Large Multiproduct Exporters Across Rich and Poor Countries: Theory and Evidence

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Abstract

I study the welfare effects of trade in the presence of large firms producing multiple varieties. Large multiproduct exporters dominate trade flows and their scope decisions have new implications for the welfare gains from trade. Using data from the Exporter Dynamics Database, I document two stylized facts for large multiproduct exporters: 1) the product scope increases with the level of development of the destination proxied by per capita income, and 2) as evidence of cannibalization effects, there exists a non-monotone, hump-shaped relationship between the product scope and market share of a firm. Guided by the evidence, I build a model in which income and cannibalization effects drive the scope decisions of large firms, and derive a new formula for the welfare gains from trade. Ignoring income or cannibalization effects causes mismeasurement of the US welfare gains. The sign and size of the mismeasurement is highly heterogeneous across industries.

Keywords: Multiproduct firms, Cannibalization Effects, Non-homotheticity, Oligopoly, Welfare gains from trade.

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1 Introduction

Import of new and cheaper product varieties is one of the major components of the welfare gains from trade (Broda and Weinstein, 2006). The traditional view, based on models where each firm produces only one variety, is that the number of new varieties is equivalent to the number of new firms selling to a destination (Krugman, 1980). Recent advances in empirical research challenge such a view. First, multiproduct firms dominate both domestic production and international trade flows (Bernard et al., 2010, 2011). Second, export markets are highly concentrated: a few large exporters, or superstars, account for most of a country's exports (Freund and Pierola, 2015).[1] In the presence of few large multiproduct exporters, welfare largely depends on the number of varieties per firm, the so-called *product scope*. The goal of this paper is to investigate the determinants of the scope of large firms and study their effects on the welfare of consumers.

To investigate the determinants of the scope of large exporters, I use transaction-level data from the Exporter Dynamics Database and document two stylized facts for large multiproduct exporters from Mexico. First, the product scope of superstars increases with the level of development of the destination proxied by per capita income. I refer to this stylized fact as *income effects* on scope. Doubling the per capita income of the destination increases the scope of large Mexican exporters by 11%. Multinationals such as Apple, Ikea, H&M, Samsung, and Zara behave similarly, and offer a larger set of varieties in the online stores that serve richer economies. This stylized fact suggests that firm level scope decisions can affect the welfare comparison between rich and poor countries.[2]

Second, I document a non-monotone, hump-shaped relationship between the product scope of a firm and its market share in a destination. This stylized fact can be rationalized by the presence of a *cannibalization effect*. To understand the cannibalization effect, consider a firm that produces imperfect substitutes. Introducing a new variety has a twofold effect on the firm's sales. First, the new variety increases total firm's sales by reducing the demand faced by its competitors. Second, the new variety reduces, or cannibalizes, the sales of the firm's existing varieties. At a large market share, a firm faces strong cannibalization effects, and, thus, reduces its scope as it gains market share. Vice versa, a small firm faces weak cannibalization effects and introducing a new variety increases the firm's market share.[3]

[1] There is a related literature that has shown increasing market concentration at the national level in the US. For instance, see Council of Economic Advisors (2016); De Loecker and Eeckhout (2017); Rossi-Hansberg et al. (2018).

[2] The literature has traditionally focused on the positive relationship between prices of tradable goods and per capita income (Alessandria and Kaboski, 2011).

[3] Hottman et al. (2016) documented sizeable cannibalization effects in US retail. Cannibalization effects also explain the reluctance of incumbents to introduce new varieties relative to new entrants (Igami, 2015).

To study how the scope decisions of large firms affect the welfare of consumers, I build a model of homogeneous, large multiproduct firms based on Feenstra and Ma (2007) and Eckel and Neary (2010).[4] My model combines three main ingredients: 1) consumers have non-homothetic preferences, 2) firms compete oligopolistically, and 3) firms have a core competence and within-firm varieties are heterogeneous in their marginal cost of production. The scope of exporters is driven by income effects, cannibalization effects, and their interaction. The combination of non-homothetic preferences and the core competence assumption generates income effects on scope. Firms begin by exporting to a destination their core varieties, which have the lowest marginal cost and the highest markup. As consumer income rises, firms expand their scope introducing non-core varieties that have higher marginal costs and lower markups. The assumption of oligopoly generates the cannibalization effects on scope: the larger the market share of a firm, the stronger the cannibalization effects it faces, and the larger the firm's markups. Finally, there is a positive relationship between the market share of the firm and the per capita income of the destination: firms selling to richer economies face stronger cannibalization effects.

The model's predictions on product scope and markups are consistent with the empirical evidence documented in the literature. Due to trade costs, firms only export a fraction of their domestic scope (Iacovone and Javorcik, 2010), and they export their core products across more destinations than the non-core products (Arkolakis et al., 2014). Because of non-homothetic preferences, firms skew their sales toward the core products in destinations with stronger competition (Mayer et al., 2014). Furthermore, a decrease in trade costs reduces the domestic scope of small firms (Bernard et al., 2011), and it increases or leaves unchanged the scope of large firms (Baldwin and Gu, 2009; Lopresti, 2016), which is consistent with the presence of cannibalization effects. In line with the empirical evidence of De Loecker et al. (2016), the model predicts that the core varieties within each firm have the highest markups. The model is also consistent with the findings of Simonovska (2015) whereby firms charge higher markups in richer economies. Finally, because of oligopolistic competition, a firm with high market share has low pass-through of prices (Amiti et al., 2014).

To evaluate the importance of modeling large multiproduct firms for the welfare of consumers, I examine the welfare effects of a reduction in trade costs. Following the line of research started by Arkolakis et al. (2012) (ACR) and Arkolakis et al. (2018) (ACDR), I derive a parsimonious welfare formula for an oligopolistic model of multiproduct firms, which

The marketing literature provides anecdotal evidence on cannibalization (Copulsky, 1976; Kerin et al., 1978).

[4] The assumption that firms from one country are homogeneous allows to represent the main results in the simplest possible setting and to derive a welfare formula. However, I have verified that the results also hold in an important extension in the spirit of Parenti (2018), in which large multiproduct firms coexist with a competitive fringe. Details are in appendix 6.3.

highlights the direct effect of cannibalization and oligopoly on welfare. In fact, the larger the average market share of the typical superstar, the larger the welfare gains from trade. This result is driven by the weakening of cannibalization effects due to trade: as firms lose market share because of tougher foreign competition, they have incentives to expand their domestic scope and reduce their markups. Such incentives have greater welfare consequences at larger values of the current market share when firms face stronger cannibalization effects.[5]

To understand the role that cannibalization and income effects play on the welfare of consumers, I study how the welfare formula changes in the following two cases. First, to neglect cannibalization effects, I consider a model of monopolistic competition: namely, I consider the limiting case of my model where firms are infinitesimally small. If a firm is atomistic, introducing a new variety has a negligible effect on its own sales. Neglecting the weakening of cannibalization effects underestimates the gains from trade, and the mismeasurement increases in the market share of the typical firm. The result highlights the role of market structure and strategic interaction, which are often ignored under the common assumption of monopolistic competition, in evaluating welfare changes.

Second, I study how the formula changes when we neglect income effects, by keeping the marginal utility of income constant. By income effects, consumers' willingness to buy a given variety declines with the mass of varieties available for consumption. Trade increases the mass of varieties available for consumption and, through income effects, it reduces the demand for individual varieties. Neglecting income effects would ignore such a reduction in demand, and, thus, would overestimate the gains from trade. The result highlights the role of preferences in the evaluation of the gains from trade: models with quasilinear preferences, which assume away income effects (Feenstra and Ma, 2007; Eckel and Neary, 2010; Dhingra, 2013; Mayer et al., 2014), overestimate the gains from trade.

Income effects are present in my model due to the assumption of non-homothetic preferences. To further understand the effects of the non-homotheticity of preferences on the welfare gains from trade, I study how my welfare formula changes in a model where consumers have homothetic preferences of the Constant Elasticity of Substitution (CES) form. I find that CES preferences also ignore income effects on scope because aggregate income,

[5] The assumption of firm heterogeneity in productivity, which would not allow to quantify the gains with a parsimonious formula, would have an ambiguous effect on welfare relative to the baseline model. In the presence of firm heterogeneity, welfare also depends on the efficiency of allocation of production across firms (Dhingra and Morrow, 2016). In this case, the most productive firms would be under-producing relative to the optimal allocation, because of their higher markups and stronger cannibalization effects relative to low-productivity firms. International trade has two effects. First, by the exit of low-productivity firms, it reallocates production towards the under-producing high-productivity firms, raising welfare. Second, trade may increase the market power of the surviving high-productivity firms, reducing welfare. In the context of single product firms, Edmond et al. (2015) show that the first effect dominates if the countries engaging in trade are sufficiently similar.

rather than per capita income, drives the scope of firms. As with the baseline non-homothetic preferences, the gains from trade are larger in the presence of stronger market concentration.

A model with CES preferences overestimates the welfare gains from trade relative to my baseline model for two reasons. The first reason is explained by ACDR: a model with homothetic preferences ignores the reduction in welfare brought about by an increase in exporters' markups. In this paper, I show a second reason that originates from the interaction of cannibalization and non-homothetic preferences. Relative to CES, non-homothetic preferences generate a particular market distortion whereby low-markup varieties are overconsumed (Dhingra and Morrow, 2016). Such a distortion is partially reduced by cannibalization effects. As trade weakens cannibalization effects, it also exacerbates the overconsumption of low-markup varieties.

How great is the mismeasurement of the welfare gains from trade when we ignore income and cannibalization effects? To answer to this question, I use industry level US Census data on the market share of domestic superstars and parameters estimated in the literature (Caliendo and Parro, 2015; Soderbery, 2015). The main result of the quantification exercise is the high degree of heterogeneity of mismeasurement across industries. Ignoring cannibalization in more concentrated industries underestimates the gains by more than 50% while in more competitive industries ignoring cannibalization leaves the welfare gains almost unchanged. The welfare consequences of ignoring income effects are also highly dispersed across industries. Ignoring both cannibalization and income effects causes the gains to be underestimated in the more concentrated industries and to be overestimated in the more competitive industries.

The paper is related to the growing body of literature on multiproduct firms in the fields of industrial organization (Brander and Eaton, 1984; Klemperer, 1992; Allanson and Montagna, 2005) and international trade (Brambilla, 2009; Manova and Zhang, 2012; Arkolakis et al., 2014; Mayer et al., 2014; Nocke and Yeaple, 2014). This paper introduces income effects as a determinant of the scope of firms. Models of multiproduct firms have so far ignored income effects on scope with quasilinear preferences (Feenstra and Ma, 2007; Dhingra, 2013; Mayer et al., 2014), by construction (Eckel and Neary, 2010).[6], or with CES preferences, in which case the scope of exporters depends on aggregate income (Bernard et al., 2011; Hottman et al., 2016).

The paper also relates to the recent literature, started by ACR, on the welfare gains from trade arising from modern trade models. Models of oligopoly have traditionally received less attention compared to the more tractable models of perfect or monopolistic competition

[6] Eckel and Neary (2010) assume that a firm is large in its own industry, but small relative to the economy. Hence, the marginal utility of income can be kept constant.

(Neary, 2010). Although Edmond et al. (2015) and Neary (2016) examined theoretically and quantitatively the welfare gains from trade in models of oligopoly, this paper is the first to propose a simple formula for their quantification. One of the results of Edmond et al. (2015) is in line with analytical findings of this paper: the larger the market concentration, the larger the welfare gains from trade.

The remainder of this paper is organized as follows. Section 2 presents the two stylized facts on multiproduct superstars. Section 3 presents the model. In section 4, I derive the welfare formula, and compare it theoretically and numerically to the results from the literature. Section 5 concludes.

2 Motivational Evidence

I use firm-level data for Mexico from 2000 to 2006 to document two stylized facts for multiproduct exporters. The source for the data is the Exporter Dynamics Database, which reports data on export values at the product-firm-destination level (Fernandes et al., 2016). A product is a Harmonized System (HS) 6 digit good. As my model considers firms producing final goods, I restrict the sample to manufactured consumption goods according to the Broad Economic Category (BEC) classification. Details are in appendix 6.1.1.

Mexican export flows are dominated by multiproduct firms, which account for 83% of Mexican exports. The distribution of export sales across firms is highly skewed: a small fraction of large multiproduct firms sells a large proportion of total exports. 40% of total export of consumption goods originates from the top 1% of multiproduct exporters while 63% arises from the top 5%. Multiproduct superstars dominate Mexican trade flows, in line with the findings of Ottaviano and Mayer (2007), Freund and Pierola (2015), and Bernard et al. (2018) for other countries.

The first stylized fact I document is a positive relationship between the scope of exporters and the per capita income of the destination. I refer to this positive relationship as income effects on scope. While the literature documented a positive relationship between the *aggregate* number of varieties exported by a country and the per capita income of the destination (Hummels and Klenow, 2002), I focus on the *within-firm* number of varieties exported. The results depend on the size of the firm: controlling for the size of the destination, I document that large firms export a wider scope in richer economies while small firms' scope is unaffected by per capita income.

Moreover, using data from the online stores of multinationals, I document that the effects of size and per capita income of the destination depend on distribution channels used. While in traditional distribution channels both per capita income and aggregate income affect the scope decisions of firms, in online retail only per capita income has an effect.

The second stylized fact is a non-monotone, hump-shaped relationship between the scope and the market share of a firm, which is evidence of cannibalization effects. Such a relationship is predicted by my model and other models featuring oligopolistic multiproduct firms as Feenstra and Ma (2007). In fact, two opposing forces influence the optimal scope of a firm. On the one hand expanding the firm's scope increases the firm's market share at the expenses of other firms. On the other hand, an increase in the firm's market share strengthens the cannibalization effects and, thus, reduces the firm's scope. In equilibrium, the two forces generate the non-monotone hump-shaped relationship between the scope and the market share of a firm.

I document the second stylized fact by tracing the hump-shaped relationship between a firm's scope across destinations and its market share across destinations, controlling for all observed and unobserved characteristics of the firm and the destination. Hence, the test of cannibalization effects is different than the one performed by Raff and Wagner (2013), who test cannibalization effects across firms, and find a hump-shaped relationship between the scope and productivity of German firms.[7]

2.1 Evidence from Mexican Exporters

To test for the presence of income effects, I consider the following regression model:

$$\ln(\#\ \text{Products}_{kMjt}) = \beta_0 + \beta_y \ln(\text{Pc. Income}_{jt}) + \beta_L \ln(\text{GDP}_{jt}) + \beta_\tau \tau_{Mjt} + f_k + g_t + \epsilon_{kMjt} \quad (1)$$

The dependent variable is the log of the number of products exported by firm k from Mexico to country j in year t. The relevant independent variable is real per capita GDP from WDI. In addition, I control for the size of the destination using real GDP.[8] β_y can be interpreted as the effect of per capita income on the scope of an exporter conditional on the size of the destination. τ_{Mjt} is a vector of trade barriers from CEPII that includes the log of bilateral distance, dummies for the presence of a shared border, commonality of language, and destination specific dummies for islands and landlocked countries (Head et al., 2010). I control for firms' productivity with firm-level fixed effects (f_k) and for year shocks with year fixed effects (g_t). ϵ_{kMjt} is the error term.

I consider three different subsamples of my data. For each year, I divide multiproduct exporters in percentiles by their total sales across all varieties and destinations as a proxy

[7] Other than Raff and Wagner (2013), the evidence on cannibalization effects in the literature is scarce and mainly anecdotal (Copulsky, 1976; Kerin et al., 1978).

[8] Similar results are achieved using $\ln(\text{Population})_{jt}$. However, comparing the coefficients between GDP and per capita GDP is immediate.

for productivity. I estimate (1) with OLS on the bottom 95% of multiproduct exporters as well as the top 5% and 1%. Table 1 shows the results.[9]

Table 1: Per Capita Income and Product Scope of Mexican Multiproduct Exporters

	Bottom 95%	Top 5%	Top 1%
Log(Pc.income)	0.027	0.065***	0.113***
	(0.023)	(0.023)	(0.037)
log(GDP)	0.056***	0.102***	0.161***
	(0.014)	(0.015)	(0.023)
Log(Distance)	-0.198***	-0.357***	-0.550***
	(0.062)	(0.072)	(0.102)
Border	0.259*	0.357**	0.265
	(0.149)	(0.167)	(0.168)
Comm. Language	0.150**	0.329***	0.549***
	(0.074)	(0.087)	(0.124)
Island	0.023	0.046	0.085
	(0.043)	(0.062)	(0.097)
Landlocked	0.015	-0.093	-0.167*
	(0.033)	(0.057)	(0.101)
R^2	0.60	0.59	0.67
# Observations	80718	14157	4380

Results from OLS of equation (1). Robust std. error in parenthesis. Cluster: destination. ***: significant at 99%, ** at 95%, * at 90%. Column (1): bottom 95% of MPF, (2): top 5%, (3): top 1%.

Multiproduct firms export more varieties in larger economies as the coefficient on GDP is positive and statistically significant in all samples. Conditional on size, superstars export more varieties in richer economies. The coefficient on per capita income, in fact, is positive and statistically significant for the top 5% and 1% of multiproduct exporters. Doubling the per capita income of the destination increases the scope of the top 1% of exporters by 11%. The coefficient on per capita income is close to zero and insignificant for small firms.

Firms' scope negatively depends on trade costs. Among the geographical barriers that proxy trade costs, distance and the commonality of language are the more statistically and economically significant. The empirical relevance of the language dummy suggests that Mexican exports are strongly determined by cultural variables and long-run persistence of taste across countries as argued by Head and Mayer (2013).[10]

[9] Results are robust to the inclusion of single product firms. For details see the online appendix.

[10] The coefficients on distance and commonality of language are larger, in absolute value, for the larger firms. The difference in coefficients across samples is not robust to analyzing the full sample of firms or of countries in the Exporter Dynamics Database.

To test for the presence of cannibalization effects, I use the following regression model:

$$\ln(\#\ \text{Products}_{kMjt}) = \beta_1 s_{kMjt} + \beta_2 s^2_{kMjt} + f_k + d_{jt} + \epsilon_{kMjt} \quad (2)$$

where the dependent variable is the log of the number of products exported by firm k from Mexico to country j in year t. Following Amiti et al. (2014), the market share of a Mexican firm k and destination j is defined as $s_{kMjt} = \ln(1 + \frac{\text{Export}_{kMjt}}{\text{Tot Export}_{vMjt}})$ where Tot Export_{vMjt} is the total exports of Mexico to j in firm k's industry v, and s^2_{kMjt} is the orthogonalized squared market share.[11] An industry is a HS section in the baseline result. I include firm-level fixed effects to control for firms' productivity. Moreover, to control all the observed and unobserved destination variables and trade costs, I use destination-year fixed effects d_{jt}.

Table 2: Multiproduct Firms and their Market Share

	Bottom 95%	Top 5%	Top 1%
s_{kMj}	0.209***	0.343***	0.318***
	(0.012)	(0.025)	(0.056)
s^2_{kMj}	-0.148***	-0.478***	-0.497***
	(0.014)	(0.047)	(0.099)
R^2	0.63	0.69	0.82
# Observations	82602	14184	4224

Results from OLS of equation (2). Robust std. error in parenthesis. Cluster: destination country. ***: significant at 99%, ** at 95%, * at 90%. The ratio of firms' exports to total exports is normalized by the year sample average.

Table 2 confirms the hump-shaped relationship between scope and market share of the firm in a destination. In each subsample, the estimated coefficient on s_{kMjt} is positive and statistically significant while the estimated coefficient on s^2_{kMjt} is negative and statistically significant.

I consider two additional tests of non-monotonicity. First, I use the Lind and Mehlum (2010) methodology, which tests whether the slope of the relationship is positive for small sample values of s_{kMjt} and negative for large sample values of s_{kMjt}. In other words, the test verifies the presence of the upward and downward sloping part of (2) within the sample of observed market shares.[12] As documented in appendix 6.1.2, for the top 5% and 1% of

[11] s^2_{kMjt} is orthogonalized to avoid multicollinearity issues between the linear and quadratic market share (Montgomery et al., 2013). There are several techniques to orthogonalize polynomials (Montgomery et al., 2013). Here, I regress the squared market share on s_{kMjt} and firm and year fixed effects and record the residuals as s^2_{kMjt}. Results are robust to using the non-orthogonalized quadratic market share.

[12] The test has been used, among others, by Rodrik (2016) to verify the presence of a hump-shaped relationship between manufacturing employment and time and by Galor and Klemp (2014) in the context of the hump-shaped relationship between fecundity and reproductive success in the long run.

multiproduct exporters, the hump-shaped relationship robustly passes the Lind and Mehlum (2010) test for non-monotone relationships.

The second test of non-monotonicity is non-parametric. I regress the scope of exporters on destination-year fixed effects and firm-level fixed effects. The residual of the regression is the scope of exporters conditional on firm and destination characteristics. Similarly, I regress the market share of exporters on destination-year fixed effects and firm-level fixed effects and record the residual. I then study the relationship between the residual scope and the residual market share using a kernel-weighted local polynomial regression smoothing. Figure 3 in appendix 6.1.2 further supports the non-monotonicity of the relationship.

I consider several robustness checks and leave all results to the online appendix. In addition to Mexico, the Exporter Dynamics Database covers ten source countries: Albania, Burkina Faso, Bulgaria, Guatemala, Jordan, Malawi, Peru, Senegal, Uruguay, and Yemen from 1993 to 2011. As these countries are low and middle income economies, a potential concern is that their exporters are not engaging in trade of differentiated goods. Hence, the choice of Mexico, whose multiproduct exporters have been the subject of empirical research in trade of differentiated goods (Iacovone and Javorcik, 2010; Eckel et al., 2015). Nevertheless, the results of this section are robust to considering the entire sample of source countries.

The results so far presented rely on real per capita GDP as measure of per capita income. Following Simonovska (2015), I repeat the analysis using different measures of per capita income: nominal per capita GDP, PPP-adjusted per capita GDP, GNI measured according to the Atlas method, GNI, and household consumption, finding similar results. Results are also robust to changes in the set of geographical controls and definitions of distance.

I consider alternative ways to distribute firms into the top 1%, 5%, and bottom 95%. In particular, results are robust when firms are assigned to bins according to lagged total sales, sales in the US, and sales within the firms' industries. Furthermore, I verified the robustness of the result using alternative measures of firms' market share s_{kMj}. Results are, in fact, similar when I define s_{kMj} as the ratio of firm's k exports to j relative to total and industry-level imports of j, and household consumption in j. Finally, results are robust to more disaggregate definitions of industry.

2.2 Evidence from Online Retailers

The scope of an exporter has so far been represented by the number of HS 6 digit goods exported by a firm. Although common in the literature (Arkolakis et al., 2014), such a classification could cause some measurement errors as it hides the number of varieties exported by a firm within a HS 6 digit product. To address the issue, I analyze the first stylized facts with an alternative dataset.

Following the example of Simonovska (2015) and Cavallo et al. (2014), I create an original dataset with the number of varieties of mobile products sold by Samsung in 50 countries in 2015. In addition, I use the dataset built by Cavallo et al. (2014), which provides the total number of varieties sold by Apple, H&M, Ikea, and Zara in their online stores.[13] While this dataset provides the most detailed description of the number of varieties offered by a firm, it lacks information on sales or market shares and, thus, it cannot be used to study cannibalization effects.[14] Ikea offers the largest scope, with a maximum number of products offered online of more than 5000, while Samsung has the smallest scope, as it is restricted to only mobile products, with a maximum of 540. Table 3 provides the summary statistics.

Table 3: Summary Statistics

	Apple	Zara	H&M	Ikea	Samsung
Average	735	2223	1361	4367	187
Min	116	400	1151	3365	41
Max	1317	2623	1774	5107	540

Average, minimum, and maximum number of varieties offered online across countries.

Table 4: Per Capita Income and Online Product Scope of Large Multinationals

	Apple	Zara	H&M	Ikea	Samsung	Pooled
Log(Pc.Income)	0.470***	0.078**	0.083***	0.050*	0.185**	0.209***
	(0.047)	(0.038)	(0.028)	(0.026)	(0.071)	(0.054)
Log(GDP)	0.051	-0.037	-0.004	0.011	0.039	-0.006
	(0.041)	(0.022)	(0.015)	(0.012)	(0.055)	(0.023)
Island	0.013	-0.246**	-0.024	-0.042	-0.183	-0.144
	(0.123)	(0.100)	(0.067)	(0.048)	(0.242)	(0.117)
Landlocked	0.008	-0.064	-0.022	0.023	-0.066	-0.063
	(0.153)	(0.123)	(0.062)	(0.041)	(0.247)	(0.071)
Tariff	-0.043*	0.004	0.006	0.002	-0.019	0.003
	(0.023)	(0.008)	(0.005)	(0.011)	(0.026)	(0.009)
R^2	0.83	0.20	0.25	0.24	0.22	0.92
# Observations	36	46	35	28	50	195

Results from OLS of equation (1). ***: significant at 99%, ** at 95%, * at 90%. For Apple, Zara, H&M, and Ikea the dependent variable is the log of daily average number of products offered online per firm per destination in 2013. The pooled regression uses firm level fixed effects, and errors are clustered at the destination level. Per capita income and population in the Samsung regression are the latest available.

[13] All details on the data collection are provided in the authors' paper. The authors collected daily data and to minimize the possibility of errors in the scraping algorithm, I focus on the average number of varieties offered in 2013, the year with the largest sample of countries.

[14] To verify the robustness of the second stylized fact, I use the data on the sales of car models in five European economies provided by Goldberg and Verboven (2005). The results in appendix 6.1.4 support the finding of a non-monotone hump-shaped relationship between scope and market share.

I estimate the empirical model (1) with no year fixed effects. Given that the origin of the varieties is unobserved, I cannot use bilateral proxies for trade cost and, thus, control for the average MFN tariff applied by the destination for the categories produced by each firm.[15] In addition, I use dummies for islands and landlocked countries.

The coefficient on per capita income is positive and statistically significant for all multinationals (Table 4). Given the size of the destination, doubling its per capita income increases the scope offered online by 21% in the pooled regression. Apple is the firm with the highest coefficient, 47%, while Ikea has the smallest, 5%.

Interestingly, the coefficient on GDP is close to zero and insignificant. The result is in contrast with the findings from the previous section, in which I document a positive relationship between GDP and the scope of traditional exporters. A positive coefficient on market size is suggestive of the presence of a fixed cost to introduce a variety in a destination. The results from tables 1 and 4 suggest that the fixed cost of selling online is negligible relative to the one emerging in standard retail markets.

3 Model

Consider two economies, home and foreign, with population L_h and L_f and per capita income y_h and y_f. In each country $i = h, f$, a discrete number M_i of firms engages in trade of varieties of a final good. I assume that firms from the same country i are homogeneous but differ across countries, hence there are only superstar firms. Each firm produces different varieties from other firms, but all firms from i have the same scope and sales.

The assumption of homogeneous firms, not uncommon in the context of oligopoly models (Feenstra and Ma, 2007; Eckel and Neary, 2010; Ottaviano and Thisse, 2011), allows me to derive analytically a simple formula for the welfare gains from trade. In the presence of large, heterogeneous firms, the law of large numbers does not hold (Feenstra and Ma, 2007). As a result, the aggregation of firm level performance measures does not yield tractable expressions, and theoretical results can only rely on numerical examples. However, in an extension described in the appendix, I have verified that the main results of the paper hold in the presence of a competitive fringe that coexists with the large multiproduct firms of the baseline model.

The market structure is oligopolistic. I choose Cournot competition, which is more tractable than Bertrand and allows for a direct comparison with the model of Eckel and

[15] For Samsung and Apple, I use the tariff on HS 8517: electrical apparatus for line telephony, telephone sets, parts. For Zara and H&M, I use tariffs on HS 62: articles of apparel and clothing accessories not knitted or crocheted. For Ikea, I used HS 94: furniture, bedding, cushions, lamps, lighting fittings nesoi, illuminated signs, nameplates and the like, prefabricated buildings.

Neary (2010). The online appendix presents the results under Bertrand competition, which are qualitatively similar. Each firm k produces a continuum of varieties: from country i to country j firm k's varieties are indexed by $\omega \in [0, \delta_{kij}]$. δ_{kij} is the mass of varieties offered by a firm - the product scope. Exporting a variety requires an iceberg trade cost τ_{ij} with $\tau_{ii} = 1$. Firms pay a fixed cost, and free entry drives profits to zero.[16]

3.1 Consumer's Problem

Consumers in both economies have identical Stone-Geary preferences (Simonovska, 2015) represented by the following utility function:

$$U_j = \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} \left[\ln(q_{kij}(\omega) + \bar{q}) - \ln \bar{q}\right] d\omega \tag{3}$$

where $q_{kij}(\omega)$ is the quantity consumed of variety ω produced by firm k in country i and sold in country j, and $\bar{q} > 0$ is a constant. This utility function is non-homothetic. The marginal utility is bounded from above: there exists a choke price for any level of consumer income: when the price of a good rises above the choke price, the demand for that good drops to zero. Since goods enter the utility function symmetrically, they can be ranked according to their prices from the cheapest necessity to the most expensive luxury.[17] The choke price is increasing with income: only richer consumers demand the most expensive goods.

Consumers maximize their utility subject to the following budget constraint:

$$\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} p_{kij}(\omega) q_{kij}(\omega) d\omega \leq y_j \tag{4}$$

which yields the inverse demand function:

$$p_{kij}(\omega) = \frac{1}{\lambda_j (q_{kij}(\omega) + \bar{q})} \tag{5}$$

where λ_j is the Lagrangian multiplier associated with the budget constraint and is interpreted

[16] I implicitly ignore the integer problem (Neary, 2010). In appendix 6.3, I show how the welfare results change when taking the integer problem into account. The main result persists: the larger the market share of the typical firm, the larger the welfare gains from trade.

[17] Jackson (1984) finds evidence for this ranking using a cross section of consumers.

as the marginal utility of income of consumers in j. I derive λ_j by plugging (5) into (4):

$$\lambda_j = \frac{1}{y_j} \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} \frac{q_{kij}(\omega)}{q_{kij}(\omega) + \bar{q}} d\omega \tag{6}$$

λ_j is decreasing in per capita income: the richer a consumer is, the lower the marginal gain from an additional unit of income. Additionally, λ_j increases in the quantities of each variety and the scope of each firm.

Letting $x_{kij}(\omega) = L_j q_{kij}(\omega)$ be the aggregate demand for the variety ω, we can rewrite the inverse demand function and the marginal utility of income as:

$$p_{kij}(\omega) = \frac{L_j}{\lambda_j(x_{kij}(\omega) + L_j\bar{q})} \tag{7}$$

$$\lambda_j = \frac{1}{y_j} \left[\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} \frac{x_{kij}(\omega)}{x_{kij}(\omega) + L_j\bar{q}} d\omega \right] \tag{8}$$

3.2 Firms' Problem

Labor is the only factor of production and receives a wage rate w_i. Each firm pays a fixed cost of production F in domestic labor units, which is independent of scope, quantity, and the number of countries served by a firm. Since free entry drives profits to zero, the wage of a worker in country i equals the per capita income y_i. The marginal cost of production and delivery of one unit of a variety ω is a constant $c_{kij}(\omega)$, which includes the iceberg trade cost τ_{ij}. Each firm has a core competence and can introduce new varieties with minimum adaptation to the production process (Eckel and Neary, 2010; Arkolakis et al., 2014; Mayer et al., 2014). The first variety of a firm is produced at the lowest marginal cost, and the marginal cost of producing a variety $c_{kij}(\omega)$ is increasing in ω.

Each firm k simultaneously chooses quantities $x_{kij}(\omega)$ for $\omega \in [0, \delta_{kij}]$ and mass of varieties δ_{kij} for $j = h, f$, taking other firms' choices as given, to maximize its profits Π_{ki}[18]:

$$\Pi_{ki} = \sum_{j=h,f} \int_0^{\delta_{kij}} \left(\frac{L_j}{\lambda_j(x_{kij}(\omega) + L_j\bar{q})} - c_{kij}(\omega) \right) x_{kij}(\omega) d\omega - w_i F \tag{9}$$

[18]Firms take the wage w_i as given: as labor is inelastically supplied, dealing with oligopsony is unfeasible.

where λ_j is defined by (8). The first order condition with respect to $x_{kij}(\omega)$ equals:

$$\underbrace{\frac{L_j}{\lambda_j}\frac{L_j\bar{q}}{(x_{kij}(\omega)+L_j\bar{q})^2}}_{\text{Standard Marginal Revenues}} - \underbrace{\frac{L_j}{\lambda_j^2}\left[\int_0^{\delta_{kij}}\frac{x_{kij}(\omega)}{x_{kij}(\omega)+L_j\bar{q}}\right]\frac{\partial\lambda_j}{\partial x_{kij}(\omega)}}_{\text{Cannibalization effect}} = \underbrace{c_{kij}(\omega)}_{\text{Marginal cost}} \tag{10}$$

A rise in the supply of $x_{kij}(\omega)$ increases firms' profits by the standard marginal revenues that arise in models with no cannibalization effects. Because of cannibalization effects, increasing $x_{kij}(\omega)$ also reduces the sales of the firm's existing varieties. Firms internalize cannibalization effects because, in Cournot competition, they take into account their effects on the marginal utility of income λ_j.[19] Increasing the supply of a variety raises the marginal utility of income $\left(\frac{\partial\lambda_j}{\partial x_{kij}(\omega)}>0\right)$: a consumer that faces a large supply values one additional unit of income more. A larger λ_j shifts down the inverse demand function (7) reducing the demand for all the varieties offered in the market at any given price.

I leave the derivations of the firms' problem to appendix 6.2.1. Let s_{kij} denote the firm's market share defined as the firm's total sales in j divided by the total sales of all firms in j. Our first order condition (10) simplifies to:

$$\frac{1}{\lambda_j}\frac{L_j^2\bar{q}}{(x_{kij}(\omega)+L_j\bar{q})^2}(1-s_{kij}) = c_{kij}(\omega) \tag{11}$$

The term $1-s_{kij}$ reduces the marginal revenue of an additional unit of $x_{kij}(\omega)$. The larger the market share of the firm, the stronger the cannibalization effects it faces, and the lower the marginal revenues of an additional unit of $x_{kij}(\omega)$.

Let us now examine the first order conditions with respect to the mass of varieties δ_{kij}:

$$\frac{L_j}{\lambda}\frac{x_{kij}(\delta_{kij})}{x_{kij}(\delta_{kij})+L\bar{q}}(1-s_{kij}) - x_{kij}(\delta_{kij})c_{kij}(\delta_{kij}) = 0 \tag{12}$$

On the one hand, profits from the new variety increase the aggregate profits of the firm. On the other hand, because of cannibalization effects, the sales from the firm's existing varieties fall. The larger s_{kij}, the stronger the cannibalization effects faced by firm k. A firm expands its scope until the demand for last variety becomes zero, that is $x_{kij}(\delta_{kij})=0$. Using this result in (11), I obtain an implicit equation that defines the optimal mass of varieties

[19] In models of monopolistic competition à la Krugman (1979), with additively separable preferences, firms take λ_j as given, hence, they do not internalize cannibalization effects (Allanson and Montagna, 2005; Brambilla, 2009; Bernard et al., 2011; Manova and Zhang, 2012; Arkolakis et al., 2014; Nocke and Yeaple, 2014). Moreover, in models with no income effects, λ_j is a constant (Eckel and Neary, 2010; Mayer et al., 2014). Here, cannibalization effects only operate via income effects.

supplied:

$$c_{kij}(\delta_{kij}) = \frac{(1 - s_{kij})}{\bar{q}\lambda_j} \tag{13}$$

Using (13), the optimal supply and price of ω equal:

$$x_{kij}(\omega) = \bar{q}L_j \left[\left(\frac{c_{kij}(\delta_{kij})}{c_{kij}(\omega)} \right)^{\frac{1}{2}} - 1 \right] \tag{14}$$

$$p_{kij}(\omega) = \frac{[c_{kij}(\omega)c_{kij}(\delta_{kij})]^{\frac{1}{2}}}{1 - s_{kij}} = \underbrace{\frac{1}{1 - s_{kij}} \left(\frac{c_{kij}(\delta_{kij})}{c_{kij}(\omega)} \right)^{\frac{1}{2}}}_{\text{Markup}} c_{kij}(\omega) \tag{15}$$

Wide-scope firms produce a larger quantity of all their varieties. Markups vary across firms and across varieties of the same firm. In particular, the core variety has the highest markup, and markups fall as the distance from the core competence increases, which is consistent with the findings of De Loecker et al. (2016). Evaluating prices at a market share of zero yields the monopolistic competition pricing of Simonovska (2015). The larger s_{kij}, the larger the deviation of markups from the monopolistically competitive markups in line with the findings of Hottman et al. (2016).

3.3 The Product Scope of Large Multiproduct Exporters

To gain a better understanding of the mechanism of the model, I introduce the following functional form for the marginal cost of production and delivery from i to j:

$$c_{kij}(\omega) = \tau_{ij} w_i c_{ki} \omega^{\theta} \qquad \omega \in [0, \delta_{kij}] \tag{16}$$

where $\tau_{ii} = 1$, and $\theta > 0$ is the elasticity of the marginal cost of a variety with respect to its distance from the core competence, and it captures how fast marginal costs rise with scope. The parameter c_{ki} represents the efficiency of firm k from country i.

Appendix 6.2.2 provides the detailed derivations. Let $r_{kij} = \int_0^{\delta_{kij}} p_{kij}(\omega)x_{kij}(\omega)d\omega$ denote the revenues of a firm k in country j. The market share of the firm equals the ratio of the firm's product scope to the total mass of varieties available for consumption $\Delta_j = \sum_v \sum_k \delta_{kvj}$:

$$s_{kij} = \frac{r_{kij}}{\sum_v \sum_k r_{kvj}} = \frac{\delta_{kij}}{\Delta_j} \tag{17}$$

A larger scope δ_{kij} increases the revenues of firm k and, hence, its market share s_{kij}. Using

(17) and (8) into (13) yields an expression for the scope of a firm:

$$\delta_{kij} = \left[\frac{\theta + 2}{\theta \bar{q} w_i c_{ki} \tau_{ij}}\right]^{\frac{1}{\theta+1}} \; y_j^{\frac{1}{\theta+1}} \; \left[s_{kij}(1 - s_{kij})\right]^{\frac{1}{\theta+1}} \tag{18}$$

In line with the stylized facts, the scope of a multiproduct superstar is declining in the iceberg trade costs τ_{ij} and is increasing in the per capita income of the destination y_j. By the non-homotheticity of preferences, only consumers in richer economies are willing to purchase the most expensive varieties. Hence, firms export their core varieties across all destinations, and their non-core varieties only in richer economies.[20]

Moreover, there is a non-monotone, hump-shaped relationship between exporter scope and market share, which is consistent with my second stylized fact. Such a relation is an equilibrium condition derived from the intersection of two functions. The first is the definition of market share (17), which features a positive relationship between δ_{kij} and s_{kij}. The second is the first order condition with respect to δ_{kij} (13), in which δ_{kij} and s_{kij} are negatively related because of cannibalization effects. In equilibrium, the locus in which the two curves are both satisfied is hump-shaped. For small firms, which face weak cannibalization effects, a rise in the market share is associated with a rise in the product scope. For large firms, cannibalization effects cause the product scope to fall with the market share. Firms reach their maximum product scope at a market share of 50%.[21] In partial equilibrium, there is an interaction between income and cannibalization effects: firms have a larger market share in richer economies and, thus, face stronger cannibalization effects.[22]

3.4 Equilibrium

I consider the symmetric equilibrium in which identical firms supply the same mass of varieties and quantities for each variety. Firms from i are symmetric in their technology:

[20] In the online appendix, I outline several extensions to the baseline model. First, assuming that firms have a quality-based core competence, as in Bernard et al. (2011), rather than cost-based, yields an identical scope to (18). Second, introducing to the model diseconomies of scope (Nocke and Yeaple, 2014) or brand differentiation (Hottman et al., 2016) only alters quantitatively the scope of exporters. Finally, in the presence of a fixed cost per variety and destination (Bernard et al., 2011), firms would also export a wider scope to larger economies. This result nicely generalizes to the case in which firms can produce several product lines, each including a continuum of varieties.

[21] The maximum scope reached at a market share of 50% is not robust to alternative model extensions. For instance, assuming Bertrand competition, generates a maximum scope reached at a market share larger than 50% and determined by the parameters of the model. See appendix for details.

[22] Using the Exporter Dynamics Database, I find evidence in support of this result. Controlling for the size of the destination, I find that Mexican firms' market shares, defined as sales over total household consumption of the destination, are larger in richer countries. Details are in appendix 6.1.3. Moreover, in the online appendix I describe how the scope reacts to changes in countries' relative productivities and sizes in general equilibrium.

$c_{ki} = c_i$ for all firms k. The cost parametrization previously introduced (16) generates a simple expression of the profits of a firm:

$$\Pi_i = \frac{(s_{ii}^2 + \theta s_{ii})}{\theta + 1} y_i L_i + \frac{(s_{ij}^2 + \theta s_{ij})}{\theta + 1} y_j L_j - w_i F$$

Using our market shares, goods markets clear if

$$M_h s_{hi} + M_f s_{fi} = 1 \qquad i = h, f$$

and trade is balanced if

$$M_h s_{hf} y_f L_f = M_f s_{fh} y_h L_h$$

Without loss of generality, I normalize the per capita income in the home country to one. The equilibrium is a vector of home and foreign firms' product scope $[\delta_{hh}, \delta_{hf}, \delta_{ff}, \delta_{fh}]$, a vector of the number of firms in each country $[M_h, M_f]$, and a foreign per capita income y_f such that: 1) firms choose the mass of varieties they sell domestically and export according to (18), 2) free entry drives profits Π_i to zero for $i = h, f$, and, hence, $w_i = y_i$[23], and 3) labor and goods market clear, and trade is balanced.

4 Welfare Gains from Trade

What are the welfare effects of trade in the presence of multiproduct superstars? To answer this question, I follow the example of ACR and ACDR and derive a formula for the welfare gains from trade.

4.1 A New Welfare Formula

The first step in deriving the welfare formula is to show that the indirect utility V_j is proportional to the mass of varieties Δ_j available to consumers in country j. I leave the algebra to appendix 6.2.2. Using (14) into (3) yields:

$$V_j = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \left[\ln\left(q_{ij}(\omega) + \bar{q}\right) - \ln \bar{q}\right] d\omega = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln\left(\frac{\delta_{ij}}{\omega}\right)^{\frac{\theta}{2}} d\omega = \frac{\theta}{2}\Delta_j \tag{19}$$

By the market share definition (17), $\Delta_j = \frac{\delta_{jj}}{s_{jj}}$. Hence, using the optimal scope of domestic firms (18), the set of varieties available to consumers can be expressed as a function of the

[23] In common with Feenstra and Ma (2007) and Eckel and Neary (2010), I abstract from the strategic interaction associated with firm's entry.

domestic market share of our multiproduct firm s_{jj}:

$$\Delta_j = \left[\frac{\theta+2}{\bar{q}c_j\theta}\left(\frac{y_j}{w_j}\right)(1-s_{jj})s_{jj}^{-\theta}\right]^{\frac{1}{\theta+1}} \tag{20}$$

Because of the zero profit condition, $y_j = w_j$. Taking the log of (19) and (20), and differentiating with respect to any change in the vector of trade costs yields:

$$d\ln V_j = d\ln\Delta_j = \frac{\theta}{\theta+1}\left[1+\frac{s_{jj}}{\theta(1-s_{jj})}\right](-d\ln s_{jj}) \tag{21}$$

Models of monopolistic competition relate the change in the mass of varieties Δ_j to the change in the domestic expenditure share on domestic goods $\Lambda_{jj} = M_j s_{jj}$ (Jung et al., 2015; Bertoletti et al., 2018). Here, I consider the change in the market share: $d\ln s_{jj} = d\ln\Lambda_{jj} - d\ln M_j$. Models of monopolistic competition that feature a Pareto distribution of productivity predict that the mass of firms M_j only depends on the size of country j, and thus a trade shock leaves M_j unchanged (ACDR). In contrast, my model predicts that a change in trade costs varies the mass of firms M_j.

Moreover, for a given change in s_{jj}, the larger the current level of s_{jj}, the larger the change in Δ_j. In models of monopolistic competition, a reduction in the domestic market share s_{jj}, or equivalently in the domestic expenditure share Λ_{jj}, causes an increase in the mass of varieties available for consumption because of an increase in the mass of imported varieties. In a model of large multiproduct firms there is an additional effect: a reduction in s_{jj} weakens the cannibalization effects, which magnifies the increase in Δ_j.

I follow Bertoletti et al. (2018) and consider the equivalent variation in income EV_j such that the indirect utility attained after the trade shock (21) equals the indirect utility attained at pre-shock prices and at an income $W_j = y_j + EV_j$. By the envelope theorem, the log change in the indirect utility V_j with respect to W_j is given by:

$$d\ln V_j = \frac{\lambda_j W_j}{V_j} d\ln W_j = \frac{2}{\theta+2} d\ln W_j \tag{22}$$

Combining (22) and (21) and rearranging, we obtain the main result of the paper:

$$d\ln W_j = \frac{\theta(\theta+2)}{2(\theta+1)}\left[1+\frac{s_{jj}}{\theta(1-s_{jj})}\right](-d\ln s_{jj}) \tag{23}$$

The change in welfare can be computed given θ and a change in the domestic market share of the typical domestic superstar $d\ln s_{jj}$. While in ACR the welfare gains from trade depend on the change in the domestic expenditure share on domestic goods (Λ_{jj}), in a model of multiproduct superstars, the sufficient statistic becomes the domestic expenditure share on the goods produced by the typical domestic superstar (s_{jj}). Moreover, while ACR's formula only needs $d \ln \Lambda_{jj}$, my welfare formula requires both the change $d \ln s_{jj}$ and the level s_{jj} of the sufficient statistic. Appendix 6.2.3 derives a formula for any change in trade costs: (23) provides a good local approximation for the welfare gains from trade.

A reduction in trade costs increases the number of imported varieties. Domestic firms become smaller relative to the market, and their market share falls: $-d \ln s_{jj} > 0$. Therefore, a reduction in trade costs improves welfare: $d \ln W_j > 0$. Cannibalization and oligopoly directly affect the welfare gains from trade: given a change in s_{jj}, the larger the current s_{jj}, the larger the welfare gains. As domestic firms lose market share, they face weaker cannibalization effects, which have a positive impact on their product scope, further increasing welfare. This channel has larger welfare consequences when firms face stronger cannibalization effects, which occurs at larger values of s_{jj}.[24]

Let us discuss in detail the effects of a reduction in trade costs on the domestic scope of firms δ_{jj}. Two forces are at play. First, the weakening of cannibalization effects has a positive effect on δ_{jj}. At the same time, the stronger competition from foreign firms forces the domestic firms to focus on their core competence, shrinking δ_{jj}. In my model, the larger the market share s_{jj}, the stronger the first (positive) effect. When firms are small, a reduction in trade costs forces them to focus on their core varieties, in line with the evidence documented by Baldwin and Gu (2009), Bernard et al. (2011), and Lopresti (2016). When firms are large, they may reduce their scope to a lesser extent than small firms or even increase it. This prediction is consistent with the findings of Baldwin and Gu (2009) and Lopresti (2016). The former document that a reduction in tariffs has insignificant effects on the scope of large Canadian plants. The latter finds that a tariff reduction increases the scope of large US firms.[25]

What happens to markups? The markup of domestic firms decreases as their market share s_{jj} shrinks. On the other hand, foreign firms' markups increase because their market share s_{ij} rises. However, the average markup in the economy falls after a reduction in τ: the reduction in domestic firms' markups dominates the increase in foreign firms' markups. The mechanism behind the result is similar to that of Edmond et al. (2015): the weight on the lower foreign markups increases while the weight on the higher domestic markups falls bringing down the average markup.

[24] If we assume away the core competence of firms, and $\theta \to 0$, as in Feenstra and Ma (2007), the formula becomes $d \ln W_j^{FM} = \left[\frac{s_{jj}}{1-s_{jj}}\right](-d \ln s_{jj}) < d \ln W_j$: weaker cannibalization effects are the only source of gains from trade.

[25] An alternative explanation for the result is the presence of a fixed cost of product introduction (Qiu and Zhou, 2013): market integration may only increase the scope of the most productive firms.

4.2 Comparison with the Literature

In this section, I study the contributions of cannibalization and income effects on welfare by comparing the welfare formula previously introduced to those arising in alternative models from the literature. First, I consider a model of monopolistic competition, which, as stated before, ignores by construction cannibalization effects. Second, I consider a version of my model where trade shocks leave the marginal utility of income constant and, thus, abstract from income effects. Finally, I consider a model where preferences are CES, where firms' scope is independent of the destination per capita income.

To compare the formulas across models, we need to take a stand on which moments to condition the parameters of each model. In particular, the welfare formulas depend on the parameter θ which controls the elasticity of marginal costs with respect to the distance from the core competence. A possible solution is to assume that θ is identical across models. This case allows us to compare each formula directly. However, in comparing the welfare gains across different models, Arkolakis et al. (2012) choose the parameters such that each model generates the same trade elasticity. In the welfare comparison, I follow their approach and study the differences in the welfare gains predicted by various models conditional on the same value of the trade elasticity.

For this reason, let us first consider the gravity equation that arises in my baseline model. The export trade share of country i to country j, denoted by Λ_{ij}, divided by Λ_{jj} equals:

$$\frac{\Lambda_{ij}}{\Lambda_{jj}} = \frac{M_i \left(\frac{1-s_{ij}}{c_i w_i \tau_{ij}}\right)^{\frac{1}{\theta}}}{M_j \left(\frac{1-s_{jj}}{c_j w_j \tau_{jj}}\right)^{\frac{1}{\theta}}}$$

The trade elasticity is defined as the elasticity of imports with respect to iceberg trade costs:

$$\varepsilon^O(\mathbf{s}, \mathbf{M}) = -\frac{d \ln \frac{\Lambda_{ij}}{\Lambda_{jj}}}{d \ln \tau_{ij}} \tag{24}$$

and depends on the vector of market shares $\mathbf{s}$ and on the vector of the number of firms $\mathbf{M}$. A tractable expression for the trade elasticity can be obtained in a symmetric country case.[26] In such a case, ε^O is monotonically increasing in the iceberg trade costs $\tau_{ij} \in [1, \infty)$. In particular, the lower bound for the trade elasticity is $\underline{\varepsilon}^O = \epsilon \left[1 + \frac{\frac{1}{\theta} s_{jj}}{(1-s_{jj})}\right]^{-1}$, while the upper bound for the trade elasticity is $\bar{\varepsilon}^O = \frac{1}{\theta}$. Moreover, holding the iceberg trade costs constant,

[26] The trade elasticity equals: $\varepsilon(s, s^*) = \dfrac{2s^2 + \theta s + 2s^{*2} + \theta s^*}{(2s^2 + \theta s)(\theta + \frac{s^*}{1-s^*}) + (2s^{*2} + \theta s^*)(\theta + \frac{s}{1-s})}$, where s is the domestic market share and s^* is the export market share.

ε^O is decreasing in s_{jj}.

Since the trade elasticity depends on the level of iceberg trade costs, I will rely on numerical methods to compare the welfare gains across models for different levels of the iceberg trade costs. For tractability, I will consider a reduction in trade costs in a model with two symmetric countries, and compare the welfare gains from trade across models. The details of the welfare comparisons are in appendix 6.4.

4.2.1 Monopolistic Competition

What are the welfare gains from trade when we ignore cannibalization effects? To answer to this question, consider a model of multiproduct firms that are monopolistically competitive as in Bernard et al. (2011) and Mayer et al. (2014). My baseline model nests a model of monopolistic competition in the limiting case in which firms are infinitesimally small and, thus, any strategic interactions disappear.

The welfare gains from trade in such a model ($d\ln W_j^{MC}$) are given by the baseline formula (23) evaluated at a market share of zero:

$$d\ln W_j^{MC} = \frac{\theta(\theta+2)}{2(\theta+1)}(-d\ln s_{jj}) \tag{25}$$

In a model of monopolistic competition, domestic market size and fixed cost of production pin down the total number of entrants. Hence, $d\ln s_{jj} = d\ln \Lambda_{jj}$ where Λ_{jj} is the domestic expenditure share on domestic goods.

In the monopolistic competition case of my model, the trade elasticity is $\varepsilon^M = 1/\theta$. Conditional on the same trade elasticity ε^O, I show in the symmetric country case that $d\ln W_j^{MC} < d\ln W_j^O$: the welfare gains that arise in a model with cannibalization effects (23) dominate those generated by monopolistic competition (25). In monopolistic competition, the gains from trade are derived only from the introduction of new imported varieties and from the change in the product scope of domestic producers that focus on their core varieties. In a model of oligopoly, there is a new channel through which trade benefits consumers: the weakening of cannibalization effects. Moreover, the average markup in a model of monopolistic competition is constant and independent of trade costs while in a model with cannibalization effects the average markup falls after a reduction in τ.

4.2.2 Constant Marginal Utility of Income

What are the welfare gains from trade when we ignore income effects? To answer to this question, I compare the welfare gains that arise in my baseline model to a case in which income effects on scope are assume away. In practice, I consider a version of (23) where I study the effects of a change in τ keeping the marginal utility of income constant but allowing the other variables to change.

To derive the formula for the welfare gains from trade, let us start by substituting (16) into the definition of the scope of domestic firms in country j (36):

$$c_j \delta_{jj}^{\theta} = \frac{(1 - s_{jj})}{\bar{q}\lambda_j}$$

Exploiting the definition of market share ($\delta_{jj} = \frac{\Delta_j}{s_{jj}}$), we obtain the aggregate mass of varieties available for consumption as a function of the market share of the typical firm and on the marginal utility of income:

$$\Delta_j^{\theta} = \frac{\theta + 2}{\bar{q} c_j \lambda_j \theta}(1 - s_{jj}) s_{jj}^{-\theta} \tag{26}$$

Differentiating (26) with respect to a change in s_{jj} while keeping λ_j constant yields the change in the mass of varieties, holding income effects constant:

$$d \ln \Delta_j = \left[1 + \frac{s_{jj}}{\theta(1 - s_{jj})}\right](-d \ln s_{jj}) \tag{27}$$

Substituting (27) into the change in the indirect utility function (21), and computing the equivalent variation in income as in the previous section yields the following formula:

$$d \ln W_j^I = \frac{(\theta + 2)}{2}\left[1 + \frac{s_{jj}}{\theta(1 - s_{jj})}\right](-d \ln s_{jj}) = \left[1 + \frac{1}{\theta}\right] d \ln W_j \tag{28}$$

In this case, the trade elasticity is the same as in the baseline model. A reduction in trade costs increases the mass of varieties available for consumption as more imported varieties increase the bundle of available goods. By income effects, consumers' willingness to buy a given variety declines with the total number of varieties available. Thus, a reduction in trade costs has the partial effect, through income effects, of reducing the demand for any variety. Hence, neglecting this channel overestimates the consumption of individual varieties and, thus, the welfare gains from trade. In particular, ignoring income effects generates an upward bias in the estimated gains from trade of $1/\theta$.[27]

[27] In partial equilibrium, income effects interact with cannibalization effects: firms in richer economies tend to have a larger market share and, thus, face stronger cannibalization effects. We may conclude that richer economies gain more from trade given that the market share of the typical firm is larger there. However, such a partial effect is dominated by general equilibrium effects that determine per capita income. Although cannibalization effects are stronger in the more productive countries, the less productive country gains more from trade. In addition, small economies gain more than large economies.

4.2.3 The CES case

The results of the paper have so far relied on the assumption of non-homothetic preferences of the Stone-Geary form. Such preferences generate income effects on scope, in combination with the core competence of firms. To further understand the role of non-homothetic preferences and their interaction with cannibalization effects, this section compares the welfare results of my baseline model to those that arise when consumers have CES preferences.[28]

Consider an extension to the baseline model where consumers have CES preferences with elasticity of substitution $\sigma > 1$. Since the choke price is infinite, I assume a fixed cost per variety and destination f_{ij} for the optimal scope to be finite. Other than the fixed cost per variety, the problem of a firm is identical to that of the baseline model.

Relative to the baseline model, there are two key differences. First, a direct consequence of CES preferences is that markups are constant within a firm. Although markups increase with the market share of a firm, as in my baseline model, they are identical across the varieties produced by the same firm. Second, firms export more varieties in larger economies, regardless of their level of per capita income. In this sense, using CES preferences ignores income effects on scope. Details are in appendix 6.4.

The welfare gains from trade under CES preferences are given by the following formula:

$$d\ln W_j^{CES} = \theta\left[1 + \left(\frac{\sigma}{\theta(\sigma-1)} - 1\right)\frac{s_{jj}}{1-s_{jj}}\right](-d\ln s_{jj}) \tag{29}$$

The term multiplying $\frac{s_{jj}}{1-s_{jj}}$ in the CES case is positive. Under CES preferences parameters are restricted so that $1 - \theta(\sigma - 1) > 0$. The main result of my baseline model are robust to the change of preferences. With CES preferences, for a given value of $d\ln s_{jj}$, the larger the current level of the market share, the larger the welfare gains.

An alternative homothetic preference structure is that of Hottman et al. (2016). The authors assume that preferences are of the Nested-CES form where σ is the elasticity of substitution across firms, and η is the elasticity of substitution across the varieties within a firm. If $\eta > \sigma$, when a firm introduces a new variety, it reduces its own sales by more than its competitors. Under such preferences, the welfare formula is identical to (29) where we substitute θ with $\left[\theta + \frac{\eta-\sigma}{(\sigma-1)(\eta-1)}\right]^{-1}$. A model with nested CES preferences is equivalent to a model with CES preferences with a larger value for the elasticity of marginal costs with respect to the distance from the core. Thus, the cannibalization effects that arise from higher substitution across products within a firm do not affect the gains from welfare.

[28]Both CES and Stone-Geary belong to a more general class of additively separable preferences known as Pollak or Generalized CES. For details see Jung et al. (2015) and ACDR. The strategic interaction across oligopolists makes the use of such preferences highly untractable.

As shown in the previous section, the welfare formula under monopolistic competition is obtained by setting the market share of the typical firm to zero. Hence, under monopolistic competition and CES preferences, we obtain the ACR formula: $d \ln W_j^{ACR} = \theta(-d \ln s_{jj})$. Conditioning the two formulas to the same trade elasticity, the results from the baseline models are robust: the gains from trade are larger under oligopoly than they are under monopolistic competition. However, while with Stone-Geary preferences welfare gains are always larger with Cournot competition, under CES preferences the welfare gains conditional on the trade elasticity under the two market structures are identical as the iceberg trade cost approaches one. This can partially explain the success of the ACR formula in models of large firms with CES preferences such as Edmond et al. (2015).[29].

Comparing the CES model to my baseline model with Stone-Geary preferences confirms ACDR's results that the predicted welfare gains from trade under homothetic preferences are larger than those predicted by non-homothetic preferences. However, the difference between my baseline model and a model of large firms with homothetic preferences goes beyond the difference highlighted by ACDR. In fact, cannibalization effects interact with the preferences chosen, and the difference between the two models increases with s_{jj}. To understand the intuition behind the result, I consider the distortions present in the two models. In the online appendix, I compare the allocation that emerges under Cournot competition to that of monopolistic competition and to that of a social planner.

Unsurprisingly, the oligopolistic allocation is inefficient: due to firms exploiting their market power, all varieties are underconsumed relative to the planner's allocation. Trade reduces these distortions as domestic firms lose their market power and, thus, charge lower markups and face weaker cannibalization effects. The reduction in market power due to trade brings the oligopolistic allocation closer to the one emerging in monopolistic competition, in which any strategic interactions disappear.

With CES preferences, the market allocation is efficient under monopolistic competition (Melitz and Redding, 2015), because markups are constant. However, the monopolistically competitive allocation with Stone-Geary preferences is inefficient. In particular, high-markup varieties are underconsumed, and low-markup varieties are overconsumed. As a result, firms' scope is too wide relative to the planner's allocation.[30] Because of cannibalization effects, firms partially internalize the business stealing bias. As a result, firms under oligopoly

[29] Edmond et al. (2015) also assume an integer number of firms and no free entry, which additionally reduces the difference between the ACR formula and the formula for the welfare gains under CES preferences and Cournot competition, for the reasons described in sections 4.2.2 and 6.3

[30] Dhingra and Morrow (2016) describe such inefficiency as a *business stealing bias*: monopolistically competitive firms do not internalize the business stealing effect of new varieties and produce too many of them.

produce fewer varieties relative to the allocation with monopolistic competition. The scope of oligopolistic firms may be larger, equal, or smaller than the planner's allocation depending on the strength of cannibalization effects. However, there is less overconsumption of low markups varieties when firms are oligopolistic. Hence, while oligopoly in the CES case is only distortionary, in my baseline model oligopoly partially reduces the business stealing bias that emerges in a model of monopolistic competition. Since trade weakens the oligopoly power, it exacerbates the business stealing bias in my baseline model. Thus, there is an additional channel through which the gains from trade in a model of CES preferences are larger than those that emerge with Stone-Geary preferences.

4.3 Quantifying the Mismeasurement

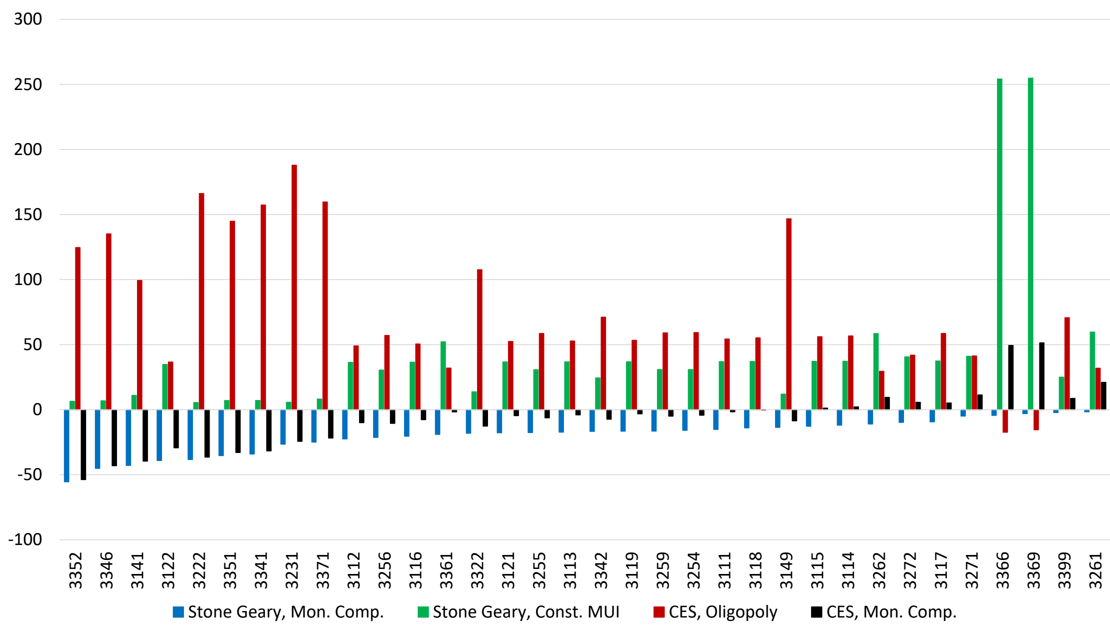
The previous section showed that neglecting income or cannibalization effects causes mismeasurement of the welfare gains from trade. In this section, I quantify the extent of the mismeasurement using US industry-level data for the period 2002 to 2007. I compare the formulas of five models: the formula in my baseline model (23), in monopolistic competition (25), holding constant the marginal utility of income (28), in the CES case (29), and the ACR formula.

This exercise hinges on data availability. First of all, to compute the change in welfare, I need data on the domestic market share of the typical firm in an industry s_{jj} and its change over time. Such data is available for the US, but not for Mexico. The US Census of Manufacturers provides the average market share of the largest four US firms in a given manufacturing industry over the total industry shipments, where an industry is a 4 digit NAICS code. I focus on industry that predominantly produce consumption goods. To obtain the domestic market share s_{jj}, I multiply the value provided by the US Census by the industry-specific US domestic absorption. For robustness, I also use the market share of the eight largest firms as well.

I choose the values for the parameter θ in each model such that each model produces the same trade elasticity. For such reason, I use the industry-specific trade elasticities estimated by Caliendo and Parro (2015). For the model of oligopoly to generate the same trade elasticity, I need data on the market shares of exporters to the US. Since this data is not available, I consider the trade elasticity that arises in a model with two-symmetric countries, and assume that the market share of exporters is a fraction of the domestic market share of domestic firms. I consider three values for such a fraction: 50%, 10%, 1%. The main results assume that the market share of exporters is 10% of the domestic market share of US firms. Finally, for the model with CES preferences I use the median σ by industry from Soderbery

(2015).

Figure 1: Welfare Gains: % Difference from Baseline Model by Industry



The figure reports the % Difference ($W_m/W_{Baseline} - 1$) relative to the baseline model across industries. The appendix reports the full list of welfare changes across industries.

I compute the change in the market share of the typical superstar $d \ln s_{jj}$ from 2002 to 2007. The market share of the typical superstar fell by 8% on average from 2002 to 2007. Such change varies considerably across industries: for seafood, s_{jj} rose by more than 20% while, within chemical products and communications equipment, it fell by 38%. I compute the industry-specific welfare changes predicted by the formulas and I implicitly ignore any interactions across industries. Figure 1 illustrates the % difference in the welfare gains from trade between models that ignore cannibalization, income effects, or both, relative to my baseline model.

Ignoring cannibalization effects generates heterogeneous underestimate of the gains from trade. The magnitude of the mismeasurement is large for industries that are more concentrated: for household appliances, and magnetic and optical media the difference between the baseline model and a model with no cannibalization effects is approximately 50%. The difference between the two models is significantly smaller in industries that are less concentrated or have smaller trade elasticities: for plastic products, the difference between the two models is approximately 2%.

Ignoring income effects, by holding the marginal utility of income constant, generates an overestimate of the gains from trade. Such an overestimate is more pronounced in the industries with smaller concentration. The model of oligopoly with CES preferences generates overestimates the gains from trade relative to the baseline model, and particularly so for industries that are more concentrated. In several industries, such a model predicts gains from trade that are more than twice as big as the baseline model. Finally, comparing the baseline model to the ACR formula highlights which determinant of firms' scope is quantitatively more relevant in each industry. In fact, the ACR formula underestimates the gains in concentrated industries — in which cannibalization effects are strong — while it overestimates them in more competitive industries in which the role of income dominates that of cannibalization effects.

Table 5: Welfare Gains Across Models (2007-2002)

	$d \ln W(\%)$	% Diff
Baseline	4.6	–
	(6.6)	
Stone-Geary, Monop. Comp	3.8	−18.8
	(5.6)	(10.8)
Stone-Geary, Constant MUI	6.8	37.6
	(14.0)	(34.4)
CES, Oligopoly	6.7	69.3
	(8.7)	(49.1)
CES, Monop. Comp	4.5	−6.0
	(7.4)	(17.2)

The table reports $d \ln W$ and the % Difference ($W_m/W_{Baseline} - 1$) relative to the baseline model averaged across industries. Standard errors in parenthesis. All values are in percentages.

Table 5 reports the weighted average welfare change as well as the average difference in gains relative to the baseline model of section 3, where the weigths on each industry are the industry expenditure share. According to the baseline formula, welfare improved by 4.6% from 2002 to 2007. Across models, the largest improvement is predicted by a model with CES preferences and cannibalization effects (6.8%), while the smallest by a model with non-homothetic preferences and monopolistic competition (3.8%). Relative to the baseline case, ignoring cannibalization underestimates the gains by 19%, while ignoring income effects overestimates the gains by 40-70% depending on whether the role of income is silent because of a constant marginal utility of income or because of the use of CES preferences. Finally, the model with CES preferences and monopolistic competition predicts welfare gains that are 6% lower than the baseline model. This latter finding should not be taken as a general result, as it is due to the US-specific changes and current levels of market shares in the period considered, and on the relative sizes of US industries.

5 Conclusion

I have argued that the level of development of the destination and the competition among the varieties produced by a firm - cannibalization effects - are relevant determinants of the scope of large multiproduct exporters. First, using evidence from the Exporter Dynamics Database and from the scope of online retailers, I documented that large firms export more varieties each in richer economies. Furthermore, there is a non-monotone, hump-shaped relationship between firm scope and its market share in a destination.

Second, the model showed that both determinants play a key role in measuring the welfare gains from trade. In more concentrated industries, ignoring cannibalization effects causes large underestimates of the gains from trade. In less concentrated industries, ignoring income effects causes large overestimate of the gains from trade.

References

G. Alessandria and J. P. Kaboski. Pricing-to-Market and the Failure of Absolute PPP. *American Economic Journal: Macroeconomics*, 3(1):91–127, 2011.

P. Allanson and C. Montagna. Multiproduct firms and market structure: An explorative application to the product life cycle. *International Journal of Industrial Organization*, 23 (7-8):587–597, 2005.

M. Amiti, J. Konings, and O. Itskhoki. Imports, Exports, and Exchange Rate Disconnect. *American Economic Review*, 104(7):1942–78, 2014.

C. Arkolakis, A. Costinot, and A. Rodriguez-Clare. New trade models, same old gains? *American Economic Review*, 102(1):94–130, 2012.

C. Arkolakis, M.-A. Muendler, and S. Ganapati. The extensive margin of exporting products: A firm-level analysis. *Mimeo. Previously NBER working paper 16641*, 2014.

C. Arkolakis, A. Costinot, D. Donaldson, and A. Rodrguez-Clare. The Elusive Pro-Competitive Effects of Trade. *forth. Review of Economic Studies*, 2018.

J. Baldwin and W. Gu. The Impact of Trade on Plant Scale, Production-Run Length and Diversification. *In NBER Chapters: Producer Dynamics: New Evidence from Micro Data*, pages 557–592, 2009.

A. B. Bernard, S. J. Redding, and P. K. Schott. Multiple-Product Firms and Product Switching. *American Economic Review*, 100(1):70–97, 2010.

A. B. Bernard, S. J. Redding, and P. K. Schott. Multiproduct Firms and Trade Liberalization. *The Quarterly Journal of Economics*, 126(3):1271–1318, 2011.

A. B. Bernard, J. B. Jensen, S. J. Redding, and P. K. Schott. Global firms. *Journal of Economic Literature*, 56(2):565–619, 2018.

P. Bertoletti, F. Etro, and I. Simonovska. International trade with indirect additivity. *American Economic Journal: Microeconomics*, 10(2):1–57, May 2018.

I. Brambilla. Multinationals, technology, and the introduction of varieties of goods. *Journal of International Economics*, 79(1):89–101, 2009.

J. A. Brander and J. Eaton. Product Line Rivalry. *American Economic Review*, 74(3): 323–34, 1984.

C. Broda and D. E. Weinstein. Globalization and the gains from variety. *The Quarterly Journal of Economics*, 121(2):541–585, 2006.

L. Caliendo and F. Parro. Estimates of the Trade and Welfare Effects of NAFTA. *Review of Economic Studies*, 82(1):1–44, 2015.

A. Cavallo, B. Neiman, and R. Rigobon. Currency unions, product introductions, and the real exchange rate. *The Quarterly Journal of Economics*, 129(2):529–595, 2014.

T. Cebeci, A. M. Fernandes, C. Freund, and M. D. Pierola. Exporter dynamics database. *The World Bank Policy Research Working Paper Series*, 2012.

W. Copulsky. Cannibalism in the Marketplace. *Journal of Marketing*, 40(4):103–105, 1976.

Council of Economic Advisors. Benefits of competition and indicators of market power. 2016.

J. De Loecker and J. Eeckhout. The Rise of Market Power and the Macroeconomic Implications. *NBER Working Papers*, (23687), 2017.

J. De Loecker, P. K. Goldberg, A. K. Khandelwal, and N. Pavcnik. Prices, markups, and trade reform. *Econometrica*, 84(2):445–510, 2016.

S. Dhingra. Trading Away Wide Brands for Cheap Brands. *American Economic Review*, 103(6):2554–84, 2013.

S. Dhingra and J. Morrow. Monopolistic Competition and Optimum Product Diversity Under Firm Heterogeneity. *Forthcoming in Journal of Political Economy*, 2016.

J. Eaton, S. S. Kortum, and S. Sotelo. International Trade: Linking Micro and Macro. *NBER Working Paper 17864*, 2012.

C. Eckel and J. P. Neary. Multi-Product Firms and Flexible Manufacturing in the Global Economy. *Review of Economic Studies*, 77(1):188–217, 2010.

C. Eckel, L. Iacovone, B. Javorcik, and J. P. Neary. Multi-product firms at home and away: Cost- versus quality-based competence. *Journal of International Economics*, 95(2): 216–232, 2015.

C. Edmond, V. Midrigan, and D. Y. Xu. Competition, markups, and the gains from international trade. *American Economic Review*, 105(10):3183–3221, 2015.

R. Feenstra. New product varieties and the measurement of international prices. *The American Economic Review*, 84(1):157–177, 1994.

R. Feenstra and H. Ma. Optimal Choice of Product Scope for Multiproduct Firms under Monopolistic Competition. *in E. Helpman, D. Marin and T. Verdier, eds., The Organization of Firms in a Global Economy, Harvard University Press*, (13703), 2007.

R. C. Feenstra and D. Weinstein. Globalization, Competition, and U.S. Welfare. *Journal of Political Economy*, 125(4):1040–1074, 2017.

A. M. Fernandes, C. Freund, and M. D. Pierola. Exporter behavior, country size and stage of development: Evidence from the exporter dynamics database. *Journal of Development Economics*, 119(C):121–137, 2016.

C. Freund and M. D. Pierola. Export superstars. *Review of Economics and Statistics*, 97, 2015.

O. Galor and M. Klemp. The biocultural origins of human capital formation. *NBER Working Paper*, (20474), 2014.

P. K. Goldberg and F. Verboven. Market integration and convergence to the Law of One Price: evidence from the European car market. *Journal of International Economics*, 65 (1):49–73, 2005.

K. Head and T. Mayer. What separates us? sources of resistance to globalization. *Canadian Journal of Economics/Revue canadienne d'conomique*, 46(4):1196–1231, 2013.

K. Head, T. Mayer, and J. Ries. The erosion of colonial trade linkages after independence. *Journal of international Economics*, 91(1):1–14, 2010.

C. Hottman, S. J. Redding, and D. E. Weinstein. Quantifying the sources of firm heterogeneity. *The Quarterly Journal of Economics*, 2016.

D. Hummels and P. J. Klenow. The Variety and Quality of a Nation's Trade. *NBER Working Papers*, (8712), 2002.

L. Iacovone and B. Javorcik. Multi-Product Exporters: Product Churning, Uncertainty and Export Discoveries. *Economic Journal*, 120(544):481–499, 2010.

M. Igami. Estimating the Innovators Dilemma: Structural Analysis of Creative Destruction in the Hard Disk Drive Industry, 1981,1998. *Journal of Political Economy*, 2015.

L. F. Jackson. Hierarchic Demand and the Engel Curve for Variety. *The Review of Economics and Statistics*, 66(1):8–15, 1984.

J.-W. Jung, I. Simonovska, and A. Weinberger. Exporter heterogeneity and price discrimination: A quantitative view. *NBER Working Paper*, (21408), 2015.

R. A. Kerin, M. G. Harvey, and J. T. Rothe. Cannibalism and new product development. *Business Horizons*, 21(5):25–31, 1978.

P. Klemperer. Equilibrium product lines: Competing head-to-head may be less competitive. *American Economic Review*, 82(4):740–755, 1992.

P. Krugman. Scale economies, product differentiation, and the pattern of trade. *American Economic Review*, 1980.

P. R. Krugman. Increasing returns, monopolistic competition, and international trade. *Journal of international Economics*, 9(4):469–479, 1979.

J. T. Lind and H. Mehlum. With or Without U? The Appropriate Test for a U-Shaped Relationship. *Oxford Bulletin of Economics and Statistics*, 72(1):109–118, 2010.

J. Lopresti. Multiproduct firms and product scope adjustment in trade. *Journal of International Economics*, 100(C):160–173, 2016.

K. Manova and Z. Zhang. Multi-Product Firms and Product Quality. *Quarterly Journal of Economics*, (127):379–436, 2012.

T. Mayer, M. J. Melitz, and G. I. P. Ottaviano. Market Size, Competition, and the Product Mix of Exporters. *American Economic Review*, 104(2):495–536, 2014.

M. J. Melitz and S. J. Redding. New trade models, new welfare implications. *American Economic Review*, 105(3):1105–46, 2015.

D. C. Montgomery, E. A. Peck, and G. G. Vining. Introduction to linear regression analysis. *Chapter 7. Paragraph 7.5. 5th Edition. Wiley.*, pages 248–251, 2013.

J. P. Neary. Two and a half theories of trade. *World Economy*, 33(1):1–19, 2010.

J. P. Neary. International trade in general oligopolistic equilibrium. *Review of International Economics*, 24(4):669–698, 2016.

V. Nocke and S. Yeaple. Globalization and multiproduct firms. *International Economic Review*, 55(4):993–1018, 2014.

G. Ottaviano and T. Mayer. The happy few: the internationalisation of European firms. *Bruegel*, 2007.

G. I. P. Ottaviano and J. Thisse. Monopolistic Competition, Multiproduct Firms And Product Diversity. *Manchester School*, 79(5):938–951, 2011.

M. Parenti. Large and small firms in a global market: David vs. Goliath. *Journal of International Economics*, 110:103 – 118, 2018.

L. Qiu and W. Zhou. Multiproduct firms and scope adjustment in globalization. *Journal of International Economics*, 91(1):142–153, 2013.

H. Raff and J. Wagner. Productivity and the product scope of multi-product firms: a test of Feenstra-Ma. *Economics Bulletin*, 33(1):415–419, 2013.

P. Robinson. Root- n-consistent semiparametric regression. *Econometrica*, 56(4):931–54, 1988.

D. Rodrik. Premature deindustrialization. *Journal of Economic Growth*, 21(1):1–33, 2016.

E. Rossi-Hansberg, P.-D. Sarte, and N. Trachter. Diverging Trends in National and Local Concentration. *NBER Working Papers*, (25066), 2018.

I. Simonovska. Income differences and prices of tradables: Insights from an online retailer. *The Review of Economic Studies*, 82(4):1612–1656, 2015.

A. Soderbery. Estimating import supply and demand elasticities: Analysis and implications. *Journal of International Economics*, 96(1):1–17, 2015.

6 Appendix

6.1 Motivational Evidence

6.1.1 Data Description

The source for the data is the Exporter Dynamics Database, which reports data on export values at the product-firm-destination level (Fernandes et al., 2016). The sources for the data for each country are detailed in the Annex of Cebeci et al. (2012). The data was collected by the Trade and Integration Unit of the World Bank Research Department as part of their efforts to build the Exporter Dynamics Database.

A product is a Harmonized System (HS) 6 digit good. As an example, consider a firm that produces seven varieties (confidentiality prevents me from specifying its destinations and sales). The varieties are: “Candles, Tapers, and the Like” (340600), “Wooden frames for paintings, photographs, mirrors, or similar objects” (441400), “Statuettes and other ornaments of wood” (442010), “Other ceramic articles” (691490), “Other Articles of Iron or Steel” (732690), “Other Statuettes and Other Ornaments, of Base Metal” (830629), “Wooden Furniture of a Kind Used in the Bedroom” (940350).

I drop all firms and products which are not classified (“OTH”) and all duplicates. Following Freund and Pierola (2015), I drop firms with less than $1000 worth of export and drop Chapter 27 according to the HS classification: mineral fuels, oils, and product of their distillation. I match each HS 6 digit good with the corresponding BEC category and keep only the BEC categories that according to UN Comtrade correspond to consumption goods: 112, 122, 522, 61, 62, and 63.

6.1.2 Test of Non-Monotonicity

The Lind and Mehlum (2010) test works as follows. The null hypothesis is that the relationship (2) between scope and market share is monotone or U-shaped, and the alternative is that it is hump-shaped. The null hypothesis is rejected if either or both the following conditions are rejected:

$$\beta_1 + 2\beta_2 \ln(1 + s_L) \leq 0$$
$$\beta_1 + 2\beta_2 \ln(1 + s_H) \geq 0$$

where s_L and s_H are some lower and upper bounds. We reject the null hypothesis if the slope of the curve is negative at the beginning and/or positive at the end. I choose for the lower bound s_L, the minimum value of market share in the sample, the 5th percentile and the 10th percentile. For the upper bound s_H, I choose the maximum, the 95th percentile and the 90th percentile. The hump-shaped relationship is confirmed (Table 6), and the results are especially robust for the top 5% and 1% of Mexican multiproduct exporters.

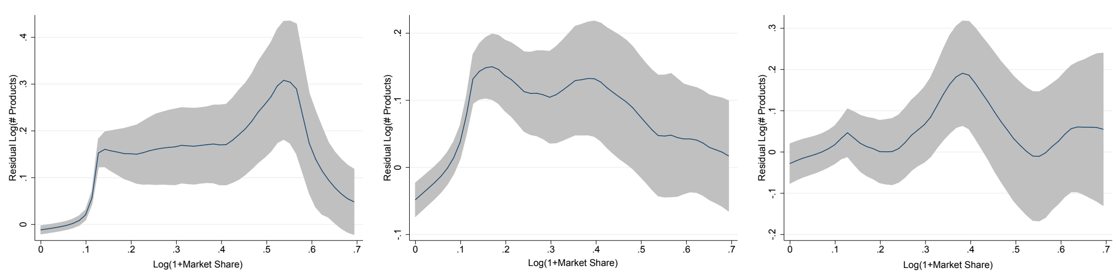
An additional test of the non-monotone, hump-shaped relationship is to use local polynomial regressions. For each group of firms, I regress $\ln(\#\ \text{Products}_{kMjt})$ on firm and destination-year fixed effects and record the residual. Then I plot the local polynomial relationship between such residual and $\ln(1 + s_{kMjt})$ for the year 2005. Figure 2 shows the result. For each group of firms, there is a non-monotone hump-shaped relationship. The presence of large market shares for the bottom 95% of exporters should not surprise as few of them tend to be the only exporters in a given industry and destination. Following Robinson (1988), I repeat the analysis, by plotting, for the year 2005, the local polynomial relationship between the residuals from regressing ln(# Products$_{kMjt}$) on firm and destination-year fixed effects, on the residuals from regressing $\ln(1 + s_{kMjt})$ on firm and destination-year fixed effects. Although the hump-shaped relationship is less prominent, the results are robust to this alternative specification (Figure 3).

Table 6: Lind and Mehlum (2010) Test

	Bottom 95%	Top 5%	Top 1%
s_{kij}	0.209***	0.343***	0.318***
	(0.012)	(0.025)	(0.056)
s^2_{kij}	-0.148***	-0.478***	-0.497***
	(0.014)	(0.047)	(0.099)
R^2	0.63	0.69	0.82
# Observations	82602	14184	4224
Hump-Shaped t-value {min, max}	8.87***	8.50***	3.84***
Hump-Shaped t-value {5^{th}pct, 95^{th}pct}	5.97***	8.16***	3.73***
Hump-Shaped t-value {10^{th}pct, 90^{th}pct}	0.98	7.47***	3.48***

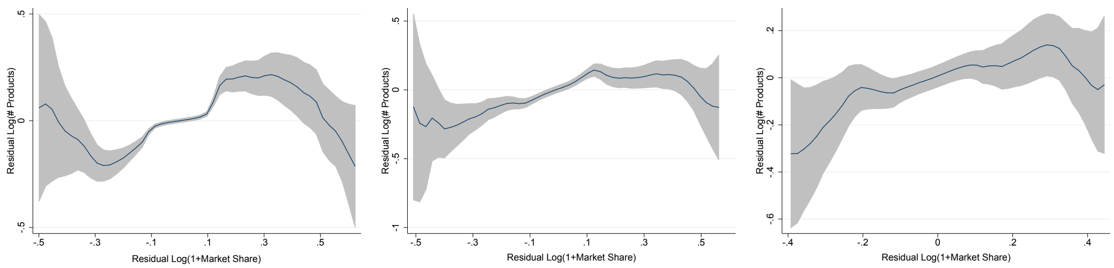
Results from OLS of equation (2). Robust std. error in parenthesis. Cluster: destination country. ***: significant at 99%, ** at 95%, * at 90%. s_{kMjt} and s^2_{kMjt} are normalized by their year sample average. Hump-shape t-test: t-value and significance of Lind and Mehlum (2010) test evaluated at s_{kMjt} ={min, max}, {5^{th}pct, 95^{th}pct} and {10^{th}pct, 90^{th}pct}. N.A.: the extremum is outside the sample. In the Hump-Shaped test for {5^{th}pct, 95^{th}pct} and {10^{th}pct, 90^{th}pct}, I drop the destinations served by only one firm.

Figure 2: Residual Scope on Market Share: Local Polynomial Smoothing



In order: Bottom 95%, Top 5%, and Top 1%. Alternative Epanechnikov kernel function with bandwidth=0.12 and degree=0. The grey area is the 95% C.I.

Figure 3: Residual Scope on Residual Market Share: Local Polynomial Smoothing



In order: Bottom 95%, Top 5%, and Top 1%. Alternative Epanechnikov kernel function with bandwidth=0.12 and degree=0. The grey area is the 95% C.I.

6.1.3 Market Share and Per Capita Income

To asses whether the market share of Mexican Exporters varies with the per capita income of the destination, I run the following regression:

$$\ln(s_{kMjt}) = \beta_0 + \beta_y \ln(\text{Pc. Income}_{jt}) + \beta_L \ln(\text{GDP}_{jt}) + \beta_\tau \tau_{Mjt} + f_k + g_t + \epsilon_{kMjt} \qquad (30)$$

where s_{kMjt} is the ratio of firm's k export to j over total household consumption in j from WDI.[31] Similar to (1) the relevant independent variable is real per capita GDP from WDI. I control for the size of the destination using real GDP. τ_{Mjt} is a vector of trade barriers from CEPII that includes the log of bilateral distance, dummies for the presence of a shared border, commonality of language, and destination specific dummies for islands and landlocked countries. f_k and g_t are firm and year fixed effects, and ϵ_{kMjt} is the error term.

Table 7 reports the results from the regression. Controlling for size, the richer the destination, the larger the market share of Mexican exporters. Trade costs and size of the destination negatively affect the market share of exporters.

6.1.4 European Car Market

To verify the robustness of the second stylized fact, I use the data on the sales of car models in five European economies provided by Goldberg and Verboven (2005). The economies considered are Belgium, Germany, Great Britain, France, and Italy from 1970 to 1999. Given the presence of large firms and the accuracy of the measure of market share, this dataset proves ideal to test cannibalization effects. However, we cannot use it to test the first stylized fact because of the limited number of destinations.

For each destination I run the following regression:

$$\ln(\#\text{ Car models}_{kijt}) = f_k + d_{jt} + \beta_1 s_{kijt} + \beta_2 s^2_{kijt} + \epsilon_{kijt} \qquad (31)$$

where f_k is a firm fixed effect, d_{jt} is a destination-year fixed effect, and ϵ_{kijt} is the error term. Since our baseline geographical controls are time invariant, they are captured by the firm

[31] I argue that this is the relevant measure of market share to capture the relationship between cannibalization effects and per capita income. Results are not robust to using s_{kMjt} as the ratio of firm's k export to j over total imports in j.

Table 7: Per Capita Income and Market Share

	(MPF)	(All)
Log(Pc.income)	0.214***	0.174***
	(0.073)	(0.059)
log(GDP)	-0.686***	-0.722***
	(0.049)	(0.041)
Log(Distance)	-0.574***	-0.455***
	(0.152)	(0.134)
Border	0.772*	0.560*
	(0.426)	(0.333)
Comm. Language	0.608**	0.517**
	(0.258)	(0.218)
Island	-0.050	-0.080
	(0.164)	(0.143)
Landlocked	-0.195	-0.233*
	(0.150)	(0.123)
R^2	0.72	0.76
# Observations	94736	160436

Results from OLS of equation (30). Robust std. error in parenthesis. Cluster: destination. ***: significant at 99%, ** at 95%, * at 90%. MPF: Sample of Mexican multiproduct exporters. All: Sample of all Mexican exporters.

level fixed effect. In the pooled regression I include origin-destination fixed effects to control for geographical barriers. The market share s_{kijt} is the share of firm's k sales in j in year t divided by the total sales by all firms' in the sample in the same destination j in year t.

Table 8 shows that cannibalization effects are present in the European car market. The Lind and Mehlum (2010) test confirms the hump-shaped relationship in the pooled regression.

Table 8: European Car Market: Scope of Exporters and Their Market Share

	BEL	FRA	DEU	ITA	GBR	Pooled
s_{kijt}	0.82***	0.83***	1.24***	0.80***	0.80***	0.35***
	(0.16)	(0.13)	(0.19)	(0.28)	(0.13)	(0.07)
s^2_{kijt}	-0.57**	0.02	-0.70***	-0.29	-0.34**	-0.24***
	(0.21)	(0.26)	(0.22)	(0.28)	(0.16)	(0.04)
R^2	0.83	0.85	0.82	0.86	0.82	0.87
# Observations	587	518	512	449	538	2601

Results from OLS of equation (31). Robust std. error in parenthesis. Cluster: year for single destination, destination in pooled regression. ***: significant at 99%, ** at 95%, * at 90%. The ratio of car's sales to total sales is normalized by the average in the sample.

6.2 Model's Derivations

6.2.1 Firms' Problem

In the main text, I derived the first order conditions with respect to $x_{kij}(\omega)$ and δ_{kij} in equations (11) and (12). Let me rewrite them here:

$$\frac{1}{\lambda_j}\frac{L_j^2\bar{q}}{(x_{kij}(\omega)+L_j\bar{q})^2}(1-s_{kij})-c_{kij}(\omega)=0 \tag{32}$$

$$\frac{L_j}{\lambda_j}\frac{x_{kij}(\delta_{kij})}{x_{kij}(\delta_{kij})+L_j\bar{q}}(1-s_{kij})-x_{kij}(\delta_{kij})c_{kij}(\delta_{kij})=0 \tag{33}$$

where $x_{kij}(\delta_{kij})=0$ satisfies (33). Let us prove that $x_{kij}(\delta_{kij})=0$ is solution to (33). By contradiction suppose instead $x_{kij}(\delta_{kij})>0$. Then we can simplify (33).

$$\frac{L_j}{\lambda_j}\frac{1}{x_{kij}(\delta_{kij})+L_j\bar{q}}(1-s_j)=c_j(\delta_{kij})$$

$$x_{kij}(\delta_{kij})=\frac{L_j(1-s_j)}{\lambda c_j(\delta_{kij})}-L_j\bar{q} \tag{34}$$

Substituting this result in the first order condition with respect to quantity (32) yields:

$$L_j\left[\frac{\bar{q}(1-s_j)}{\lambda c_j(\delta_{kij})}\right]^{\frac{1}{2}}-L_j\bar{q}=\frac{L_j(1-s_j)}{\lambda_j c_j(\delta_{kij})}-L\bar{q}$$

$$c_j(\delta_{kij})=\frac{(1-s_j)}{\bar{q}\lambda_j}$$

Substituting it into the pricing equation yields:

$$p_{kij}(\delta_{kij})=\frac{1}{\lambda_j\bar{q}}$$

By evaluating the inverse demand function at $q_j(\omega)=0$, the choke price p_j^{max} equals:

$$p_j^{max}=\frac{1}{\lambda_j\bar{q}} \tag{35}$$

Hence, $p_{kij}(\delta_{kij})=p_j^{max}$, and therefore $x_{kij}(\delta_{kij})=0$, a contradiction with the hypothesis $x_{kij}(\delta_{kij})>0$. To conclude the argument, let us consider the second order condition with respect to δ_{kij}:

$$\frac{\partial^2\Pi_j}{\partial\delta_{kij}^2}=-\frac{L_j}{\lambda_j^2}\frac{x_{kij}(\delta_{kij})}{x_{kij}(\delta_{kij})+L_j\bar{q}}(1-s_j)\frac{\partial\lambda_j}{\partial\delta_{kij}}-\frac{L_j}{\lambda_j}\frac{x_{kij}(\delta_{kij})}{x_{kij}(\delta_{kij})+L_j\bar{q}}\frac{\partial s_j}{\partial\delta_{kij}}-x_{kij}(\delta_{kij})\frac{\partial c_j(\delta_{kij})}{\partial\delta_{kij}}$$

where the terms multiplying $\frac{\partial x_{kij}(\delta_{kij})}{\partial\delta_{kij}}$ are equal to zero by the first order conditions with respect to $x_{kij}(\omega)$ and, thus, are ignored here. The second order condition is zero at the equilibrium, but it is negative for $x_{kij}(\delta_{kij}) > 0$. In fact, $\frac{\partial \lambda_j}{\partial \delta_{kij}} > 0$. In addition, since $\left[\int_0^{\delta_{kij}} \frac{x_{kij}(\omega)}{x_{kij}(\omega)+L_j\bar{q}}\right]$ is increasing in the mass of varieties, so is the market share.

6.2.2 Characterization of the Equilibrium

This section shows the derivations of the equilibrium condition of the model. Recall the implicit equation that defines the scope of a firm from i to j:

$$c_{ij}(\delta_{ij}) = \frac{(1-s_{ij})}{\bar{q}\lambda_j} \tag{36}$$

Using our functional form for the marginal cost $c_{ij}(\omega) = y_i \tau_{ij} c_i \omega^\theta$, we obtain:

$$\tau_{ij} w_i c_i \delta_{ij}^\theta = \frac{1-s_{ij}}{\bar{q}\lambda_j}$$

We can express both quantities and prices as functions of the marginal cost of the last variety:

$$x_{ij}(\omega) = \bar{q}L_j \left[\left(\frac{c_{ij}(\delta_{ij})}{c_{ij}(\omega)}\right)^{\frac{1}{2}} - 1\right] = \bar{q}L_j \left[\left(\frac{\delta_{ij}}{\omega}\right)^{\frac{\theta}{2}} - 1\right] \tag{37}$$

$$p_{ij}(\omega) = \frac{[c_{ij}(\omega)c_{ij}(\delta_{ij})]^{\frac{1}{2}}}{1-s_{ij}} = \frac{w_i \tau_{ij} c_i [\omega \delta_{ij}]^{\frac{\theta}{2}}}{1-s_{ij}}$$

Revenues and total variable costs to produce in i and sell to j are:

$$r_{ij} = \int_0^{\delta_{ij}} p_{ij}(\omega)x_{ij}(\omega)d\omega = \frac{\bar{q}L_j w_i \tau_{ij} c_i}{1-s_{ij}} \int_0^{\delta_{ij}} \left[\delta_{ij}^\theta - (\delta_{ij}\omega)^{\frac{\theta}{2}}\right] d\omega = \frac{\theta \bar{q} L_j w_i \tau_{ij} c_i \delta_{ij}^{\theta+1}}{(1-s_{ij})(\theta+2)}$$

$$C_{ij} = \int_0^{\delta_{ij}} c_{ij}(\omega)x_{ij}(\omega)d\omega = \bar{q}L_j w_i \tau_{ij} c_i \int_0^{\delta_{ij}} \left[(\delta_{ij}\omega)^{\frac{\theta}{2}} - \omega^\theta\right] d\omega = \frac{\theta \bar{q} L_j w_i \tau_{ij} c_i \delta_{ij}^{\theta+1}}{(\theta+1)(\theta+2)}$$

Hence, since $r_{ij} = s_{ij} y_j L_j$,

$$C_{ij} = \frac{r_{ij}(1-s_{ij})}{\theta+1} = \frac{s_{ij} y_j L_j (1-s_{ij})}{\theta+1}$$

The operating profits of a firm from i to j are:

$$\pi_{ij} = r_{ij} - C_{ij} = \frac{s_{ij}^2 + \theta s_{ij}}{\theta+1} y_j L_j \tag{38}$$

Let us now look at our definition of market share. First, note that using our cutoff condition (36), we can re-write the revenues of a firm as:

$$r_{ij} = \frac{\theta \bar{q} L_j w_i \tau_{ij} c_i \delta_{ij}^{\theta+1}}{(1-s_{ij})(\theta+2)} = \frac{\theta L_j \delta_{ij} \bar{q} c_{ij}(\delta_{ij})}{(\theta+2)(1-s_{ij})} = \frac{\theta L_j \delta_{ij}}{\lambda_j(\theta+2)}$$

Let the mass of varieties available for consumption be denoted by $\Delta_j = \sum_i M_i \delta_{ij}$. Firm's market share equals the ratio between that firm's scope and Δ_j:

$$s_{ij} = \frac{r_{ij}}{M_j r_{jj} + M_i r_{ij}} = \frac{\delta_{ij}}{M_j \delta_{jj} + M_i \delta_{ij}} = \frac{\delta_{ij}}{\Delta_j} \tag{39}$$

Finally, the marginal utility of income λ_j is given by:

$$\begin{aligned}\lambda_j &= \frac{1}{y_j}\left[\sum_{i=h,f} M_i \int_0^{\delta_{ij}} \frac{x_{ij}(\omega)}{x_{ij}(\omega) + L_j \bar{q}} d\omega\right] = \frac{1}{y_j}\left[\sum_{i=h,f} M_i \int_0^{\delta_{ij}} \left(1 - \left(\frac{\omega}{\delta_{ij}}\right)^{\frac{\theta}{2}} d\omega\right)\right] \\ &= \frac{1}{y_j}\left[\sum_{i=h,f} M_i \frac{\theta \delta_{ij}}{\theta+2}\right] = \frac{\theta}{\theta+2}\frac{\Delta_j}{y_j}\end{aligned} \tag{40}$$

Using (39) into (40) yields:

$$\lambda_j = \frac{\theta}{\theta+2}\frac{\delta_{ij}}{s_{ij} y_j} \tag{41}$$

Using (41) in the cutoff condition (36) gives us the scope of a firm:

$$\delta_{ij} = \left[\frac{\theta+2}{\theta \bar{q} w_i c_i \tau_{ij}}\right]^{\frac{1}{\theta+1}} \; y_j^{\frac{1}{\theta+1}} \; \left[s_{ij}(1-s_{ij})\right]^{\frac{1}{\theta+1}} \tag{42}$$

We can express the equilibrium of the model in terms of the firms' market shares, which yields easier equations, and it is faster to solve numerically. Using (39) into (18) we obtain:

$$w_j c_j s_{jj}^{\theta} \Delta_j^{\theta+1} = y_j \frac{\theta+2}{\bar{q}\theta}(1-s_{jj}) \tag{43}$$

$$\tau_{ij} w_i c_i s_{ij}^{\theta} \Delta_j^{\theta+1} = y_j \frac{\theta+2}{\bar{q}\theta}(1-s_{ij}) \tag{44}$$

Dividing (43) by (44) yields:

$$w_j c_j s_{jj}^{\theta}(1-s_{ij}) = \tau c_i w_i s_{ij}^{\theta}(1-s_{jj}) \tag{45}$$

Using (38), the zero profit condition equals:

$$(s_{jj}^2 + \theta s_{jj}) y_j L_j + (s_{ji}^2 + \theta s_{ji}) y_i L_i = F(\theta+1) w_j \tag{46}$$

Market clearing implies that:

$$M_i r_{ii} + M_j r_{ji} = y_i L_i$$

$$M_i s_{ii} + M_j s_{ji} = 1 \tag{47}$$

Trade balance requires:

$$\begin{aligned} M_j r_{ji} &= M_i r_{ij} \\ M_j s_{ji} y_i L_i &= M_i s_{ij} y_j L_j \end{aligned} \tag{48}$$

Goods market clearing and the zero profit conditions satisfy labor market clearing. Labor market in country i clears when:

$$\begin{aligned} y_i L_i &= M_i(w_i F + C_{ii} + C_{ij}) \\ y_i L_i &= M_i(w_i F - w_i F + r_{ii} + r_{ij}) \quad \text{by Zero profit condition} \\ y_i L_i &= M_i r_{ii} + M_j r_{ji} \quad \text{by Trade Balance} \end{aligned}$$

which is the goods market clearing condition. Normalizing home per capita income to 1, the equilibrium is a vector of market shares $[s_{hh},\, s_{hf},\, s_{ff},\, s_{fh}]$, of masses of firms $[M_h,\, M_f]$ and foreign per capita income y_f such that equations (45), (46), (47), and (48) are satisfied.

Finally, recall that $q_{ij}(\omega) = \frac{x_{ij}(\omega)}{L_j}$ where $x_{ij}(\omega)$ is given by (37). The indirect utility function equals

$$\begin{aligned} V_j &= \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \left[\ln(q_{ij}(\omega) + \bar{q}) - \ln \bar{q}\right] d\omega = \\ &= \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \left[\ln\left(\bar{q}\left(\frac{\delta_{ij}}{\omega}\right)^{\frac{\theta}{2}} - \bar{q} + \bar{q}\right) - \ln \bar{q}\right] d\omega = \\ &= \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln\left(\frac{\delta_{ij}}{\omega}\right)^{\frac{\theta}{2}} d\omega = \frac{\theta}{2} \sum_{i=h,f} M_i \int_0^{\delta_{ij}} [\ln \delta_{ij} - \ln \omega] d\omega \\ &= \frac{\theta}{2} \sum_{i=h,f} M_i \delta_{ij} = \frac{\theta}{2} \Delta_j \end{aligned}$$

where Δ_j can be expressed as a function of the domestic market share of domestic firms from equation (43):

$$\Delta_j = \left[\frac{\theta + 2}{\bar{q} c_j \theta} \left(\frac{y_j}{w_j}\right) (1 - s_{jj}) s_{jj}^{-\theta}\right]^{\frac{1}{\theta+1}}$$

Let us consider the sales-weighted geometric mean of markups $\bar{\mu}_j$ in an economy j. Letting $\mu_{ij}(\omega)$ be the markup on a variety ω from i to j, the sales-weighted geometric mean of markups equals:

$$\bar{\mu}_j = \left[\sum_{i=h,f} M_i s_{ij} \int_0^{\delta_{ij}} \frac{1}{\mu_{ij}(\omega)} \frac{r_{ij}(\omega)}{r_{ij}} d\omega\right]^{-1} = \frac{\theta + 1}{1 - H_j} \tag{49}$$

where $H_j = M_j s_{jj}^2 + M_i s_{ij}^2$ is the Herfindahl index of market concentration in country j.

Finally, let us consider the gravity equation generated by the model. The export trade share of country i to country j, denoted by Λ_{ij}, equals:

$$\Lambda_{ij} = \frac{M_i r_{ij}}{\sum_{v=h,f} M_v r_{vj}} = \frac{M_i \left(\frac{1-s_{ij}}{c_i w_i \tau_{ij}}\right)^{\frac{1}{\theta}}}{\sum_{v=h,f} M_v \left(\frac{1-s_{vj}}{c_v w_v \tau_{vj}}\right)^{\frac{1}{\theta}}}$$

Ignoring cannibalization effects, which is equivalent to setting $s_{ij} = 0$, generates the traditional gravity equation that emerges in models of monopolistic competition. In such a case, the trade elasticity would be $\epsilon = 1/\theta$ and, thus, would depend on the distribution of marginal costs of the varieties within a firm.

6.2.3 Welfare Formula for a Large Change in Trade Costs

Let us now consider the welfare formula for any (large) change in trade costs. First, I derive the equivalent variation in income EV_j such that the indirect utility attained after the trade shock equals the indirect utility attained at pre-shock prices and at an income $W_j = y_j + EV_j$. Let the vector of pre-shock prices be P_j. First, I derive $V_j(W_j, P_j)$. By the consumer's problem, the quantity demanded is a function of the marginal utility of income and price:

$$q_{ij}(\omega) = \frac{1}{\lambda_j p_{ij}(\omega)} - \bar{q}$$

The marginal utility of income can be written as a function of the total mass of varieties available for consumption and prices:

$$\lambda_j = \frac{\Delta_j}{y_j + EV_j + \bar{q} P_j}$$

where P_j is a price index. Using (13), the price of a variety ω (15) can be written as:

$$p_{ij}(\omega) = \frac{[c_{kij}(\omega) c_{kij}(\delta_{kij})]^{\frac{1}{2}}}{1 - s_{kij}} = \frac{1}{\bar{q}\lambda_j} \left(\frac{c_{ij}(\omega)}{c_{ij}(\delta_{ij})}\right)^{\frac{1}{2}} = \frac{1}{\bar{q}\lambda_j} \left(\frac{\omega}{\delta_{ij}}\right)^{\frac{\theta}{2}}$$

The price index at the pre-shock prices ($EV_j = 0$) can then be computed as:

$$\bar{q} P_j = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} p_{ij}(\omega) = \frac{2\Delta_j}{\bar{q}\lambda_j(\theta + 2)} = \frac{2}{\theta} y_j$$

Therefore, the marginal utility of income equals:

$$\lambda_j = \frac{\Delta_j}{\left(\frac{\theta+2}{\theta}\right) y_j + EV_j}$$

The indirect utility function is then equal to:

$$V_j = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} [\ln(q_{ij}(\omega)+\bar{q}) - \ln \bar{q}]\, d\omega =$$

$$= \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln\left(\frac{1}{\bar{q}\lambda_j p_{ij}(\omega)}\right) d\omega =$$

$$= -\Delta_j \ln(\bar{q}\lambda_j) - \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln(p_{ij}(\omega)) d\omega$$

$$= -\Delta_j \ln(\bar{q}\Delta_j) + \Delta_j \ln\left(\left(\frac{\theta+2}{\theta}\right) y_j + EV_j\right) - \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln(p_{ij}(\omega)) d\omega$$

Let us now derive the log change in the indirect utility $V_j(W_j, P_j)$ with respect to W_j. First, holding prices constant,

$$\frac{dV_j}{dW_j} = \frac{dV_j}{dEV_j} = \frac{\Delta_j}{\left(\frac{\theta+2}{\theta}\right) y_j + EV_j}$$

Then, using the fact that at the pre-shock prices $V_j = \frac{\theta}{2}\Delta_j$, we obtain

$$d\ln V_j = \frac{dV_j}{dW_j}\frac{W_j}{V_j} d\ln W_j = \frac{2W_j}{2y_j + \theta W_j} d\ln W_j \tag{50}$$

For a small change in trade cost, we can evaluate (50) at $W_j = y_j$, which yields the expression obtained in the main text using the envelope theorem.

Let us denote the proportional change in a variable x from x^0 to x^1 as $\hat{x} = x^1/x^0$. The proportional change in the indirect utility $\hat{V}_j$ due to a large trade shock is given by integrating (21) for $s \in [s_{jj}^0, s_{jj}^1]$ where superscript 0 denotes the pre-shock level and superscript 1 denotes the after-shock level.

$$\ln \hat{V}_j = \ln \hat{\Delta}_j = -\frac{\theta}{\theta+1}\left[\int_{s_{jj}^0}^{s_{jj}^1} \left(1 + \frac{s}{\theta(1-s)}\right) d\ln s\right]$$

$$= -\frac{\theta}{\theta+1}\left[\int_{s_{jj}^0}^{s_{jj}^1} \left(1 + \frac{s}{\theta(1-s)}\right) \frac{ds}{s}\right] = -\ln\left[\hat{s}_{jj}\left(\frac{1-s_{jj}^0}{1-\hat{s}_{jj}s_{jj}^0}\right)^{\frac{1}{\theta}}\right]^{\frac{\theta}{\theta+1}} \tag{51}$$

The equivalent variation in income is obtained by integrating (50) for $t \in [y_j, W_j]$:

$$\ln \hat{V}_j = \int_{y_j}^{W_j} \frac{2t}{2y_j + \theta t} d\ln t = \ln\left[\frac{\theta \hat{W}_j + 2}{\theta + 2}\right]^{\frac{2}{\theta}} \tag{52}$$

Combining (51) with (52) yields a general formula for the change in welfare due to a large trade shock:

$$\hat{W}_j = \frac{\theta+2}{\theta}\left[\hat{s}_{jj}\left(\frac{1-s^0_{jj}}{1-\hat{s}_{jj}s^0_{jj}}\right)^{\frac{1}{\theta}}\right]^{\frac{\theta^2}{2(\theta+1)}} - \frac{2}{\theta} \tag{53}$$

The online appendix shows that local approximation yields virtually identical changes in welfare compared to the exact change in welfare obtained by the general formula.

6.3 Extensions to the Model

Superstars VS Competitive Fringe

For tractability, the baseline model assumes that the large oligopolists are the only active firms. This section studies how the interaction between small and large multiproduct firms affect the welfare gains from trade. I follow Parenti (2018) and add a multiproduct competitive fringe to my baseline model.

Let superscript o denote the variables of interest of large multiproduct firms and c those of the competitive fringe. An infinite number of perfectly competitive firms is producing in i and selling to j a continuum of varieties indexed by $\omega \in [0, \delta^c_{ij}]$. The marginal cost of producing a variety ω by the competitive fringe is $c^c_{ij}(\omega) = \tau_{ij} w_i c^c_i \omega^\theta$. Without loss of generality, I assume that θ is common across all firms and that $c^c_i > c^o_i$.

Let the preferences of consumers in country j be represented by the following utility function:

$$U_j = \sum_{i=h,f}\left(\alpha \sum_{k=1}^{M_i}\int_0^{\delta^o_{kij}}\left[\ln(q^o_{kij}(\omega)+\bar{q}) - \ln(\bar{q})\right]d\omega + (1-\alpha)\int_0^{\delta^c_{ij}}\left[\ln(q^c_{ij}(\omega)+\bar{q}) - \ln(\bar{q})\right]d\omega\right)$$

where α is the weight on the goods produced by large multiproduct firms. If $\alpha = 1$, the model is the same as in section 3, whereas if $\alpha = 0$, all the varieties are produced by the competitive fringe.

The welfare change in country j from a small reduction in trade costs equals:

$$d\ln W_j = \underbrace{\mu^o_j\left[\frac{\theta(\theta+2)}{2(\theta+1)}\right]\left[1+\frac{s_{jj}}{\theta(1-s_{jj})}\right](-d\ln s_{jj})}_{\text{Large Multiproduct Firms}} + \mu^c_j \underbrace{\theta(-d\ln\Lambda^c_{jj})}_{\text{Competitive Fringe}} + \underbrace{\frac{\theta}{2}\mu^c_j d\ln\mu^c_j}_{\text{Interaction}} \tag{54}$$

where the weight μ^o_j (μ^c_j) is the expenditure share in country j on goods produced by superstars (competitive fringe), both domestic and foreign. As in the baseline model, s_{jj} is the domestic market share of the typical large domestic firm. Λ^c_{jj} is the domestic expenditure share on goods produced by the domestic competitive fringe.

The welfare gains from trade can be decomposed in three components. The first is the welfare formula that arises in a model of large multiproduct firms weighted by the expenditure share on the goods of superstars μ^o_j. The second term is the welfare formula generated by a model of perfect competition weighted by μ^c_j. In addition, there is an interaction term whose sign depends on whether a reduction in trade costs increases or decreases the expenditure share on the competitive fringe's goods. The appendix shows that the contribution to welfare of the interaction and second term is positive.

The presence of a competitive fringe does not alter the welfare effects of large multiproduct firms. The larger the market share of the typical firm s_{jj}, the larger the gains from trade both because of the weakening of cannibalization effects and because of the larger share of goods produced by oligopolists in the consumption bundle μ_j^o.

Integer Number of Firms

The baseline model ignores the so-called integer problem. Free entry implies that profits are exactly equal to zero: for such a condition to be satisfied for any set of parameters, the number of firms M_i must be a real number. In this section, I discuss the welfare consequences of limiting the number of firms to an integer number.

Following Eaton et al. (2012), the equilibrium number of firms M_j is such that the profits of the M_j firms are positive or zero, and entry of an additional firm generates negative profits. Since profits are no longer equal to zero, per capita income equals the sum of the labor wage and of the per capita profits:

$$y_j = w_j + \frac{\Pi_j M_j}{L_j}$$

As per capita income differs from the wage, the welfare formula becomes:

$$d\ln W_j = \underbrace{\frac{\theta(\theta+2)}{2(\theta+1)}\left[1+\frac{s_{jj}}{\theta(1-s_{jj})}\right](-d\ln s_{jj})}_{\text{Baseline Formula}} + \underbrace{\frac{\theta(\theta+2)}{2(\theta+1)}d\ln y_j}_{\text{Integer Problem}}$$

The welfare formula consists of two components. The first one is the baseline formula (23). The second component, which I label "Integer Problem", is the change in per capita income relative to the wage rate. Since per capita income is not equal to the wage, changes in y_j affect the mass of varieties available for consumption (20). The "Integer problem" component depends on the presence of income effects: a model with quasi-linear preferences would not feature it.

The sign of $d\ln y$ is ambiguous: accounting for the integer problem can yield larger or smaller gains from trade relative to the baseline model. The sign of $d\ln y_j$ depends on whether the trade shock generates a discrete change in the number of firms or if it leaves M_j constant. A reduction in trade costs reduces firms' profits: trade reduces domestic market shares and it increases the foreign market share. As firms charge higher markups in the domestic market relative to the export markets, trade reduces firms' profits. If M_j is continuous, a reduction in profits leads to firms' exit. With an integer number of firms, the reduction in trade costs may leave M_j constant.

If the reduction in trade costs leaves the number of firms unchanged, the reduction in profits due to trade causes a reduction in per capita income relative to the wage. As a result, welfare increases by a smaller amount relative to the baseline model. On the other hand, if the reduction in trade costs generates exit of firms, the surviving firms enjoy larger profits. When trade reduces the integer number of firms, per capita income increases, and the welfare gains from trade are larger than those predicted by the baseline model.

6.4 Welfare Comparison with the Literature

Trade Elasticity

Consider two countries of size $L_f = L_h = L$ and cost parameter $c_f = c_h = c$. We can normalize per capita income by setting $y_h = y_f = 1$. The number of firms in each country equals M and the total mass of varieties is Δ. I denote the domestic market shares by $s = s_{hh} = s_{ff}$ and the export market shares by $s^* = s_{hf} = s_{fh}$. The equilibrium equations that relate domestic and export market shares become:

$$\frac{s^{\theta}}{1-s} = \tau \frac{s^{*\theta}}{1-s^*} \tag{55}$$

The zero profit condition provides the second equilibrium condition:

$$s^2 + \theta s + s^{*2} + \theta s^* = F(\theta + 1)/L \tag{56}$$

The two equations (55) and (56) determine the equilibrium values of the market shares. Taking the total derivative of (55) and (56) yields:

$$\frac{\theta(1-s)+s}{1-s} d\ln s = \frac{\theta(1-s^*)+s^*}{1-s^*} d\ln s^* + \widehat{\tau}$$
$$(2s+\theta)sd\ln s + (2s^* + \theta)s^* d\ln s^* = 0$$

The formula for the trade elasticity in the symmetric country case only depends on the change in the domestic and export market share:

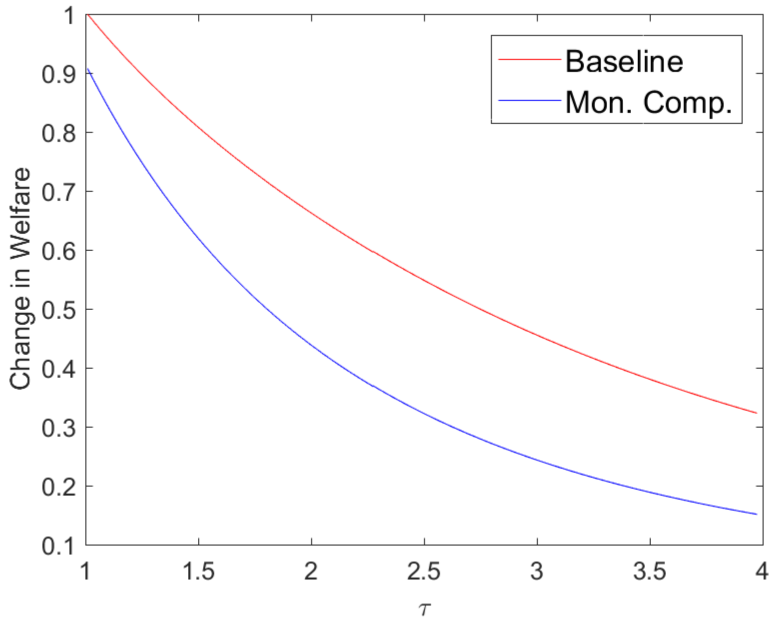
$$\varepsilon(\mathbf{s}, M) = -\frac{d\ln\frac{\Lambda_{ij}}{\Lambda_{jj}}}{d\ln\tau} = -\frac{d\ln\frac{Ms^*}{Ms}}{d\ln\tau} = \frac{d\ln s}{d\ln\tau} - \frac{d\ln s^*}{d\ln\tau} \tag{57}$$

Solving in the previous system of equations for the change in the two market shares yields the trade elasticity shown in the main text of the paper.

Welfare gains with Monopolistic Competition

Figure 4 shows the different welfare gains from trade predicted by a model with monopolistic competition and my baseline model, conditional on the same trade elasticity. The symmetric country model depends on a vector of four parameters $\Theta = [\tau, \theta, L, F]$. Without loss of generality, I choose the following parametrization: $\theta = 0.5$, $L = 1$ and $F = 0.32$, so that in the case of costless trade, the market share of the typical firm is 0.3. I let τ vary in $[1, 4]$, with 1% steps. The results are robust to alternative choices of the vector of parameters Θ.

Figure 4: Welfare Gains: Baseline Model VS Monopolistic Competition



Change in Welfare Normalized by Baseline at $\tau^1 = 1$

Welfare gains with CES preferences

This section derives the welfare formula for the models, discussed in the main text of the paper, in which consumers have homothetic preferences of the CES form. In particular, I compare the welfare gains from trade that arise in:

1. A model of large multiproduct firms;
2. A model of large multiproduct firms, where consumers have Nested CES preferences and σ and η are the elasticities of substitution across and within firms;

For each of the three models I describe the environment and derive the welfare formulas. The results are summarized in the following table:

Table 9: Welfare Gains from Trade with Homothetic preferences

Model	$\left\|\frac{d \ln W_j}{d \ln s_{jj}}\right\|$	ϵ
Multi Prod.	$\frac{1}{\epsilon} + \left(1 + \frac{1}{\sigma-1} - \frac{1}{\epsilon}\right) \frac{s_{jj}}{1-s_{jj}}$	$\frac{1}{\theta}$
Nested CES	$\frac{1}{\epsilon} + \left(1 + \frac{1}{\sigma-1} - \frac{1}{\epsilon}\right) \frac{s_{jj}}{1-s_{jj}}$	$\left[\theta + \frac{\eta-\sigma}{(\sigma-1)(\eta-1)}\right]^{-1}$

Let us start with a baseline CES utility function:

$$U_j = \left[\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} q_{kij}(\omega)^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

where $\sigma > 1$ is the elasticity of substitution across goods. For simplicity I assume that the elasticity of substitution within a firm is the same as the elasticity of substitution across firms as in Bernard et al. (2011). Solving the consumer's problem and aggregating yields the inverse demand function for a variety ω produced by firm k from i to j:

$$p_{kij}(\omega) = \left[\frac{y_j L_j}{\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{kij}} x_{kij}(\omega)^{\frac{\sigma-1}{\sigma}}} \right] x_{kij}(\omega)^{-\frac{1}{\sigma}} = A_j x_{kij}(\omega)^{-\frac{1}{\sigma}}$$

where $x_{kij}(\omega) = L_j q_{kij}(\omega)$. The demand shifter A_j equals:

$$A_j = \frac{y_j L_j^{\frac{1}{\sigma}}}{U_j^{\frac{\sigma-1}{\sigma}}} \tag{58}$$

Moreover, the marginal utility of income equals:

$$\lambda_j = \frac{U_j}{y_j} \tag{59}$$

The firm's problem is identical to the baseline case: firms compete à la Cournot choosing quantities and scope taking other firms' choices as given. Since the choke price is infinite with CES preferences, the core competence assumption and cannibalization effects are not enough to guarantee a finite solution for the scope of a firm. Hence, we need to add a fixed cost per variety f_{ij} in labor units.

The profits of a firm k in country j are then:

$$\Pi_{kij} = A_j \int_0^{\delta_{kij}} x_{kij}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega - \int_0^{\delta_{kij}} x_{kij}(\omega) c_{kij}(\omega) - \delta_{kij} f_{ij}$$

Solving the firm's problem yields the following implicit equation for the optimal scope:

$$c_{kij}(\delta_{kij}) = \left[\frac{\sigma-1}{\sigma} A_j (1 - s_{kij}) \right]^{\frac{\sigma}{\sigma-1}} [(\sigma-1) f_{ij}]^{\frac{1}{\sigma-1}} \tag{60}$$

The optimal quantity and prices a variety ω are:

$$\begin{aligned} x_{kij}(\omega) &= f_{ij}(\sigma-1) c_{kij}(\delta_{kij})^{\sigma-1} c_{kij}(\omega)^{-\sigma} \\ p_{kij}(\omega) &= \frac{\sigma}{(1-s_{kij})(\sigma-1)} c_{kij}(\omega) \end{aligned}$$

As in the baseline model, let us adopt the following functional form for the marginal cost of production and delivery $c_{kij}(\omega) = \tau_{ij} y_i c_{ki} \omega^\theta$. Aggregate revenues of a firm in country j are proportional to the firm's scope δ_{kij}.

$$r_{kij} = \int_0^{\delta_{kij}} x_{kij}(\omega) p_{kij}(\omega) = \frac{\delta_{kij} \sigma f_{ij}}{(1-\theta(\sigma-1))(1-s_{kij})}$$

For the firm's revenues to be finite, I restrict the parameters so that $\theta(\sigma-1) < 1$. Since $r_{kij} = s_{kij} y_j L_j$, the optimal scope of a firm can be written as:

$$\delta_{kij} = \frac{1-\theta(\sigma-1)}{\sigma f_{ij}} y_j L_j s_{kij}(1-s_{kij}) \tag{61}$$

The scope of the firm exhibits a non-monotone, hump-shaped relationship with respect of the firm's market share. The scope of the firm increases with the aggregate size of the destination $y_j L_j$ while in the non-homothetic case firms export more varieties in richer economies, regardless of the size of the destination. Moreover, if the fixed cost per variety is expressed in labor units of the destination, δ_{kij} only increases with the size L_j of the destination. Finally, the scope of an exporter does not directly depend on iceberg trade costs τ_{ij} nor the firm's productivity c_k, although those variables affect the market share s_{kij}. As in my baseline model, I assume that firms from the same country are identical: $c_{ki} = c_i$. I consider the symmetric equilibrium in which firms with identical cost parameter c_{ki} produce the same scope and the same quantity for each variety with distance from the core ω. To derive the equilibrium conditions, let us first use the definition of scope (61) into the the relative marginal cost of the last variety $c_{ij}(\delta_{ij})/c_{jj}(\delta_{jj})$, defined by (60). The first condition that relates the market share of domestic firms to exporters is then:

$$\frac{s_{jj}^\theta}{(1-s_{jj})^{\frac{\sigma}{\sigma-1}-\theta}} = \left(\frac{c_i w_i \tau_{ij}}{c_j w_j}\right) \frac{s_{ij}^\theta}{(1-s_{ij})^{\frac{\sigma}{\sigma-1}-\theta}} \tag{62}$$

Firm's profits equal:

$$\Pi_i = \sum_{j=h,f} \frac{y_j L_j}{\sigma} \left(s_{ij} + (\sigma-1)s_{ij}^2\right) - F w_i \tag{63}$$

Market clearing implies

$$M_i s_{ii} + M_j s_{ji} = 1 \tag{64}$$

Trade balance requires:

$$M_j s_{ji} y_i L_i = M_i s_{ij} y_j L_j \tag{65}$$

Normalizing home per capita income to 1, the equilibrium is a vector of market shares [s_{hh}, s_{hf}, s_{ff}, s_{fh}], of masses of firms [M_h, M_f], and foreign per capita income y_f such that equations (62), (64), and (65) are satisfied, and profits (63) are equal to zero, which implies that $w_j = y_j$.

Let us derive a formula for the welfare gains from a small variation in τ. Without loss of generality, let us focus on country j and let us normalize its income y_j to 1. Using (58) and

(61) in (60) yields an expression for the indirect utility function: V_j[32]:

$$V_j = s_{jj}^{-\theta}(1-s_{jj})^{\frac{\sigma}{\sigma-1}-\theta}\, L_j^{\frac{1}{\sigma-1}-\theta} c_j^{-1}\tilde{\kappa} \tag{66}$$

Given (59), the change in welfare can be computed as:

$$d\ln W_j = \theta\left[1+\left(\frac{\sigma}{\theta(\sigma-1)}-1\right)\frac{s_{jj}}{1-s_{jj}}\right](-d\ln s_{jj}) \tag{67}$$

To obtain the formula for a model with CES preferences and no cannibalization effects it suffices to set the market share s_{jj} to zero.

A tractable expression for the trade elasticity can be obtained in a symmetric country model. Consider two countries of size $L_f = L_h = L$ and cost parameter $c_f = c_h = c$. We can normalize per capita income by setting $y_h = y_f = 1$. The number of firms in each country equals M. I denote the domestic market shares by $s = s_{hh} = s_{ff}$ and the export market shares by $s^* = s_{hf} = s_{fh}$. When countries are symmetric, the trade elasticity equals:

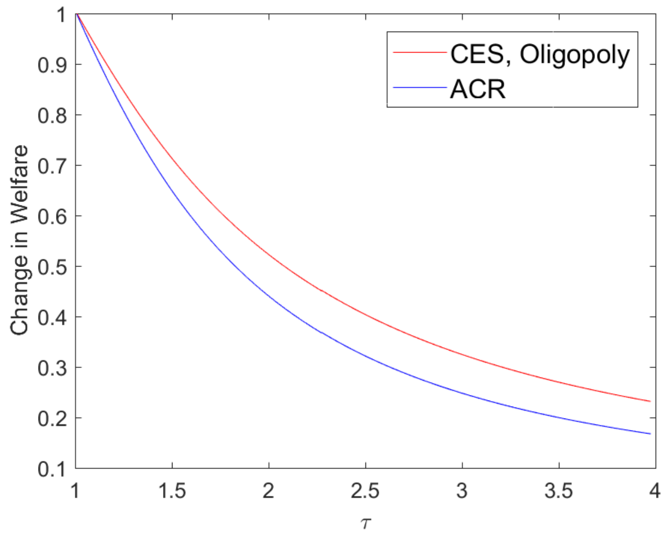
$$\varepsilon^O(\mathbf{s}) = \frac{1}{\theta}\frac{2(\sigma-1)s^2+s+2(\sigma-1)s^{*2}+s^*}{\left[1+\left(\frac{\sigma}{\theta(\sigma-1)}-1\right)\frac{s}{1-s}\right](2(\sigma-1)s^{*2}+s^*)+\left[1+\left(\frac{\sigma}{\theta(\sigma-1)}-1\right)\frac{s^*}{1-s^*}\right](2(\sigma-1)s^2+s)}$$

Conditional on the trade elasticity, $d\ln W_j^{ACR(\varepsilon)} \leq d\ln W_j^O$. The two models predict the same welfare gains when the iceberg trade costs approach the unit value. The difference between the two models' predictions increases as trade costs are larger.

I use numerical methods to solve for the equilibrium in a symmetric country model and compute the change in welfare that is generated by a 1% reduction in τ. The symmetric country model depends on a vector of five parameters $\Theta = [\tau, \theta, \sigma, L, F]$. Without loss of generality, I choose the following parametrization: $\theta = 1$, $\sigma = 2.5$, $L = 1$ and $F = 0.348$, so that in the case of costless trade, the market share of the typical firm is 0.3. I let τ vary in $[1, 4]$, with 1% steps. The results are robust to alternative choices of the vector of parameters Θ.

[32] $\tilde{\kappa} = \left[\frac{\sigma-1}{\sigma}\right]^{\frac{\sigma}{\sigma-1}}\left[\frac{\sigma}{1-\theta(\sigma-1)}\right]^{\theta}(\sigma-1)^{\frac{1}{1-\sigma}}$

Figure 5: Welfare: Local and General Formula



Change in Welfare Normalized by Baseline-CES at $\tau^1 = 1$

Figure 5 shows the welfare gains from trade predicted by an oligopolymodel with CES preferences, and those predicted by the ACR formula. Consider now the case in which consumers have Nested CES preferences of the following form (Hottman et al., 2016):

$$U_j = \left[\sum_{i=h,f} \sum_{k=1}^{M_i} Q_{kij}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \qquad \text{where}$$

$$Q_{kij} = \left[\int_0^{\delta_{kij}} q_{kij}(\omega)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}$$

where $\sigma > 1$ is the elasticity of substitution of the varieties across firms, and η is the elasticity of substitution across the varieties within a firm. I assume that $\eta > \sigma$, which implies that varieties are more substitutable within a firm that they are across firms.

Following the same steps of the previous section it can be shown that the optimal scope of a firm is a constant fraction of (61).

$$\delta_{kij} = \frac{(1 - \theta(\eta - 1))(\sigma - 1)}{\sigma(\eta - 1) f_{ij}} y_j L_j s_{kij}(1 - s_{kij})$$

and that the welfare formula is analogous to the previous case, but the θ is substituted by $\left[\theta + \frac{\eta-\sigma}{(\sigma-1)(\eta-1)}\right]^{-1}$

6.5 Quantifying the Mismeasurement

The US Economic Census of Manufacturers reports the total market share (defined as firm's shipment over total US shipments) in a NAICS 4 digits industry, of the largest four and eight firms in 2002 and 2007[33]. I use the industry definition (as provided on the US Census website) to identify the industries that produce consumers goods. Dividing the total market share by the number of firms considered yields the average market share of the largest four or eight firms, denoted by $\tilde{s}^g_{jj}$ in industry g. To obtain the market share of the typical US superstar in an industry, we also need the US supply share in the same industry Λ^g_{jj}. To compute Λ^g_{jj} I follow Feenstra and Weinstein (2017). I use data from the Bureau of Economic Analysis (BEA) on gross output by industry. BEA reports data in NAICS 6 digits, which is aggregated to compute the industry gross output at the NAICS 4 digits level. I use data on exports and imports at the NAICS 4 digits level from United States International Trade Commission, for 2002 and 2007. First, the US supply of an industry g in year t is $\text{Supply}_{gt} = \text{Gross Output}_{gt} - \text{Export}_{gt}$. Λ^g_{jj} is then:

$$\Lambda^g_{jj} = \frac{\text{Supply}_{gt}}{\text{Supply}_{gt} + \text{Imports}_{gt}}$$

The market share of the typical superstar in an industry g and year t is $s^g_{jj} = \tilde{s}^g_{jj}\Lambda^g_{jj}$[34]. The change in the market share is $d\ln s^g = \ln(s^g_{jj2002}) - \ln(s^g_{jj2007})$.

I use the trade elasticities estimated by Caliendo and Parro (2015) using 99% of their sample. Caliendo and Parro (2015) use ISIC Rev. 3 industries and I match those with NAICS industries. I match the 4 digits NAICS industry to the corresponding 3 digits level of ISIC since Caliendo and Parro (2015) do not provide trade elasticities at a higher level of disaggregation.

I use the σ estimated by Soderbery (2015) according to the method of Feenstra (1994) and Broda and Weinstein (2006). I match each HS 10 digits goods to the corresponding 3 digits ISIC Rev. 3 industry used by Caliendo and Parro (2015). For each industry σ is the median elasticity of substitution across the HS 10 goods that belong to an industry.

Table 10 shows the welfare change from 2002 to 2007 at the industry level. The table reports $d\ln W$ as computed in equation (23). In addition, it provides the extent of the mismeasurement of welfare gains that arises from models that ignore cannibalization effects or per capita income.

[33] For a full set of measures of market concentration see https://www.census.gov/econ/concentration.html

[34] $\text{Supply}_{gt} + \text{Imports}_{gt}$ is also the total absorption I use in weighting the changes in the averages.

Table 10: Industry Level Welfare Gains Across Models (2007-2002) (%)

Code	Description	s_{jj}	$d\ln s_{jj}$	SG, MC	SG, Const. MUI	CES, Olig.	CES, MC
3111	Animal food	0.07	5	-15	37	54	-2
3112	Grain and oilseed milling	0.11	7	-22	36	49	-10
3113	Sugar and confectionery	0.08	-6	-17	37	53	-4
3114	Fruit and vegetable preserving	0.06	-16	-12	37	57	2
3115	Dairy product	0.06	-6	-13	37	56	1
3116	Animal slaughtering and processing	0.10	-11	-20	37	50	-8
3117	Seafood	0.04	22	-9	37	59	5
3118	Bakeries and tortilla	0.07	-23	-14	37	55	0
3119	Other food	0.08	-9	-17	37	53	-3
3121	Beverage	0.09	-6	-18	37	52	-5
3122	Tobacco	0.21	3	-39	35	37	-29
3141	Textile furnishings mills	0.09	-30	-43	11	99	-40
3149	Other textile product mills	0.02	2	-14	12	147	-9
3222	Converted paper product	0.04	-7	-38	5	166	-36
3231	Printing and related support activities	0.02	24	-27	6	188	-24
3254	Pharmaceutical and medicine	0.07	-22	-16	31	59	-4
3255	Paint, coating, and adhesive	0.07	-6	-18	31	59	-6
3256	Soap, cleaning compound, and toilet preparation	0.09	6	-21	30	57	-11
3259	Other chemical product and preparation	0.07	-38	-16	31	59	-5
3261	Plastics product	0.01	3	-2	60	32	21
3262	Rubber product	0.08	-15	-11	59	29	9
3271	Clay product and refractory	0.02	3	-5	41	41	11
3272	Glass and glass product	0.05	11	-10	41	42	6
3322	Cutlery and handtool	0.04	-36	-18	14	108	-13
3341	Computer and equipment	0.04	-13	-34	7	157	-32
3342	Communications equipment	0.06	-38	-17	24	71	-7
3346	Magnetic and optical media	0.07	6	-45	7	135	-43
3351	Electric lighting	0.05	-28	-35	7	145	-33
3352	Household appliance	0.10	-20	-55	6	125	-54
3361	Motor vehicle	0.13	-26	-19	52	32	-2
3366	Ship and boat building	0.12	-15	-4	254	-17	49
3369	Other transportation equipment	0.09	12	-3	255	-15	51
3371	Furniture	0.03	-7	-25	8	160	-22
3399	Other miscellaneous	0.01	3	-2	25	71	9