

# Multiproduct Firms across Rich and Poor Countries

## Theory and Evidence

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Preliminary. Comments Welcome!

### Abstract

I document two new stylized facts for multiproduct exporters. First, the number of exported varieties per firm increases with the per capita income of the destination country. Second, there exists a non-monotone, hump-shaped relationship between the number of varieties exported by a firm in a destination and the market share of the firm itself. I rationalize these findings in a model of large multiproduct firms. The model features consumers with non-homothetic preferences and firms that have a core competence and face cannibalization effects. I derive a new formula for the welfare gains from trade that relates the change in the domestic market share of the typical domestic firm to the change in welfare due to trade liberalization. The stronger the cannibalization effects, the larger the welfare gains from trade. Common models of monopolistic competition, which ignore cannibalization effects, generate smaller welfare gains.

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

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# 1 Introduction

The expansion of the number of varieties available to consumers constitute a major component of the gains from trade (Krugman, 1980). In traditional models of international trade (Melitz, 2003), the number of varieties available for consumption is equivalent to the number of firms selling to an economy, because of the common assumption of single product firms. However, such an assumption is at odds with the data: world trade is dominated by multiproduct firms (Bernard et al., 2011). Consequently, understanding the determinants of the number of varieties exported per firm, the so-called *product scope*, has new implications for the welfare of consumers. This paper studies the effects of the product scope of exporters on consumers' welfare from two perspectives.

First, I document a new stylized fact on multiproduct firms: the product scope of exporters increases with the per capita income of the destination. Using transaction-level data from the Exporter Dynamics Database (Cebeci et al., 2012), I find that doubling the per capita income of the destination is associated with a 6.4% increase in the number of varieties exported per firm. Large multinationals such as Samsung, Apple, Zara, Ikea and H&M<sup>1</sup> behave similarly, and offer a larger set of varieties on the online stores of richer economies. Combined with the positive relationship between firms' markups and per capita income of the destination (Simonovska, 2015), the new stylized fact sheds some light on the different effects of trade on rich and poor economies.

Second, I study the welfare effects of a typical feature of multiproduct firms, often neglected: *cannibalization effects*. When a firm that produces imperfect substitutes introduces a new variety it reduces, or cannibalizes, the sales from its existing varieties. As a result, cannibalization effects limit the product scope of firms<sup>2</sup>. I document cannibalization effects through a new stylized fact on multiproduct firms. Using data from the Exporter Dynamics Database and data on the European car market from Goldberg and Verboven (2005) I find a non-monotone, hump-shaped relationship between the product scope of a firm and its market share, as predicted by Feenstra and Ma (2007). While for small firms an increase in the market share is associated with a rise in the product scope, the largest firms, which face stronger cannibalization effects, reduce their scope as they gain market share. Since large exporters account for a large share of a country's exports (Freund and Pierola, 2012)<sup>3</sup>, cannibalization effects could potentially have a large impact on the welfare of consumers.

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<sup>1</sup>I created an original dataset with the varieties offered on the website of Samsung. The data on the remaining firms was collected by Cavallo et al. (2014).

<sup>2</sup>Moreover, the quantity or price chosen for one variety affects the demand for all other existing varieties produced by the same firm. Hottman et al. (2014) found that cannibalization effects can explain the price choices of the largest firms. Cannibalization effects also explain the so-called "innovation gap": the reluctance of incumbents to introduce new varieties relative to new entrants (Igami, 2015). The marketing literature provides additional anecdotal evidence on cannibalization, in the Food, Automotive (Copulsky, 1976) and Pharmaceutical Industry (Kerin et al., 1978).

<sup>3</sup>Using the Exporter Dynamics Database I find that the top 1% of exporters accounts for 20-50% of all exports of consumption goods. Freund and Pierola (2012) finds similar results for all goods with a larger base of countries by (Freund and Pierola, 2012). Using US bar code data, Hottman et al. (2014) find that within a product group half of all output is produced by a handful of firms and 98% of firms have market shares of less than 2%.

I rationalize these two stylized facts in a model of large multiproduct firms. I combine, in a tractable way, three main assumptions: 1) consumers have non-homothetic preferences, 2) firms compete oligopolistically and 3) firms have a core competence and adding a new variety requires minimal adaptation of the production process (Eckel and Neary, 2010). The model generates the first stylized fact: the product scope of exporters is larger in richer economies. Firms tend to export their core variety in all destinations, but export their non-core varieties only in richer economies. Such a prediction is exemplified by Samsung: while Samsung offers its core varieties - smartphones and tablets - in all destinations, only richer economies have a wide choice of Samsung's accessories. The model also generates the non-monotone, hump-shaped relationship found in the data between product scope of a firm and its market share. Large firms reduce their product scope and focus on the high-markup, core varieties as they gain market shares.

The model is consistent with several established stylized facts on multiproduct exporters. The model predicts that only a fraction of domestic varieties per firm are exported, as documented by Iacovone and Javorcik (2010). Moreover, the most successful varieties tend to be sold across more destination than the least successful ones, consistently with the evidence provided by Arkolakis et al. (2014). According to the model, trade liberalization reduces the product scope of domestic producer as shown by Bernard et al. (2011) and, consistently with Mayer et al. (2014), firms skew their sales towards the most successful product in destinations with stronger competition. The model features variable markups, with the most productive firms charging the highest markups, in line with the evidence documented by De Loecker and Warzynski (2012). The model is also consistent with the recent empirical findings of Simonovska (2015) that firms charge higher markups in richer economies. Cannibalization effects alone generate other predictions in line with empirical evidence. For Bertrand competition, the pass-through with respect to the real exchange rate exhibits a U-shaped relationship with the firm market share, as documented by Auer and Schoenle (2015). In addition, after a trade liberalization, firms with a larger market share tend to reduce their domestic scope by less, consistently with the findings of Baldwin and Gu (2009).

The model generates a parsimonious formula to compute the welfare gains from a reduction in trade costs.

$$d \ln W = \frac{\theta(\theta + 2)}{2(\theta + 1)} \left[ 1 + \frac{s}{\theta(1 - s)} \right] (-d \ln s) \quad (1)$$

The change in welfare  $d \ln W$  is related to the change in the market share of the typical domestic firm  $d \ln s$ . The formula only requires a parameter  $\theta$  that represents how fast marginal costs rise with the product scope of a firm, and on the current market share  $s$  of the typical firm. The welfare effects of a trade liberalization can be computed *ex-post* from the resulting change in the domestic market share of the typical domestic firm, and *ex-ante* by estimating the change in  $s$  after a change in trade costs. The welfare formula is similar to the one introduced by Arkolakis et al. (2012) where the welfare gains from trade are a function of the expenditure share on domestic goods. Cannibalization effects change the sufficient statistic required to compute gains from trade:

from the domestic trade share to the domestic market share of the typical domestic firm.

In addition, given  $d \ln s$  and  $\theta$ , the welfare gains from trade are increasing in the level of the market share of the typical firm. Trade liberalization improves welfare of consumers by allowing the introduction of new imported varieties: new firms enter and existing firms increase the number of exported varieties. A larger set of imported varieties weakens the cannibalization effects faced by domestic firms, which, in turn, expand their product scope, further increasing welfare. The larger the cannibalization effects, which are associated with a larger market share of the typical domestic firm, the larger the benefits from a trade liberalization.

The paper makes us reconsider the role of market structure on the welfare gains from trade. The usually assumed monopolistic competition<sup>4</sup>, which by construction ignores cannibalization effects, generates lower gains from trade than a model of oligopoly. In models of monopolistic competition where firms have a core competence, the gains from trade mainly derive from the selection of varieties within firms: firms abandon the non-core varieties and focus on their most successful products. In my model of oligopoly, the welfare gains from the selection of varieties within firms are augmented by the weakening of cannibalization effects. The implications are momentous, given the new wave of trade agreements that involves the United States. On October 2015 the United States and eleven other countries reached an agreement on the Trans-Pacific Partnership (TPP), one of the largest trade agreement in history. Meanwhile, the European Union and the US are negotiating the Transatlantic Trade and Investment Partnership (TTIP), a free trade agreement that could be finalized in 2016. Such trade agreements could affect relatively concentrated sectors as the car industry (Head and Mayer, 2015), where the domestic market shares of domestic producers are quite large (Cosar et al., 2015).

The remainder of the paper is organized as follows. Section 2 surveys the related literature highlighting the contributions of this paper. Section 3 presents the model. I first consider the behavior of firms and generate the firm-level testable predictions that guide the empirical analysis. Then, I solve the model in general equilibrium, proving that firms expand their product scope in richer economies and studying the effects of a reduction in trade barriers on the product scope of exporters. Finally, I derive the welfare formula (1) and compare the welfare gains generated by model to other models of multiproduct firms with and without cannibalization effects. Section 4 presents the two stylized facts on multiproduct firms previously described. Section 5 concludes the paper.

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<sup>4</sup>Since Krugman (1980) the assumption of monopolistic competition is widely used in models of international trade (Melitz, 2003). In the context of multiproduct firm, monopolistic competition has been used, for instance, by Bernard et al. (2011), Manova and Zhang (2012), Arkolakis et al. (2014), Mayer et al. (2014). When a firm is monopolistically competitive, the cannibalization effects are negligible and thus ignored.

## 2 Related Literature

The paper relates to the theoretical and empirical research on multiproduct exporters, which has taken shape since the 2000s. Models of multiproduct exporters add a new layer of heterogeneity to the [Melitz \(2003\)](#) model at the firm level. The varieties of a firm differ because of variety-specific cost of production ([Arkolakis et al., 2014](#); [Mayer et al., 2014](#)) or variety-specific quality ([Bernard et al., 2011](#); [Manova and Zhang, 2012](#); [Eckel et al., 2015](#)). In addition to the selection of the most productive firms into export markets, these models predict that only the most successful products within firms are exported<sup>5</sup>.

A common feature of the papers described is the assumption of monopolistic competition, in which firms produce differentiated varieties and are infinitesimally small. In such a market structure, a firm introduces a variety ignoring its effect on the sales of existing varieties: by construction, monopolistic competition neglects cannibalization effects<sup>6</sup>. In fact, given standard demand functions, when a firm introduces a new variety it reduces the sales on the existing varieties through changes in the price or quantity indices. For cannibalization effects to affect the optimal prices and quantities, firms must realize their influence on price or quantity indices. While monopolistic competition assumes that firms take these indexes as given, oligopoly allows firms to realize their effects on market aggregates and thus is the market structure required for cannibalization effects<sup>7</sup>. Cournot competition is the favorite choice for [Eckel and Neary \(2010\)](#), [Ottaviano and Thisse \(2011\)](#) and [Baldwin and Gu \(2009\)](#), while [Feenstra and Ma \(2007\)](#) and [Hottman et al. \(2014\)](#) assume Bertrand competition.

The model presented in this paper is the first to introduce per capita income effects into a model of multiproduct firms. The papers listed, in fact, either ignore per capita income effects by assuming quasilinear preferences with a homogeneous outside good, or consider homothetic preferences<sup>8</sup>. The most closely related papers are [Eckel and Neary \(2010\)](#) and [Feenstra and Ma \(2007\)](#). Both papers consider symmetric firms that face cannibalization effects. While in [Feenstra and Ma \(2007\)](#) all products of a firm are produced with the same marginal cost, [Eckel and Neary \(2010\)](#) assume a core competence and that marginal costs rise with scope<sup>9</sup>. The two papers consider an integrated world economy, whereas I am able to study a two asymmetric country model with iceberg trade costs.

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<sup>5</sup>[Allanson and Montagna \(2005\)](#) consider symmetric firms. [Brambilla \(2009\)](#) builds a partial equilibrium model where firms pay an information cost to discover their R&D capabilities. [Nocke and Yeaple \(2014\)](#) model symmetric products within a firm, but firms are endowed with different levels of organizational capital and efficiency.

<sup>6</sup>Equivalently, monopolistic competition assumes that each firm has a product manager that maximizes the profits of his own product neglecting how other products of the same firm are affected.

<sup>7</sup>Unless ad hoc preferences are developed as in [Dhingra \(2013\)](#).

<sup>8</sup>With homothetic preferences, the demand elasticities are independent of per capita income. As a result, the effect of per capita income is often indistinguishable from the effect of market size.

<sup>9</sup>[Feenstra and Ma \(2007\)](#) assumes CES preferences with an outside numeraire good. [Eckel and Neary \(2010\)](#) assume that a firm is large in its own industry, but small relative to the economy. This assumption boils down to ignoring the role of per capita income differences despite the use of non-homothetic preferences.

The paper is also related to the literature that studies the effects of the destination per capita income on the extensive margin of trade. [Hummels and Klenow \(2002\)](#) and [Sauré \(2012\)](#) document that rich countries import a larger number of varieties<sup>10</sup>. Traditionally, the literature assumes single-product firms: as a result models consistent with these facts predict that more firms export to richer economies. The most common reason that explains the larger set of varieties offered to richer economies are non-homothetic preferences ([Matsuyama, 2000](#))<sup>11</sup>. This paper focuses on the within-firm extensive margin: non-homothetic preferences drive the positive relationship between product scope of exporters and per capita income of the destination.

That per capita income, rather than market size, affects trade patterns and exporters' choices is an old idea that dates back to Linder's hypothesis of 1961. In recent years there has been a revival for the role of non-homothetic preferences and per capita income in trade theories. According to [Markusen \(2013\)](#) and [Caron et al. \(2014\)](#) non-homothetic preferences could explain the home bias in consumption, the "missing" trade and skill premia puzzles. Non-homothetic preferences rationalize stylized facts on the export specialization of countries ([Fajgelbaum et al., 2015](#)), their import specialization ([Matsuyama, 2000](#)) and even aggregate trade patterns ([Fieler, 2011](#)). Per capita income differences across countries affect exporters' choices beyond the exporter scope, influencing product quality and prices. Firms export higher quality goods to richer countries, and a possible explanation is a non-homothetic demand for quality ([Feenstra, 2014](#)). Moreover, prices of tradable goods are systematically higher in richer economies ([Alessandria and Kaboski, 2011](#)). Reasons for such an empirical fact are related to quality choices ([Schott, 2004](#)), higher distribution margins in richer countries ([Crucini and Yilmazkuday, 2009](#)) or higher markups ([Simonovska, 2015](#)). In my model product scope and prices are positively related: firms set larger markups and export more varieties in richer countries.

The paper also relates to the recent literature, started by [Arkolakis et al. \(2012\)](#) (ACR), on the welfare gains from trade arising from modern models. ACR showed that for a large class of models, notably the Ricardian and the Melitz model, the welfare gains from trade can be computed with a parsimonious formula that uses the expenditure share on domestic goods and the trade elasticity. The literature has grown considerably after ACR extending the quantitative analysis of welfare to other classes of models not included in ACR. The research has looked at different preferences ([Feenstra, 2014](#); [Levchenko and Zhang](#); [Arkolakis et al., 2015](#); [Caliendo et al., 2015](#); [Jung et al., 2015](#); [Bertoletti et al., 2016](#)). While welfare gains under oligopoly have been studied by [Edmond et al. \(2015\)](#), this paper is the first to propose a simple formula for their quantification.

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<sup>10</sup>[Bernard et al. \(2007\)](#) additionally documents that larger economies import more varieties. Moreover, rich and large economies export a larger set of varieties ([Hummels and Klenow, 2005](#))

<sup>11</sup>In addition to [Matsuyama \(2000\)](#), the models of [Simonovska \(2015\)](#), [Ramezzana \(2000\)](#) and [Bernasconi and Wuergler \(2013\)](#) predict larger entry, and therefore larger set of varieties exported, in richer countries. The model of ideal variety of [Hummels and Lugovskyy \(2009\)](#) provides a different explanation that relies on the heterogeneous preferences of consumers.

### 3 Model

In this section I develop a model of large multiproduct firms. In the first part of the section I generate the testable predictions of the model. In the second one I consider the general equilibrium and prove the main results of the paper. Finally, I study the welfare gains from trade predicted by the model.

#### 3.1 Firm-Level Analysis

I 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 finite number  $M_i$  of firms engage in trade of varieties of a final good. Each firm  $k$  produces a continuum of varieties: from country  $i$  to country  $j$  firm  $k$ 's varieties are indexed by  $\omega \in [0, \delta_{k,ij}]$ .  $\delta_{k,ij}$  is then the mass of varieties offered by an exporter - the exporter's product scope. Trade requires an iceberg trade cost  $\tau$ . Firms compete à la Cournot and free entry drives their profits to zero.

##### 3.1.1 Consumers' Problem

Consumers in both economies have the same Stone-Geary preferences ([Simonovska, 2015](#)) represented by the following utility function<sup>12</sup>:

$$U_j = \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} [\ln(q_{k,ij}(\omega) + \bar{q}) - \ln \bar{q}] d\omega \quad (2)$$

where  $q_{k,ij}(\omega)$  is the quantity consumed of variety  $\omega$  produced by firm  $k$  in country  $i$  to country  $j$ , and  $\bar{q} > 0$  is a constant. This utility function is non-homothetic<sup>13</sup>. The marginal utility is bounded from above, and thus there exists a choke price for any level of per capita 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<sup>14</sup>. The choke price is increasing with income, thus only richer economies exhibit positive demand for the most expensive goods.

Consumers maximize their utility subject to the following budget constraint:

$$\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} p_{k,ij}(\omega) q_{k,ij}(\omega) d\omega \leq y_j \quad (3)$$

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<sup>12</sup>I focus here on home consumers, since the problem for foreign consumers is identical. Relative to [Simonovska \(2015\)](#) I added the  $-\ln \bar{q}$  term that allows the utility to equal zero when none of the potential varieties available is consumed. On the other hand, [Simonovska \(2015\)](#) assumes that the variety space is compact.

<sup>13</sup>Results would still hold with a linear quadratic utility function of the form used by ([Eckel and Neary, 2010](#)).

<sup>14</sup>[Jackson \(1984\)](#) finds evidence for this ranking using a cross section of consumers.



which yields the inverse demand function:

$$p_{k,ij}(\omega) = \frac{1}{\lambda_j(q_{k,ij}(\omega) + \bar{q})} \quad (4)$$

where  $\lambda_j$  is the Lagrangian multiplier associated with the budget constraint and has the textbook interpretation of being the marginal utility of income of consumers in  $j$ . Using (4) into the budget constraint yields an expression for the marginal utility of income:

$$\lambda_j = \frac{1}{y_j} \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} \frac{q_{k,ij}(\omega)}{q_{k,ij}(\omega) + \bar{q}} d\omega \quad (5)$$

$\lambda_j$  is decreasing in per capita income: the richer a consumer is, the lower the marginal gain from an additional unit of income<sup>15</sup>.

Since all consumers in the home country are identical, the aggregated demand for the variety  $\omega$  produced by firm  $k$  in country  $i$  can be denoted by  $x_{k,ij}(\omega) = L_j q_{k,ij}(\omega)$ . We can rewrite the inverse demand function and the marginal utility of income in terms of the aggregate demand:

$$p_{k,ij}(\omega) = \frac{L_j}{\lambda_j(x_{k,ij}(\omega) + L_j \bar{q})} \quad (6)$$

$$\lambda_j = \frac{1}{y_j} \left[ \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} \frac{x_{k,ij}(\omega)}{x_{k,ij}(\omega) + L_j \bar{q}} d\omega \right] \quad (7)$$

### 3.1.2 Firms' Problem

Labor is the only factor of production and the marginal cost of production and delivery of one unit of a variety is a constant  $c_{k,ij}(\omega)$ <sup>16</sup>. Each firm pays a fixed cost of production  $F$  in labor units, which is independent of scope and quantity. Since free entry drives profits to zero, the wage of a worker in country  $i$  equals the per capita income  $y_i$ .

I assume that the technology of the firm is characterized by a core competence and flexible manufacturing. Firms are able to increase the number of varieties with minimum adaptation to the production processes (Arkolakis et al., 2014; Mayer et al., 2014; Eckel and Neary, 2010): the marginal cost of producing a variety  $c_{k,ij}(\omega)$  is increasing in  $\omega$ . Such an assumption is consistent with the empirical finding that firms' exports are skewed towards the most successful, or the core, varieties and that core varieties tend to be sold in every market (Arkolakis et al., 2014). In addition, the distribution of within-firm sales is similar across destination (Arkolakis et al., 2014).

In my baseline model, firms in each country are homogeneous: each firm produces differentiated varieties but  $c_{k,ij}(\omega') = c_{k',ij}(\omega')$  for  $k, k' = 1, \dots, M_i$  and for each  $\omega' > 0$ . Oligopoly models widely

<sup>15</sup> $\lambda_j$  is also increasing in the quantities of each variety and the mass of varieties produced by each firm.

<sup>16</sup>The marginal cost of production and delivery includes the iceberg trade cost  $\tau$  of exporting.



assume homogeneous firms because of their tractability (Eckel and Nary, 2010; Feenstra and Ma, 2007). Moreover, we can interpret my model as describing the behavior of export superstars: large firms that account for most of a country's export and that have a major role in shaping trade patterns (Freund and Pierola, 2012). However, we do not need to impose such an assumption to generate the testable prediction of the model. Therefore, in this section, I consider asymmetric firms, imposing symmetry only in the general equilibrium section.

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

$$\Pi_{k,i} = \sum_{j=h,f} \int_0^{\delta_{k,ij}} \left( \frac{L_j}{\lambda_j (x_{k,ij}(\omega) + L_j \bar{q})} - c_{k,ij}(\omega) \right) x_{k,ij}(\omega) d\omega - y_i F \quad (8)$$

where  $\lambda_j$  is defined by (7). The first order condition with respect to the quantity produced of  $\omega$  from  $i$  to  $j$  equals:

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

A rise in the production of  $x_{k,ij}(\omega)$  increases the revenues from the sales of that variety, generating the standard marginal revenues that arise in models with no cannibalization effects. Because of cannibalization effects, increasing  $x_{k,ij}(\omega)$  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  $\lambda_j$ . Increasing the quantity produced of one variety raises the marginal utility of income  $\lambda_j$ : a consumer that faces a large supply values more one additional unit of income. A larger  $\lambda_j$  shifts down the inverse demand function (6), reducing the demand for all the varieties offered in the market at any given price.

Letting  $s_{k,ij}$  denote the firm's market share, defined as the firm's total sales in  $j$  divided by the total sales of all firms in  $j$ , the equation simplifies to<sup>17</sup>

$$\frac{1}{\lambda_j} \frac{L_j^2 \bar{q}}{(x_{k,ij}(\omega) + L_j \bar{q})^2} (1 - s_{k,ij}) = c_{k,ij}(\omega) \quad (9)$$

The term  $1 - s_{k,ij}$  reduces the marginal revenue of an additional unit of  $x_{k,ij}(\omega)$ . The higher the market share of the firm, the stronger the cannibalization effects, the lower the marginal revenues of a new variety.

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<sup>17</sup>The appendix reports the steps that yields such a solution and the second order conditions.

The first order conditions with respect to the mass equal:

$$\frac{\partial \Pi_{k,j}}{\partial \delta_{k,ij}} = \frac{L_j}{\lambda} \frac{x_{k,ij}(\delta_{k,ij})}{x_{k,ij}(\delta_{k,ij}) + L\bar{q}} (1 - s_{k,ij}) - x_{k,ij}(\delta_{k,ij}) c_{k,ij}(\delta_{k,ij}) = 0 \quad (10)$$

Introducing new varieties causes revenues from other varieties to fall by a factor proportional to the firm's market share. [Hottman et al. \(2014\)](#) introduced a useful way to understand the magnitude of cannibalization effects through the ‘‘Cannibalization rate’’, defined as the partial elasticity of sales of firm  $k$  from existing varieties ( $R_{k,ij}$ ) with respect to the number of varieties produced by firm  $j$  ( $\delta_{k,ij}$ ):

$$\text{Cannibalization rate} = -\frac{\partial R_{k,ij}}{\partial \delta_{k,ij}} \frac{\delta_{k,ij}}{R_{k,ij}} = s_{k,ij}$$

While [Hottman et al. \(2014\)](#) use a nested CES framework, and their cannibalization rate depends on the elasticities of substitution across and within firms, in my model the cannibalization rate equals the market share of the firm.

By the core competence assumption, as the firm expands its scope, the marginal cost of production of the new varieties increases. The firm then expands the mass of its varieties until the demand for last variety becomes zero, i.e.  $x_{k,ij}(\delta_{k,ij}) = 0$ . Using this result into (9) I obtain an implicit equation that defines the optimal mass of varieties supplied by the firm:

$$c_{k,hj}(\delta_{k,ij}) = \frac{(1 - s_{k,ij})}{\bar{q}\lambda_j} \quad (11)$$

By the core competence assumption, the left hand side of equation (11) increases with the mass of varieties  $\delta_{k,ij}$ . By decreasing marginal utility of income, higher per capita income reduces  $\lambda_j$  thus increasing the mass of varieties produced, given the market share. Using (11) the optimal supply of  $\omega$  is:

$$x_{k,ij}(\omega) = \bar{q}L_j \left[ \left( \frac{c_{k,ij}(\delta_{k,ij})}{c_{k,ij}(\omega)} \right)^{\frac{1}{2}} - 1 \right] \quad (12)$$

The larger the scope of the firm, the larger the marginal cost of its last variety, the larger the quantity produced of all its varieties. Substituting (12) into the inverse demand function (6) yields the pricing equation:

$$p_{k,ij}(\omega) = \frac{[c_{k,ij}(\omega)c_{k,ij}(\delta_{k,ij})]^{\frac{1}{2}}}{1 - s_{k,ij}} = \underbrace{\frac{1}{1 - s_{k,ij}} \left( \frac{c_{k,ij}(\delta_{k,ij})}{c_{k,ij}(\omega)} \right)^{\frac{1}{2}}}_{\text{Markup}} c_{k,ij}(\omega) \quad (13)$$

Markups vary across firms and across varieties of the same firm. In particular, the closer to the core competence a variety is, the higher the markup. Across firms, those with the largest scope

and the largest market share charge the highest markups, in line with the evidence documented by [De Loecker and Warzynski \(2012\)](#). Setting the market share to zero yields the same pricing equation of a model with monopolistic competition ([Simonovska, 2015](#)). Consistently with the findings of [Hottman et al. \(2014\)](#), prices of firms with a small market share can be approximated by the monopolistic competition outcome. However the markups of firms with a large market share deviates from those predicted by monopolistic competition.

Revenues from a variety  $\omega$  are:

$$r_{k,ij}(\omega) = x_{k,ij}(\omega)p_{k,ij}(\omega) = \frac{\bar{q}L_j}{1 - s_{k,ij}} \left( c_{k,ij}(\delta_{k,ij}) - [c_{k,ij}(\delta_{k,ij})c_{k,ij}(\omega)]^{\frac{1}{2}} \right) \quad (14)$$

Using the cost of the last variety, we can express our marginal utility of income as:

$$\lambda_j = \frac{1}{y_j} \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} \left[ 1 - \left( \frac{c_{k,ij}(\omega)}{c_{k,ij}(\delta_{k,ij})} \right)^{\frac{1}{2}} \right] d\omega \quad (15)$$

### 3.1.3 Optimal Product Scope and Prices

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  $j$ :

$$c_{k,ij}(\omega) = \tau_{ij} y_i c_{k,i} \omega^\theta \quad (16)$$

where  $\theta > 0$  and  $\tau_{ii} = 1$ . The marginal cost increases with the varieties produced to capture the core competence assumption.  $\theta$  is the elasticity of the marginal cost of the last variety with respect to the product scope of a firm, and it captures how fast marginal costs rise with scope. The parameter  $c_{k,i}$  captures the efficiency of firm  $k$  in country  $i$ .

Firm's revenues can then be written as:

$$r_{k,ij} = \frac{\theta L_j \delta_{k,ij}}{\lambda_j (\theta + 2)}$$

Hence, the market share of the firm equals the ratio of the firm's product scope to the total mass of varieties available:

$$s_{k,ij} = \frac{r_{k,ij}}{\sum_v \sum_k r_{k,vj}} = \frac{\delta_{k,ij}}{\Delta_j} \quad (17)$$

where  $\Delta_j = \sum_v \sum_k \delta_{k,vj}$  is the total mass of varieties available to consumers in  $j$ . Using (17) and (15) into (11) we can derive an expression for exporter scope of home firms that depends on the home firm's market share in the foreign economy and on the foreign per capita income:

$$\delta_{k,ij} = \left[ \frac{\theta + 2}{\theta \bar{q} y_i c_{k,i} \tau_{ij}} \right]^{\frac{1}{\theta+1}} y_j^{\frac{1}{\theta+1}} [s_{k,ij} (1 - s_{k,ij})]^{\frac{1}{\theta+1}} \quad (18)$$

There is a non-monotone, hump-shaped relationship between exporter scope and market share. 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. The maximum product scope is reached at a market share<sup>18</sup> of 1/2.

Using the described functional form yields the following expression for the price of a variety  $\omega$ :

$$p_{k,ij}(\omega) = \left( \frac{\theta + 2}{\theta \bar{q}} \right)^{\frac{\theta}{2(\theta+1)}} \omega^{\frac{\theta}{2}} (c_{k,ij} y_i \tau_{ij})^{\frac{\theta+2}{2(\theta+1)}} y_j^{\frac{\theta}{2(\theta+1)}} s_{k,ij}^{\frac{\theta}{2(\theta+1)}} (1 - s_{k,ij})^{-\frac{\theta+2}{2(\theta+1)}} \quad (19)$$

The expression is similar to that of [Simonovska \(2015\)](#), whose model considers single product firms. While in [Simonovska \(2015\)](#) prices depend on the aggregate export share of country  $i$  of country  $j$ 's total expenditure, here prices are an increasing function of the firm's market share.

The model is consistent with the firm-level prediction documented by [Mayer et al. \(2014\)](#): the ratio of sales of the core product to the second best product, increases with competition. Using (14), for any  $\omega < \omega'$ :

$$\frac{r_{k,ij}(\omega)}{r_{k,ij}(\omega')} = \frac{\delta_{k,ij}^{\frac{\theta}{2}} - \omega^{\frac{\theta}{2}}}{\delta_{k,ij}^{\frac{\theta}{2}} - \omega'^{\frac{\theta}{2}}} \quad (20)$$

which is decreasing in  $\delta_{k,ij}$ . For a market share less than half, higher competition, represented by a smaller  $s_{k,hj}$ , reduces the product scope of an exporter and thus increases the sales of a good closer to the core competence relative to those of a good farther away from the core.

### 3.1.4 Bertrand Competition

Let us consider the optimal scope and prices of multiproduct firms under Bertrand competition. Both Bertrand and Cournot competition yield qualitatively similar predictions. However, the relationship between prices, product scope and market shares is quantitatively different and such difference maps into different welfare gains from trade.

Solving the consumer problem yield the following direct demand of variety  $\omega$  from firm  $k$ :

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

Using the first order condition of the consumer problem into the budget constraint yields an expression for our marginal utility of income:

$$\lambda_j = \frac{\sum_{k=1}^M \delta_{k,ij}}{y_j + \bar{q} P_j}$$

where  $P_j = \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ij}} p_{k,ij}(\omega)$  is a price index.

<sup>18</sup>[Feenstra and Ma \(2007\)](#) find the same maximum with a CES elasticity of substitution equal to 1.

Firm  $k$  chooses its prices  $p_{k,ij}(\omega)$  for  $\omega \in [0, \delta_{k,ij}]$ , and mass of varieties  $\delta_{k,ij}$  in order to maximize profits  $\Pi_k$ , taking other firms' choices as given. Similar to Cournot competition, firms add new varieties until the demand for the last variety is zero. The following implicit equation defines the optimal mass of varieties supplied by the firm:

$$c_k(\delta_{k,hj}) = \frac{(1 - \bar{\mu}_{k,hj} s_{k,hj})}{\bar{q}\lambda_j}$$

where  $s_{k,hj}$  is the market share of firm  $k$  and  $\bar{\mu}_{k,hj} = \frac{1}{\delta_{k,hj}} \int_0^{\delta_{k,hj}} \frac{p_{k,hj}(\omega) - c_{k,hj}(\omega)}{p_{k,hj}(\omega)} d\omega$  is the Lerner index of market power averaged on each product. Since the Lerner index is always less or equal to one, we can conclude that all else constant, cannibalization effects are stronger in Cournot competition.

Optimal prices are given by the following expression:

$$p_{k,hj}(\omega) = \underbrace{\frac{1}{(1 - \bar{\mu}_{k,hj} s_{k,hj})}}_{\text{Mark-up}} \left( \frac{c_{k,hj}(\delta_{k,hj})}{c_{k,hj}(\omega)} \right)^{\frac{1}{2}} c_{k,hj}(\omega)$$

The pricing equation is similar to the one emerging from Cournot competition: the largest firms charge the largest markups and within a firm the price of products close to the core competence have the largest markup.

Using the functional form for marginal costs that we employed before (16), we can find the following expression for the optimal scope of firms:

$$\delta_{k,hj}^B = \left[ \frac{(\theta + 2)^2}{\bar{q}\theta c_k y_i \tau_{ij}} \right]^{\frac{1}{\theta+1}} y_j^{\frac{1}{\theta+1}} \left[ \frac{s_{k,hj}(1 - s_{k,hj})}{\theta + 2 - 2s_{k,hj}} \right]^{\frac{1}{\theta+1}}$$

Since cannibalization effects are weaker in Bertrand competition than in Cournot, everything else being constant, the product scope of exporters is larger when firms compete choosing their prices relative to quantities. In addition, the largest scope is reached at a market share equal to  $s^* = 0.5\theta + 1 - [(0.5\theta + 1)0.5\theta]^{\frac{1}{2}}$ . While in Cournot competition the maximum scope is reached at a market share of one half, in Bertrand  $s^* > 0.5$  and  $s^* \rightarrow 0.5$  for  $\theta \rightarrow \infty$ .

### 3.1.5 Scope and Price Elasticities

In this section I derive the model's predictions regarding scope and price elasticities across destinations and firms. Let us start with the elasticity of the product scope  $\epsilon_\delta$  with respect to trade costs.  $\epsilon_\delta$  is defined as the partial elasticity of exporter scope  $\delta_{ij}$  with respect to bilateral trade costs  $\tau_{ij}$  (or equivalently to firm's productivity or home country wages), keeping all other firms'

decisions constant, and it is given by:

$$\begin{aligned} \text{Cournot: } \epsilon_{\delta}^C &= \frac{d \ln \delta_{k,ij}}{d \ln \tau_{ij}} = -\frac{1}{\theta + 2s_{k,ij}} \\ \text{Bertrand: } \epsilon_{\delta}^B &= \frac{d \ln \delta_{k,ij}}{d \ln \tau_{ij}} = -\frac{\theta + 2 - 2s_{k,ij}}{\theta^2 + 2\theta + 2(s_{k,ij} - s_{k,ij}^2)} \end{aligned}$$

An increase in  $\tau$ , keeping other firms' decisions constant, reduces the product scope of exporters. Due to cannibalization effects  $|\epsilon_{\delta}|$  is decreasing in the firm's market share in both types of competition: larger firms are less reactive to changes in trade costs. Consider a trade liberalization that reduces  $\tau$ . Exporters would then be relative more efficient than domestic producer and would thus gain market shares and expand their product scope. A rise in the market share is associated with stronger cannibalization effects that limit the scope expansion.

Let us now consider the elasticity of prices  $\epsilon_p$  with respect to trade costs  $\tau_{ij}$  (or equivalently to firm's productivity or home country wages).  $\epsilon_p$ , defined as the partial elasticity of prices with respect to trade costs, keeping other firms' prices and scope constant, is given by:

$$\begin{aligned} \text{Cournot: } \epsilon_p^C &= \frac{d \ln p_{ij}^k}{d \ln \tau_{ij}} = \frac{1}{2} \\ \text{Bertrand: } \epsilon_p^B &= \frac{d \ln p_{ij}^k}{d \ln \tau_{ij}} = \left[ 1 - \frac{\theta^2 + 2\theta}{2(\theta^2 + 2\theta) + 4(s_{ij} - s_{ij}^2)} \right] \end{aligned}$$

Surprisingly, Cournot competition generates a constant elasticity of price with respect to trade costs. The value of such an elasticity is the same arising from a model of monopolistic competition with Stone-Geary preferences ([Simonovska, 2015](#)). Instead, Bertrand competition yields a non-monotone, hump-shaped relationship between price elasticity and firm's market share. For a market share of zero and one, the price elasticity collapses to a half. However, firms with an intermediate market share increase their prices by more than a half. The maximum pass through is reached at a market share of 0.5. The hump-shape of the pass-through in Bertrand competition is similar to what predicted in other work by [Atkeson and Burstein \(2008\)](#). The authors use nested CES preferences and thus predict a full pass-through for firms with a market share of 0 or 1<sup>19</sup>

For both types of competition, the elasticity of scope,  $\xi_{\delta}$  and of price  $\xi_p$  with respect to the destination's per capita income (or real exchange rate) equals:

$$\begin{aligned} \xi_{\delta} &= \frac{d \ln \delta_{k,ij}}{d \ln y_j} = -\epsilon_{\delta} > 0 \\ \xi_p &= \frac{d \ln p_{k,ij}(\omega)}{d \ln y_j} = 1 - \epsilon_p > 0 \end{aligned}$$

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<sup>19</sup>A firm with a market share of 0 is monopolistically competitive within the nest of products it belongs in, while a firm with a market share of 1 is the only producer of a particular nest of products, but it is monopolistically competitive with respect the remaining product groups.

The pass-through with respect to the real exchange rate in Bertrand competition is then U-shaped, consistently with the evidence that [Auer and Schoenle \(2015\)](#) provide. In partial equilibrium (keeping other firms' decisions constant) the product scope of a firm and its prices rise with the per capita income of the destination.

### 3.1.6 Extensions to the Baseline Model

This section illustrates how the optimal scope of exporters is affected by alternative assumptions on the demand and supply side of the model.

#### Luxuries and Necessities

The core competence assumption used in the paper rationalizes the robust empirical finding that sales within firms are skewed towards a few successful products, and most of the scope adjustment within a firm occurs at the bottom of the distribution. To generate the same stylized fact we could adopt the following modified Stone-Geary preferences:  $U_j = \int_{\Sigma_j} [\ln(q_j(\omega) + \bar{q}(\omega)) - \ln \bar{q}(\omega)] d\omega$ , where  $\bar{q}(\omega)$  is no longer constant but is variety specific.  $\bar{q}(\omega)$  controls the vertical intercept of the Engel curves: the higher the  $\bar{q}(\omega)$ , the lower the intercept<sup>20</sup>.

Suppose that the marginal cost of all varieties within a firm are identical. Let us assume that  $\bar{q}(\omega) = \bar{q}\omega^\theta$ : firms start producing necessity goods, with the lowest  $\bar{q}(\omega)$ , and then introduce luxury goods with a higher  $\bar{q}(\omega)$ . Moreover, . In this model, the optimal scope of the firm is identical to the one found using our core competence assumption. The only difference between the two models is in the price distribution within a firm. When the core competence of a firm is cost-based there is a negative correlation between prices and sales within a firm, whereas the correlation is positive with demand-based core competence. Using Mexican data, [Eckel et al. \(2015\)](#) find the cost-based explanation to hold in homogeneous-goods sectors, while the demand-based core competence is consistent with differentiated-goods sectors.

#### Brand Differentiation

In the model, because of the preferences assumed, the effect of a scope expansion of one firm on the firm's existing sales is identical to the effect on all other firms' sales. To introduce brand differentiation we could adopt, in the spirit of [Benassy \(1996\)](#), the following preferences:  $U = \sum_{k=1}^M \delta_k^\gamma \int_0^{\delta_k} \ln(q_k(\omega) + \bar{q}) d\omega$  for  $\gamma > -1$ . The parameter  $\gamma$  controls the degree of brand differentiation, or the consumer love for the variety of one firm. For a positive  $\gamma$  consumers demand larger quantities from wider brands, and vice versa for a negative value of  $\gamma$ . The new preferences allow a more realistic framework in which the introduction of a new variety by a firm reduces its own sales more than the sales of other firms. However, brand differentiation changes only quantitatively the optimal scope of firms: the smaller the  $\gamma$ , the smaller the scope.

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<sup>20</sup>Consider a two-good example, where  $\bar{q}_1 < \bar{q}_2$ . While good 1 is consumed at any level of income, good 2's consumption is positive if the income is high enough. An alternative interpretation is that good 1 is a necessity while good 2 is a luxury.



The relationship between scope, per capita income and market share of the firm are qualitatively identical to the baseline model.

### Fixed Cost per Variety and Destination

Suppose that firms must pay a fixed cost  $f_{k,ij}(\omega)$  of entry per variety and that  $f_{k,ij}(\omega)$  is weakly increasing in  $\omega$ . A firm introduces varieties until the profits from the last variety, discounted by the cannibalization effects, barely cover the fixed cost per variety. The introduction of a fixed cost generates a positive relationship between the product scope of the firm and size of the destination: larger markets yield higher revenues that can cover a larger fixed cost. A fixed cost of entry per variety replicates at the firm level what [Eaton et al. \(2011\)](#) achieved at the aggregate level. The authors introduced a fixed cost of entry per firm to rationalize the positive relationship between extensive margin of trade and size of the destination.

To further clarify the role played by the fixed cost of entry, consider a scenario in which marginal costs  $c_{k,ij}(\omega)$  are zero for all varieties. Per capita income and size of the destination have then identical effects on the scope of firms:  $\delta_{k,ij}f(\delta_{k,ij}) = s_{k,ij}(1 - s_{k,ij})y_jL_j$ . The Exporter Dynamics Database, that features traditional exporters from poorer economies, suggests the presence of fixed cost of entry, as the scope of exporters increases with the per capita income and size of the destination. On the other hand, large multinationals that sell online face negligible fixed costs.

### Multiple Product Lines

Let us now consider a case in which firms produce different product lines indexed by  $n_{k,ij} \in [0, N_{k,ij}]$ . Within each product line  $n$  a firm produces a continuum of varieties indexed by  $\omega \in [0, \delta_{k,ij}(n)]$ . Within each product line, firms have a core competence, and additional varieties are produced at increasing marginal costs. Product lines are ranked by increasing fixed cost of production  $F_{k,ij}(n)$ . Firms introduce product lines that require the lowest fixed cost first and then introduce lines with higher fixed costs. An alternative structure, that yields the same predictions, assumes that the  $\bar{q}(n)$  varies across product lines.

Similarly to the baseline model, the number of varieties  $\delta_{k,ij}(n)$  within each product line  $n$  is increasing in the per capita income of the destination and it features a hump-shaped relationship with respect to the market share of the firm in the destination. There is a non-monotone hump-shaped relationship between the number of product lines  $N_{k,ij}$  and the market share of the firm as well. The effect of market size is twofold. Firms are, in fact, facing a new tradeoff: either export the core varieties of several product line, which requires a larger fixed cost, or export fewer and longer product lines, with many “non-core” varieties. In larger destinations, the fixed cost of entry have a smaller impact and firms export a larger number of shorter product lines. On the other hand, firms export fewer but longer product lines in smaller economies. Overall, the sum of varieties exported by a firm across its product lines is increasing in size and per capita income of the destination.

## Diseconomies of Scope

With a minor modification of (16) we could consider (dis)economies of scope as in [Nocke and Yeaple \(2014\)](#), where each variety is produced at the same marginal cost, but the larger the scope the larger the marginal cost. Consider  $c_{k,ij}(\omega) = \delta_{k,ij}^\gamma \tau_{ij} y_i c_{k,i} \omega^\theta$ . If  $\gamma > 0$  firm's technology exhibits diseconomies of scope: the same variety  $\omega$  is produced at a higher marginal cost if the product scope expands. Vice versa if  $\gamma < 0$ , firm's technology exhibits economies of scope: the marginal cost of producing a variety falls with the scope. Using such a functional form changes only quantitatively the optimal scope of the firm found in the baseline model.

## 3.2 General Equilibrium

To solve the general equilibrium of the model of Cournot competition I use the simplifying assumptions employed by [Feenstra and Ma \(2007\)](#), [Eckel and Neary \(2010\)](#) and [Ottaviano and Thisse \(2011\)](#). First, I restrict the analysis to homogeneous firms: all firms from the same country of origin have identical cost structures: introducing heterogeneity across producers would not yield analytical solutions, given that the law of large numbers, extensively used in models of monopolistic competition, does not hold with a finite number of firms ([Feenstra and Ma, 2007](#))<sup>21</sup>. Given that I consider a model of large multiproduct firms, such an assumption appears reasonable. Second, to ensure tractability I assume free entry and I ignore the integer problem<sup>22</sup>.

Recall from the previous section the optimal scope (11) and quantity (12). The cost parametrization previously introduced (16) generates a simple expression of firms' profits:

$$\Pi_I = \frac{(s_{ii}^2 + \theta s_{ii})}{\theta + 1} y_i L_i + \frac{(s_{ij}^2 + \theta s_{ij})}{\theta + 1} y_j L_j - y_i F \quad (21)$$

Using our market shares, goods markets clear if

$$M_h s_{hi} + M_f s_{fi} = 1$$

and trade is balanced if

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

Goods market clearing, trade balance and the zero profit condition ensure that labor markets clear in both countries.

I consider the symmetric equilibrium in which identical firms supply the same mass of varieties. I normalize the per capita income in the home country to one. Since firms within a country are identical, an equilibrium is a vector of masses of varieties for home firms  $[\delta_{hh}, \delta_{hf}]$  and for foreign firms  $[\delta_{ff}, \delta_{fh}]$ , a vector of the number of firms in each country  $[M_h, M_f]$  and a foreign per capita

<sup>21</sup>In an extension I consider heterogeneous firms. Results from simulation supports the finding in the homogeneous firms' model. Details available upon request.

<sup>22</sup>For a discussion of the integer problem and its consequences see [Peter Neary \(2010\)](#).

income  $y_f$  such that:

- (i). Firms choose the mass of varieties they sell domestically and export according to (11)
- (ii). Free entry drives profits  $\Pi_i$  to zero, for  $i = h, f$ .
- (iii). The labor and goods market clear, and trade is balanced.

Let us consider the gravity equation generated by the model. Using (10), total exports from  $i$  to  $j$  can be written as:

$$M_i r_{ij} = \frac{\theta L_j M_i}{\lambda_j^{\frac{\theta+1}{\theta}} (\theta+2) \bar{q}^{\frac{1}{\theta}}} \left( \frac{1-s_{ij}}{c_i y_i \tau_{ij}} \right)^{\frac{1}{\theta}}$$

The export trade share of country  $i$  to country  $j$ , denoted by  $\Lambda_{ij}$ , equals:

$$\Lambda_{ij} = \frac{M_i r_{ij}}{\sum_{v=h,f} M_v r_{vj}} = \frac{M_i \left( \frac{1-s_{ij}}{c_i y_i \tau_{ij}} \right)^{\frac{1}{\theta}}}{\sum_{v=h,f} M_v \left( \frac{1-s_{vj}}{c_v y_v \tau_{vj}} \right)^{\frac{1}{\theta}}} \quad (22)$$

Ignoring cannibalization effects is equivalent to setting  $s_{ij} = 0$ , generating a gravity equation similar to the standard expressions found in the literature of monopolistic competition ([Simonovska and Waugh, 2014](#)). The elasticity of trade with respect to trade cost is  $1/\theta$  and thus depend on the elasticity of marginal costs with respect to an additional variety.

### 3.2.1 Two Symmetric Countries

To better understand the effects of trade liberalization in this model, let us start with two symmetric countries, with 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  $\Delta$ . I denote the domestic market shares by  $s = s_{hh} = s_{ff}$  and the export market shares by  $s^* = s_{hf} = s_{fh}$ . We can rewrite the conditions that determine the mass of varieties in terms of market shares:

$$\begin{aligned} c s^\theta \Delta^\theta &= \frac{1-s}{\bar{q} \lambda} \\ \tau c s^{*\theta} \Delta^\theta &= \frac{1-s^*}{\bar{q} \lambda} \end{aligned}$$

Taking the ratio of the two equations yields:

$$\frac{s^\theta}{1-s} = \tau \frac{s^{*\theta}}{1-s^*} \quad (23)$$

The zero profit condition provides the second equilibrium condition:

$$s^2 + \theta s + s^{*2} + \theta s^* = F(\theta + 1)/L \quad (24)$$

The two equations (23) and (24) determine the equilibrium values of the market shares. By market clearing, the number of firms in each country is given by:

$$M = (s + s^*)^{-1}$$

While [Feenstra and Ma \(2007\)](#) and [Eckel and Neary \(2010\)](#) study the effect of a trade liberalization as an increase in market size, à la Krugman, because of the assumption of an integrated world economy, here we can consider the effects of a reduction in the iceberg trade cost  $\tau$ . Proposition 1 summarizes the results.

**Proposition 1.** *A reduction in the iceberg trade cost  $\tau$  causes:*

1. *A reduction in the domestic market share  $s$  and an increase in the export market share  $s^*$ .*
2. *Firms focus on their core competence reducing the domestic product scope  $\delta$ , but they increase the number of exported varieties  $\delta^*$ .*
3. *The aggregate mass of varieties available to consumers  $\Delta$  increases.*

Proof in the Appendix.

Consistently with the evidence on multiproduct firm and trade liberalization literature on multiproduct firms ([Bernard et al., 2011](#); [Baldwin and Gu, 2009](#)), a reduction in trade costs forces firms to focus on their most successful products, abandoning inefficient product lines. If we assume that there exist at least two firms from both markets, which guarantees a market share of less than half, cannibalization effects change the magnitude of the effect of trade liberalization on the product scope of firms. Without cannibalization effects, the reduction in the domestic product scope and the expansion of the exported varieties would be larger. Such a result is consistent with the evidence provided by [Baldwin and Gu \(2009\)](#). Using Canadian plant-level data [Baldwin and Gu \(2009\)](#) find that a reduction in tariffs reduces the domestic product scope of firms. Moreover, such an effect is related to the size of plants: small plants experience the largest decline while for larger plants the effect of a tariff reduction is insignificant.

Trade liberalization reduces the average markup of domestic producers, but it increases that of foreign exporters. However, the average markup in the economy decreases. Let us consider the sales weighted geometric mean of markups in the economy, as in [Edmond et al. \(2015\)](#), which equals:

$$\bar{\mu} = (\theta + 1) [1 - H]^{-1} \tag{25}$$

where  $H = \sum s^2$  is the Herfindhal index of market concentration. The average markup in the economy is positively related to the Herfindhal index: the larger the market concentration, the larger the average markup. Trade liberalization reduces the average markup in the economy as long as it reduces market concentration. In the symmetric country setting such a result is always achieved since the market share of domestic producers is always larger than the market share of foreign firms. The average markup falls because the weight on the lower foreign markups increases,

while the weight on the higher domestic markups falls. A model of monopolistic competition fails to generate such a result as the average markup would be constant<sup>23</sup>. While home firms reduce their markups, they also focus on their core high-markup varieties and vice versa foreign firms raise their markup but introduce low-markup varieties. The two forces exactly offset each other in a model of monopolistic competition. In contrast, in a model of oligopoly, trade barriers affect the distribution of markups.

Finally, proposition 2 summarizes the effects of a rise in the market size  $L$  in both economies.

**Proposition 2.** *An increase in the market size  $L$  causes:*

1. *A reduction in the domestic market share  $s$  in the export market share  $s^*$ .*
2. *The total number of firms  $M$  increases, and the higher competition forces firms to reduce their domestic and exported product scope  $\delta$  and  $\delta^*$ .*
3. *The aggregate mass of varieties available to consumers  $\Delta$  increases.*

Proof in the Appendix.

The results are consistent with those of [Eckel and Neary \(2010\)](#). However, while [Feenstra and Ma \(2007\)](#) predict a rise in the product scope of firms because of weaker cannibalization effects, in this model cannibalization effects only change the magnitude of product scope adjustments.

### 3.2.2 Two Asymmetric Countries

What is the effect of per capita income on the product scope of exporters? To answer this question we must depart from the identical countries setting, and study the effects of a change in the productivity of the foreign country. In particular, let us consider a reduction in  $c_f$ , the multiplicative parameter in the marginal cost function. I can prove analytically in a neighborhood of the identical countries equilibrium, and more in general through numerical methods, the following proposition:

**Proposition 3.** *A reduction in  $c_f$  causes:*

1. *An increase in the foreign per capita income  $y_f$ .*
2. *A reduction of the market share of home firms in the foreign market  $s_{hf}$*
3. *A rise in the product scope of home firms in the foreign market  $\delta_{hf}$*

Proof in the Appendix.

Higher foreign per capita income has a positive effect on the scope of home exporters as it raises the choke price, allowing the introduction of more expensive products. On the other hand, home firms face stronger competition from the now more productive foreign firms. Stronger competition causes home firms' market shares to fall, thus reducing firms' scope at any level of income<sup>24</sup>. However, the positive effect of per capita income on scope dominates the negative effect of competition. Figure 1 shows the positive relationship between the exporter scope of home firm abroad, and the

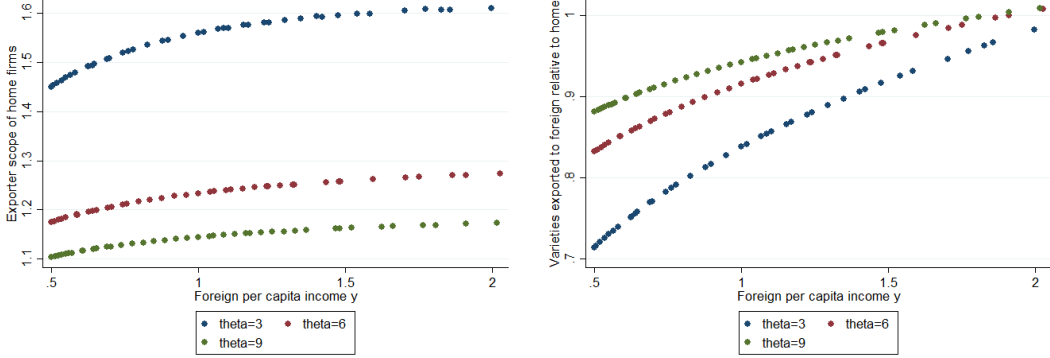
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<sup>23</sup>It suffices to set home and foreign firms' market shares to zero in (25). Such a result is similar in spirit to that shown by [Arkolakis et al. \(2015\)](#) that proved the independence of the markup distribution from trade costs in a model of heterogeneous single product firms.

<sup>24</sup>Since we are considering the region of (18) where product scope is positively related to the market shares.

relative exporter scope as a function of the foreign per capita income for different values of  $\theta^{25}$ . A larger value for  $\theta$  increases marginal cost, thus reducing the product scope of firms.

Figure 1: Exporter Scope  $\delta_{hf}$  and Relative Exporter Scope  $\frac{\delta_{hf}}{\delta_{hh}}$  and Foreign Per Capita Income



Let us consider the relative price of a variety in the foreign economy:

$$\frac{p_{hf}(\omega)}{p_{hh}(\omega)} = \tau^{\frac{\theta+2}{2(\theta+1)}} y_f^{\frac{\theta}{2(\theta+1)}} \left( \frac{s_{hf}^\theta (1 - s_{hf})^{-\theta-2}}{s_{hh}^\theta (1 - s_{hh})^{-\theta-2}} \right)^{\frac{1}{2(\theta+1)}}$$

An increase in the foreign productivity, by raising  $y_f$ , positively contributes to  $p_{hf}(\omega)$ . This effect is analogous to the one studied by [Simonovska \(2015\)](#): higher per capita income reduces the demand elasticity of a variety, allowing the firm to charge higher markups. Cournot competition brings about an additional effect of per capita income on prices: because of the rise in foreign firms' productivity,  $s_{hf}$  falls. A reduction in  $s_{hf}$  negatively affects the price of home goods abroad<sup>26</sup>. However, our numerical exercise shows that the first effect dominates and firms charge higher prices in richer economies (Figure 2).

Finally, proposition 4 summarizes the effects of a rise in foreign market size on the product scope of home exporters:

**Proposition 4.** *An increase in the foreign market size  $L_f$  causes:*

1. *A reduction in the foreign per capita income  $y_f$ .*
2. *A reduction of the market share of home firms in the foreign market  $s_{hf}$*
3. *A reduction in the product scope of home firms in the foreign market  $\delta_{hf}$*

Proof in the Appendix.

In the neighborhood of the identical countries equilibrium, a rise in the foreign market size  $L$  reduces foreign per capita income. In addition, foreign firm entry and lower foreign wages reduce

<sup>25</sup>The parameters of the model for the numerical exercise are:  $\tau = 1.7$ ,  $F = 0.01$ ,  $L_h = L_f = 1$ ,  $c_h = 1$ ,  $\bar{q} = 0.001$ . The Appendix shows the relationship between other variables of interest and  $c_F$ .

<sup>26</sup>Proving that the relative price of home goods sold in the foreign market is not immediate. A sufficient condition is  $s^* < \theta/4$ , where  $s^*$  is the market share of an exporter. If  $\theta$  is too small, prices are a convex function of the market share for large values of  $s^*$ . As a result, in this particular case, the reduction in the market share can be enough to reduce the prices of exported goods.

Figure 2: Relative Prices  $\frac{p_{hf}(\omega)}{p_{hh}(\omega)}$  and Foreign Per Capita Income

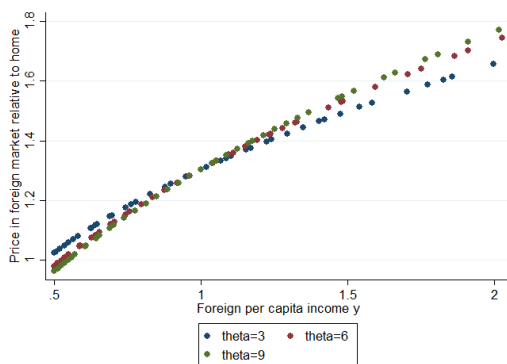
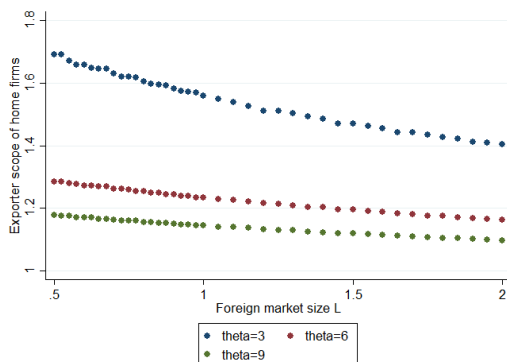


Figure 3: Exporter Scope  $\delta_{hf}$  and Foreign Market Size



the market shares of home firms abroad. As a result, the exported number of varieties by home firms falls. Figure 3 shows the negative relationship between product scope of exporters and foreign market size. In addition, a reduction of the scope and the market share of home exporters reduces the price of home exported varieties.

### 3.3 Welfare gains from trade

In this section I examine the welfare gains from trade liberalization predicted by the model. Following the example of [Arkolakis et al. \(2012\)](#) and [Arkolakis et al. \(2015\)](#) I derive a welfare formula that predicts that a small variation in the iceberg trade cost  $\tau$  generates a change in consumer welfare proportional to the change in the domestic market share of the typical domestic firm<sup>27</sup>. While in [Arkolakis et al. \(2012\)](#) the welfare gains from trade can be computed using the change in the domestic expenditure share on domestic goods ( $\Lambda_{jj}$ ), in a model of multiproduct firms facing cannibalization effects, the sufficient statistic becomes the domestic expenditure share on the goods produced by the typical domestic firm ( $s_{jj}$ ). In addition, cannibalization effects and market

<sup>27</sup>I compute the welfare gains from trade liberalization as the equivalent variation in the consumer's income that generate the same utility attained with the trade liberalization.



structure, have a deeper effect on the welfare gains from trade: given a change in  $s_{jj}$ , the stronger the cannibalization effects (or the more concentrated the market), the larger the welfare gains.

The first step in deriving the welfare formula is to show that the indirect utility  $V_j$  is a function of the aggregate set of varieties  $\Delta_j$  available to consumers in country  $j$ .

$$V_j = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \left[ \ln \left( \frac{\bar{q} \frac{\delta_{ij}^{\frac{\theta}{2}}}{\omega^{\frac{\theta}{2}}}}{\bar{q}} \right) - \ln \bar{q} \right] d\omega = \frac{\theta}{2} \Delta_j \quad (26)$$

Let us start by considering the welfare gains that arise in a model of Cournot competition. From the optimal scope of firms, the set of varieties available to consumers can be expressed as a function of the domestic market share of our multiproduct firm  $s_{jj}$ :<sup>28</sup>

$$\Delta_j^{\theta+1} = \frac{\theta+2}{q\bar{c}_j\theta} (1-s_{jj})s_{jj}^{-\theta} \quad (27)$$

Taking logs of (26) and differentiating with respect to a change in the trade costs  $\tau$  and per capita income  $y$  we obtain, using (27):

$$d \ln V_j = d \ln \Delta_j = \frac{\theta - s_{jj}(\theta - 1)}{(\theta + 1)(1 - s_{jj})} (-d \ln s_{jj}) \quad (28)$$

To compute the equivalent variation we need to take the derivative of the (log) indirect utility  $V_j$  with respect to (log) income  $W_j$ :<sup>29</sup>

$$d \ln V_j = \frac{2}{\theta + 2} d \ln W_j \quad (29)$$

Combining (29) and (28) and rearranging, we obtain the formula for the welfare gains from a small variation in  $\tau$  shown in the introduction:

$$d \ln W_j^{Cournot} = \frac{\theta(\theta + 2)}{2(\theta + 1)} \left[ 1 + \frac{s_{jj}}{\theta(1 - s_{jj})} \right] (-d \ln s_{jj}) \quad (30)$$

The welfare gains from a reduction in trade barriers can be expressed as a function of the change in the domestic market share of the typical domestic firm. Trade liberalization reduces the market share of domestic firms ( $-d \ln s_{jj} > 0$ ) and therefore it improves welfare ( $d \ln W_j^{Cournot} > 0$ ).

Let us understand the underlying sources of the gains from trade in this model. A reduction in  $\tau$  allows all firms exporting to country  $j$  to expand their product scope, thus allowing the consumption on new varieties. In addition, domestic firms reduce their product scope abandoning non-core expensive varieties and focusing on the core and cheap ones. Cannibalization and

<sup>28</sup>Alternatively we can derive the same result starting from the gravity equation generated by the model (22).

<sup>29</sup>By the envelope theorem  $d \ln V_j = (W_j/V_j)\lambda_j d \ln W_j$ , where  $\lambda_j$  is the marginal utility of income (15).

oligopoly directly affect the welfare gains from trade as those increase in the market share  $s_{jj}$ . A reduction in the firm's market share weakens cannibalization effects, giving incentives to firms to expand their product scope. Such incentives have larger welfare consequences when firms face stronger cannibalization effects, which occurs at larger values of  $s_{jj}$ . In welfare terms, the weakening of cannibalization effects for domestic firms dominates the larger market power, and stronger cannibalization effects, of foreign exporters<sup>30</sup>.

Let us now consider the welfare gains generated by a more common model of monopolistic competition ( $d \ln W_j^{MC}$ ). A model of monopolistic competition neglects, by construction, cannibalization effects and market structure. The formula for the welfare gains becomes<sup>31</sup>:

$$d \ln W_j^{MC} = \frac{\theta(\theta + 2)}{2(\theta + 1)}(-d \ln s_{jj}) \quad (31)$$

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  $\Lambda_{jj}$  is the domestic expenditure share on domestic goods<sup>32</sup>. For a given  $d \ln s_{jj}$  and a given  $\theta$  the welfare gains that arise with cannibalization effects dominates those generated by monopolistic competition. In monopolistic competition in fact, 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<sup>33</sup>. In addition, while the average markup in a model of monopolistic competition is independent of trade costs, the average markup arising from a model with cannibalization effects decreases after a reduction in  $\tau$ .

We can now compare the welfare gains that arise from my model to those generated by other models of multiproduct firms that face cannibalization effects: [Feenstra and Ma \(2007\)](#) and [Eckel and Neary \(2010\)](#). I denote the welfare gains in the two models by  $d \ln W_j^{FM}$  and  $d \ln W_j^{EN}$ . Ideally, we would derive and compare their welfare formulas to (30)<sup>34</sup>. However, the authors use different preferences and technological assumptions, thus making cross-models comparisons unfeasible without an empirical estimation of the parameters. To obtain some intuition on the different welfare gains, we can consider how the current model could change to capture the main features of [Feenstra and Ma \(2007\)](#) and [Eckel and Neary \(2010\)](#).

In [Feenstra and Ma \(2007\)](#) firms do not have a core competence: all varieties are produced

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<sup>30</sup>As the sufficient statistic is  $s_{jj}$ , there is no simple expression to compute the welfare cost of autarky. However, by the zero profit condition (21) adapted to autarky, the market share of the typical firm when no trade is allowed is decreasing in market size  $L$  and increasing in the fixed cost  $F$ . Hence, a small variation in  $s_{jj}$  from autarky would benefit smaller economies more than larger economies.

<sup>31</sup>The formula is (30) evaluated at a market share  $s_{jj}$  of zero.

<sup>32</sup>In oligopoly entry is not fixed and  $d \ln s_{jj} = d \ln \lambda_{jj} - d \ln M_j$ .

<sup>33</sup>Note that the welfare gains from monopolistic competition can be re-written using the notation of [Arkolakis et al. \(2015\)](#):  $d \ln W_j^{MC} = \left[1 - \frac{\rho}{\epsilon + 1}\right] \frac{1}{\epsilon}(-d \ln s_{jj})$  where  $\rho = 1/2$  is the average markup elasticity and  $\epsilon = 1/\theta$  is the trade elasticity.

<sup>34</sup>In addition none of these papers provides a welfare formula.

at the same marginal cost. This assumption could be allowed in my model taking the limit as  $\theta \rightarrow 0$ <sup>35</sup>. The welfare formula can be written as:

$$d \ln W_j^{FM} = \left[ \frac{s_{jj}}{1 - s_{jj}} \right] (-d \ln s_{jj}) \quad (32)$$

The welfare gains are smaller than those generated by a model where firms have a core competence. When firms have no core competence, weaker cannibalization effects are the only source of gains from trade.

Let us now compare our results to the model of [Eckel and Neary \(2010\)](#), which is quite a challenge, despite the similarities with the model presented here. [Eckel and Neary \(2010\)](#) assume that the marginal utility of income is constant (and normalized to 1). However, with Stone-Geary preferences such an assumption does not allow for any cannibalization effects. Those effects still arise in the model of [Eckel and Neary \(2010\)](#) because of the non-additive component of the linear quadratic preferences<sup>36</sup>. To obtain some intuition on the difference between the two models, I consider the effects of trade liberalization keeping the marginal utility of income constant, but allowing the other variables to change. The welfare gains are then:

$$d \ln W_j^{EN} = \frac{(\theta + 2)}{2} \left[ 1 + \frac{s_{jj}}{\theta(1 - s_{jj})} \right] (-d \ln s_{jj}) = \frac{\theta + 1}{\theta} d \ln W_j^{Cournot} \quad (33)$$

Because new varieties enter the consumption bundle, the marginal utility of income increases with trade liberalization. A rise in the marginal utility of income reduces the demand for all the varieties produced by a firm, which decides to shrink its product scope. As a result, ignoring income effects generates an upward bias in the estimated gains from trade. If we consider linear marginal costs in the product scope (i.e.  $\theta = 1$ , as in the examples provided in [Eckel and Neary \(2010\)](#)) the welfare gains in a more general model that includes income effects are half of those predicted by [Eckel and Neary \(2010\)](#).

Finally, let us consider our baseline model with Bertrand competition, in which the welfare formula equals:

$$d \ln W_j^{Bertrand} = \frac{(\theta + 2)\theta}{2(\theta + 1)} \left[ 1 + \frac{s_{jj}}{(1 - s_{jj})(\theta + 2 - 2s_{jj})} \right] (-d \ln s_{jj}) \quad (34)$$

Given a  $\theta$  and a change in  $s_{jj}$ ,  $d \ln W_j^{Bertrand} < d \ln W_j^{Cournot}$ . Due to the different demand elasticities faced by firms in the two types of competition, the aggregate set of varieties increases by less in Bertrand competition relative to Cournot after a trade liberalization.

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<sup>35</sup>Clearly, this is a strong simplification. The model developed in [Feenstra and Ma \(2007\)](#) considers CES preferences, and firms pay a fixed cost per variety.

<sup>36</sup>In [Eckel and Neary \(2010\)](#), the indirect demand for a variety  $\omega$  can be written as:  $p_j(\omega) = a - bq(\omega) - cQ$  where  $Q$  is quantity index that the firms takes into account in the profit maximization problem. Note that in their baseline model the authors do not assume free entry, allowing for it only in an extension.

## 4 Stylized Facts on Multiproduct firms

This section documents two new stylized facts for multiproduct exporters: (1) the number of varieties exported per firm increases in the per capita income of the destination and, (2) there exists a non-monotone, hump-shaped relationship between the product scope of an exporter in a destination and the market share of the exporter in the same destination.

### 4.1 Data Description

For both stylized facts the main data source is the Exporter Dynamics Database, a new dataset from the World Bank that reports transaction-level customs data. The dataset covers eight source countries: Albania, Burkina Faso, Bulgaria, Guatemala, Jordan, Mexico, Peru and Senegal from 1993 to 2011<sup>37</sup>. For each exporting country and in each destination served, the Exporter Dynamics Database reports the export value and volume for all firm-product pairs. A product is a HS 6 digit good, the same classification used in [Arkolakis et al. \(2014\)](#)<sup>38</sup>. I consider both a sample with all goods and another one restricted to consumption products according to the Broad Economic Category (BEC) classification<sup>39</sup>.

To further support the first stylized fact I use additional data scraped from the Internet on the number of varieties offered online by large multinationals. 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<sup>40</sup>. Samsung is a South Korean multinational conglomerate company that produces a vast array of electronic appliances, from smartphones to fridges. With more than \$300 billion in 2013 revenues it is one of the biggest world players in the electronic industry. I focus on the “Mobile” business unit of the company, which sells Smart Phones, Other Mobile Phones, Tablets, Accessories and Wearables. A variety is a product offered on each Samsung national website.

In addition I use the dataset built by [Cavallo et al. \(2014\)](#), which provides the total number of varieties sold by Apple, Ikea, Zara and H&M in their online stores. All details on the data

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<sup>37</sup>The detailed year coverage is in Appendix B. The sources for the data for each country are detailed in the Annex of [Cebeci, Fernandes, Freund and Pierola \(2012\)](#). 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.

<sup>38</sup>As an example, consider a firm that produces seven varieties (confidentiality prevents me from specifying its origin, 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).

<sup>39</sup>I drop all firms and products which are not classified (“OTH”) and all duplicates. Following [Freund and Pierola \(2012\)](#) 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; etc. In case of consumption goods, I match each HS6 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.

<sup>40</sup>The website <http://www.samsung.com/us/common/visitcountrysite.html> collects all the links to the national online websites of Samsung.

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. While the data scraped from the Internet provides the most detailed description of the number of varieties offered by a firm, it lacks information on sales or market shares and cannot be used for the second stylized fact.

To verify the robustness of the second stylized fact I use the data on the sales of cars in five European economies provided by [Goldberg and Verboven \(2005\)](#). The authors provide the sales of each car model offered by all firms selling to Belgium, Germany, Great Britain, France and Italy from 1970 to 1999. Given the presence of large firms and the fact that all firms selling to a market are reported, 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.

Finally, for the years considered I use per capita income in constant US dollars and population size from WDI. Geographical trade barriers are from CEPII and tariff data from WTO.

## 4.2 Descriptive Statistics on Multiproduct firms

Let us start with an overview of the role of multiproduct firms in international trade using the Exporter Dynamics Database. Table 1 confirms that, indeed, multiproduct firms dominate world trade. Around half of the exporters in each country are multiproduct: they sell at least two varieties to one location. However, with the exception of Burkina Faso, those multiproduct firms account for over 80% of total export value<sup>41</sup>. [Bernard et al. \(2010\)](#) discovered a similar result for the US and [Goldberg et al. \(2010\)](#) for India.

Table 1: Multiproduct Firms Dominate World Trade

Exporter	Albania	Burkina Faso	Bulgaria	Guatemala	Jordan	Mexico	Peru	Senegal
# of MPF (Share)	50.5%	34.6%	60.8%	63.4%	37.2%	48.1%	62.4%	46.3%
Export of MPF (Share)	80.5%	50.3%	91.1%	88.0%	84.3%	84.1%	81.2%	78.2%

Large multiproduct firms, those that according to my model should be the more affected by cannibalization effects, constitute a large share of total export. Consistently with the evidence provided by [Freund and Pierola \(2012\)](#), the top 1% of exporters by sales in each source country accounts for more than 20% of total exports. The highest share is recorded in Mexico, where the top 1% of firms accounts for 56.8% of total exports and the lowest in Burkina Faso where the share is 23%. Table (2) shows the descriptive statistics for all firms and for the top 1%. The most successful firms tend to sell a larger number of varieties and reach more destinations than the average firm.

<sup>41</sup>The table considers only consumption goods. Results are similar if we incorporate all goods.

Table 2: Scope and Destinations per Firm by Origin

Exporter	Albania	Burkina Faso	Bulgaria	Guatemala	Jordan	Mexico	Peru	Senegal
All firms								
# Prod. per firm (mean)	3.50	2.61	6.86	7.97	2.65	3.40	6.76	3.63
# Dest. per firm (mean)	1.38	2.23	2.38	2.35	3.12	1.81	2.44	3.06
Top 1% of firms								
# Prod. per firm (mean)	7.09	1.75	28.00	14.85	8.65	12.34	12.17	8.13
# Dest. per firm (mean)	3.65	1.83	9.61	8.04	13.50	8.80	14.53	12.22
Share of total sales	23.5%	23.0%	29.7%	34.2%	45.1%	56.8%	38.6%	28.0%

### 4.3 Product Scope of Exporters across Rich and Poor Countries

This section documents a new stylized fact for multiproduct firms: the number of varieties per exporter increases in the per capita income of the destination country. I verify the stylized fact using two datasets: the Exporter Dynamics Database and data scraped from the Internet.

#### 4.3.1 Evidence from the Exporter Dynamics Database

I run the following regression, where the dependent variable is the logarithm of the number of products exported by firm  $k$  from country  $i$  to country  $j$  in year  $t$ .

$$\ln(\# \text{ Products}_{k,ijt}) = \beta_0 + \beta_y \ln(\text{Pc. Income}_{jt}) + \beta_L \ln(\text{Population}_{jt}) + \beta_\tau \tau_{ijt} + f_k + g_{it} + \epsilon_{k,ijt} \quad (35)$$

where  $\tau_{ijt}$  is a vector of trade barriers<sup>42</sup>,  $f_k$  denotes firm level fixed effects,  $g_{it}$  represent source-year fixed effects to control for shocks to the country of origin in a given year, and  $\epsilon_{k,ijt}$  is the error.

Table 3 reports the results of regression (35) for different specifications of the empirical model. The coefficient on per capita income is positive and statistically significant in all specifications and samples. For the sample of all firms that sell consumption goods the coefficient is 0.064: doubling the per capita income of the destination increases the product scope of exporters by 6.4%. If we restrict the sample to the top 1% of firms the coefficients on per capita income rises to 14%: larger firms are more sensitive to changes in the per capita income of the destination relative to the average. Similar results arise if we consider all goods exported, without restricting the sample to consumption goods. Tables in Appendix B show that the results hold if we consider each source country separately.

As the model predicts, 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

<sup>42</sup> $\tau_{ijt}$  includes, in the baseline specification, the logarithm of bilateral distance, dummies for the presence of a shared border, past colonial relationships, commonality of official language and destination specific dummies for islands or landlocked countries. The second specification of  $\tau_{ijt}$ , which for lack of data ends in 2006, additionally includes dummies for a common currency and common legislation between country pairs, regional trade agreements and for being a member of the WTO.

Table 3: Per Capita Income and Product Scope of Exporters

	All Goods		Consumption Goods		Top 1% Exporters	
	(1)	(2)	(1)	(2)	(1)	(2)
Log(Pc.income)	0.087*** (0.018)	0.077*** (0.018)	0.064*** (0.012)	0.062*** (0.012)	0.139*** (0.025)	0.156*** (0.024)
Log(Population)	0.075*** (0.012)	0.073*** (0.013)	0.055*** (0.012)	0.055*** (0.012)	0.099*** (0.024)	0.106*** (0.025)
Log(Distance)	-0.163*** (0.026)	-0.151*** (0.026)	-0.117*** (0.021)	-0.127*** (0.023)	-0.279*** (0.039)	-0.311*** (0.051)
Border	0.208*** (0.071)	0.190** (0.076)	0.064* (0.033)	0.050 (0.039)	0.085 (0.079)	0.034 (0.088)
Comm. Language	0.144*** (0.049)	0.126** (0.050)	0.110*** (0.039)	0.094** (0.041)	0.197*** (0.063)	0.270*** (0.069)
Colonial Rel.	-0.145** (0.068)	-0.153 (0.097)	-0.060 (0.051)	-0.055 (0.070)	-0.052 (0.131)	-0.038 (0.173)
Island	-0.028 (0.036)	-0.030 (0.039)	-0.014 (0.027)	-0.015 (0.031)	-0.029 (0.045)	-0.045 (0.057)
Landlocked	-0.003 (0.040)	0.010 (0.045)	-0.002 (0.036)	-0.002 (0.039)	-0.092* (0.049)	-0.089 (0.055)
RTA		0.031 (0.029)		-0.002 (0.024)		-0.029 (0.055)
Comm. Currency		0.092 (0.062)		0.023 (0.047)		0.024 (0.149)
GATT/WTO member		-0.027 (0.035)		-0.001 (0.028)		0.104* (0.054)
Common Leg.		-0.023 (0.032)		-0.004 (0.025)		-0.059 (0.054)
$R^2$	0.48	0.54	0.60	0.64	0.52	0.53
# Observations	1259349	822654	554597	364778	25998	16282

Results from OLS of equation (35). Robust std. error in parenthesis. Cluster: destination country. \*\*\*: significant at 99%, \*\* at 95%, \* at 90%. Dependent variable: log of number of products exported per firm per destination. The first two columns uses all products available, while the remaining only consumption products. The last two columns restrict the sample to the top 1% of exporters by sales. Source: Exporter Dynamics Database.

and economically significant<sup>43</sup>. While the model predicts that market size would reduce the product scope of exporters, via a reduction in the market share of the firm, the evidence shows the opposite. There is a positive a statistically significant relationship between product scope of exporters and the population of the destination in all specifications of the model. Only for the top 1% of firms the coefficient on population is different and smaller than the coefficient on per capita income at the 99% confidence level. As shown in the following section, the positive effect of population on the product scope of exporters vanishes when we consider the varieties offered online by large multinationals. How could we explain the difference in results?

The model could rationalize the positive effect of population on the product scope of exporters by introducing a fixed cost of exporting per variety. The empirical evidence then suggests a certain degree of heterogeneity in fixed costs across firms and markets. Large firms may have

<sup>43</sup>Results are robust to changes in the set of geographical controls and definitions of distance. In the Appendix I consider a third-degree polynomial for log(distance) and the distance dummies of Eaton and Kortum (2002).



lower fixed costs than smaller firms and online markets have almost zero fixed costs relative to traditional retail markets. In addition, the model consider firms that introduce new varieties with a minimum of adaptation in their production processes. However, while such an assumption may represent the production function of Samsung’s smartphones, it may be inconsistent with the level of disaggregation of the HS 6 digit in the Exporter Dynamics Database<sup>44</sup>. The evidence, in fact, suggests that there may well be fixed costs to add a new HS 6 digit good.

### 4.3.2 Evidence from Scraped Data

I count the number varieties offered in 2015 by Samsung and I use the average number of varieties offered in 2013 by Apple, Ikea, Zara and H&M. I test the first prediction of the model by estimating the empirical model (35), 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. In addition I use dummies for islands and landlocked countries<sup>45</sup>.

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

	Apple	Zara	H&M	Ikea	Samsung	Pooled
Log(Pc.Income)	0.521*** (0.054)	0.041 (0.038)	0.079*** (0.026)	0.061** (0.027)	0.224*** (0.075)	0.203*** (0.051)
Log(Population)	0.051 (0.041)	-0.037 (0.022)	-0.004 (0.015)	0.011 (0.012)	0.039 (0.055)	-0.006 (0.023)
Island	0.013 (0.123)	-0.246** (0.100)	-0.024 (0.067)	-0.042 (0.048)	-0.183 (0.242)	-0.144 (0.117)
Landlocked	0.008 (0.153)	-0.064 (0.123)	-0.022 (0.062)	0.023 (0.041)	-0.066 (0.247)	-0.063 (0.071)
Tariff	-0.043* (0.023)	0.004 (0.008)	0.006 (0.005)	0.002 (0.011)	-0.019 (0.026)	0.003 (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 (35). \*\*\*: 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.

<sup>44</sup>Higher level of disaggregation are not available for confidentiality reasons.

<sup>45</sup>These are standard controls in the literature that uses scraped data (Simonovska, 2015). Given the role of per capita income in shaping the product scope choices of firms, I also controlled for income inequality in the destination (Bekkers et al., 2012). However, given the data availability adding the Gini Index from WDI reduces an already small sample of destinations. Results are in the appendix. 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.

As shown in Table 4, for all multinationals but Zara, the coefficient on per capita income is positive and statistically significant. On average, doubling the per capita income of the destination increases the scope offered online by almost 20%. Apple is the firm with the highest coefficient, 52%, while Ikea has the smallest, 6.1%. As anticipated in the previous section, the coefficients on population is statistically and economically insignificant.

The results so far presented rely on real per capita GDP as measure of per capita income. Following [Simonovska \(2015\)](#), in Appendix B, 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. For both datasets the coefficient on per capita income is remarkably similar across measures. Only when using PPP-adjusted per capita GDP does the coefficient increases to 8.9% with the Exporter Dynamics Database and to 29.8% with the data scraped from the Internet.

#### 4.4 Which Products Are Sold in Poor and Rich Economies?

While the previous section showed that firms sell more varieties in richer economies, this sections looks at which particular varieties are sold. The model predicts that firms tend to sell their core varieties to all locations, while they export their non-core varieties only to richer economies.

Table 5: Core vs. Non-Core Varieties and Per Capita Income

	All Exporters		Top 1% Exporters	
	(Core)	(Non-Core)	(Core)	(Non-Core)
Log(Pc.income)	0.027*** (0.004)	0.087*** (0.016)	0.055*** (0.009)	0.196*** (0.030)
Log(Population)	0.026*** (0.005)	0.059*** (0.014)	0.038*** (0.008)	0.125*** (0.029)
Log(Distance)	-0.048*** (0.008)	-0.145*** (0.030)	-0.117*** (0.013)	-0.360*** (0.059)
Border	0.021 (0.014)	0.077* (0.042)	-0.023 (0.021)	0.043 (0.101)
Comm. Language	0.051*** (0.016)	0.121** (0.059)	0.091*** (0.024)	0.244** (0.099)
Colonial Rel.	-0.025 (0.023)	-0.058 (0.077)	0.034 (0.056)	-0.091 (0.155)
Island	-0.005 (0.010)	-0.015 (0.041)	-0.009 (0.019)	-0.053 (0.070)
Landlocked	0.002 (0.018)	-0.015 (0.046)	-0.034* (0.019)	-0.133 (0.082)
$R^2$	0.60	0.57	0.50	0.52
# Observations	527702	198627	23939	12780

Results from OLS of equation (35) by type of variety. Robust std. error in parenthesis. Cluster: destination country. \*\*\*: significant at 99%, \*\* at 95%, \* at 90%. Dependent variable: log of number of Core (Non-Core) consumption varieties per firm per destination. Source: Exporter Dynamics Database.

Let us start by considering the Exporter Dynamics Database. For each firm I select the most

successful variety by total export value. I define a variety “Core” if its total sales are more than one tenth of the sales of the most successful variety. Otherwise the variety is Non-Core<sup>46</sup>. I then count the number of Core and Non-Core varieties exported per firm, and run regression (35) on the two types of varieties separately. Table 5 illustrates the results.

While more Core varieties are sold in richer economies, Non-Core varieties are far more sensitive to changes in the per capita income of the destination. Doubling the per capita income of the destination increases the number of Core varieties by 2.7% and the number of Non-Core varieties by 8.7% for all firms. If we focus on the top 1% of exporters, the difference in the coefficients for Core and Non-Core varieties is even starker. Non-Core varieties are also more sensitive to changes in the population of the destination, in the distance and other geographical barriers.

Since we do not have information on sales of each product for the scraped data, dividing varieties in Core and Non-Core is quite challenging. Ranking varieties according to the number of destinations reached generates similar results. However such a finding could seem obvious given that we established in the previous section that these firms sell more varieties in richer economies. In addition, a well-known fact on multiproduct firms is that their core goods are sold in all destinations (Arkolakis et al., 2014).

However, we can consider the Samsung dataset for which we have five distinct categories of goods: a group of Core goods (Smartphones, Other phones, Tablets and Wearables) and Non-Core Accessories. I count the number of varieties in each category separately and run regression (35). Table 6 shows that Samsung offers Core varieties independently of the level of development of a country. However, the number of accessories is highly sensitive to the per capita income of the destination and it drives the result that more varieties are offered in richer economies.

Table 6: Per Capita Income and Samsung’s Core and Non-Core Varieties

	Accessories	Smartphones	Other phones	Tablets	Wearables
Log(Pc.Income)	0.483*** (0.133)	-0.089 (0.094)	-0.124 (0.145)	-0.048 (0.065)	0.070 (0.056)
Log(Population)	0.137 (0.097)	-0.017 (0.069)	-0.140 (0.108)	-0.154*** (0.048)	0.088** (0.041)
Island	-0.421 (0.426)	-0.116 (0.303)	0.186 (0.445)	-0.118 (0.210)	-0.009 (0.181)
Landlocked	0.173 (0.435)	-0.343 (0.310)	-0.357 (0.473)	-0.347 (0.214)	0.173 (0.185)
Tariff	-0.058 (0.046)	0.014 (0.033)	0.029 (0.058)	0.023 (0.023)	-0.053*** (0.019)
$R^2$	0.29	0.05	0.05	0.22	0.21
# Observations	49	50	47	50	50

Results from OLS of equation (35). \*\*\*: significant at 99%, \*\* at 95%, \* at 90%. Dependent variable: log of number of products offered online per category per destination. Results are reported by category. The category “Other Phones” is missing for Brazil, Colombia, and United States. The category “Accessories” is missing for Iran.

<sup>46</sup>Results are robust to changes in the threshold.

## 4.5 Cannibalization Effects

The model predicts a non-monotone, hump-shaped relationship between the market share of a firm and its product scope. Taking logs of the optimal scope of firms (18) yields the following expression:

$$\ln \delta_{k,ij} = \frac{1}{\theta + 1} \ln \left[ \frac{\theta + 2}{\theta \bar{q} y_i C_{k,i}} \right] + \frac{1}{\theta + 1} \ln y_j + \frac{1}{\theta + 1} \ln(s_{k,ij} - s_{k,ij}^2) - \frac{1}{\theta + 1} \ln \tau_{ij} \quad (36)$$

The product scope of an exporter is decomposed in several determinants: a firm-level constant productivity, per capita income of the destination, a function of the firm's market share and bilateral trade costs. The model's prediction translates into the following regression model:

$$\ln \delta_{k,ijt} = \beta_y \ln y_j + \beta_s s_{k,ijt} + \beta_{s^2} s_{k,ijt}^2 + f_k + g_{it} + \gamma \ln \tau_{ij} + \epsilon_{k,ijt} \quad (37)$$

I control for the firm-level productivity with firm fixed effects ( $f_k$ ) and, similarly to the previous section, I use source-year fixed effects ( $g_{it}$ ). Real per capita GDP is the measure for per capita income and  $\tau_{ij}$  is a vector of the geographical controls previously used. I follow [Amiti et al. \(2014\)](#) and compute the market share of firm  $k$  from country  $i$  to country  $j$  as the ratio of firm's  $k$  exports to  $j$  over the total export from  $i$  to  $j$ .

Whether the data suggests the presence of cannibalization effects depends on the statistical and economic significance of the coefficient  $\beta_{s^2}$ . A negative  $\beta_{s^2}$  implies a hump-shaped relationship between market share of the firm and its product scope. If  $\beta_{s^2} = 0$ , then the relationship between  $\delta_{k,ij}$  and  $s_{k,ij}$  is monotone. Finally if  $\beta_{s^2}$  is positive, there would be a U-shaped relationship between scope and market share. Table 7 shows the results of regression (37) using the Exporter Dynamics Database.

In the three samples considered, the evidence confirms the non-monotone, hump-shaped relationship between the market share of a firm  $s_{k,ij}$  and its product scope  $\delta_{k,ij}$ . The coefficient  $\beta_{s^2}$  is in fact negative and statistically significant in each specification. For consumption goods, the largest scope is reached at a market share of 49%. As the appendix shows, the results hold at the source country level for both model specifications.

For robustness I consider three additional measures of the market share of a firm  $s_{k,ij}$  computed as follows:

1.  $s_{k,ij}^A = \text{Export}_{k,i} / \sum_k \text{Export}_{k,i}$ : the share of firm  $k$  exports over total exports from country  $i$  across all destinations.
2.  $s_{k,ij}^B = \text{Export}_{k,ij} / \text{Imports}_j$ : the share of firm  $k$  exports to country  $j$  over total imports of country  $j$  from all destinations.
3.  $s_{k,ij}^C = \text{Export}_{k,ij} / \text{Household Consumption}_j$ : the share of firm  $k$  exports to country  $j$  over total Household Consumption in country  $j$ .

The different measures of market shares are ranked in decreasing order:  $s_{k,ij}^{\text{Baseline}} > s_{k,ij}^A > s_{k,ij}^B >$

Table 7: Product Scope of Exporters and Their Market Share

	All Goods	Consumption	Top 1% Exporters
$s_{k,ij}$	2.661*** (0.221)	1.907*** (0.153)	2.741*** (0.324)
$s_{k,ij}^2$	-2.626*** (0.203)	-1.946*** (0.156)	-2.593*** (0.299)
Log(Pc.income)	0.095*** (0.017)	0.074*** (0.012)	0.165*** (0.028)
Log(Population)	0.083*** (0.012)	0.062*** (0.012)	0.118*** (0.026)
Log(Distance)	-0.178*** (0.026)	-0.133*** (0.021)	-0.313*** (0.043)
Border	0.197*** (0.069)	0.054 (0.033)	0.085 (0.077)
Comm. Language	0.165*** (0.050)	0.135*** (0.040)	0.260*** (0.062)
Colonial Rel.	-0.149** (0.067)	-0.064 (0.051)	-0.091 (0.130)
Island	-0.029 (0.035)	-0.014 (0.025)	-0.034 (0.046)
Landlocked	-0.004 (0.040)	-0.003 (0.037)	-0.101* (0.054)
$R^2$	0.49	0.60	0.53
# Observations	1259349	554597	25998

Results from OLS of equation (37). Robust std. error in parenthesis. Cluster: destination country. \*\*\*: significant at 99%, \*\* at 95%, \* at 90%. Dependent variable: log of number of products exported per firm per destination. Source: Exporter Dynamics Database. (1): All goods, (2): Consumption goods, (3): Consumption goods + Top 1% of exporters.

$s_{k,ij}^C$  Tables in the Appendix show the results of regression (37) using the additional measures of market shares. The hump-shaped relationship between product scope of exporters and their market share is robust to changes in the measure of market share.

Lind and Mehlum (2010) argued that when testing the presence of a hump-shaped relationship, the significance of the coefficient of the quadratic term,  $\beta_{s^2}$  in this paper, is not sufficient. In fact, the relationship could be concave but mistakenly assumed to be hump-shaped. Hence, Lind and Mehlum (2010) developed a proper test for a hump-shaped relationship where the null hypothesis, in the content of this paper, is that the relationship between scope and market share is monotone or U-shaped, and the alternative is that the relationship is hump-shaped. The null hypothesis is rejected when 1) the extreme point is reached at a market share within the range of the data and 2) the slope of the relationship is positive at the beginning and/or negative at the end of the observed market share data.

Table 8 shows that we can reject the null hypothesis of a monotone or U shaped relationship in all four specifications of regression (37). The table also report the value of the market share  $s^*$  that maximizes the product scope of exporters and its 95% Fieller Confidence Interval. Given

Table 8: [Lind and Mehlum \(2010\)](#) Test for Hump Shaped Relationship

	Baseline	Share of Total Exports	Share of Total Imports	Share of Household Cons.
$s^*$	.49***	.10***	.018**	.004***
95% Fieller C.I.	[.47; .51]	[.08; .12]	[.016; .033]	[.003; .007]

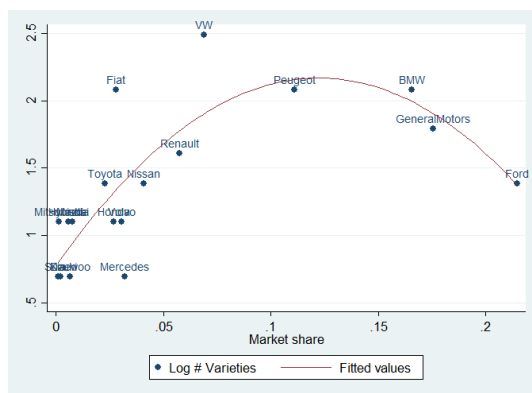
$s^*$  is the market share at which the maximum scope is attained. Asterisks indicate confidence in rejecting the null hypothesis of a monotone or U-shaped relationship: \*\*\*: 99% confidence level, \*\* 95%, \* 90%. The definitions of market shares employed can be found in the text.

that the measures of market shares shown are ranked in decreasing value, it is no surprise that the maximum scope is reached at decreasing values of market share.

#### 4.5.1 Evidence from the European Car Market

Using data from [Goldberg and Verboven \(2005\)](#) on the European car market provides additional evidence on the hump-shaped relationship between the market share of a firm  $s_{k,ij}$  and its product scope  $\delta_{k,ij}$ . As an illustrative example, Figure 4 shows the hump-shaped relationship between product scope and market share of the firms selling to the United Kingdom in 1995. Even though Ford attains the largest market share, it produces fewer varieties than other car companies with a smaller market share, such as Fiat or Peugeot.

Figure 4: Product Scope of Exporters and their Market Share



For each destination I run the following regression:

$$\ln \delta_{k,ijt} = f_k + d_{jt} + \beta_s s_{k,ijt} + \beta_{s^2} s_{k,ijt}^2 + \epsilon_{k,ijt} \quad (38)$$

where  $f_k$  is a firm fixed effect,  $d_{jt}$  is a destination-year fixed effects and  $\epsilon_{k,ijt}$  is the error term. Since our baseline geographical controls are time invariant they are captured by the firm level fixed effect. In the pooled regression I include origin-destination fixed effects to control for geographical barriers.

Table 9: European Car Market: Product Scope of Exporters and Their Market Share

	BEL	FRA	DEU	ITA	GBR	Pooled
Market share	14.05*** (2.93)	4.78*** (1.36)	15.82*** (3.24)	5.20*** (1.34)	9.06*** (0.62)	3.99*** (0.64)
Market share squared	-41.49*** (10.56)	-0.29 (2.93)	-34.49*** (9.87)	-3.31* (1.73)	-14.97*** (1.63)	-5.65** (1.39)
$R^2$	0.82	0.85	0.80	0.86	0.81	0.80
# Observations	588	520	513	451	538	2610
$s^*$	.17***	8.26	.23***	.78	.30***	.35**
95% Fieller C.I.	[.15; .22]	-	[.18; .36]	-	[.27; .35]	[.28; .67]

Results from OLS of equation (38). Robust std. error in parenthesis. Cluster: year for single destination, destination in pooled regression. \*\*\*: significant at 99%, \*\* at 95%, \* at 90%. Dependent variable: log of number of car models exported per firm per destination. Source: [Goldberg and Verboven \(2005\)](#).  $s^*$  is the market share at which the maximum scope is attained. Asterisks on  $s^*$  indicate confidence in rejecting the null hypothesis of a monotone or U-shaped \*\*\*: 99% confidence level, \*\* 95%, \* 90%.

Table 9 show that cannibalization effects are present in the European car market. With the exception of France, in each sample the coefficient on  $s_{k,ijt}^2$  is negative and statistically significant. The largest scope is reached at a market share of 35% in the pooled regression. In each market the market share that maximizes the scope of a firm ranges from a minimum of 17% in Belgium to a maximum of 79% in Italy. The [Lind and Mehlum \(2010\)](#) test fails to reject the null hypothesis of a monotone or U-shaped relationship for France and Italy because the extreme point is outside the interval of  $s_{k,ij}$  in the data. However, the hump-shape is confirmed by the [Lind and Mehlum \(2010\)](#) test for the other markets and in the pooled regression.

## 5 Concluding Remarks

The paper presents a model of large multiproduct firms that face cannibalization effects. The model is consistent with two new stylized facts on multiproduct firms documented in the paper: 1) the exporter product scope increases with the per capita income of the destination and 2) there is a non-monotone, hump-shaped relationship between product scope of a firm and its market share.

Introducing cannibalization effects and, more in general, a model of oligopoly has profound consequence on the effects of a trade liberalization. Traditionally, models of international trade assume that firms are monopolistically competitive ([Arkolakis et al., 2012, 2015](#)) and thus ignore the role of market structure in the analysis of the welfare gains from trade. The paper shows that for sectors relatively concentrated as the car industry, the welfare gains from trade could be quite large compared to those predicted in models of monopolistic competition.

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