-$ and $L-attribute$ firms. Thus, in the steady state heterogeneity and the composition of exports does not matter for average trade flows.

This sheds a new light on Linder's (1961) hypothesis. 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. While this insight holds for a given industry structure. However, in general equilibrium, the country in question loses 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.

The main conceptual insight arising from the analysis of this section is that the industrial reshuffling that underlies the home market effect also has major implications for the volume of and the gains from trade. Each country specializes into market segments with comparatively

[27] As is demonstrated in the appendix, 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 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 foreign exports are concentrated in. Thus, home's overall exports are smaller than its imports from foreign if its exports tend to be concentrated in the more competitive industry, which is the case if $\pi_H + \pi_H^* > 1$.

[28] Hanson and Xiang (2004) allow for the degree of returns to scale to vary across industries. Similarly, in Fajgelbaum et al. (2011) markups are different for high quality goods and low quality goods. In these two frameworks, cross-country taste differences can influence the long run volume of trade also in the case of incomplete specialization, since some countries may end up with industries that are characterized by a high degree of returns to scale.

large domestic demand, implying that domestic firms leave market segments in which the foreign industry specializes in. Thus, the increasing specialization that underlies the home market effect increases the demand for foreign goods, the volume of trade, and the average gains from liberalization.

The extent to which cross-country taste differences affect the volume of trade in the long run is determined by the degree to which the domestic industry can react to trade liberalization. In the case that countries specialize completely, the consumption home bias does not disappear entirely.

Corollary 2 (Complete Specialization in Symmetric Countries) *Assume that countries are equal-sized and that preferences are symmetric ($\pi_H = 1 - \pi_H^*$ and $e^{\sigma v_L a_L} = e^{\sigma v_H a_H}$ and $e^{\sigma v_H a_L} = e^{\sigma v_L a_H}$). If $\pi_H > \pi_H^*$ and $\pi_H \geq \frac{e^{\sigma v_L a_L} - \tau^{-\sigma} e^{\sigma v_L a_H}}{e^{\sigma v_L a_L} + e^{\sigma v_H a_L}} \left(1 + \tau^{-\sigma}\right)^{-1}$, countries are completely specialized ($n_H^T = 1$ and $n_H^{T*} = 0$) and the volume of trade is equal to*

$$X^T = \tau^{-\sigma} L \left((1 - \pi) \frac{e^{v_H a_H}}{\tau^{-\sigma} e^{v_H a_H} + e^{v_H a_L}} + \pi \frac{e^{v_H a_L}}{\tau^{-\sigma} e^{v_L a_H} + e^{v_L a_L}} \right),$$

where it is true that

$$X^S \leq X^T \leq \frac{LL^*}{L + \tau^{-\sigma} L^*}$$

and $\frac{\partial X^T}{\partial \pi} < 0$.

Proof. *see Appendix.* ■

Cross-country taste differences thus impede the long run volume of trade if they are so large so that both countries are completely specialized. In the above-introduced example, Germany then produces only fast cars, for which demand in France is so low that even in the absence of any French fast-car producers there is still little demand for these type of cars; German exports are thus not "appropriate" for the tastes of French consumers and taste differences are associated with a consumption home-bias.

The pervasiveness of both complete specialization and zero trade flows (see, for example, Schott (2004) and Helpman et al. (2006)) suggests that complete specialization is a relevant case. Indeed, Bernasconi (2009) finds direct evidence that the degree of country-similarity (in terms income similarity) is a strong predictor of zero trade flows.[29]

The response of industrial composition to trade also has implications for the welfare effects of liberalization. At the moment of opening to trade, the relatively larger domestic group gains less from trade than the smaller group. For example, given that Germany produces many large car varieties, French consumers with a preference for large cars do gain more at the moment of liberalization than do the French consumers with a preference for small cars. Dynamically, however, trade induces French producers of large cars to switch into the small car segment, which favors the lovers of small cars.

Corollary 3 (The Gains From Trade Under Incomplete Specialization) *Assume that $\pi_H > \pi_H^*$ and that parameters are such that in the long run equilibrium of the open economy $n_H^T, n_H^{T*} \epsilon\,]0,1[$. Then, it is true that at Home, the expected welfare of an H-valuation consumer is smaller than in the short run after liberalization, but larger than in autarky, while the expected welfare of an L-valuation consumer is larger than in the short run after liberalization and larger than in autarky. The unweighted average welfare gain from trade is larger in the long run than in the short run.*

Proof. *See appendix* ■

[29] Still, it is true that the adjustment of industry composition to trade has affected international taste differences in the sense that the volume of trade in the short run after opening markets to trade.

6 Transition to the Open Economy Steady State

Having analyzed the industry structure prevailing in the steady state with open market, it is possible to describe the transition path of the economy after liberalization.

The first result emerging from the analysis of this transition is that the static effects of liberalization may persist for a nontrivial amount of time. The reason for this is that immediately after liberalization, the global economy is characterized by the presence of too many firms so that entry of *any* kind of firm is unprofitable (see Chaney (2005) for an analysis of how the toughness of competition generally "overshoots" in the aftermath of trade liberalization and Burstein and Melitz (2011) for an overview of the literature of firm dynamics after liberalizations). Since firms incur no fixed cost to keep their business alive, there is no active exit and the number of firms only decreases due to exogenous firm-death at rate δ. Consequently, the autarky industry composition is preserved for some time and, with it, the impact of cross-country taste differences on the volume of trade in the immediate aftermath of liberalization described in Section 4.

The second result is that along the transition path, the volume of trade starts to rise gradually once entry occurs. This happens as entry is entirely directed towards the segment the country specializes in. The increasing specialization, in turn, leads to the domestic industry leaving precisely the market segments the foreign industry is specialized in and, thus, increases the volume of trade.

The following proposition summarizes firm dynamics after liberalization.

Proposition 5 (Transitional Dynamics in Symmetric Countries) *Assume that countries are equal-sized and that preferences are symmetric ($\pi_H = 1 - \pi_H^*$ and $e^{\sigma v_L a_L} = e^{\sigma v_H a_H} = H$ and $e^{\sigma v_H a_L} = e^{\sigma v_L a_H} = 1$). Further, denote the moment of trade liberalization by t_0 and assume that $\frac{T+F}{F} > \frac{\pi_H\left(H+\tau^{-\sigma}\right)\left(\tau^{-\sigma}\pi_H+(1-\pi_H)\right)+(1-\pi_H)\left(1+\tau^{-\sigma}H\right)\left(\pi_H+\tau^{-\sigma}(1-\pi_H)\right)}{(\pi_H+\tau^{-\sigma}(1-\pi_H))(\tau^{-\sigma}\pi_H+(1-\pi_H))(H+1)}$. Then, at home, there is no entry of any firm from time t_0 to t_1 and the law of motion for the number of home firms is given by $N_{H,t} = n_H^A N^A e^{-\rho(t-t_0)}$ and $N_{L,t} = n_L^A N^A e^{-\rho(t-t_0)}$. From time t_1 to t_2 there is only entry of H-type firm producers and the law of motion for the number of active firms is given by*

$$N_{L,t} = n_L^A N^A e^{-\rho(t-t_0)}$$

$$N_{H,t} = \frac{-\left(\left(\Gamma_1^2+\Gamma_2^2\right)N_{L,t}-\Gamma_2\Gamma_1\right)+\Gamma_4}{2\Gamma_1\Gamma_2\Gamma_3}$$

where

$$\Gamma_1 = e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H}, \Gamma_2 = e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L}, \Gamma_3 = L^{-1}\frac{T+F}{\sigma(\rho+\delta)}, \text{ and}$$

$$\Gamma_4 = \sqrt{\left(\left(\Gamma_1^2+\Gamma_2^2\right)\Gamma_3 N_{L,t}-\Gamma_2\Gamma_1\right)^2 - 4\Gamma_1\Gamma_2\Gamma_3\left(\Gamma_1\Gamma_2\Gamma_3 N_{L,t}^2 - \left(\pi_H\Gamma_1^2+(1-\pi_H)\Gamma_2^2\right)N_{L,t}\right)}$$

t_1 and t_2 are given by

$$\begin{aligned} t_1 &= t_0 + \rho^{-1}\ln\left(\frac{T+F}{F}\right) - \rho^{-1}\ln\left(\frac{\pi_H\Gamma_1}{\pi_H+\tau^{-\sigma}(1-\pi_H)} + \frac{(1-\pi_H)\Gamma_2}{(1-\pi_H)+\tau^{-\sigma}\pi_H}\right) \\ &\quad +\rho^{-1}\ln\left(e^{\sigma v_L a_L}+e^{\sigma v_H a_L}\right) \\ t_2 &= t_0 + \rho^{-1}\ln\left(\frac{T+F}{F}\right) \\ &\quad -\rho^{-1}\ln\left(\frac{(1-\pi_H)e^{\sigma v_H a_H}-e^{\sigma v_H a_L}\pi_H}{(1-\pi_H)e^{\sigma v_H a_H}-e^{\sigma v_H a_L}\pi_H-\left(e^{\sigma v_L a_L}+e^{\sigma v_H a_L}\right)\left(\pi_H-\pi_H^*\right)\frac{\tau^{-\sigma}}{1-\tau^{-\sigma}}}\right). \end{aligned}$$

Proof. *see Appendix* ■

Figure 7 summarizes the firm dynamics for the case where T is sufficiently large such that after an unanticipated trade liberalization at time t_0, there is a period of no entry. Between t_0 and t_1, there is not entry of any kind of firms. The reason for this is that compared to autarky, there are too many $L-$type firms, which also somewhat compete for $H-$type consumers and so markets are too tight even for $H-$type firms to enter the market.

Entry of a given type of firm only occurs once the profit flow for that type of firm is enough to recover the fixed cost of entry. With the assumption that $\pi_H > \pi_H^*$, at home $H-$type firms are relatively more profitable than $L-$type producers. Thus, the transitory path of the economy from the autarky steady state to the open economy one is characterized by two phases. In the first phase, there is 0 entry and the number of both types of firms decreases. In the second phase, there is entry of only H-type firms while the number of $L-$type firms continues to decrease. Once the number of $L-$firms has decreased enough so that the new steady state is reached, there is entry of both types of firms sufficient to replace firm death, so that the size and composition is constant throughout time.

Akin to the channel pointed out in Yi (2003), the model thus predicts that trade volume and welfare gains increase substantially after the point of liberalization since it generally takes time until the industry composition of each country adjusts to the demand structure of the global economy.[30]

7 An Extension to Comparative Advantage

The above section demonstrates that taste differences may not matter at all for the volume of trade in the long run. This section examines the generality of this result with respect to asymmetric entry costs and comparative advantage. The main finding is that taste differences do matter for the volume of world trade in the long run if comparative advantage and relative tastes are correlated.

In the generalized setup of the model, firms pay an attribute-specific entry cost $F(a_j)$ in Home and $F^*(a_j)$ in Foreign and they pay an attribute-specific marginal cost of producing a good of a given type $c(a_j)$ if the firm is based in Home and $c^*(a_j)$ is the firm is based in Foreign.[31] Because this section allows for differences in comparative advantage, it is necessary to re-define domestic revenue in the open market economy as the domestic revenue occurring to a firm that charges a price of 1.

Definition 2 $\widetilde{\Pi}(a_j)$ *denotes the domestic revenue of a firm based in home that charges a price of* $p_j = 1$.

$$\widetilde{\Pi}(a_j) = \frac{\pi_H L e^{\sigma v_H a_j}}{(P(v_h))^{1-\sigma}} + \frac{(1-\pi_H) L e^{\sigma v_L a_j}}{(P(v_l))^{1-\sigma}} \tag{16}$$

[30] How long does the period of transition generally last? Chaney (2005) argues that transition dynamics after liberalization are slow so that analyzing the transition and not only the new steady state this might well be an important time. Burstein and Melitz (2012) examine how firm responses evolve over time to changes in the extent of globalization. Ghironi and Melitz (2005), Alessandria and Choi (2007), Ruhl (2008), and Burstein and Melitz (2011) analyze the transitional dynamics following trade opening in models with heterogeneous firms. Ghironi and Melitz argue that deviations long run equilibria display substantial persistence in response to transitory aggregate shocks.

[31] To save on space (and remembering that there is no export selection), $F(a_j)$ in Home and $F^*(a_j)$ also include the cost of accessing the export market.

similarly

$$\widetilde{\Pi}^*(a_j) = \frac{\pi_H^* L^* e^{\sigma v_H a_j}}{(P^*(v_h))^{1-\sigma}} + \frac{(1-\pi_H^*) L^* e^{\sigma v_L a_j}}{(P^*(v_l))^{1-\sigma}} \tag{17}$$

With this definition, free entry at home implies that the domestic revenue of $H-$firms at Home has to equal the fixed costs minus export revenue per firm.

$$\begin{aligned} c(a_j)^{-\sigma}\widetilde{\Pi}(a_j) + \tau^{-\sigma}c(a_j)^{-\sigma}\widetilde{\Pi}^*(a_j) &= \sigma F(a_j) \\ \tau^{-\sigma}c^*(a_j)^{-\sigma}\widetilde{\Pi}(a_j) + c^*(a_j)^{-\sigma*}\widetilde{\Pi}^*(a_j) &= \sigma F^*(a_j) \end{aligned}$$

Non-specialization implies that both free entry conditions have to hold. With comparative advantage, it is generically not the case that firm's domestic revenue is equalized across the market segments:

$$\widetilde{\Pi}(a_j) = c(a_j)^{-\sigma}\sigma F(a_j) - \tau^{-\sigma}c^*(a_j)^{\sigma*}\sigma F^*(a_j).$$

Since in foreign, domestic revenue varies across the market segments, export revenue for home firms is attribute-specific. Hence, the volume of trade is affected by the distribution of firm types, which in turn depends on the distribution of tastes.

Proposition 6 (Taste Differences, Comparative Advantage and Trade) *Assume that a firm of type a_j pays an entry cost $F(a_j)$ if it is located in Home and $F^*(a_j)$ if it is located in Foreign, that to produce a unit of the good, a firm of type a_j pays a marginal cost of $c(a_j)$ if it is located in Home and $c^*(a_j)$ if it is located in Foreign respectively, and that parameters are such that specialization is incomplete. Then, exports are equal to*

$$\begin{aligned} X_H &= \left(e^{\sigma v_L a_L}\left(Z_H\pi_H L - \tau^{-\sigma}Z_H^*\pi_H^* L^*\right) - e^{\sigma v_H a_L}\left(Z_L(1-\pi_H)L - \tau^{-\sigma}Z_L^*(1-\pi_H^*)L^*\right)\right)\frac{\tau^{-\sigma}\varphi_H^*\sigma}{1-(\tau^{-\sigma})^2} \\ X_L &= \left(e^{\sigma v_H a_H}\left(Z_L(1-\pi_H)L - \tau^{-\sigma}Z_L^*(1-\pi_H^*)L^*\right) - e^{\sigma v_L a_H}\left(Z_H\pi_H L - \tau^{-\sigma}Z_H^*\pi_H^* L^*\right)\right)\frac{\tau^{-\sigma}\varphi_L^*\sigma}{1-(\tau^{-\sigma})^2} \\ X_H^* &= \left(e^{\sigma v_L a_L}\left(Z_H^*\pi_H^* L^* - \tau^{-\sigma}Z_H\pi_H L\right) - e^{\sigma v_H a_L}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma}Z_L(1-\pi_H)L\right)\right)\frac{\tau^{-\sigma}\sigma\varphi_H}{1-(\tau^{-\sigma})^2} \\ X_L^* &= \left(e^{\sigma v_H a_H}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma}Z_L(1-\pi_H)L\right) - e^{\sigma v_L a_H}\left(Z_H^*\pi_H^* L^* - \tau^{-\sigma}Z_H\pi_H L\right)\right)\frac{\tau^{-\sigma}\sigma\varphi_L}{1-(\tau^{-\sigma})^2} \end{aligned}$$

where

$$\begin{aligned} (Z_H)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L\right) \text{ and } (Z_L)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H\right) \\ (Z_H^*)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*\right) \text{ and } (Z_L^*)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*\right) \end{aligned}$$

and

$$\begin{aligned} \varphi_H &\equiv \frac{F(a_H)}{c(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} \text{ and } \varphi_H^* \equiv \frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_H)}{c(a_H)^{-\sigma}} \\ \varphi_L &\equiv \frac{F(a_L)}{c(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} \text{ and } \varphi_L^* \equiv \frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_L)}{c(a_L)^{-\sigma}}. \end{aligned}$$

The volume of world trade in differentiated goods is affected by shifts in the distribution of tastes.

Proof. *see Appendix* ■

With comparative advantage, the volume of world trade is affected by the distribution of tastes, i.e. changes of π_H^* and π_H affect X^W. How does the distribution of tastes affect the volume of trade in the generalized case? Whether the volume of world trade is increasing in π_H depends on whether

$$\frac{e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*}{e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L} > \frac{e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*}{e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H}$$

holds or not. The latter conditions holds, for example, if it is true that entry costs are equal across attributes and countries and that Home has a comparative advantage in $L-$attribute goods $(c(a_H)/c(a_L) < c^*(a_H)/c^*(a_L))$. In this case, the intuition is straightforward: if tastes are distributed in such a way that each country's tastes are concentrated in the sector in which the country also has the comparative advantage in, the volume of trade is low because each country is good at producing goods that it also likes to consume. On the other side, if tastes are distributed such that each country's tastes are concentrated in the sector in which the country has the comparative disadvantage, the volume of trade is larger than if tastes are the same in both countries.[32]

8 Conclusion

This paper starts by showing that in the European car industry, there exist cross-country taste differences along the product attribute dimension that significantly drive net trade patterns and that reduce the volume of trade. Further it is shown that, after the creation of the European common market, these cross-country taste differences caused a sluggish response of trade volume to liberalization as it took time for each country's industry structure to adapt to the demand structure of the common market.

To rationalize such trade patterns, a structural model of demand featuring products with heterogeneous attributes and consumers with heterogeneous tastes over attributes is developed that augments the preference structure of Dixit and Stiglitz (1977) with a model of the demand for heterogeneous products in the spirit of Mussa and Rosen (1978). I nest these preferences in a model of the international economy featuring two countries that differ in their average tastes and are separated by iceberg transportation costs.

In the short run after liberalization, the industry structure is still determined by autarky demand conditions. Consumption is then shown to be "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 and thus does not match well with the demand structure abroad.

Dynamically, however, the industry structure in each country specializes into market segments with comparatively large domestic demand, implying that domestic firms leave those market segments the foreign industry specializes in. The main insight emerging from the model of this paper is that the industry-restructuring associated with the "home market" effect also has important implications for the way in which cross-county taste differences affect the aggregate volume of trade and the welfare gains from liberalization. The reason for this is that as countries specialize into the segment with relatively large domestic demand, they make room for foreign exporters

[32] Roy and Viaene (1998) analyse preference heterogeneity in a Ricardian economy featuring homogenous goods that are differentiated by location of production; they also find that the interaction of comparative advantage and preferences can affect the volume of trade.

in other segments of the market. Since the latter happens to be exactly the market segment the trade partner's industry is concentrated in, the volume of trade increases with specialization.

These findings highlight that endogenizing how a nation's industrial composition responds to trade liberalization is of importance for understanding trade patterns and the welfare gains from open markets. The model also offers a new explanation why trade grows sluggish after liberalization (as for example documented by 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. 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.

References

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

[2] Amiti, Mary and Amit Khandewal (2009). "Competition and Quality Upgrading," Mimeo, GSB, Columbia 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] _ _ _ (2004) "Trade Costs," Journal of Economic Literature, American Economic Association, vol. 42(3), pages 691-751, September

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

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

[7] Arkolakis, Costas. (2010). "Market Penetration Costs and the New Consumers Margin in International Trade",

[8] Journal of Political Economy, 2010, 118 (6), 1151-1199.

[9] 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.

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

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

[12] Atkin, David G. (forthcoming). "Trade, Tastes and Nutrition in India." *The American Economic Review,* forthcoming.

[13] AUER, Raphael. (2008). "Product Heterogeneity, Trade Liberalization, and the Dynamics of Industry." Mimeo, SNB (available on request).

[14] AUER, Raphael, and Thomas CHANEY. (2007). "How do the Prices of Different Goods Respond to Exchange Rate Shocks? A Model of Quality Pricing-to-Market." Mimeo, University of Chicago.

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

[16] AUER, Raphael, and Philip SAURE. (2009). "Spatial Competition in Quality" Mimeo, SNB (available on request).

[17] 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.

[18] BALDWIN, Richard, and James HARRIGAN. (2011). "Zeros, Quality and Space: Trade Theory and Trade Evidence." *American Economic Journal: Microeconomics*, May 2011.

[19] BALDWIN, Richard, and Paul R. KRUGMAN. (1989). "Persistent trade effects of large exchange rate shocks." *The Quarterly Journal of Economics*, 104 (4): 635–654.

[20] BEHRENS, Kristian, LAMORGESE, Andrea R., OTTAVIANO, Gianmarco I.P. and TABUCHI, Takatoshi, 2009. "Beyond the home market effect: Market size and specialization in a multi-country world," Journal of International Economics, Elsevier, vol. 79(2), pages 259-265, November.

[21] 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.

[22] 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.

[23] 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.

[24] 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.

[25] 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.

[26] BRENKERS, Randy & Frank VERBOVEN, 2006. "Liberalizing A Distribution System: The European Car Market," Journal of the European Economic Association, MIT Press, vol. 4(1), pages 216-251, 03.

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

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

[29] Brooks, Eileen L. (2006). "Why don't firms export more? Product quality and Colombian plants." *The Journal of Development Economics*, 80 (1): 160–178.

[30] Bustos, Paula. (2005). "The Impact of Trade on Technology and Skill Upgrading: Evidence from Argentina." Mimeo, CREI.

[31] Chaney, Thomas. (2008). "Distorted Gravity: The Intensive and Extensive Margins of International Trade." *The American Economic Review*, 98 (4): 1707–1721.

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

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

[34] 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.

[35] Das, Sanghamitra, Mark J. Roberts, and James R. Tybout. (2007). "Market Entry Costs, Producer Heterogeneity and Export Dynamics." *Econometrica*, 75 (3): 837–873.

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

[37] Deardorff, Alan V. 1998. "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?" In The Regionalization of the World Economy, ed. Jeffrey A. Frankel, 7–22. Chicago: University of Chicago Press.

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

[39] Eaton, Jonathan, Samuel Kortum, and Francis Kramarz. (2008). "An Anatomy of International Trade: Evidence from French Firms." Mimeo.

[40] Evans, Carolyn L., 2001. "Home bias in trade: location or foreign-ness?," Staff Reports 128, Federal Reserve Bank of New York.

[41] Fajgelbaum, Pablo, Gene Grossman, and Elhanan Helpman. (2009). "Income Distribution, Product Quality and International Trade." Mimeo, Princeton University.

[42] Fieler, Ana Cecilia (2011). "Non-Homotheticity and Bilateral Trade: Evidence and a Quantitative Explanation" *Econometrica*, volume 79, issue 4, p. 1069-1101, July 2011

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

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

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

[46] Gabaix, Xavier, David Laibson, Deyuan Li, Hongyi Li, Sidney Resnick, and Caspar G. de Vries. (2010). "Competition and Prices: Insights from Extreme Value Theory." Mimeo, NYU Stern.

[47] Glazer, Amihai, and Priya Ranjan. (2003). "Preference heterogeneity, wage inequality, and trade." *The Journal of International Economics*, 60 (2): 455–469.

[48] 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.

[49] _ _ (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.

[50] Hallak, Juan Carlos. (2006). "Product Quality and the Direction of Trade." *The Journal of International Economics*, 68 (1): 238–265.

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

[52] Hallak, Juan Carlos, and Peter Schott. (2008). "Estimating Cross-Country Differences in Product Quality." National Bureau of Economic Research, Working Paper No. 13807.

[53] Hallak, Juan Carlos, and Jagadeesh Sivadasan. (2009). "Firms' Exporting Behavior under Quality Constraints." National Bureau of Economic Research, Working Paper No. 14928.

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

[55] Holmes, Thomas J., and John J. Stevens. (2005). "Does home market size matter for the pattern of trade?" *The Journal of International Economics*, 65 (2): 489–505.

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

[57] Hummels, David, and James Levinsohn. (1995). "Monopolistic Competition and International Trade: Reconsidering the Evidence." *The Quarterly Journal of Economics*, 110 (3): 799–836.

[58] Hummels, David, and Peter Klenow. (2005). "The Variety and Quality of a Nation's Exports." *The American Economic Review*, 95 (3): 704–723.

[59] Hummels, David, and Alexandre Skiba. (2004). "Shipping the Good Apples Out: An Empirical Confirmation of the Alchian-Allen Conjecture." *The Journal of Political Economy*, 112 (6): 1384–1402.

[60] JOHNSON, Robert C. (2012). "Trade and Prices with Heterogeneous Firms." Journal of International Economics, 86 (1), 2012

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

[62] KHANDEWAL, Amit (forthcoming). "The Long and Short (of) Quality Ladders," forthcoming, *The Review of Economic Studies.*

[63] 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.

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

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

[66] KUGLER, Maurice, and Eric A. VERHOOGEN. (2008). "Product Quality at the Plant Level: Plant Size, Exports, Output Prices and Input Prices in Colombia." National Bureau of Economic Research, Working Paper No. 14418.

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

[68] MANOVA, Kalina B. and Zhiwei ZHANG "Export Prices and Heterogeneous Firm Models." Mimeo, Department of Economics, Standford University.

[69] MAYER, Thierry, Marc J.MELITZ, and Gianmarco OTTAVIANO. (2009). "Market size, Competition, and the Product Mix of Exporters". Mimeo, Harvard University

[70] 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.

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

[72] MELITZ, Marc J., and Gianmarco OTTAVIANO. (2008). "Market Size, Trade, and Productivity." *Review of Economic Studies*, 75 (1): 295–316.

[73] MUNCH, Jakob R. and Daniel X. NGUYEN. (2009). "Decomposing Firm-level Sales Variation." Mimeo, Department of Economic, University of Copenhagen

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

[75] NOCCO, Antonella. (2009). "Preference Heterogeneity and Economic Geography." *The Journal of Regional Science*, 49 (1): 33–56.

[76] RAUCH, James E. (1999). "Networks Versus Markets in International Trade." *The Journal of International Economics*, 48 (1): 7–35.

[77] Roy, S. and Viaene, J.M.A. (1998), Preferences, country bias, and international trade, Review of International Economics, 6(2), pp 219-16.

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

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

[80] Sivadasan, Jagadeesh. (2007). "Productivity Consequences of Product Market Liberalization: Microevidence from Indian Manufacturing Sector Reforms." Mimeo.

[81] Sutton, John. (2007). "Quality, Trade and the Moving Window: The Globalisation Process." *The Economic Journal*, 117 (524): F469–F498.

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

[83] Verboven, Frank 1996. "International Price Discrimination in the European Car Market," RAND Journal of Economics, The RAND Corporation, vol. 27(2), pages 240-268, Summer.

[84] Verhoogen, Eric A. (2008). "Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector." *The Quarterly Journal of Economics*, 123 (2): 489–530.

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

[86] Yi, Kei-Mu. (2010). "Can Multi-Stage Production Explain the Home Bias in Trade?" *American Economic Review*, March 2010, 100 (1), 364-393.

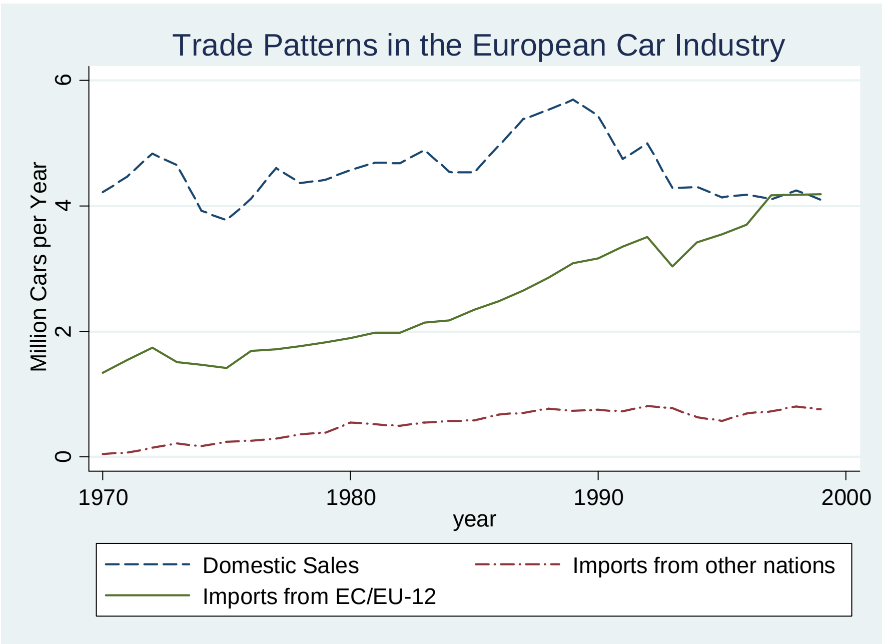

Figure 1

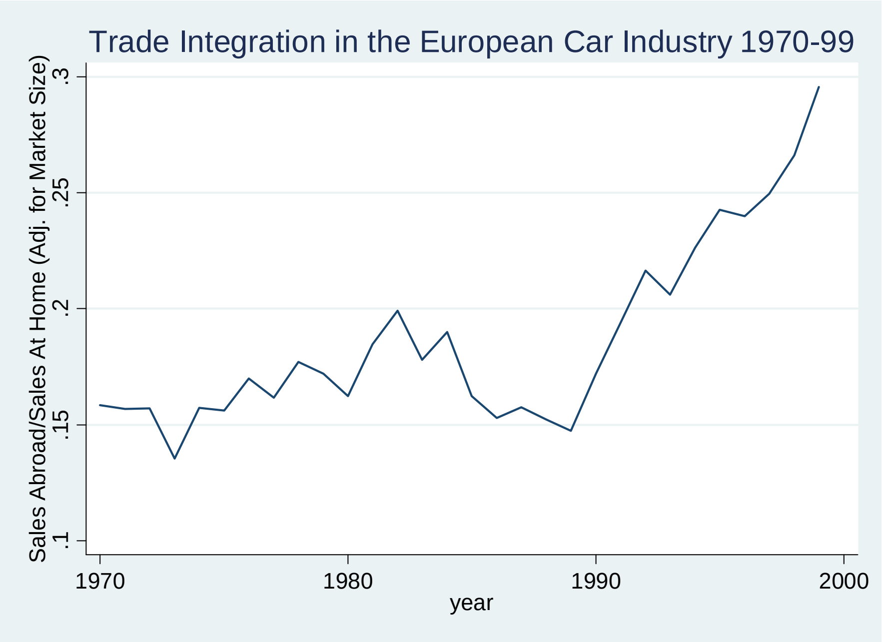

Figure 2

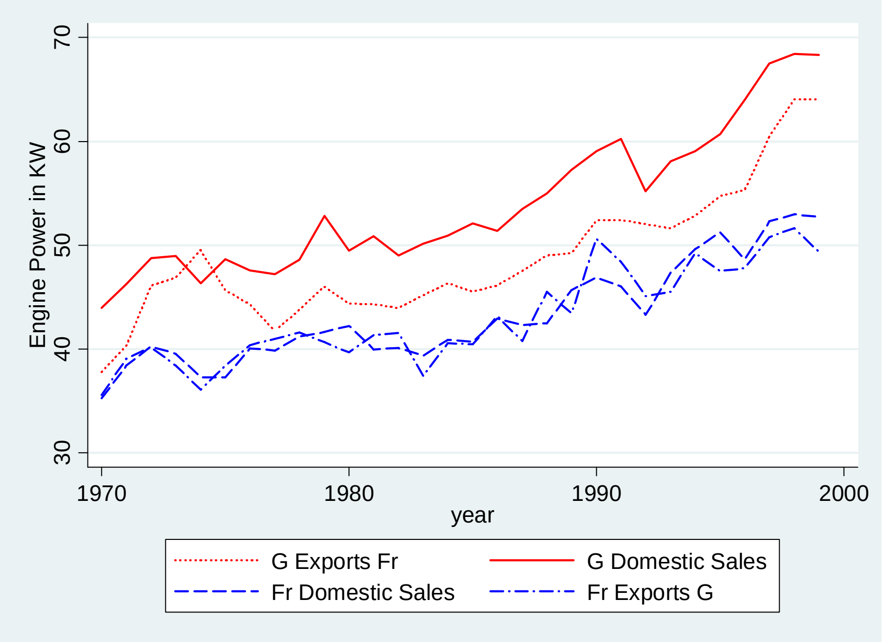

Figure 3

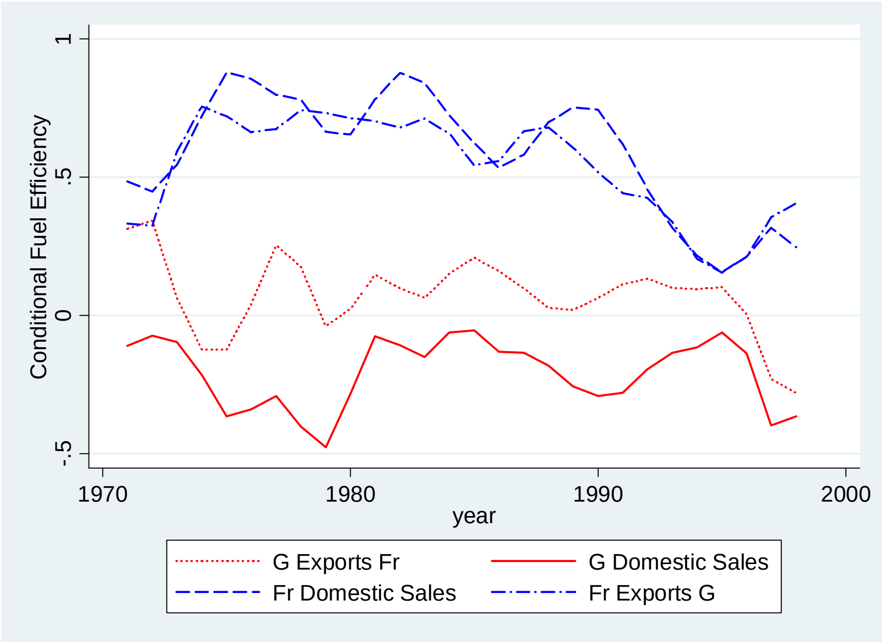

Figure 4

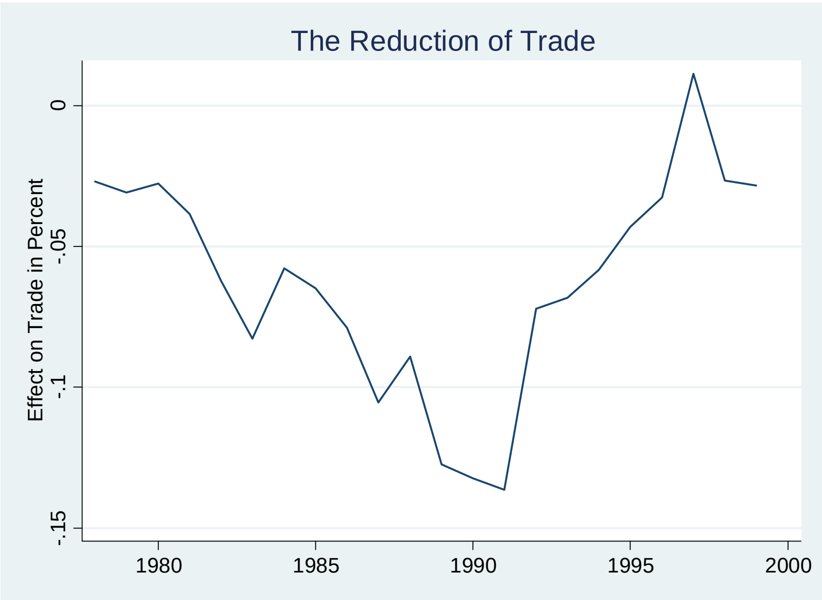

Figure 5

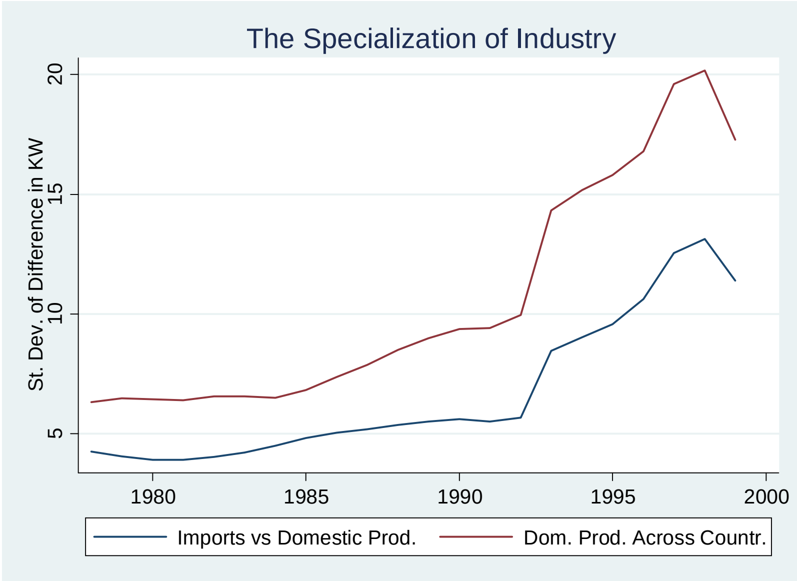

Figure 6

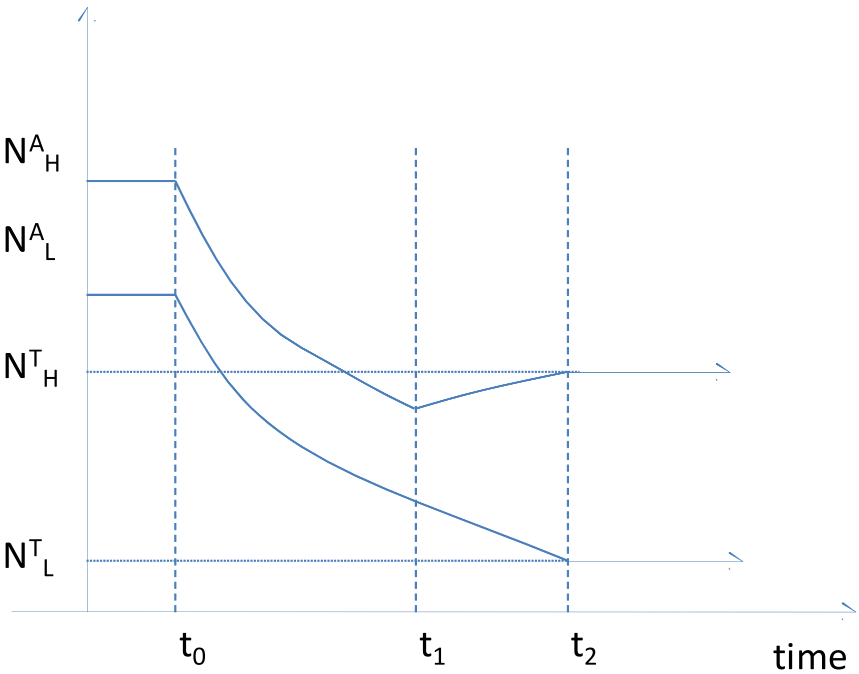

Figure 7

Table 1 - Domestic Consumption and Home market Effects (Panel Estimations Using Bilateral Aggregate Data)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Attribute	Engine (KW)	Engine (KW)	Engine (KW)	Engine (KW)	Li	HP, Taste	Li, Taste	Cla, Taste
Variable Type	(1) - (5) Domestic Average Charateristic					(6) - (8) **Taste** for Attribute		
Sample:	All Bilateral Aggregate Trade Flows between BEL, FRA, ITA, GER and UK During 1970-99							
Dependent Variable:	**Average Attribute Content of Bilateral Trade Flows**							
Ln Importer **Avg.** HP		0.267***	0.224***					
		[0.082]	[0.071]					
Ln Exporter **Avg.** HP	0.548***		0.540***					
	[0.116]		[0.111]					
Ln Importer ***Avg.*** Li				0.207***				
				[0.061]				
Ln Exporter ***Avg.*** Li				0.693***				
				[0.058]				
Ln Importer ***Avg.*** Cla					0.072			
					[0.084]			
Ln Exporter ***Avg.*** Cla					0.463***			
					[0.097]			
Ln Importer ***Taste*** HP						0.760***		
						[0.196]		
Ln Exporter ***Taste*** HP						0.719***		
						[0.238]		
Ln Importer ***Taste*** Li							0.315**	
							[0.159]	
Ln Exporter ***Taste*** Li							0.728***	
							[0.115]	
Ln Importer ***Taste*** Cla								0.007
								[0.304]
Ln Exporter ***Taste*** Cla								0.514***
								[0.185]
Trend	y	y	y	y	y	y	y	y
Observations	567	567	567	567	567	567	567	567
Number of groups	20	20	20	20	20	20	20	20
Within R2	0.528	0.499	0.540	0.759	0.105	0.548	0.749	0.130

Notes: Table 1 presents random effects panel estimations relating the average attribute of car trade flows to the attribute composition or taste of the exporting and/or the importing nation. In columns (1) to (3), the dependent variable is the log of average engine strength of the bilateral trade flow, in (5) and (7) it is the average fuel consumption of the bilateral trade flow, and in (6) and (8) it is the average class of the bilateral trade flow (all average are volume-weighted). "Class" can take integer values between 1 and 5 and is higher for larger and more luxurious cars. In (1) to (5), the independent variables is the volume-weighted average attribute of domestically consumed cars (attribute are engine strength, fuel consumption, or class) in the exporter and/or the importer market. In (6), (7), and (8), the independent variable are the importers' and the exporters' taste for the respective attribute (for construction see appendix A). Heteroscedasticity robust standard errors clustered by the model's origin are reported in Brackets; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2 - Tastes, Attributes and the Volume of Car Sales (Random Effects Panel Estimations)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Domestic sales	Dist Hp	Dist Fuel	Dist Cla		Dist HP, Fuel Eff, and Cla		
					full sample	Pre 1980	80-90	Post 1990
Sample:	All Car models Produced in and exportet to BEL, FRA, ITA, GER and UK							
Dependent Variable:	**Logarithm of the Quantity of the car model sold in a specifc market**							
Log of Model Sales in Exporter's Market	0.794*** [0.036]	0.794*** [0.036]	0.793*** [0.036]	0.786*** [0.036]	0.785*** [0.036]	0.722*** [0.067]	0.770*** [0.061]	0.956*** [0.052]
Dist of HP from importer taste		-0.062* [0.032]			-0.030 [0.035]	0.025 [0.037]	-0.119* [0.067]	-0.041 [0.090]
Dist of Fuel Inefficiency from importer taste			-0.045 [0.033]		-0.035 [0.032]	-0.027 [0.026]	-0.066 [0.124]	0.096 [0.052]
Dist of CLA from importer taste				-0.167*** [0.051]	-0.148*** [0.052]	-0.158*** [0.058]	-0.411*** [0.083]	-0.167** [0.074]
Origin & Market Dummies	y	y	y	y	y	y	y	y
Model Dummies	y	y	y	y	y	y	y	y
Trend	y	y	y	y	y	y	y	y
Observations	5926	5926	5926	5926	5926	1980	1757	1988
Number of groups	809	809	809	809	809	414	346	406
Overall R^2	0.448	0.449	0.450	0.451	0.453	0.379	0.487	0.535

Notes: Table 2 presents random effects panel estimations relating the sales of a car model to the distance from the car's attributes to the average taste of the importing nation. In all estimations, the dependent variable is the logarithm of exports of a specific car model to a specific market. All estimations include the logarithm of sales of the same car model in its market of production, a trend, as well as market and origin dummies. The measures of distance from the average importer taste are equal to the absolute value of the difference between the car model's attribute and the average taste for the attribute in the importing nation. Heteroscedasticity robust standard errors clustered by car model are reported in Brackets; significant at 5%; ** significant at 1%.

Table 3 - Cross-Country Taste Differences and the Reduction of Trade Flows

All Predictions Use Model in Column (5) in Table 2 re-estimated for:

Time Period:	**70-98**	**70-79**	**80-89**	**90-98**
Predicted Trade Volume (in mio cars):				
using actual country-specific tastes	54.1	12.3	18.4	25
without cross-country taste differences	56	12.9	20.4	25.6
% Reduction Due to Taste Differences	**3.6%**	**4.3%**	**10.6%**	**2.2%**

9 Appendix

9.1 Appendix A: Adjusting the Consumption Basket for Differences in Prices and the Toughness of Competition

Different car models are priced differently on different markets and, consequently, also the "toughness" of competition for consumers with heterogeneous valuations varies across markets. This appendix thus adjusts consumption baskets constructed in the main part of the paper such as

$$AvgKW_c = \frac{\sum_{j\epsilon J_c} KW_j * \text{Quantity}_{j,c}}{\sum_{j\epsilon J_c} \text{Quantity}_{j,c}}$$

for the fact that $\text{Quantity}_{j,c}$ also depends on prices and market "toughness". I follow Atkin's (forthcoming) notion, who constructs taste shifters as the country-specific composition of consumption that cannot be explained by the vector of prices in each market. While Atkin (forthcoming) estimates expenditure shares for distinct categories of goods such as rice or wheat, most of the attributes examined in this paper take continuous values such as do fuel consumption or engine power, so that separate expenditure shares cannot be estimated. Rather, I demonstrate how the effect of price differences across markets can be netted out from consumption decisions in a model featuring price-isoelastic demand by consumers with heterogeneous valuations over product attributes. I then construct the average attribute composition of this adjusted consumption basket.[33]

National Taste Shifters. To demonstrate the methodology, I start by demonstrating how simple cross-country taste shifters can be uncovered in a CES preference framework. I let country-specific "tastes" take the form of multiplicative country-specific demand shifters. More specific, demand for firm $j\epsilon J$ that produces a good with attribute a_j and sells it at price p_j faces demand $q_{c,t}(a_j, p_j)$ in country c and at time t, given by

$$q_{c,t}(a_j, p_j) = \frac{p_{j,c,t}^{-\sigma}\theta_c(a_j)}{\sum\limits_{n\epsilon J_c} p_{n,c,t}^{-\sigma}\theta_c(a_n)} D_{c,t}\epsilon_{j,c,t} \tag{18}$$

where $D_{c,t}$ denotes total car expenditures and the country's taste shifter over the attribute level a_j is represented by $\theta_c(a_j)$. While in (18), market toughness $\sum\limits_{n\epsilon J_c} p_{n,c,t}^{-\sigma}\theta_c(a_n)$ is unobserved, it is still straightforward to uncover $\theta_c(a_j)$ as at each point in time, there are multiple car models sold on each market so that $D_{c,t}$ and the toughness of competition can be absorbed by market-country fixed effects. Taking the log of (18) yields

$$\ln(q_{c,t}(a_j, p_j)) = -\sigma \ln(p_{j,c,t}) + \ln(\theta_c(a_j)) + \delta_{c,t} + \ln(\epsilon_{j,c,t})$$

where

$$\delta_{c,t} = \ln\left(\frac{D_{c,t}}{\sum\limits_{n\epsilon J_c} p_{n,c,t}^{-\sigma}\theta_c(a_n)}\right).$$

Uncovering country-specific tastes shifters is most straightforward for attributes that take discrete values. Columns (1) to (3) of Table A1 document such an estimation for the case of an attribute

[33] I thank David Aktin for his comments regarding the construction of adjusted consumption baskets undertaken in this appendix.

that takes only two values, a dummy that is equal to one for luxury cars and equal to zero otherwise. The model presented in Column (1) is

$$\ln q_{j,c,t} = -\widehat{\sigma} \ln \left(p_{j,c,t}\right) + \sum_{c \epsilon C} \widehat{\theta}_c \Pi_j^{LUX} + \sum_{c \epsilon C} \widehat{\delta}_{c,t} \Pi_{c,t} + \ln \left(\epsilon_{j,t}\right), \tag{19}$$

where Π_j^{LUX} is equal to one if the car is a luxury car and 0 otherwise (the luxury dummy does not vary across markets within one model and is thus not indexed by c). $\Pi_{c,t}$ is a dummy equal to 1 if the year is equal to t and the market is equal to c (i.e. $\widehat{\delta}_{c,t}$ are market-year-fixed effects).

A baseline estimation of equation (19) is presented in Column (1) of Table A1, which presents a joint estimation in Germany and France. In this joint estimation, market-year-fixed effects are included, which soak up the aggregate variation over time and account for different developments in Germany and France. In addition to controlling for the price, a dummy equal to one for luxury cars – as well as this dummy interacted with another dummy that is equal to one if the market is Germany – is included. The coefficient of the luxury dummy is equal to -0.259, while the interaction of the luxury dummy with a dummy that is equal to one in Germany is equal to $+0.357$. That is, for given prices, market size and market toughness, luxury cars sell on average 0.357 ln-points more in Germany than in France.

Table A1 - Constructing Tastes (RE Panel Estimations)

	(1)	(2)	(3)
	France & Germay	All 5 Markets	Add CO dummies
Sample:	All Car Models Sold During 1970-99 in:		
	France	Germany	France
Dependent Variable - Ln of Quantity of Model Sold in Market and Year			
Price Difference Foreign/Home in %	-0.964***	-0.895***	-0.963***
	[0.008]	[0.114]	[0.180]
Luxury Dummy	-0.259***	-0.191**	0.070
	[0.005]	[0.081]	[0.879]
Luxury Dummy * MA FR		-0.118***	-0.135***
		[0.004]	[0.031]
Luxury Dummy * MA DE	0.357***	0.243***	0.293***
	[0.000]	[0.006]	[0.046]
Luxury Dummy * MA IT		-0.236***	-0.362***
		[0.005]	[0.027]
Luxury Dummy * MA UK		-0.129***	-0.148***
		[0.003]	[0.039]
Market-Year Dummies	y	y	y
Model Dummies			y
Observations	4548	11549	11549
Number of groups	596	1510	1510
R2	0.0639	0.0723	0.0727

The results in the full sample estimation of Column (2) show that Germany has the highest preference for luxury cars, followed by Belgium, the UK, France, and finally Italy. Column (2) presents the same estimation as Column (1), but in all five markets and thus with four interacted luxury dummies. The interaction coefficients are estimated at -0.118 for France, $+0.243$ for Germany, -0.236 for Italy, and -0.128 for the UK (Belgium is the omitted group).

When estimating tastes over attributes, an important concern regards the fact that only some attributes are observed, while many other characteristics are intrinsically immeasurable; for example, the general appeal of a certain car model. If the latter immeasurable attributes are correlated with the observed attributes, the uncovered taste shifters $\widehat{\theta}_c$ are then biased since they also reflect the tastes for the immeasurable attributes. An advantage of the dataset used in this study is that the immeasurable attributes of each car model do not vary across the five European markets, as car producers do not modify the cars they sell when exporting to the other five markets.[34] It is thus possible to condition on the unobserved car characteristics by including model-fixed effects to the estimation. Column (3) thus presents an estimation that also includes a dummy for each car model. For each car model, the luxury dummy is time-invariant and it thus drops out of the estimation when model-dummies are included in the estimation. The interaction of the luxury dummy with the market dummy does not drop out, however, as the sales of one model may differ across the five markets and this variation in sales may be correlated with the luxury dummy. The addition of the model dummies does neither alter the relative ranking of the coefficients nor does it significantly alter them in magnitude (compare Columns (2) and (3)).

Allowing for Within-Country Heterogeneity. In the model presented in the main text, consumers are heterogeneous and cross-country taste differences derive from differences in the distribution of consumer valuations. I next augment the preferences (18) by such within-country heterogeneity. Following Equation (7), if within each country, there are two kinds of consumers that have a taste shifter $\theta^H(a_j)$ and $\theta^L(a_j)$, respectively, demand takes the form

$$q_{j,c} = p_{j,c}^{-\sigma}\left(\theta^L(a_j)\,F_c^L + \theta^H(a_j)\,F_c^H\right)\varepsilon_{j,c} \tag{20}$$

where

$$F_c^L = \frac{D_c^L}{\sum\limits_{n\epsilon J_c} p_{n,c}^{-\sigma}\theta^L(a_j)} \text{ and } F_c^H = \frac{D_c^H}{\sum\limits_{n\epsilon J_c} p_{n,c}^{-\sigma}\theta^H(a_j)}.$$

F_c^L is hence an amalgam of the toughness of competition for consumers with preference shifter $\theta_c^L(a_j)$ and the total spending by such consumers D_c^L (this could reflect a large number of consumers with preferences $\theta_c^L(a_j)$ or high expenditures per such consumer).

I want to uncover how the attribute composition of countries were to differ if the countries were offered the same set of cars at identical prices. For this, I need to uncover σ, $\theta^L(a_j)$ and $\theta^H(a_j)$, and F_c^L and F_c^H. I then need to predict consumption choices under common prices. I thus estimate (20) using Nonlinear Least Squares in a pooled estimation in all countries. This yields the nonlinear relation

$$\begin{aligned} \ln(q_{c,t,j}) \quad &= \quad -\sigma \ln p_{j,c,t} + \Pi_{c,t} + \ln(\varepsilon_{j,c,t}) \\ &\quad + \ln\left(\exp\left[\widetilde{v_L}\Pi_j^{LUX}\right]\sum_{m\epsilon C}(\delta_{L,c}\Pi_{m,c}) + \exp\left[\widetilde{v_H}\Pi_j^{LUX}\right]\sum_{m\epsilon C}(\delta_{H,c}\Pi_{m,c})\right) \end{aligned} \tag{21}$$

where $\widehat{\delta_{L,c}}$ and $\widehat{\delta_{H,c}}$ measure demand from the two sets of consumers in each country, and $\widetilde{v_H}$ and $\widetilde{v_L}$ measure the relative preference for more luxurious cars in each of the two groups. $\Pi_{c,t}$ is a country-time fixed effect that absorbs differences in market sizes over time and across the markets.

When estimating this relation for the luxury dummy, I find that $\widetilde{v_L} = -1.13$ and $\widetilde{v_H} = 0.165$ and the two country-specific constants of interest (normalized such that they sum to 1) are

[34] Goldberg and Verboven (2001 and 2005) collect the price of the baseline model that is identical across Europe. The only exception is the UK, due to left hand traffic. Inclusion or exclusion of the UK does not alter the results of this study.

estimated as

c	$\widehat{\delta_{L,c}}$	$\widehat{\delta_{H,c}}$
Belgium	0.44	0.56
France	0.60	0.40
Germany	0.09	0.91
Italy	0.76	0.24
UK	0.56	0.44

The coefficients from the nonlinear estimation confirm the ranking of preference for luxury cars the OLS estimation in Table A1 suggested: Germany has the highest preference for luxury cars, followed by Belgium, the UK, France, and Italy.

Constructing An Adjusted Consumption Basket. I next construct the average attribute composition of the consumption basket adjusted for price differences. The above model relates sales to prices, the distribution of country's taste over the car's attribute value, and overall market size. I am interested in the average attribute composition of cars sold in each model in the hypothetical case that the price of each model was the same across market. I thus generate the average price of each car model across the markets (within each year) as

$$\overline{p_{j,t}} = 1/5 \sum_{c \epsilon B,F,G,I,U} p_{j,c,t}$$

I next derive the level of demand that would prevail for a certain car model if all car models were priced equally on all markets. For this, I predict the demand model (21) replacing the actual price by the average one. I also adjust the market toughness for consumers with the $\widetilde{v_L}$ taste shifter and for consumers with the $\widetilde{v_H}$ shifter by price differences. I generate (omitting time subscripts)

$$\widetilde{Q_{j,c}} = Q^L_{j,c} \left(\frac{\overline{p_{j,t}}}{p_j}\right)^{-\sigma} \frac{\sum\limits_{n \epsilon J_c} p^{-\sigma}_{n,c,t} \theta^L \widehat{\left(D^{Lux}_j\right)}}{\sum\limits_{n \epsilon J_c} \overline{p_{j,t}}^{-\sigma} \theta^L \widehat{\left(D^{Lux}_j\right)}} + Q^H_{j,c} \left(\frac{\overline{p_{j,t}}}{p_j}\right)^{-\sigma} \frac{\sum\limits_{n \epsilon J_c} p^{-\sigma}_{n,c,t} \theta^H \widehat{\left(D^{Lux}_j\right)}}{\sum\limits_{n \epsilon J_c} \overline{p_{j,t}}^{-\sigma} \theta^H \widehat{\left(D^{Lux}_j\right)}}$$

where

$$Q^L_{j,c} = p^{-\sigma}_{j,c} \widehat{D_{c,t}} \widehat{\varepsilon_{j,c}} \widehat{F^L_c} \theta^L \widehat{\left(D^{Lux}_j\right)} \text{ and } Q^H_{j,c} = p^{-\sigma}_{j,c} \widehat{D_{c,t}} \widehat{\varepsilon_{j,c}} \widehat{F^H_c} \theta^H \widehat{\left(D^{Lux}_j\right)}$$

and

$$\theta^L \widehat{\left(D^{Lux}_j\right)} = Exp\left[-1.13 * D^{Lux}_j\right] \text{ and } \theta^H \widehat{\left(D^{Lux}_j\right)} = Exp\left[0.165 * D^{Lux}_j\right]$$

The constructed quantities measure the number of units a given car model would have sold on a given market if the model's price was equal to the average of the model across the five markets and the same was true for all car models. Using the adjusted quantities of the models in (21), I then construct the adjusted average composition of the country's consumption basket for each attribute. For the attribute "Luxury Dummy", I construct the adjusted average as

$$Adj\ Avg\ D^{Lux}_{j,c,t} = \frac{\sum_{j \epsilon J_c} D^{Lux}_j * \widetilde{Q_{j,c}}}{\sum_{j \epsilon J_c} \widetilde{Q_{j,c}}}$$

Following the same methodology, I next construct the average taste for fuel efficiency, engine power, technical fuel inefficiency, and for car class. For this, I make the additional assumption that consumers have preferences over the attributes in accordance with the specification of the model developed in the main section of the text; for example for Fuel inefficiency FIE), I assume that $\theta^L(FIE_j) = v^L FIE_j$, whereas $\theta^H(FIE_j) = v^H FIE_j$. I then estimate

$$\ln(D_{j,c}) = -\sigma \ln p_{j,c} + \ln\left(\exp[\widetilde{v_H} FIE_j] \sum_{m\epsilon C}(\delta_{1,c}\Pi_{m,c}) + \exp[\widetilde{v_L} FIE_j] \sum_{m\epsilon C}(\delta_{2,c}\Pi_{m,c})\right) + \varepsilon_{j,c} \tag{22}$$

where $\Pi_{j,c}$ is the indicator function equal to 1 if $m = c$ and 0 otherwise.

Since I estimate (22) over all years jointly, I need to adjust attributes for technological progress over the three decades of the sample. For this, I demean each attribute by year over the all the market-model combinations sold in the respective year. Therefore, the uncovered country-specific shifters $\delta_{1,c}$ and $\delta_{2,c}$ measure whether compared to the average set of car models that is on sale at each point in time, the country has a relative preference for those with above-average or below average attributes. This model estimation then allows to adjust the two price indices for price differences across the markets.

9.2 Appendix B: Proofs

Proposition 1 (Demand) (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

$$D(a_j, p_j) = (1-\alpha)\theta L \Gamma(1-\sigma) p_j^{-(1+\sigma)} \int_{v\epsilon V} f_v(v) \frac{\exp[\sigma v a_j]}{\overline{P(v)}^{-\sigma}} dv, \tag{23}$$

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

$$\overline{P(v)} = \left(\sum_{n\epsilon J}\left(\frac{p_n}{\exp[v a_n]}\right)^{-\sigma}\right)^{-1/\sigma}. \tag{24}$$

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 $\widetilde{j}=\arg\max_{i\epsilon J} \frac{e^{a_j\widetilde{v}+x_{i,j}}}{p_j}$. 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

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

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

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

so that

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

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

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

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 $\widetilde{v}$

$$D_j\left(a_j, p_j, \widetilde{v}\right) = \Gamma\left(1-\sigma\right)\frac{w}{p_j}\frac{p_j^{-\sigma}\exp\left[\sigma\widetilde{v}a_j\right]}{\sum\limits_{n\epsilon J}\left(p_n^{-\sigma}\exp\left[\sigma\widetilde{v}a_n\right]\right)}. \tag{25}$$

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

$$\begin{aligned} & D_j\left(a_j, p_j\right) \\ = \; & L\Gamma\left(1-\sigma\right)\frac{(1-\alpha)\,\theta_i}{p_j}\int\limits_{v\epsilon V} j_v\left(v\right)\frac{p_j^{-\sigma}\exp\left[\sigma v a_j\right]}{\sum\limits_{n\epsilon J}\left(p_n^{-\sigma}\exp\left[\sigma v a_n\right]\right)} dv \end{aligned}$$

■

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

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

where the ideal price index $\overline{P\left(v\right)}$ is as defined in (8) and $\Gamma\left(..\right)$ 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

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

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

$$\begin{aligned} F\left(\widetilde{U}_i\right) &= \Pr\left[\max_{j\epsilon J}\left(\frac{e^{x_{i,j}+a_j v_i}}{p_j}\right)^\alpha < \widetilde{U}_i\right] \\ &= \prod_{j\epsilon J}\Pr\left[x_{i,j} < \ln\widetilde{U}_i^{\frac{1}{\alpha}} + \ln\left(\frac{p_j}{e^{a_j v_i}}\right)\right] \\ &= \prod_{j\epsilon J}\exp\left[-\exp\left[-\left[\ln\widetilde{U}_i^{\frac{1}{\alpha}} + \ln\left(\frac{p_j}{e^{a_j v_i}}\right)\right]\sigma\right]\right] \\ &= \exp-\left[\left(\frac{\widetilde{U}_i}{\left(\sum_{j\epsilon J} p_j^{-\sigma}e^{\sigma a_j v_i}\right)^{\frac{\alpha}{\sigma}}}\right)^{-\frac{\sigma}{\alpha}}\right] \end{aligned}$$

$\widetilde{U}_i$ 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 $\frac{\sigma}{\alpha}$.

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

■

(Short Run Attribute Content of Trade)

Lemma 2 (Short Run Attribute Content of Trade) (reminded) 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

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

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)}{\left(1-n_H^A\right)\left(\pi_H^* \frac{e^{\sigma v_H a_L}}{P^{*S}(v_H)^{-\sigma}} + \left(1-\pi_H^*\right)\frac{e^{\sigma v_L a_L}}{P^{*S}(v_L)^{-\sigma}}\right)} \\ &= \frac{\dfrac{\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{\left(1-\pi_H^*\right)}{\tau^{-\sigma}L(1-\pi_H)+L^*\left(1-\pi_H^*\right)}\frac{e^{\sigma v_L a_L}}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}} \cdot \left(\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{\left(1-\pi_H^*\right)}{\tau^{-\sigma}L(1-\pi_H)+L^*\left(1-\pi_H^*\right)}\frac{e^{\sigma v_L a_H}}{e^{\sigma v_L a_L} - e^{\sigma v_L a_H}}\right)}{\left(1-n_H^A\right)} \\ \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)}{\left(1-n_H^{*A}\right)\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{\dfrac{\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)}}{} \cdot \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^*\left(1-\pi_H^*\right)}\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^*\left(1-\pi_H^*\right)}\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 3 (Short Run Trade Volume) (reminded) 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. Regarding the volume of trade,

I. For given $\tau^{-\sigma}$, the volume of trade is decreasing in $|\pi_H - \pi_H^*|$
II. The importance of taste heterogeneity is increasing in $\tau^{-\sigma}$. As $\tau^{-\sigma} \to 0$ the volume of trade is unaffected by the distribution of tastes.

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 foreign $H-$ and $L-valuation$ consumers are given by Lemma (1) thus yielding

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

$$X^{S*} = \frac{\tau^{-\sigma} LL^* \pi_H^* \pi_H}{\tau^{-\sigma} L\pi_H + L^* \pi_H^*} + \frac{\tau^{-\sigma} LL^* (1-\pi_H^*)(1-\pi_H)}{\tau^{-\sigma} L(1-\pi_H) + L^* \left(1-\pi_H^*\right)} \tag{27}$$

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 3 . Next, setting $\pi_H = \pi_H^*$ in (27) and (26) 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 $L = L^*$, $X - X^* = \frac{\left(\pi_H^2 + \pi_H^{*2}\right)(1-\pi_H)\left(1-\pi_H^*\right) - \left((1-\pi_H)^2 + \left(1-\pi_H^*\right)^2\right)\pi_H \pi_H^*}{\left(\tau^{-\sigma}\pi_H + \pi_H^*\right)\left(\pi_H + \tau^{-\sigma}\pi_H^*\right)\left(\tau^{-\sigma}(1-\pi_H) + \left(1-\pi_H^*\right)\right)\left((1-\pi_H) + \tau^{-\sigma}\left(1-\pi_H^*\right)\right)}$ $(\pi_H - \pi_H^*)\,\tau^{-\sigma}\,(1+\tau^{-\sigma})$. 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 foreign yields (27). 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. ■

Proposition 4 (Trade and its Net Attribute Content) (reminded) Assume that $\pi_H > \pi_H^*$ and that parameters are such that $n_H^T, n_H^{T*} \epsilon\,]0,1[$. Then, the volume of Home's manufacturing exports is equal to $\frac{LL^*}{L+\tau^{-\sigma}L^*}$ for any π_H, π_H^* that satisfy the stated assumptions. If $L^* = L$, Home has 0 net exports of manufactured goods. If $L > L^*$, Home is a net exporter of manufactured goods. For any combination of L and L^* that is consistent with the stated assumptions, Home's manufacturing exports are more $H-attribute$ intensive that Foreign's manufacturing exports. Home's manufacturing exports are more $H-attribute$ intensive in the open economy equilibrium than just after trade liberalization.

Proof. Home's Exports and Imports of goods that embody the $H-attribute$ are proportional to the number of domestic respectively foreign H firms. Home's total exports of $H-attribute$ goods equal

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

Similarly,

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

Because each $H-attribute$ and $L-attribute$ producer of a country exports the same amount, the composition of the industry does not affect the overall volume of exports.

$$\begin{aligned} X^T &= X_H^T + X_L^T = N^T \frac{L^* \tau^{-\sigma}}{\tau^{-\sigma} N^T + N^{T*}} = \left(L - \tau^{-\sigma} L^*\right) \frac{\tau^{-\sigma}}{1 - \tau^{-2\sigma}} \\ X^{T*} &= X_H^{T*} + X_L^{T*} = N^{T*} \frac{L \tau^{-\sigma}}{N^T + \tau^{-\sigma} N^{T*}} = \left(L^* - \tau^{-\sigma} L\right) \frac{\tau^{-\sigma}}{1 - \tau^{-2\sigma}} \end{aligned}$$

and Home's net exports of manufactured goods equal

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

Home's net exports of $H-attribute$ equal

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

and the labor intensity of

$$\frac{X_H^T}{X_H^T + X_L^T} = n_H^T > n_H^{T*} = \frac{X_H^{T*}}{X_H^{T*} + X_L^{T*}}$$

Last, it is also true that

$$\frac{X_H^T}{X_H^T + X_L^T} = n_H^T > \frac{X_H^S}{X_H^S + X_L^S}$$

Since both $n_H^T > n_H^A$ and after trade liberalization , an $H - attribute$ firm exports less than an $L - attribute$ firms so that $\frac{\pi_H^* \frac{e^{\sigma v_H a_H}}{P^* S(v_H)^{-\sigma}} + (1-\pi_H^*) \frac{e^{\sigma v_L a_H}}{P^* S(v_L)^{-\sigma}}}{\pi_H^* L^* \frac{\tau^{-\sigma} e^{\sigma v_H a_L}}{P^* S(v_H)^{-\sigma}} + (1-\pi_H^*) L^* \frac{\tau^{-\sigma} e^{\sigma v_L a_L}}{P^* S(v_L)^{-\sigma}}} < 1.$ ■

Corollary 3 (The Gains From Trade Under Incomplete Specialization) (reminded) Assume that $\pi_H > \pi_H^*$ and that parameters are such that in the long run equilibrium of the open economy $n_H^T, n_H^{T*} \epsilon]0,1[$. Then, it is true that at Home, the expected welfare of an H-valuation consumer is smaller than in the short run after liberalization, but larger than in autarky, while the expected welfare of an L-valuation consumer is larger than in the short run after liberalization and larger than in autarky. The unweighted average welfare gain from trade is larger in the long run than in the short run.

Proof. Note that by Corollary 1, the gains from trade are exclusively dependent on the ideal price indeces. Lemma 3 pins down the sales of firms, and recalling the definition of domestic revenue $\Pi(a_j)$ and $\Pi^*(a_j)$ in equation (10) yields

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

which, when compared to Lemma 1 and the autarky ideal price indeces (see Proposition 2), satisfies the stated relations. ■

Corollary 2 (Complete Specialization) (reminded) Assume that countries are equal-sized and that preferences are symmetric ($\pi_H = 1 - \pi_H^*$ and $e^{\sigma v_L a_L} = e^{\sigma v_H a_H}$ and $e^{\sigma v_H a_L} = e^{\sigma v_L a_H}$). If $\pi_H > \pi_H^*$ and $\pi_H \geq \frac{e^{\sigma v_L a_L} - \tau^{-\sigma} e^{\sigma v_L a_H}}{e^{\sigma v_L a_L} + e^{\sigma v_H a_L}} (1+\tau^{-\sigma})^{-1}$, countries are completely specialized ($n_H^T = 1$ and $n_H^{T*} = 0$) and the volume of trade is equal to

$$X^T = \tau^{-\sigma} L \left((1-\pi) \frac{e^{v_H a_H}}{\tau^{-\sigma} e^{v_H a_H} + e^{v_H a_L}} + \pi \frac{e^{v_H a_L}}{\tau^{-\sigma} e^{v_L a_H} + e^{v_L a_L}} \right),$$

where it is true that

$$X^S \leq X^T \leq \frac{LL^*}{L + \tau^{-\sigma} L^*}$$

and $\frac{\partial X^T}{\partial \pi} < 0$.

Proof. Under the stated assumptions, $n_H = 1$, $n_H^* = 0$ and

$$\begin{aligned} P(v_H)^{-\sigma} &= N e^{\sigma v_H a_H} + \tau^{-\sigma} N^* e^{\sigma v_H a_L}, \; P(v_L)^{-\sigma} = N e^{\sigma v_L a_H} + \tau^{-\sigma} N^* e^{\sigma v_L a_L}, \\ P^*(v_H)^{-\sigma} &= \tau^{-\sigma} N e^{\sigma v_H a_H} + N^* e^{\sigma v_H a_L}, \text{ and } P^*(v_L)^{-\sigma} = \tau^{-\sigma} N e^{\sigma v_L a_H} + N^* e^{\sigma v_L a_L} \end{aligned}$$

hold. Free entry in Home and Foreign satisfies

$$\begin{aligned} (F+T)\delta\sigma &= L \left(\pi \frac{e^{\sigma v_H a_H}}{P(v_H)^{-\sigma}} + (1-\pi) \frac{e^{\sigma v_L a_H}}{P(v_L)^{-\sigma}} \right) + \tau^{-\sigma} L^* \left(\pi^* \frac{e^{\sigma v_H a_H}}{P^*(v_H)^{-\sigma}} + (1-\pi^*) \frac{e^{\sigma v_L a_H}}{P^*(v_L)^{-\sigma}} \right) \\ (F+T)\delta\sigma &= L^* \left(\pi^* \frac{e^{\sigma v_H a_L}}{P^*(v_H)^{-\sigma}} + (1-\pi^*) \frac{e^{\sigma v_L a_L}}{P^*(v_L)^{-\sigma}} \right) + \tau^{-\sigma} L \left(\pi \frac{e^{\sigma v_H a_L}}{P(v_H)^{-\sigma}} + (1-\pi) \frac{e^{\sigma v_L a_L}}{P(v_L)^{-\sigma}} \right) \end{aligned}$$

under the stated assumptions of symmetry, $P(v_H)^{-\sigma} = P^*(v_L)^{-\sigma}$ and $P(v_L)^{-\sigma} = P^*(v_H)^{-\sigma}$, which solves for $N = \frac{L}{(F+T)\delta\sigma} = N^*$. This then solves for exports as stated in the corollary. ∎

Proposition 5 Transitional Dynamics in Symmetric Countries (reminded) Denote the moment of trade liberalization by t_0. Then, at home, there is no entry of any firms from time t_0 to t_1 and the law of motion for the number of home firms is given by $N_{H,t} = n_H^A N^A e^{-\rho(t-t_0)}$ and $N_{L,t} = n_L^A N^A e^{-\rho(t-t_0)}$. From time t_1 to t_2 there is only entry of H-type firm producers and the law of motion for the number of active firms is given by

$$N_{L,t} = n_L^A N^A e^{-\rho(t-t_0)}$$

$$N_{H,t} = \frac{-\left(\left(\Gamma_1^2+\Gamma_2^2\right) X N_{L,t} - \Gamma_2\Gamma_1\right) + \sqrt{\begin{array}{c}\left(\left(\Gamma_1^2+\Gamma_2^2\right)\Gamma_3 N_{L,t} - \Gamma_2\Gamma_1\right)^2 \\ -4\Gamma_1\Gamma_2\Gamma_3\left(\Gamma_1\Gamma_2\Gamma_3 N_{L,t}^2 - \left(\pi_H\Gamma_1^2 + (1-\pi_H)\Gamma_2^2\right) N_{L,t}\right)\end{array}}}{2\Gamma_1\Gamma_2\Gamma_3}$$

where

$$\begin{aligned}
\Gamma_1 &= e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H}, \Gamma_2 = e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L}, \Gamma_3 = L^{-1}\frac{T+F}{\sigma(\rho+\delta)}, \text{ and} \\
\Gamma_4 &= \sqrt{\left(\left(\Gamma_1^2+\Gamma_2^2\right)\Gamma_3 N_{L,t} - \Gamma_2\Gamma_1\right)^2 - 4\Gamma_1\Gamma_2\Gamma_3\left(\Gamma_1\Gamma_2\Gamma_3 N_{L,t}^2 - \left(\pi_H\Gamma_1^2 + (1-\pi_H)\Gamma_2^2\right) N_{L,t}\right)}
\end{aligned}$$

and the time tome to transition is equal to $\ln\left(\frac{\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} - \Lambda\pi_H}{\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} - \Lambda\pi_H - \left(\pi_H - \pi_H^*\right)\frac{\tau^{-\sigma}}{1-\tau^{-\sigma}}\Lambda}\right) + \ln\left(\frac{T+F}{F}\right)$.

$$\begin{aligned}
t_1 &= t_0 + \rho^{-1}\ln\left(\frac{T+F}{F}\right) - \rho^{-1}\ln\left(\frac{\pi_H\Gamma_1}{\pi_H + \tau^{-\sigma}(1-\pi_H)} + \frac{(1-\pi_H)\Gamma_2}{(1-\pi_H) + \tau^{-\sigma}\pi_H}\right) + \rho^{-1}\ln\left(e^{\sigma v_L a_L} + e^{\sigma v_H a_L}\right. \\
t_2 &= t_0 + \rho^{-1}\ln\left(\frac{T+F}{F}\right) + \rho^{-1}\ln\left(\frac{\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} - \Lambda\pi_H - \left(\pi_H - \pi_H^*\right)\frac{\tau^{-\sigma}}{1-\tau^{-\sigma}}\Lambda}{\frac{e^{\sigma v_H a_H}}{e^{\sigma v_H a_H} - e^{\sigma v_H a_L}} - \Lambda\pi_H}\right).
\end{aligned}$$

Proof. Note that:

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

whereas in foreign

$$\tau^{-\sigma}\left(\frac{\pi_H L e^{\sigma v_H a_L}}{P(v_H)^{-\sigma}} + \frac{(1-\pi_H) L e^{\sigma v_L a_L}}{P(v_L)^{-\sigma}}\right) + \frac{\pi_H^* L^* e^{\sigma v_H a_L}}{P^*(v_H)^{-\sigma}} + \frac{(1-\pi_H^*) L^* e^{\sigma v_L a_L}}{P^*(v_L)^{-\sigma}} = \frac{T+F}{\sigma(\rho+\delta)}$$

Note by perfect symmetry $P(v_H)^{-\sigma} = P^*(v_L)^{-\sigma}$ and $P(v_L)^{-\sigma} = P^*(v_H)^{-\sigma}$ and $\pi_H^* = (1-\pi_H)$ together

$$\begin{aligned}
\frac{\pi_H}{P(v_H)^{-\sigma}}\left(e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H}\right) + \frac{(1-\pi_H)}{P(v_L)^{-\sigma}}\left(e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_H a_H}\right) &= L^{-1}\frac{T+F}{\sigma(\rho+\delta)} \\
\frac{\pi_H}{P(v_H)^{-\sigma}}\left(e^{\sigma v_H a_L}\tau^{-\sigma} + e^{\sigma v_L a_L}\right) + \frac{(1-\pi_H)}{P(v_L)^{-\sigma}}\left(\tau^{-\sigma} e^{\sigma v_L a_L} + e^{\sigma v_H a_L}\right) &= L^{-1}\frac{T+F}{\sigma(\rho+\delta)}
\end{aligned}$$

Noting that $\left(e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H}\right) = \left(e^{\sigma v_H a_L} \tau^{-\sigma} + e^{\sigma v_L a_L}\right)$ and $\left(\tau^{-\sigma} e^{\sigma v_L a_L} + e^{\sigma v_H a_L}\right) = \left(e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_H a_H}\right)$ and by symmetry it is true that

$$\begin{aligned} P(v_H)^{-\sigma} &= \left(e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_H a_L}\right) N_{H,t} + \left(e^{\sigma v_H a_L} + \tau^{-\sigma} e^{\sigma v_H a_H}\right) N_{L,t} = \Gamma_1 N_{H,t} + \Gamma_2 N_{L,t} \\ P(v_L)^{-\sigma} &= \left(e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L}\right) N_{H,t} + \left(e^{\sigma v_L a_L} + \tau^{-\sigma} e^{\sigma v_L a_H}\right) N_{L,t} = \Gamma_2 N_{H,t} + \Gamma_1 N_{L,t} \end{aligned}$$

Next, defining $\Gamma_1 = e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H} > \Gamma_2 = e^{\sigma v_L a_H} + \tau^{-\sigma} e^{\sigma v_L a_L}$ it holds that

$$\pi_H \left(e^{\sigma v_H a_H} + \tau^{-\sigma} e^{\sigma v_L a_H}\right) P(v_L)^{-\sigma} = \pi_H \Gamma_1 \left(N_{H,t} \Gamma_2 + \Gamma_1 N_{L,t}\right)$$

and setting $L^{-1} \frac{T+F}{\sigma(\rho+\delta)} = \Gamma_3$, leads to

$$\Gamma_1 \Gamma_2 \Gamma_3 N_{H,t}^2 + N_{H,t} \left(\left(\Gamma_1^2 + \Gamma_2^2\right) \Gamma_3 N_{L,t} - \Gamma_2 \Gamma_1\right) + \Gamma_1 \Gamma_2 \Gamma_3 N_{L,t}^2 - \left(\pi_H \Gamma_1^2 + (1-\pi_H) \Gamma_2^2\right) N_{L,t} = 0$$

with the solution

$$N_{H,t} = \frac{-\left(\left(\Gamma_1^2 + \Gamma_2^2\right) \Gamma_3 N_{L,t} - \Gamma_2 \Gamma_1\right) \pm \sqrt{\left(\left(\Gamma_1^2 + \Gamma_2^2\right) \Gamma_3 N_{L,t} - \Gamma_2 \Gamma_1\right)^2 - 4 \Gamma_1 \Gamma_2 \Gamma_3 \left(\Gamma_1 \Gamma_2 \Gamma_3 N_{L,t}^2 - \left(\pi_H \Gamma_1^2 + (1\right.\right.}}{2 \Gamma_1 \Gamma_2 \Gamma_3}$$

Last, to solve for t_1, note that from liberalization onwards, both types of firms are decreasing at rate $e^{-\rho(t-t_0)}$. Thus

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

so that

$$\frac{\pi_H \Gamma_1}{\Gamma_1 N_{H,t} + \Gamma_2 N_{L,t}} + \frac{(1-\pi_H) \Gamma_2}{\Gamma_2 N_{H,t} + \Gamma_1 N_{L,t}} = L^{-1} \frac{T+F}{\sigma(\rho+\delta)},$$

where since $N_{H,t} = n_H^A N^A e^{-\rho(t-t_0)}$ and $N_{L,t} = n_L^A N^A e^{-\rho(t-t_0)}$ and $N^A = \frac{L}{\sigma(\rho+\delta)F}$ $t_1 - t_0$ is defined by

$$\rho(t_1 - t_0) = \ln\left(\frac{T+F}{F}\right) - \ln\left(\frac{\pi_H \Gamma_1}{\pi_H + \tau^{-\sigma}(1-\pi_H)} + \frac{(1-\pi_H) \Gamma_2}{(1-\pi_H) + \tau^{-\sigma} \pi_H}\right) + \ln\left(e^{\sigma v_L a_L} + e^{\sigma v_H a_L}\right)$$

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Proposition 6 Taste Differences, Comparative Advantage and Trade (reminded). Assume that a firm of type a_j pays an entry cost $F(a_j)$ if it is located in Home and $F^*(a_j)$ if it is located in Foreign, that to produce a unit of the good, a firm of type a_j pays a marginal cost of $c(a_j)$ if it is located in Home and $c^*(a_j)$ if it is located in Foreign respectively, and that parameters are such that specialization is incomplete. Then, exports are equal to

$$\begin{aligned} X_H &= \left(e^{\sigma v_L a_L} \left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right) - e^{\sigma v_H a_L} \left(Z_L (1-\pi_H) L - \tau^{-\sigma} Z_L^* (1-\pi_H^*) L^*\right)\right) \frac{\tau^{-\sigma} \varphi_H^* \sigma}{1 - (\tau^{-\sigma})^2} \\ X_L &= \left(e^{\sigma v_H a_H} \left(Z_L (1-\pi_H) L - \tau^{-\sigma} Z_L^* (1-\pi_H^*) L^*\right) - e^{\sigma v_L a_H} \left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right)\right) \frac{\tau^{-\sigma} \varphi_L^* \sigma}{1 - (\tau^{-\sigma})^2} \\ X_H^* &= \left(e^{\sigma v_L a_L} \left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right) - e^{\sigma v_H a_L} \left(Z_L^* (1-\pi_H^*) L^* - \tau^{-\sigma} Z_L (1-\pi_H) L\right)\right) \frac{\tau^{-\sigma} \sigma \varphi_H}{1 - (\tau^{-\sigma})^2} \\ X_L^* &= \left(e^{\sigma v_H a_H} \left(Z_L^* (1-\pi_H^*) L^* - \tau^{-\sigma} Z_L (1-\pi_H) L\right) - e^{\sigma v_L a_H} \left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right)\right) \frac{\tau^{-\sigma} \sigma \varphi_L}{1 - (\tau^{-\sigma})^2} \end{aligned}$$

where

$$\begin{aligned}(Z_H)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L\right) \text{ and } (Z_L)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H\right)\\ (Z_H^*)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*\right) \text{ and } (Z_L^*)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*\right)\end{aligned}$$

and

$$\begin{aligned}\varphi_H &\equiv \frac{F(a_H)}{c(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} \text{ and } \varphi_H^* \equiv \frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_H)}{c(a_H)^{-\sigma}}\\ \varphi_L &\equiv \frac{F(a_L)}{c(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} \text{ and } \varphi_L^* \equiv \frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_L)}{c(a_L)^{-\sigma}}.\end{aligned}$$

The volume of world trade in differentiated goods is affected by shifts in the distribution of tastes.

Proof. The free entry conditions

$$\begin{aligned}c(a_j)^{-\sigma}\widetilde{\Pi}(a_j) + \tau^{-\sigma}c(a_j)^{-\sigma*}\widetilde{\Pi}(a_j) &= \sigma F(a_j) \text{ and}\\ c^*(a_j)^{-\sigma}\widetilde{\Pi}(a_j) + \tau^{-\sigma}c^*(a_j)^{-\sigma*}\widetilde{\Pi}(a_j) &= \sigma F^*(a_j)\end{aligned}$$

imply that domestic revenue per firm is a function of relative fixed costs and comparative advantage only and does not depend on market size, i.e.

$$c^*(a_j)^{-\sigma}\Pi^*(a_j) = \frac{\sigma F^*(a_j) - \tau^{-\sigma}\frac{c^*(a_j)^{-\sigma}}{c(a_j)^{-\sigma}}F(a_j)}{1-(\tau^{-\sigma})^2} \text{ and } c(a_j)^{-\sigma}\Pi(a_j) = \frac{\sigma F(a_j) - \tau^{-\sigma}\sigma\frac{c(a_j)^{-\sigma}}{c^*(a_j)^{-\sigma}}F^*(a_j)}{1-(\tau^{-\sigma})^2}.$$

Domestic revenue is defined as in (17) and (16) above; thus the two free entry conditions implicitly pin down the relative ideal price indices in Home and Foreign

$$\begin{aligned}c(a_j)^{-\sigma}\frac{\pi_H L e^{\sigma v_H a_j}}{(P(v_h))^{1-\sigma}} + c(a_j)^{-\sigma}\frac{(1-\pi_H)Le^{\sigma v_L a_j}}{(P(v_l))^{1-\sigma}} &= \frac{\sigma F(a_j) - \tau^{-\sigma}\sigma\frac{c(a_j)^{-\sigma}}{c^*(a_j)^{-\sigma}}F^*(a_j)}{1-(\tau^{-\sigma})^2}\\ c^*(a_j)^{-\sigma}\frac{\pi_H^* L^* e^{\sigma v_H a_j}}{(P^*(v_h))^{1-\sigma}} + c^*(a_j)^{-\sigma}\frac{(1-\pi_H^*)L^*e^{\sigma v_L a_j}}{(P^*(v_l))^{1-\sigma}} &= \frac{\sigma F^*(a_j) - \tau^{-\sigma}\frac{c^*(a_j)^{-\sigma}}{c(a_j)^{-\sigma}}\sigma F(a_j)}{1-(\tau^{-\sigma})^2}\end{aligned}$$

which then allows us to solve for $P(v_h)$ and $P(v_l)$. Next, defining

$$\begin{aligned}(P(v_H))^{1-\sigma} &= Z_H\left(1-\left(\tau^{-\sigma}\right)^2\right)\left(e^{\sigma v_H a_H}e^{\sigma v_L a_L} - e^{\sigma v_L a_H}e^{\sigma v_H a_L}\right)\pi_H L\\ (P(v_H))^{1-\sigma} &= Z_L\left(1-\left(\tau^{-\sigma}\right)^2\right)\left(e^{\sigma v_H a_H}e^{\sigma v_L a_L} - e^{\sigma v_L a_H}e^{\sigma v_H a_L}\right)(1-\pi_H)L\\ (P^*(v_H))^{1-\sigma} &= Z_H^*\left(1-\left(\tau^{-\sigma}\right)^2\right)\left(e^{\sigma v_H a_H}e^{\sigma v_L a_L} - e^{\sigma v_L a_H}e^{\sigma v_H a_L}\right)\pi_H^* L^*\\ (P^*(v_L))^{1-\sigma} &= Z_L^*\left(1-\left(\tau^{-\sigma}\right)^2\right)\left(e^{\sigma v_H a_H}e^{\sigma v_L a_L} - e^{\sigma v_L a_H}e^{\sigma v_H a_L}\right)(1-\pi_H^*)L^*\end{aligned}$$

where

$$\begin{aligned}(Z_H)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L\right) \text{ and } (Z_L)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H\right)\\ (Z_H^*)^{-1} &\equiv \sigma\left(e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*\right) \text{ and } (Z_L^*)^{-1} \equiv \sigma\left(e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*\right)\end{aligned}$$

and

$$\begin{aligned}
\varphi_H &\equiv \frac{F(a_H)}{c(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} \text{ and } \varphi_H^* \equiv \frac{F^*(a_H)}{c^*(a_H)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_H)}{c(a_H)^{-\sigma}} \\
\varphi_L &\equiv \frac{F(a_L)}{c(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} \text{ and } \varphi_L^* \equiv \frac{F^*(a_L)}{c^*(a_L)^{-\sigma}} - \tau^{-\sigma}\frac{F(a_L)}{c(a_L)^{-\sigma}}
\end{aligned}$$

Finally, ideal price indices include four times of firms: $H-$good producers from Home and $L-$good producers and Foreign producers from Home and Foreign. Thus, it also must be true that

$$\begin{aligned}
(P(v_h))^{1-\sigma} &= N\left(n_h c(a_H)^{-\sigma} e^{\sigma v_H a_H} + (1-n_h)c(a_L)^{-\sigma} e^{\sigma v_H a_L}\right) + \tau^{-\sigma}N^*\left(n_h^* c^*(a_H)^{-\sigma} e^{\sigma v_H a_H} + (1-n_h^*\right. \\
(P^*(v_h))^{1-\sigma} &= \tau^{-\sigma}N\left(n_h c(a_H)^{-\sigma} e^{\sigma v_H a_H} + (1-n_h)c(a_L)^{-\sigma} e^{\sigma v_H a_L}\right) + N^*\left(n_h^* c^*(a_H)^{-\sigma} e^{\sigma v_H a_H} + (1-n_h^*\right. \\
(P(v_l))^{1-\sigma} &= N\left(n_h c(a_H)^{-\sigma} e^{\sigma v_L a_H} + (1-n_h)c(a_L)^{-\sigma} e^{\sigma v_L a_L}\right) + \tau^{-\sigma}N^*\left(n_h^* c^*(a_H)^{-\sigma} e^{\sigma v_L a_H} + (1-n_h^*\right. \\
(P^*(v_l))^{1-\sigma} &= \tau^{-\sigma}N\left(n_h c(a_H)^{-\sigma} e^{\sigma v_L a_H} + (1-n_h)c(a_L)^{-\sigma} e^{\sigma v_L a_L}\right) + N^*\left(n_h^* c^*(a_H)^{-\sigma} e^{\sigma v_L a_H} + (1-n_h^*\right.
\end{aligned}$$

This solves for the total number of firms in each market and of each type:

$$\begin{aligned}
c(a_H)^{-\sigma} N n_h &= e^{\sigma v_L a_L}\left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right) - e^{\sigma v_H a_L}\left(Z_L(1-\pi_H)L - \tau^{-\sigma} Z_L^*(1-\pi_H^*)L^*\right) \\
c(a_L)^{-\sigma} N(1-n_h) &= e^{\sigma v_H a_H}\left(Z_L(1-\pi_H)L - \tau^{-\sigma} Z_L^*(1-\pi_H^*)L^*\right) - e^{\sigma v_L a_H}\left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right) \\
c^*(a_H)^{-\sigma} N^* n_h^* &= e^{\sigma v_L a_L}\left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right) - e^{\sigma v_H a_L}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma} Z_L(1-\pi_H)L\right) \\
c^*(a_L)^{-\sigma} N^*(1-n_h^*) &= e^{\sigma v_H a_H}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma} Z_L(1-\pi_H)L\right) - e^{\sigma v_L a_H}\left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right)
\end{aligned}$$

Turning to the volume of trade, the export volume of $H-$goods from Home to Foreign is equal to $\tau^{-\sigma} c(a_H)^{-\sigma} \Pi^*(a_H)$ per home $H-$type firm, and there are Nn_h such firms. Total H-type exports from Home to foreign are thus

$$X_H = \left(e^{\sigma v_L a_L}\left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right) - e^{\sigma v_H a_L}\left(Z_L(1-\pi_H)L - \tau^{-\sigma} Z_L^*(1-\pi_H^*)L^*\right)\right)\frac{\tau^{-\sigma}\varphi_H^*\sigma}{1-(\tau^{-\sigma})^2}$$

Similarly,

$$\begin{aligned}
X_L &= \left(e^{\sigma v_H a_H}\left(Z_L(1-\pi_H)L - \tau^{-\sigma} Z_L^*(1-\pi_H^*)L^*\right) - e^{\sigma v_L a_H}\left(Z_H \pi_H L - \tau^{-\sigma} Z_H^* \pi_H^* L^*\right)\right)\frac{\tau^{-\sigma}\varphi_L^*\sigma}{1-(\tau^{-\sigma})^2} \\
X_H^* &= \left(e^{\sigma v_L a_L}\left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right) - e^{\sigma v_H a_L}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma} Z_L(1-\pi_H)L\right)\right)\frac{\tau^{-\sigma}\sigma\varphi_H}{1-(\tau^{-\sigma})^2} \\
X_L^* &= \left(e^{\sigma v_H a_H}\left(Z_L^*(1-\pi_H^*)L^* - \tau^{-\sigma} Z_L(1-\pi_H)L\right) - e^{\sigma v_L a_H}\left(Z_H^* \pi_H^* L^* - \tau^{-\sigma} Z_H \pi_H L\right)\right)\frac{\tau^{-\sigma}\sigma\varphi_L}{1-(\tau^{-\sigma})^2}
\end{aligned}$$

Gives the volume of world trade as

$$X^W = X_H + X_L + X_H^* + X_L^*,$$

which is trivially shown to be affected by π_H^* or π_H. Note that with identical entry costs and symmetric comparative advantage defined as

$$\gamma c(a_H)^{-\sigma} = c = c^*(a_H)^{-\sigma} \text{ and } \gamma c^*(a_L)^{-\sigma} = c = c(a_L)^{-\sigma}$$

i.e., if Home has a comparative advantage in the H sector and if $F(a_H) = F^*(a_H) = F(a_L) = F^*(a_L) = F$ it is true that

$$\begin{aligned}\left(\gamma - \tau^{-\sigma}\right)\frac{F}{c} &= \varphi_H = \varphi_L^* \\ \left(1 - \tau^{-\sigma}\gamma\right)\frac{F}{c} &= \varphi_L = \varphi_H^*\end{aligned}$$

and the volume of word trade is equal to

$$\begin{aligned}X^W &= \left(\pi_H L \frac{e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*}{e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L} + (1-\pi_H) L \frac{e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*}{e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H} - \tau^{-\sigma} L\right)\frac{\tau^{-\sigma}}{1-(\tau^{-\sigma})^2} \\ &+ \left(\pi_H^* L^* \frac{e^{\sigma v_L a_L}\varphi_H - e^{\sigma v_L a_H}\varphi_L}{e^{\sigma v_L a_L}\varphi_H^* - e^{\sigma v_L a_H}\varphi_L^*} + (1-\pi_H^*) L^* \frac{e^{\sigma v_H a_H}\varphi_L - e^{\sigma v_H a_L}\varphi_H}{e^{\sigma v_H a_H}\varphi_L^* - e^{\sigma v_H a_L}\varphi_H^*} - \tau^{-\sigma} L^*\right)\frac{\tau^{-\sigma}}{1-(\tau^{-\sigma})^2}\end{aligned}$$

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