The Effect of Per Capita Income on the Product Scope of Exporters

Luca Macedoni*

UC Davis

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Preliminary

Abstract

I use the Exporter Dynamics Database (Cebeci et al., 2012) to document a new regularity for multiproduct exporters: the number of exported products per firm (product scope) is positively correlated with the per capita income of the destination country. On average, doubling the per-capita income of the destination country is associated with a 7% increase in the product scope. To rationalize this finding I develop a general equilibrium, two-country model of multiproduct firms. I combine in a tractable way two features of models of multiproduct firms: non-homothetic preferences, and that firms' technology exhibits a core competence. Firms face "cannibalization effects": expanding the product scope "cannibalizes" the firm's sales on its existing products. A rise in the productivity of the foreign economy causes the foreign per capita income to increase. As a result, home firms expand the product scope they export to the foreign country despite the tougher competition they face. The model generates a testable prediction on the optimal scope of exporters that I subject to empirical analysis.

Keywords: Multiproduct firms, product scope, non-homothetic preferences, cannibalization effects.

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*lmacedoni@ucdavis.edu. I am grateful to Ina Simonovska and Robert Feenstra for their suggestions and support. I also thank Alan Taylor, Deborah Swenson and Katheryn Russ for their comments.

1 Introduction

"*If you can have everything in 57 varieties, making decisions becomes hard work*". This Economist title[1] illustrates a common complaint of consumers in supermarkets. In rich economies, the number of varieties offered to consumers has become so large as to be "paralyzing"[2]. In the international trade literature this complaint is actually a well-established fact: rich countries import a larger number of varieties (Hummels and Klenow, 2002; Sauré, 2012)[3]. Even though the literature views more varieties as welfare improving, it provides an explanation for why rich economies are offered a larger choice of products: non-homothetic preferences (Matsuyama, 2000)[4].

The literature so far has considered the aggregate number of varieties available to consumers as equivalent to the aggregate number of firms, domestic and foreign, that sell to a market, because of the traditional assumption of single product firms[5]. This paper focuses instead on the firm level and studies the product scope of multiproduct exporters. I document a new regularity for multiproduct exporters: the number of varieties (*exporter scope*) that a multiproduct exporter offers is positively related with the level of development of the destination country. Using exporter level data from the Exporter Dynamics Database of the World Bank (Cebeci et al., 2012) I find that doubling the per capita income of the destination country increases the product scope of exporters by 7% on average. I rationalize this finding in a model of homogeneous multiproduct firms, which face cannibalization effects[6]. I combine in a tractable way two existing features of models of multiproduct firms: non-homothetic preferences, and that firms' technology exhibits a core competence. To my

[1] http://www.economist.com/node/17723028

[2] http://www.nytimes.com/2010/02/27/your-money/27shortcuts.html.

[3] Hummels and Klenow (2005) also document that rich and large economies export a larger set of varieties.

[4] A different explanation is provided by the model of ideal variety of Hummels and Lugovskyy (2009)

[5] 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.

[6] When the products offered by a firm are imperfect substitutes, adding a new variety "cannibalizes", that is, reduces, the sales from the existing varieties. Cannibalization effects limit product scope expansion, and have observable consequences on prices of large firms (Hottman et al., 2014)

knowledge, this is the first model that studies the effects of per capita income on the product scope of exporters.

Multiproduct firms (MPFs) have played a major role in the literature on international trade since the 2000's, after realizing that MPFs dominate international trade (Bernard et al., 2011). In addition, a large fraction of variety changes take place within firms (Bernard et al., 2010; Baldwin and Gu, 2009). The Melitz model (2003) of heterogeneous firms has been extended to include firms' product scope decisions and to study how trade costs, competition and entry costs affect this new margin of trade (Bernard et al., 2011; Mayer et al., 2014; Arkolakis et al., 2014). Models have used non-homothetic preferences (Ottaviano and Thisse, 2011), both in monopolistic competition (Dhingra, 2013) and in oligopoly (Eckel and Neary, 2010). However, no previous contribution has fully explored the role non-homothetic preferences to study the effects of per capita income differences on the product scope of exporters.

That per capita income, rather than aggregate income, 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 help understand 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, such as product quality and prices. Firms export higher quality goods to richer countries, and a possible explanation is a non-homothetic demand for quality (Feenstra and Romalis, 2014). Prices of tradable goods are consistently 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, which is due to non-homothetic preferences (Simonovska, 2015). My model predicts that product scope and prices are positively related at the firm level: firms set larger markups in richer countries because of the larger exporter scope.

The remainder of the paper is organized as follows. In section 2 I document the positive relationship between per capita income and the product scope of exporters. In addition to the Exporter Dynamics Database, I use a case study provided by the online store of Samsung. Section 3 surveys the literature, focusing on the theoretical models that I extend to incorporate per capita income effects. Section 4 presents a two country model in which I study how per capita income (determined by the productivity of firms) affects exporter choices. In addition, I present an extension of the model that allows for heterogeneous firms and that requires numerical solutions. The model generates a testable prediction on the optimal scope of exporters that I subject to empirical analysis in section 5. Section 6 concludes the paper.

2 Exporter scope and per capita income

I use transaction-level customs data for 2004. The sources for the data for each country are detailed in the Annex of Cebeci, Fernandes, Freund and Pierola (2012)[7]. In my sample there are seven exporting countries: Albania, Bulgaria, Guatemala, Jordan, Mexico, Peru and Senegal. For each exporting country I have data on the export value and volumes for each product and destination of each exporter. A product is a HS 6 digit good as in Arkolakis et al. (2014)[8].

[7]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.

[8]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).

Table 1: MPFs dominate world trade

Exporter	Albania	Bulgaria	Guatemala	Jordan	Mexico	Peru	Senegal
N. of MPF (Share)	50%	51%	59%	37%	52%	59%	57%
Export of MPF (Share)	92%	96%	85%	89%	98%	87%	96%

Table 1 confirms that 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, those MPFs account for 90% of total export value. Bernard et al. (2010) discovered a similar result for the US, where multiproduct firms produce 87% of US output, and so did Goldberg et al. (2010) for India.

Table 2: Average number of products offered by firms across destination

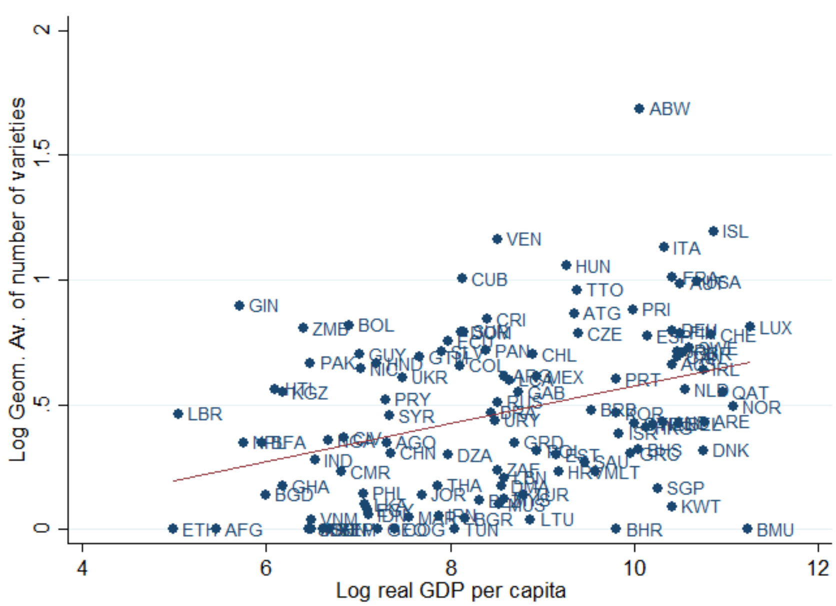
Exporter	Albania	Bulgaria	Guatemala	Jordan	Mexico	Peru	Senegal
Mean	2.7	3.4	4.7	1.4	3.8	4.4	2.6
Std. Dev.	3.8	8.3	11.4	0.8	8.3	7.8	3.4
Max	85	278	366	8	260	195	34
25^{th} pctile	1	1	1	1	1	1	1
50^{th} pctile	1.16	1.25	1.8	1	1.5	1.86	1.5
75^{th} pctile	3	3	4	1.5	3	4	2.75
90^{th} pctile	6	7	12	2	8	11	5
95^{th} pctile	9	12	18	3	14	17	7.6
99^{th} pctile	16	32	40	4.5	38	36	21

Let us now look at the distribution of exporter scope across firms in each exporting country. Table 2 reports the summary statistics and the percentile distribution of the average number of varieties exported by firm across destinations. The first row reports the average number of varieties exported across all firms and destination. On average Guatemalan firms have the highest scope (4.7), while Jordanian exporters have the lowest one (1.4). The percentile distribution indicates that few firms in the top percentiles offer a large number of varieties. The skewness of the distribution of product scope reminds us of a common pattern in international trade data[9], where few superstar exporters (Freund and Pierola, 2012) account for large shares of export values and quantities[10]. Here a similar distribution arises for product scope[11].

2.1 The product scope of exporters is larger in rich countries

This paragraph documents the positive relationship between exporter scope and per capita income of the destination country. For the purpose of illustration, figure 1 plots the logarithm of the average number of products offered in each destination country by Peruvian firms, against the logarithm of real per capita income[12].

Figure 1: On average Peruvian firms sell a wider scope to richer countries



9For instance the distribution of firms' sizes (Chaney, 2008).

10Bernard et al. (2012) suggest some caution in describing those firms as the most productive: many MPFs export varieties that they do not produce, a phenomenon called carry along trade

11The skewness of the product scope distribution is a recurring feature of MPFs and has been documented by Bernard et al. (2011), Arkolakis et al. (2014) and Mayer et al. (2014) among the others.

12Data on real per capita GDP from WDI. With other exporting countries the plots look noisier and heavily affected by other variables such as distance

There is a positive and statistically significant relationship[13] between average product scope and per capita income, with a slope of 7.6%. We can interpret the slope as the elasticity of scope with respect to per capita income: doubling the per capita income of the destination country is associated with a 7.6% increase in the product scope.

Let us now use a more formal regression analysis to document the positive relationship between exporter scope and per capita income. For each exporting country I run the following regression:

$$\log(n.products_{ij}^{k}) = \alpha + \beta \log(pcincome_j) + \gamma \tau_{ij} + f^k + \epsilon_{ij}^{k} \tag{1}$$

where τ_{ij} proxies trade costs and includes distance and a dummy for contiguity, and f^k is a firm level fixed effect. Table 3 reports the estimated coefficient of regression (1) using the different origin countries.

Table 3: Relationship between scope of exporters and per capita income (2004)

	ALB	BGR	GTM	JOR	MEX	PER	SEN	All
β_y	**.12**	.02	**.07**	.01	**.08**	**.08**	**.05**	**.07**
	(.06)***	(.02)	(.04)*	(.01)	(.04)*	(.04)*	(.02)*	(.03)**
log dist	-.15	-.08	-.28	-.00	-.23	-.19	-.07	-.11
	(.11)	(.02)***	(.03)***	(.03)	(.05)***	(.08)**	(.04)	(.06)*
contig	.21	.03	-.08	.18	.52	.07	.31	.33
	(.21)	(.064)	(.11)	(.03)***	(.22)**	(.09)	(.11)***	(.18)
N.Obs.	2222	33259	9935	3486	65839	13955	2072	130834
R^2	.74	.64	.73	.43	.68	.69	.55	.65

Results from OLS of equation (1). Robust std. error in parenthesis. Cluster: destination country. ***: significant at 99%, ** at 95%, * at 90%. Per capita GDP at constant 2005 US dollars from WDI. Distance and border from CEPII. log distance is the logarithm of bilateral distance in kilometers. contig = 1 if countries share a border. Each column reports the results for the sample of the corresponding exporting country's firms. In "All" standard errors are clustered at the exporting country level.

For all the exporting countries of my sample the estimated coefficient is positive, and it is significant in five cases out of seven and in the pooled regression. The lack of significance in the

[13]Standard errors clustered at the country of destination level

case of Jordan is not surprising given the little variation in the subsample (from table 2). The estimated $\hat{\beta}$ ranges from the 5% of Senegal to the 16% of Albania, while in the pooled regression the elasticity of exporter scope with respect to per capita income is 7%: on average, doubling the per capita income of the destination country increases the product scope of exporters by 7%[14].

2.2 A case study

Following the example of Simonovska (2015) and Cavallo et al. (2013), among others, I use a case study as an additional piece of evidence in support of the stylized fact here presented. I use data scraped from the Internet on the number of varieties of mobile products sold by Samsung in 53 countries[15]. 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 mobile phones, Notes, Tablets, Accessories and Watches[16]. A variety is a product offered on the Samsung website prior to any costless personalization. This means that two varieties of tablets may belong to the same series (say Tab S10) but they differ in terms of memory or network properties, since those differences influence the price. However, their only distinction cannot be the color.

For each country I collect the number of varieties of Mobile products sold by Samsung through the company's website. On average Samsung sells 245 varieties of mobile products per country, with a minimum of 61 in Vietnam and a maximum of 874 in Germany. Figure (2) shows the correlation between the logarithm of the number of varieties and the log real GDP per capita in 2013. A clear

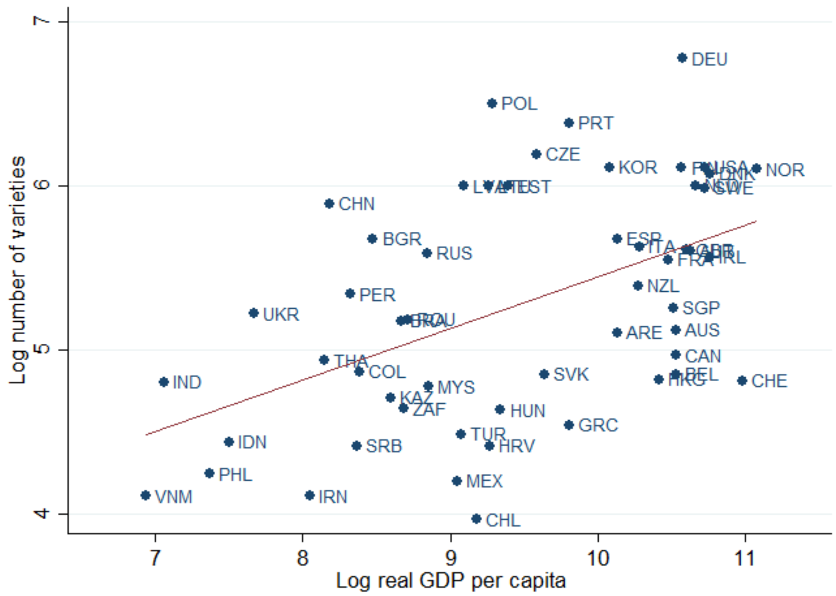
[14]I verify the robustness of this result by including a large array of geographical and trade barriers. Since the scope decisions of exporters may be affected by the heterogeneity of consumers (Hummels and Lugovskyy, 2009), I also control for market size and inequality as in Bekkers et al. (2012) and Simonovska (2015). Results are shown in table 3 of Appendix B

[15]The website http://www.samsung.com/us/common/visitcountrysite.html collects all the links to the national online stores of Samsung.

[16]In some, but not all, countries cameras are sold under the label mobile, but I decided to ignore this category

pattern emerges, confirming the results obtained with the Exporter Dynamics database: Samsung offers more varieties in richer countries.

Figure 2: Samsung mobile scope and per capita income



The correlation is confirmed by a simple regression of the log of the number of products on a constant and on log per capita income:[17]

$$\log(\text{n.prod.}) = \underset{(.58)}{2.31} + \underset{(.06)^{***}}{.33} \log(\text{GDP per capita}) + \underset{(.07)}{.02} \log(\text{Population})$$

The elasticity of the product scope with respect to per capita income is positive and statistically significant, with a magnitude of .33. Doubling per capita income is correlated with a rise in Samsung's product scope of 33%[18]. I control for market size without finding any relationship between the product scope of Samsung and the size of the destination market.

[17]Standard errors in parenthesis. The R^2 of the regression is .24 with 47 observations. Standard errors are clustered at the destination country level. Data on GDP per capita at constant US dollars and population size from WDI. Excluding population does not affect the results.

[18]This estimate is larger than what found in the previous section. The reason for that be the size of Samsung: when I restrict my sample from the Exporter Dynamics Database on large firms I obtain similar estimates.

Using the Exporter Dynamics Database and the case study, I showed a new regularity for MPFs: the number of varieties per exporter, or exporter scope, increases with the per capita income of the destination country. As next section shows, the literature has so far ignored such a relationship.

3 Related Literature

Since the 2000s, a solid body of research has taken shape on trade by multiproduct firms. The main novelty of modeling MPFs lies in the combination of supply and demand linkages across the products of the same firm (Eckel and Neary, 2010). Supply and demand linkages affect the scope of a firm, generate heterogeneity within the product scope, and more generally influence the optimal choices of firms[19].

Demand linkages affect the competition across products of the same firm, if these products are substitutes: when a MPF internalizes those demand linkages it faces cannibalization effects. New varieties cannibalize sales from the existing varieties, limiting the expansion of the product scope. In addition, producing a unit more of one variety decreases the demand for all other varieties and limits a firms' supply of goods, thus increasing its markups.

Because cannibalization effects are difficult to model in a tractable way, the literature splits in two branches: one that ignores cannibalization effects and one that does not. In fact, we can model cannibalization effects only assuming that firms are large in their markets, and thus internalize their influence on prices and quantity indexes. Including cannibalization effects in a model then requires a change in the market structure: from the commonly used monopolistic competition, in

[19] When choosing the product scope, a firm internalizes the supply linkages across its products that generate cost advantages or disadvantages (Eckel and Neary, 2010). For instance, the technology of a MPF may exhibit economies of scope: for a given level of output a single firm can produce a number of varieties cheaper than a number of firms each producing one variety (Bailey and Friedlaender, 1982). Another common example of supply linkages is flexible manufacturing: the ability of the firm to introduce new products with minor adjustments to the existing product line (Eaton and Schmitt, 1994)

favor of oligopoly.

Models that ignore cannibalization effects refined the Melitz model of heterogeneous firms to account for firms that produce multiple heterogeneous products (Bernard et al., 2011; Arkolakis et al., 2014; Manova and Zhang, 2012; Mayer et al., 2014)[20]. Selection across firms depends on their productivity as in the Melitz model. A similar idea drives selection within the product scope: firms produce only the highest quality varieties (Bernard et al., 2011; Manova and Zhang, 2012) or the cheapest ones (Arkolakis et al., 2014; Mayer et al., 2014).

To model cannibalization effects we need firms that are large in the market and realize their influence on price or quantity indexes. Since those indexes are taken as given in models of monopolistic competition, modeling cannibalization effects requires more general models of oligopoly. Oligopolistic competition, however, is not as tractable[21] and since the mid-2000s the literature has tried to refine models of cannibalization and MPFs while maintaining tractability[22].

The most closely related paper is Eckel and Neary (2010). Eckel and Neary (2010) introduce supply linkages across the varieties in the model by Ottaviano and Thisse (2011). There is a finite number of firms each producing a continuum of varieties. Firms have a core competence and producing additional varieties is done with a minimum adaptation. In the model this amounts to a

[20] Allanson and Montagna (2005) consider symmetric firms. Brambilla (2009) builds a partial equilibrium model in which she introduces the assumption that firms, in order to discover their R&D capabilities, must pay an information cost. Nocke and Yeaple (2014) model symmetric products within a firm, but firms differ in terms of organizational capital and organizational efficiency.

[21] The lack of tractability in models of oligopoly arises from the fact that firms are large relative to the market. First, with large firms we cannot apply a law of large numbers to compute aggregate variables, like a price index (Feenstra and Ma, 2007). To obtain closed form solutions the majority of authors have thus only considered homogeneous firms. However, Baldwin and Gu (2009) ignore this issue and develop a model with cannibalization treating firms as being negligible. Second, when the number of firms is discrete, as it is the case with large firms, the definition of a free entry equilibrium is complicated by the so called "integer problem. To avoid the integer problem, the literature has either conveniently ignored it, or fixed the number of firms in the model. Only Feenstra and Ma (2007) and Hottman et al. (2014) model free entry equilibrium with a discrete number of asymmetric firms. The lack of tractability may be the reason why we only have two and a half theories of trade (Neary, 2010), where the half reflects trade due to the fact that firms want to exploit their market power.

[22] In the industrial organization literature, the seminal work by Brander and Eaton (1984) introduced the demand linkages across variety to motivate the existence of MPF using demand motivation rather than supply motives like economies of scope. Using a similar setup, Baldwin and Ottaviano (2001), in what is probably the first introduction of cannibalization in trade, argue that multiproduct firms and cannibalization effects could be the cause for the correlation between FDI and trade.

marginal cost function that increases in the mass of varieties. The authors consider a world with a number of identical and integrated countries.

A firm is large in its own industry, but small relative to the economy as a whole. This latter assumption boils down to ignoring the role of per capita income differences despite the use of non homothetic preferences (Eckel et al., 2011). To better understand, let us consider the problem of a consumer that maximizes its utility subject to the budget constraint. The FOC of the consumer's problem defines an inverse demand function, where the price of a good depends on the Lagrangian multiplier associated with the budget constraint and on an aggregate measure of the quantities in the economy. Eckel and Neary (2010) normalize the Lagrangian multiplier, interpreted as the marginal utility of income, to one, thus neglecting the effects of per capita income on MPFs' choices.

In the next section I extend the model by Eckel and Neary in two important ways. First I abandon the assumption that firms are small in the economy. By taking into account their effect on the marginal utility of income, my model can explicitly account for the effects of per capita income on the product scope. In addition, I consider a two country model to study how differences in per capita income affect exporter scope.

4 The Model

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, there is a finite number M_i of firms that engage in trade of varieties of a final good. Exporting a variety from one country to another requires an iceberg trade cost τ. Firms are large and compete à la Cournot. Each firm, indexed by k, produces a continuum of varieties. The continuum of varieties that the k^{th} firm in country i sells to country j are indexed by $\omega \in [0, \delta_{k,ij}]$. That is, $\delta_{k,ij}$ is the mass of varieties offered by an exporter - the exporter scope.

Free entry of firms drives profits to zero.

4.1 Consumers' Problem

Consumers in both economies have the same Stone-Geary preferences. I focus here on home consumers, since the problem for foreign consumers is identical. The utility function, which I borrow from Simonovska (2015) is:

$$U_h = \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ih}} \ln(q_{k,ih}(\omega) + \bar{q}) d\omega \tag{2}$$

where $q_{k,ih}(\omega)$ is the quantity consumed of variety ω produced by the k^{th} firm in country i to country h, and $\bar{q} > 0$ is a constant. This utility function is non-homothetic[23]. The marginal utility is bounded from above, and thus there exists a choke price for any level of per capita income: there is zero demand for goods with a price higher than the choke price. Since goods enter the utility function in the same way, they can be ranked according to their prices from the cheapest necessity to the most expensive luxury[24]. 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:

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

which yields the inverse demand function:

$$p_{k,ih}(\omega) = \frac{1}{\lambda_h(q_{k,ih}(\omega) + \bar{q})} \tag{4}$$

[23] Results would still hold with a linear quadratic utility function of the form used by (Eckel and Neary, 2010). However, the Stone-Geary formulation simplifies the algebra work.

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

where λ_h is the Lagrangian multiplier associated with the budget constraint and has the textbook interpretation of being the marginal utility of income in the home country. Using (4) into the budget constraint yields an expression for the marginal utility of income:

$$\lambda_h = \frac{1}{y_h} \sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ih}} \frac{q_{k,ih}(\omega)}{q_{k,ih}(\omega) + \bar{q}} d\omega \tag{5}$$

The marginal utility of income falls with per capita income: the richer a consumer is, the lower the marginal gain from an additional unit of income[25].

Let us now move to the aggregate indirect demand. Since all consumers in the home country are identical, the aggregated demand for the variety ω produced by the k^{th} firm in country i is denoted by $x_{k,ih}(\omega) = L_h q_{k,ih}(\omega)$. We can rewrite the inverse demand function and the marginal utility of income in terms of the aggregate demand:

$$p_{k,ih}(\omega) = \frac{L_h}{\lambda_h(x_{k,ih}(\omega) + L_h\bar{q})} \tag{6}$$

$$\lambda_h = \frac{1}{y_h} \left[\sum_{i=h,f} \sum_{k=1}^{M_i} \int_0^{\delta_{k,ih}} \frac{x_{k,ih}(\omega)}{x_{k,ih}(\omega) + L_h\bar{q}} d\omega \right] \tag{7}$$

4.2 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 $c_{k,ij}(\omega)$[26]. Each firm pays a fixed cost of production F in labor units, which is independent of scope and quantity[27]. Since free entry drives profits to zero, the wage of a

[25] The marginal utility of income is also increasing in the quantities of each variety and the mass of varieties produced by each firm. The larger then available quantity and the available choice are, the larger the value of an additional unit of income.

[26] The marginal cost of production and delivery includes the iceberg trade cost τ of exporting

[27] Arkolakis et al. (2014) consider fixed costs that vary with the scope to explain why the least successful products of wide scope firms sell less that the least successful products of small scope exporters.

worker in country i equals the per capita income y_i.

I assume that the technology of MPFs is characterized by a core competence and flexible manufacturing[28]: the marginal cost of producing a variety $c_j(\omega)$ is increasing in ω[29]. Such an assumption is consistent with the empirical finding that firms' exports are skewed towards the most successful, or the core, products and that successful products tend to be sold in every market (Arkolakis et al., 2014)[30].

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 $k, k' = 1, ..., M_i$ and for each $\omega' > 0$. Oligopoly models widely assume homogeneous firms because of their tractability (Eckel and Neary, 2010; Feenstra and Ma, 2007). Moreover, we can interpret my model as describing the behaviour of export superstars (Freund and Pierola, 2012): large firms that account for most of a country's export and that have a major role in shaping trade patterns[31].

Firms simultaneously choose quantities $x_{k,ij}(\omega)$ for $\omega \in [0, \delta_{k,ij}]$ and mass of varieties $\delta_{k,ij}$ for $j = h, f$ to maximize its profits $\Pi_{k,h}$. Each firm takes into account its effect on the marginal utility of income λ_j and takes other firms' choices as given. The k^{th} firm in the home country maximizes

$$\begin{aligned}\Pi_{k,h} &= \sum_{j=h,f} \int_0^{\delta_{k,hj}} (p_{k,hj}(\omega) - c_{k,hj}(\omega)) x_{k,hj}(\omega) d\omega - y_h F = \\ &= \sum_{j=h,f} \int_0^{\delta_{k,hj}} \left(\frac{L_j}{\lambda_j (x_{k,ij}(\omega) + L_j \bar{q})} - c_{k,hj}(\omega) \right) x_{k,hj}(\omega) d\omega - y_h F \qquad (8)\end{aligned}$$

where $p_{k,hj}$ is defined by (6) and λ_j by (7). In Cournot competition firms take λ_j into consideration. That is, the firm realizes the demand linkages across its varieties that occur through the marginal

[28] Firms are able to increase the number of varieties with minimum adaptation to the production processes. Such an assumption is used by Arkolakis et al. (2014), Mayer et al. (2014) and Eckel and Neary (2010).

[29] More formally, for $\omega' > \omega$, $c_{k,ij}(\omega') > c_{k,ij}(\omega)$.

[30] The Exporter Dynamics Database further confirms the result. I divide firms in groups by their product scope by destination, finding that the distribution of within firm sales is similar across groups and destinations

[31] Since this assumption is at odd with the observed heterogeneity of exporters' scope, in later section I extend the model to incorporate firm heterogeneity.

utility of income. By producing one unit more of one variety the firm reduces the demand for all its other varieties. Increasing the quantity produced of one variety raises the marginal utility of income λ_j: one additional unit of income is valued more by a consumer that faces a larger supply. A larger λ_j shifts down the inverse demand function (6), reducing at any given price the quantities of all the varieties offered in the market. The drop in demand for each variety reduces one firm's total sales, and this effect is larger the larger its sales. The same mechanism is at work when the firm introduces more varieties: by the cannibalization effects operating through λ_j the new variety reduces the demand for all the existing ones.

Let us consider the first order condition with respect to the quantity produced of one variety:

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

A rise in the production of $x_{k,hj}(\omega)$ increases the revenues from the sales of that variety. However, because of cannibalization effects, it also reduces the sales from all the other varieties the firm produces. The optimal choice satisfies the equality between marginal revenues, reduced by the cannibalization effects, and the marginal costs. Letting $s_{k,hi}$ denote the firm's market share, defined as the total revenues of the firm from all its varieties, divided by total sales of all firms in market i, the equation simplifies to[32]

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

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

[32] Appendix A report the steps that yields such a solution and the second order conditions.

Similarly, the first order conditions with respect to the mass of varieties yields:

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

Introducing new varieties causes revenues from other varieties to fall by a factor proportional to the firm's market share. In addition, as the firm expands its scope, the marginal cost of production of the new varieties increases. This implies that the firm expands the mass of its varieties until the demand for last variety becomes zero, i.e. $x_{k,hj}(\delta_{k,hj}) = 0$[33]. Using this result into (9) I obtain an implicit equation that defines the optimal mass of varieties supplied by the firm:

$$c_k(\delta_{k,hj}) = \frac{(1 - s_{k,hj})}{\bar{q}\lambda_j} \tag{11}$$

By the core competence assumption, the left hand side of equation (11) increases with the mass of varieties. Hence, everything else constant, a larger market share causes the firm to produce fewer varieties. By decreasing marginal utility of income, higher income per capita reduces λ_j thus increasing the mass of varieties produced, given the market share. Holding the market share constant, higher income per capita leads to a larger mass of varieties produced by each firm.

We can use (11) to re-write our performance variables in a more convenient way:

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

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

[33] Appendix A shows all the work to find the first order conditions and the proof for this solution.

the pricing equation:

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

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. The marginal utility of income equals:

$$\lambda_j = \frac{1}{y_j}\sum_{i=h,f}\sum_{k=1}^{M_i}\int_0^{\delta_{k,hj}}\left[1-\left(\frac{c_{k,hj}(\omega)}{c_{k,hj}(\delta_{k,hj})}\right)^{\frac{1}{2}}\right]d\omega \tag{14}$$

Let $r_{k,h}$ denote the revenues of a firm in the home country and $C_{k,h}$ denote its total variable costs.

$$r_{k,h} = \sum_{j=h,f}\int_0^{\delta_{k,hj}} p_{k,hj}(\omega)x_{k,hj}(\omega)d\omega = \sum_{j=h,f}\frac{L_j\bar{q}}{1-s_{k,hj}}\int_0^{\delta_{k,hj}}\left(c_{k,hj}(\delta_{k,hj}) - [c_{k,hj}(\delta_{k,hj})c_{k,hj}(\omega)]^{\frac{1}{2}}\right)d\omega$$

$$C_{k,h} = \sum_{j=h,f}\int_0^{\delta_{k,hj}} c_{k,hj}(\omega)x_{k,hj}(\omega)d\omega = \sum_{j=h,f}L_j\bar{q}\int_0^{\delta_{k,hj}}\left([c_{k,hj}(\omega)c_{k,hj}(\delta_{k,hj})]^{\frac{1}{2}} - c_{k,hj}(\omega)\right)d\omega$$

The labor market clearing condition in each country i, written in labor units is $M_i(C_i + Fy_i) = L_i y_i$: the total labor costs of each firm equals the wage bill. Using market shares, goods market clear if $M_h s_{hi} + M_f s_{fi} = 1$ and trade is balanced if $M_h s_{hf} y_f L_f = M_f s_{fh} y_h L_h$[34].

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 and ignore the integer problem as in Eckel and Neary (2010); Feenstra and Ma (2007); Ottaviano and Thisse (2011). 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 income y_f such that:

[34] We can derive these condition simply recalling the definition of market share

1. Firms choose the mass of varieties they sell domestically and export according to (11)

2. Free entry drives profits $\Pi_i = r_i - C_i - Fy_i$ to zero, for $i = h, f$.

3. The labor market and the goods market clear, and trade is balanced.

4.3 Parametrization of technology

To gain a better understanding of the mechanism of the model I introduce a simple functional form of the marginal cost of production and delivery. Let us assume that the marginal cost of production and delivery from i to j is $c_{ij}(\omega) = \tau_{ij} y_i c_i \omega^\theta$ where $\theta > 0$, $\tau_{ii} = 1$ and $\tau_{ij} = \tau$. The marginal cost increases with the varieties produced to capture the core competence assumption, with its convexity regulated by the parameter θ. The parameter c_i captures the efficiency of firms in country i. Our equation (11) that determines the optimal mass of varieties produced and exported becomes for $i = h, f$

$$\begin{aligned} y_i c_i \delta_{ii}^\theta &= \frac{1 - s_{ii}}{\bar{q}\lambda_i} \\ \tau y_i c_i \delta_{ij}^\theta &= \frac{1 - s_{ij}}{\bar{q}\lambda_j} \end{aligned}$$

The marginal utility of income in country i is given by:

$$\lambda_i = \frac{\theta \Delta_i}{y_i(\theta + 2)} \tag{15}$$

where $\Delta_i = M_h \delta_{hi} + M_f \delta_{fi}$ is the aggregate mass of varieties in country i. The zero profit conditions for firms in country i is given by:

$$(s_{ii}^2 + \theta s_{ii}) y_i L_i + (s_{ij}^2 + \theta s_{ij}) y_j L_j = y_i F(\theta + 1) \tag{16}$$

The market clearing conditions are already defined in the previous paragraph. Given the cost function, the firm's market share equals the ratio of the firm's mass of varieties, relative to the aggregate set of varieties. As a result, exporter scope of home firms depends on the home firm's market share in the foreign economy and on the foreign per capita income in the following way:

$$\delta_{hf} = \left[\frac{\theta + 2}{\theta \bar{q} y_h c_h \tau}\right]^{\frac{1}{\theta+1}} \; y_f^{\frac{1}{\theta+1}} \; \left[s_{hf}(1 - s_{hf})\right]^{\frac{1}{\theta+1}} \tag{17}$$

There is a non-monotone 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 product scope to fall with the market share. The maximum product scope is associated with a market share of 1/2[35]. The exporter scope is positively related to the per capita income of the destination country. However, we have yet to determine whether the firm's market share depends on per capita income and whether the relation is positive or negative. Before determining such a relation, let us start analyzing a setting with two identical countries, to assess whether the model is consistent with the previous literature that has focused on integrated economies.

4.4 Two identical countries

Consider two identical 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 Δ. The domestic market shares are denoted by $s = s_{hh} = s_{ff}$ and the market shares obtained from exports are $s^* = s_{hf} = s_{fh}$. We can rewrite the conditions

[35]This maximum is identical to the result of Feenstra and Ma (2007), that use CES preferences, for an elasticity of substitution of 1.

that determine the mass of varieties in terms of market shares:

$$cs^{\theta}\Delta^{\theta} = \frac{1-s}{\bar{q}\lambda}$$
$$\tau cs^{*\theta}\Delta^{\theta} = \frac{1-s^*}{\bar{q}\lambda}$$

Taking the ratio of the two equations yields:

$$\frac{s^{\theta}}{1-s} = \tau\frac{s^{*\theta}}{1-s^*} \tag{18}$$

The zero profit condition provides the second equilibrium condition:

$$s^2 + \theta s + s^{*2} + \theta s^* = F(\theta+1)/L \tag{19}$$

The two equations (18) and (19) determine the equilibrium values of the market shares. By market clearing, the number of firms in each country is given by[36]:

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

The effects of trade liberalization in the context of cannibalization have been studied only à la Krugman through an increase in market size (Feenstra and Ma, 2007; Eckel and Neary, 2010). Here, we can consider the effects of a reduction in the iceberg trade cost τ. A fall in τ reduces the domestic market shares of firms, and it increases their export market shares. Trade liberalization forces firms to focus on their core competences, since the mass of varieties each firm produces

[36]The first equilibrium condition can be represented in the plane (s, s^*) as an increasing function that crosses the origin. As long as $\tau > 1$, then $s > s^*$. The second equilibrium condition is an ellipse defined only on the first quadrant of (s, s^*). The two lines cross once, hence there is a unique equilibrium. For the equilibrium $s \leq \frac{1}{2}$ we require $\frac{F}{L} \leq \frac{3\theta}{4(\theta+1)}$

shrinks. At the same time, a lower τ increases the mass of varieties exported, consistently with the predictions of Bernard et al. (2011).

At the aggregate level, trade liberalization increases the aggregate number of varieties available to consumers, Δ. In fact, entry of new firms more than offsets the reduction in the number of varieties per firm. The increase in Δ improves welfare, since the indirect utility function of our consumers equal:

$$U_j = \sum_{i=h,f} M_i \int_0^{\delta_{ij}} \ln\left(\bar{q}\frac{\delta_{ij}^{\theta}}{\omega^{\theta}}\right) d\omega = (\theta + \bar{q})\Delta_j \tag{20}$$

The model also supports the results of Eckel and Neary (2010) on the effects of a rise in the market size of both economies. Entry of new firms reduces the market share in the domestic and foreign markets. The mass of varieties per firm falls, but the aggregate mass of varieties rises. As the market shares of firms shrink, the cannibalization effects are weaker. However, contrary to Feenstra and Ma (2007), weaker cannibalization effects are not enough to raise the number of varieties per firm.

4.5 Comparative statics

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 starting from an identical countries setting. 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[37]:

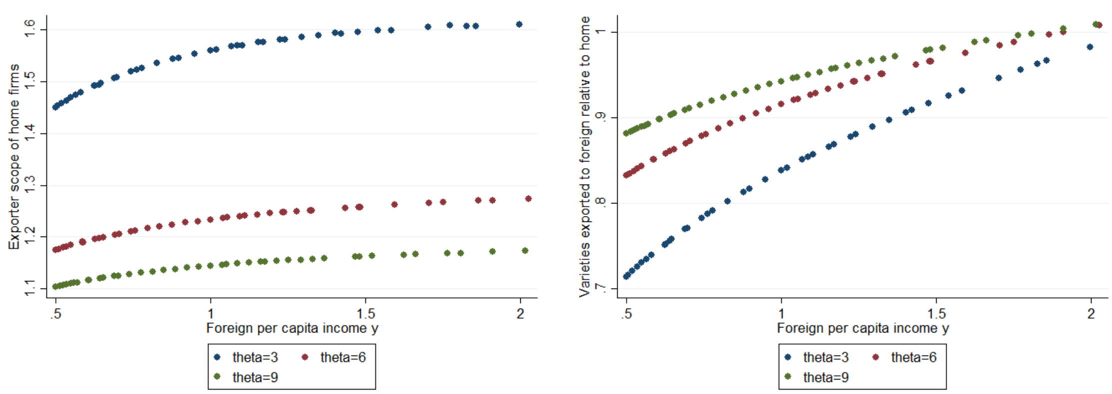
Proposition 1. *A rise in foreign productivity increases the relative per capita income of the foreign economy. As a result, the export scope of home firms increases.*

[37] Appendix A contains the proof

A rise in the foreign productivity increases the foreign per capita income. Keeping the market share $s_{j,hi}$ constant, the exported mass of varieties would increase, by equation (17). Higher per capita income raises the choke price, hence 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[38]. However, the reduction in scope due to a fall in the firm's market share does not offset the rise in scope brought about by the rise of the per capita income.

Figure 3 shows the positive relationship between the exporter scope of home firm abroad, and the relative exporter scope as a function of the foreign per capita income for different values of θ[39]. When the increase in the marginal cost of a new variety is high (large θ), the product scope is limited and δ_{hf} is smaller.

Figure 3: Exporter scope δ_{hf} and relative exporter scope $\frac{\delta_{hf}}{\delta_{hh}}$ as a function of y_f.



The rise in per capita income in the foreign economy brings about firm entry from both countries. Both the number of home and foreign firms rises. A larger entry of firms reduces home firms domestic market share, causing the domestic product scope per firm to fall. As a result, the

[38]Since we are considering the region of equation (17) where product scope is positively related to the market shares

[39]The parameters of the model for the numerical exercise are: $\tau = 1.7$, $F = 0.01$, $L_h = L_f = 1$, $c_h = 1$, $\bar{q} = 0.001$.

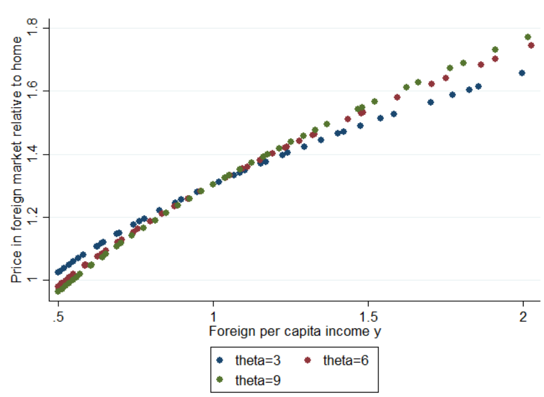
relative scope of home firms abroad, relative to the domestic scope is increasing in the foreign per capita income.

Let us consider the relative price of the variety in the foreign economy, relative to its price at home:

$$\frac{p_{hf}(\omega)}{p_{hh}(\omega)} = \tau \frac{1 - s_{hh}}{1 - s_{hf}} \left(\frac{\delta_{hf}}{\delta_{hh}} \right)^{\frac{\theta}{2}} \tag{21}$$

Per capita income affects prices in two ways: an increase in the foreign productivity generates an increase in the exported product scope δ_{hf}, which positively contributes to $p_{hf}(\omega)$. This effect is analogous to the one studied by Simonovska (2015): higher per capita income reduces the elasticity of substitution across varieties, thus allowing firms to charge higher markups. In my model markups are a positive function of the product scope. Cournot competition brings about an additional effect of per capita income on prices: rising per capita income reduces the market power of the firm, s_{hf}, negatively affecting the price of home goods abroad. A sufficient condition for the first effect to dominate, in the neighborhood of the identical countries equilibrium, is that $\theta > 1$. In addition, I can show numerically that the relative price of a good sold in two countries increases with the relative per capita income of the two countries (Figure 4).

Figure 4: Relative price of the same good $\frac{p_{hf}(\omega)}{p_{hh}(\omega)}$ as a function of the foreign per capita income.

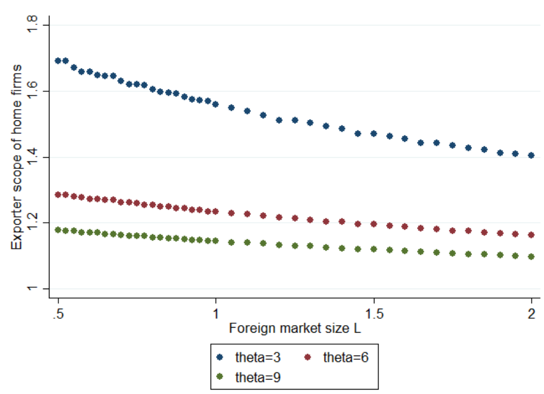


Finally, proposition 2 summarizes the effects of changing foreign market size on the product scope of home exporters:

Proposition 2. *An increase in the foreign market size reduces the product scope of home exporters.*

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 the market shares of home firms abroad. As a result, the exported number of varieties by home firms falls. Figure 5 shows how the product scope of exporter is affected by changes in the foreign market size. Finally, a reduction in the scope and the market share of home exporters reduces the price of home exported varieties. However, the relative exporter scope and relative prices are ambiguously affected.

Figure 5: Exporter scope δ_{hf} as a function of L_f.



4.6 Extension to heterogeneous firms

This section briefly illustrate that the main results of the model still hold in a heterogeneous firm setting. Since section 2 showed that the product scope of firms in the data exhibits a considerable degree of heterogeneity, it is worthed to verify that the relationship between per capita income and the product scope of exporters is robust to the introduction of heterogeneous firms.

Let us consider the following modification of the marginal cost function I employed before. The marginal cost of production and delivery is given by $c_{k,ij}(\omega) = w_i c_{k,i}(\omega + b)^\theta$, where w_i is the wage in country i[40] and $b > 0$ is a parameter that guarantees that the marginal cost of the first variety is positive[41]. Each firm k in country i draws $c_{k,i}$ from a Pareto distribution with parameter β and maximum $\bar{c}_i$.

I follow Eaton et al. (2012) and assume that there is a finite number of potential entrants in each country. Contrary to Feenstra and Ma (2007) there is no uncertainty: each firm knows its draw of c_k. Firms choose simultaneously scope, quantity and prices using equation (11), and their profits are defined by (8). To avoid uninteresting multiple equilibria I assume that entry follows the productivity ranking: at first the most productive firms enter, followed by the others. Profits of the k_i firm are denoted by $\Pi(k_i)$. Letting $\pi_i = \sum_k \Pi_{k,i}/L_i$ the per capita profits, I can define per capita income as $y_i = w_i + \pi_i$.

The equilibrium is defined in the following way:

1. Given a number of firms M_h and M_f, each firm maximizes its profits taking other firms' choices as given. Its optimal scope and quantity choices are defined by (11).

2. The equilibrium number of firms is defined by M_h and M_f such that, (i) the least productive firm in both markets has positive profits and (ii) if a firm were to enter in the home or foreign market, the profits of such a firm will become negative

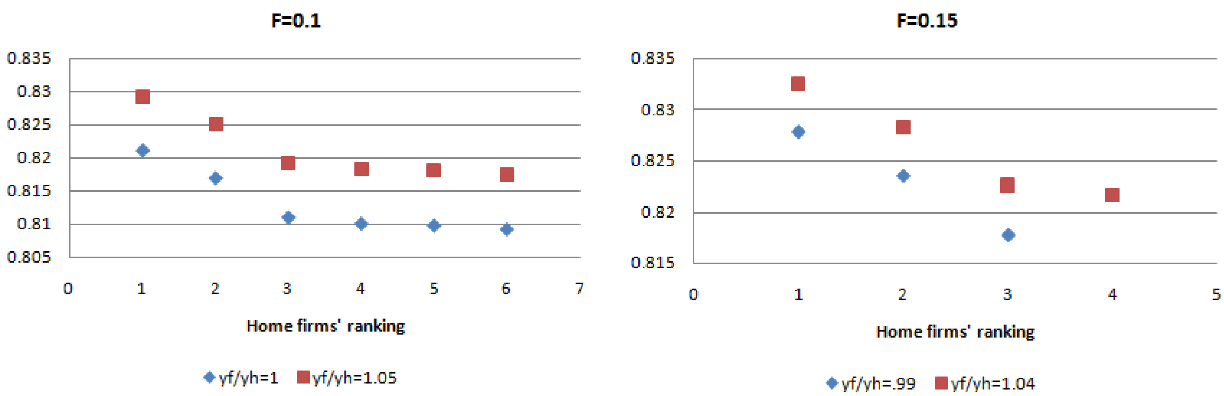
3. Markets clear

[40] I have to make a distinction here between wages and per capita income, because in equilibrium, the average profits of firm will be positive.

[41] This assumption allows for selection in the export market. When $b = 0$ as in the homogeneous firms case, even in the presence of iceberg trade costs, all firms that produce also export, since the marginal cost of exporting the first variety is zero. While this assumption is not relevant in the homogeneous firms case, here, where I include heterogeneity selection in the export market becomes relevant.

Figure 6[42] shows the relative scope exported by home firms, given different values for the average cost of foreign firms. In particular I consider a 10% reduction in the mean parameter of the Pareto distribution. Such a reduction brings about higher foreign per capita income. For all home firms, the relative export scope increases.

Figure 6: Relative exporter scope $\frac{\delta_{hf}}{\delta_{hh}}$ as a function of the foreign per capita income.



5 Empirical test of the model

The model generates an empirical prediction that positively relates the product scope of exporters to the per capita income of the destination country. Such a relationship is consistent with the stylized fact that firms export more varieties in richer country, as shown in section 2 of the paper. Following equation (17), my model suggests to use the firm's market share in the destination country as a control variable for the firm's market power and the cannibalization effect. Taking the relative number of products exported by firm k from country h to country i, relative to some numeraire

[42] A more formal presentation of the heterogeneous firms' model and of the algorithm used to solve it is in Appendix A. The two graphs feature different values of the fixed cost F. The parameters of the numerical exercise are: $\tau = 1.7$, $\theta = 3$, $\bar{c} = 5$ for both country in the baseline, and $\bar{c_f} = 4.5$ in the exercise. $L_h = L_f = 1$, $b = 0.1$, the Pareto parameter $\beta = 4$

country n[43] yields the following expression for the relative scope of the firm:

$$\underbrace{\left(\frac{\delta_{ij}^k}{\delta_{in}^k}\right)}_{\text{Relative scope}} = \underbrace{\left(\frac{y_j}{y_n}\right)^{\frac{1}{\theta+1}}}_{\text{Rel. pc. income}} \underbrace{\left(\frac{\tau_{in}}{\tau_{ij}}\right)^{\frac{1}{\theta+1}}}_{\text{Trade costs}} \underbrace{\left(\frac{s_{ij}^k}{s_{in}^k}\right)^{\frac{1}{\theta+1}}}_{\text{Firm mkt power}} \underbrace{\left(\frac{1-s_{ij}^k}{1-s_{in}^k}\right)^{\frac{1}{\theta+1}}}_{\text{Cannibalization}} \tag{22}$$

Such expression decomposes the scope choice of firms as being determined by a number of explanatory variables: the relative per capita income, trade costs, the firm market power, which measures the competition effects, and a cannibalization effect.

Guided by the model, I use equation (22) to test the hypothesis that firms export more varieties to richer countries. I use data from the Exporter Dynamics Database for the year 2004 as described in section 2. For each exporting country I select as numeraire the destination with the largest total sales. Table 4 summarizes the top destinations for each exporter.

Table 4: Destination with the highest total sales by exporting country

Exporter	ALB	BGR	GTM	JOR	MEX	PER	SEN
Top destination	ITA	ITA	USA	USA	USA	USA	IND

I proxy trade costs τ_{ij} with bilateral distance between country i and j and dummies for contiguity, common language, colonial relationships, being landlocked or an island. The firm's market share in country j is defined as $Export_{ij}^k/Tot.Absorption_j$ [44]. Taking logs of 22 yields:

$$\log\left(\frac{\delta_{ij}^k}{\delta_{in}^k}\right) = \beta_y \log\left(\frac{y_j}{y_n}\right) + \beta_s \log\left(\frac{\mathrm{s}_{ij}^k}{\mathrm{s}_{in}^k}\right) + \beta_{1-s} \log\left(\frac{1-s_{ij}^k}{1-s_{in}^k}\right) + \gamma \log\left(\frac{\tau_{ij}}{\tau_{in}}\right) + \epsilon_{ij}^k \tag{23}$$

Using firm level fixed effects, the results of such a regression are shown in table 5[45]. The esti-

[43]Taking the ratio allows me to avoid the estimate of preference parameters and cost parameters altogether.
[44]Total Absorption is defined as gross manufacturing output - exports + imports, and is from Simonovska and Waugh (2014)
[45]The coefficients of the extended regression are shown in Appendix B. Results are robust to including only distance and border effects as controls.

mates of $\hat{\beta}_y$ are positive and significant in all cases but Senegal. The magnitude of the coefficients are larger than those found in section 2. Doubling the per capita income of the destination country increases the relative exporter scope by 12% on average. The coefficient on the firms' market shares are positive and statistically significant. However, the results on the cannibalization effects are not always positive and statistically significant.

Table 5: Result of OLS regression (23)

	ALB	BGR	GTM	JOR	MEX	PER	SEN	All
β_y	.35	.22	.11	.23	.13	.12	.09	.12
	(.12)***	(.03)***	(.03)***	(.06)***	(.05)**	(.03)***	(.05)	(.01)***
β_s	.21	.16	.14	.19	.21	.15	.07	.10
	(.02)***	(.01)***	(.01)***	(.01)***	(.001)***	(.01)***	(.02)***	(.01)***
β_{1-s}	-3024	67	-2073	1140	-291	300	-2.9	-163
	2770	(11)***	(2067)	(128)***	(261)	(.338)	(94)	(226)
N.Obs.	1002	8844	2982	556	44338	7437	206	65365
R^2	.40	.28	.32	.45	.60	.29	.16	.31

Results from OLS on equation (23). Appendix B reports the coefficients on the trade costs proxies. Robust std. error in parenthesis. Cluster: destination country. ***: significant at 99%, ** at 95%, * at 90%. The additional controls are: relative distance in logs, a dummy for contiguity, common official language, a dummy if a language is spoken by at least 9% of the population in both countries, a dummy for colonial relationship, common colonizer, colonial relationship post 1945, if country were the same country, landlocked and island.

To reduce the endogeneity connected with firms' market shares, I consider taking averages across firms for each source-destination, yielding the following equation[46]:

$$\overline{\log}\left(\frac{\delta_{ij}^k}{\delta_{in}^k}\right) = \beta_y \log\left(\frac{y_j}{y_n}\right) + \beta_s \overline{\log}\left(\frac{\mathrm{s}_{ij}^k}{\mathrm{s}_{in}^k}\right) + \beta_{1-s}\overline{\log}\left(\frac{1-s_{ij}^k}{1-s_{in}^k}\right) + \gamma \log\left(\frac{\tau_{ij}}{\tau_{in}}\right) + \epsilon_{ij}^k$$

The estimates of such a regression, for all pooled observations with country of origin fixed effects are as follows [47]:

[46] $\bar{log}(x)$ indicates the log of the geometric average of x

[47] The remaining coefficients are: -.10**distance+.13**contig-.00 Official common language+ .32** Ethnology common language +.09 Colony + .04 Common colony +.43 colony in '45 + .14 Same country - .2 landlocked -.05 island. The R^2 of the regression is .45, with 453 observations. Standard errors clustered at the country of origin level.

$$\overline{\log}\left(\frac{\delta_{ij}^k}{\delta_{in}^k}\right) = \underset{(0.03)**}{.08\ \log\left(\frac{y_j}{y_n}\right)} + \underset{(0.02)*}{.05\ \overline{\log}\left(\frac{\mathrm{s}_{ij}^k}{\mathrm{s}_{in}^k}\right)} + \underset{(81)**}{186\ \overline{\log}\left(\frac{1-s_{ij}^k}{1-s_{in}^k}\right)}$$

The maximum scope given per capita income is reached at s=0.02% of total absorption, which falls in the top 5^{th} percentile of my sample: only the largest firm are affected by cannibalization effects, as found by Hottman et al. (2014). While the estimated coefficient on the relative per capita income and market shares are similar, as predicted by the model, the coefficient on the cannibalization effect is not [48]. The results of the regressions show a positive correlation between the product scope per exporter and the per capita income of the destination. Such a relation is influenced by the market share of firms in the destination country, and the predictions on the nature of that relation are not rejected by the data. Finally, cannibalization effects are tangibly limiting product scope expansion for the largest firms.

6 Conclusions

This paper documented a new stylized fact for multiproduct exporters: the number of varieties exported by firm increases with the per capita income of the destination country. This regularity is robust to changing the country of origin and is confirmed by the Mobile business unit of Samsung.

I develop a tractable general equilibrium model of multiproduct firms to rationalize this finding. The model main assumptions are non homothetic preferences and firms' technology exhibiting a core competence. Non homothetic preferences generate a ranking of goods depending on their

[48] The reason for such an odd result may be that the market shares firms consider when choosing their scope is the ratio of sales not to total absorption, but rather to the absorption of the industry in which they compete. Let us assume that consumers aggregate the utility from goods of different industries in a Cobb-Douglas way. Therefore, the expenditure share on industry i is a share α_i of total domestic absorption. This implies that the observed market share I use $s_{ij}^k = \alpha_i \tilde{s}_{ij}^k$ and $\tilde{s}_{ij}^k$ is the true market share. If consumers across countries are identical, $\frac{s_{ij}^k}{s_{in}^k} = \frac{\tilde{s}_{ij}^k}{\tilde{s}_{in}^k}$, while $\overline{\log}\left(\frac{1-s_{ij}^k}{1-s_{in}^k}\right) \approx s_{in}^k - s_{ij}^k = \alpha_i(\tilde{s}_{in}^k - \tilde{s}_{ij}^k)$. Therefore, the estimates of β_{1-s} are biased upward. The smaller α_i, the bigger the bias.

prices: only rich economies demand expensive goods. By the core competence assumption, firms start exporting the cheapest varieties and each new variety that is introduced is relatively more expensive than the previous ones. As a result, exporter scope is larger in richer countries.

Even though more varieties per firm directly increases welfare and therefore does not addresses the complaints of the general press about the excessive varieties, it may offer a different downside of variety proliferation. The model predicts that the larger firms' product scope, the higher the markups they charge. As a result, higher markups partially reduce the welfare gains from product scope expansion.

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