Entry barriers to international trade: product versus firm fixed costs

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Abstract

Market size matters for exporters if firms must recover fixed costs. I use the relationship between the extensive margins of exports and destination market size to evaluate whether fixed costs operate at the firm or at the product level. If fixed costs are at the firm level, multi-product firms have a cost advantage and dominate international trade. If fixed costs are at the product level, larger markets allow more firms to benefit from economies of scale. Using detailed product level data from 40 exporting countries to 180 destination markets, the results indicate that entry barriers operate at the product level. Looking at firm entry within products across time and destinations, I find evidence of spillover effects that reduce fixed costs, increase firm entry and augment export revenues. The efficiency gains in production through lower product fixed costs outweigh the competition effects from more firm entry. Trade policies encouraging product entry, such as advertising products in destination markets through export promotion agencies or lowering technical barriers to trade, would result in more firm entry and generate higher export revenues.

JEL Classifications: F12, F14, F23

*I would like to thank Francisco Alvarez-Cuadrado, Andriana Bellou, Rui Castro, Stefania Garetto, Baris Kaymak, Miklos Koren, Michael Siemer, and Pierre-Yves Yanni for their useful comments and suggestions. All remaining errors are mine. Contact: Université de Montréal, Département de Sciences Économiques, 3150 rue Jean-Brillant, Montréal - Québec - H3T 1N8, Canada, (E-mail: walter.steingress@umontreal.ca).

1 Introduction

Fixed costs to export create entry barriers that restrict trading opportunities. Larger markets ease the relevance of fixed costs by allowing firms to slide down the average cost curve and produce at a more efficient scale. As a result more firms enter larger markets. These fixed costs can be of two types: either at firm or at the product level. The current view of the literature[1] is that fixed costs to export are mainly at the firm level, for example advertising a firm brand or setting up a distribution network. Given this cost structure, multi-product firms have a cost advantage and dominate international trade. Anecdotal evidence[2] suggests an alternative view where fixed costs operate at the product level, for example acquiring export/import licenses or technical barriers to trade. In this case, product entry is accompanied with lots of firm entry and international trade is characterized by many firms selling different varieties of the same product.

This paper develops an empirical framework to infer the dominant nature of fixed costs form the different effects they might have on international trade patterns. I argue that the elasticities of the number of exporting firms and exported products with respect to destination market size informs on whether fixed costs operate at the firm or at the product level. Using detailed trade data from 40 exporting countries across 180 destination markets, I assess the relevance of fixed costs by testing for differences in entry elasticities. Within this framework, I then present empirical evidence consistent with the view that product fixed costs create spillovers effects that lead to higher firm entry and give grounds for trade policies promoting exports.

The starting point is to test whether the number of exporters and the number of exported products vary with market size in a significantly different way. In the case of fixed costs operating at the firm level, a firm pays a common fixed cost to advertise the firm brand or to create a distribution network in the export destination for all the products it exports. By spreading the fixed cost over more products, multi-product firms have a cost advantage over single-product firms, as in Feenstra and Ma (2007) and Eckel and Neary (2010). The presence of spillovers effects through lower per product costs allows the firm to expand its product range with market size, i.e. economies of scope. As a result, few firms with many products enter large markets leading to a higher average number of products per firm. The testable implication is that the elasticity of products with respect to market size should be higher than the elasticity of firms.

Fixed costs at the product level are instead costs that firms have to incur in order to introduce a product into a destination market, i.e. acquiring an import license, meeting a product standard or advertise a product in the destination. The key point is that the firm that pays the product fixed cost creates a spillover to rival firms by lowering the fixed cost for subsequent exporters. Hausmann and Rodrik (2003) argue that export pioneers create an externality/spillover by making a

[1]see for example Arkolakis and Muendler (2010), Eaton, Kortum, and Kramarz (2011) and Bernard, Redding, and Schott (2011)

[2]see for example Hausmann and Rodrik (2003) and Artopoulos, Friel, and Hallak (2013)

considerable investment in attempts opening up foreign markets, cultivating contacts and establishing legal standards. The investment in these costly activities can then be used by domestic rival firms operating in the same product category. The spillover reduces the rival firms' fixed costs to export and facilitates entry into export markets. Due to the higher demand in larger markets, we expect that the export pioneer is more likely to create an externality for subsequent exporters in larger markets because of higher expected export revenues. Given this reasoning, there is relative more firm than product entry once market size increases. The testable implication is that the entry elasticity of firms with respect to market size should be higher than for products.

Using bilateral data for 40 exporting countries in 180 destinations, I find that the entry elasticity of the number of firms with respect to market size is significantly higher than the entry elasticity of the number of products. This holds for a broad set of countries at different levels of development. Two potential explanations for a higher firm than product elasticity are: either the average number of firms per product increases with market size or the average number of products per firm decreases with market size. The first effect points to more product varieties in larger markets and is consistent with product fixed costs. The second effect suggests that multi-product firms enter in small and large markets. However, in larger markets multi-product firms export less products compared to the small market because of more competition from single product firms, see Mayer, Melitz, and Ottaviano (2011). This finding would be consistent with firm fixed costs. My results show that larger markets have on average more firms per exported product and that the number of products per firm does not vary with market size. This finding supports the claim that entry barriers operate on the product level.

Next, I build on the previous framework and present supportive evidence for spillover effects consistent with product fixed costs. Once the export pioneer pays the product fixed costs and introduces a new product into a destination market, rival firms benefit from lower fixed costs. To test this implication, I investigate how firm entry changes over time after a new product is introduced. Also, the willingness of an export pioneer to introduce a new product depends on the number of product market rivals because of business stealing effects, i.e. more firm entry increases competitive pressure and reduces prices. When regressing the number of exporters within a product category in a given destination on export prices and quantities, we expect that the number of exporters should be negatively correlated with prices and positively with quantity. The lower price indicates competitive pressure from the entry of product market rivals. The larger quantity captures the efficiency gains in production through economies of scale, i.e. firms slide down the average cost curve and sell more at lower prices. Furthermore, firm entry should depend on the product type. Exporters of differentiated products face less competitive pressure from product market rivals.

Using detailed product level data (4912 product categories) from 40 exporting countries in 180 destination countries, I find that the first two years after a product is exported for the first time to a destination, the firm entry rate within the product category increases significantly. The following years the firm entry rate is lower than the average entry rate and declines steadily over time. The results also show that within a product category, countries with more firms per export destination have significant lower export prices and sell a larger quantity. The quantity effect dominates the price effect indicating that lower fixed costs increase average export revenues of the firm. Taking the degree of product differentiation into account, I estimate the model for differentiated, less differentiated and homogenous products separately and test for significant differences in the estimated coefficients. I find that prices of differentiated products are less sensitive to firm entry, which points to lower competitive pressure in differentiated products. Overall, the results are consistent with fixed costs operating at the product level and suggest that rival firms benefit from spillovers that lower fixed costs and increase average export revenues per firm.

Understanding the nature of fixed costs is an important guide for effective trade policy among countries. This is because different set of policies can reduce product as opposed to firm fixed costs to encourage exports. For example, the exporting country can stimulate new product entry by advertising new products in destination markets through export promotion agencies.[3] This may lead to spillover effects that translate into higher level of firm participation and export growth. By subsidizing part of the product fixed costs, the government also increases incentives for firms to explore new export destinations and offsets part of the free riding from rival firms. The importing country can lower product fixed costs by reducing technical-barriers to trade. As a result, consumer surplus increases because of lower product prices due to competitive pressure from more firm entry.

More generally, the existence of fixed costs to export implies that trade policy can affect market structure. When conducting policy experiments in the form of a reduction in trade costs, it is standard in the international trade literature to consider only a fall in marginal costs and evaluate the resulting impact on the patterns of trade and consumer welfare. However, my results suggest that fixed costs at the product level are an important entry barrier to international trade. In addition, an important aspect of free trade negotiations is the reduction of these costs by alleviating technical barriers to trade and establishing common product standards, see the current EU-US free trade negotiations. Kehoe and Ruhl (2013) provide empirical evidence that liberalization increases product entry and leads to significant growth in export revenues from these products. Thus, neglecting changes in these barriers underestimates the impact of trade reforms.

My work contributes to the empirical international trade literature that analyses the relationship between market characteristics, fixed costs and product entry. Hummels and Klenow (2005) focus on characteristics of the exporting country when studying the extensive product margin. They suggest that trade models featuring product fixed costs can reconcile the fact that larger

[3]see Görg, Henry, and Strobl (2008) and Lederman, Olarreaga, and Payton (2010) for empirical evidence on export promotion agencies

economies export a given product to more countries. My argument for product fixed costs is based on the fact that the number of products increases significantly in destination market size independently of the exporter country characteristics. The difference is that in Hummels and Klenow (2005) the product fixed cost is a global fixed cost independent of the destination, whereas my results indicate that firms have to incur a market specific fixed costs for every export destination. Consistent with their argument, I find higher entry elasticities for larger exporting economies. As destination market size increases, larger economies start to export relative more products than smaller ones. Combined these results suggests that market specific product fixed costs are an important entry barrier to international trade and that home market size matters.

Going a step further, this paper analyzes implications of product fixed costs on firm entry within a product category. Hausmann and Rodrik (2003) argue that higher firm entry rates may be the result of spillover effects. Pioneer exporters create spillovers by making investments in attempts to open foreign markets and other costly activities that can be used by rival firms within the same product category. By analyzing firm entry within products over time and across countries, I find supportive evidence of these spillovers. In line with lower fixed costs, firm entry increases significantly the year after an export pioneer introduces a product into a destination. The lower fixed cost allows rival firms to exploit scale, increase their export revenue and the survival probability in international markets. These results are consistent with micro evidence of spillovers among exporters as found in the case of France (Koenig (2009) and Koenig, Mayneris, and Poncet (2010)) and Argentina (Artopoulos, Friel, and Hallak (2013)).

The analysis also contributes to the international trade literature analyzing the empirical relationship between market size and firm entry, for single product firms, see Helpman, Melitz, and Rubinstein (2008), Melitz and Ottaviano (2008), Arkolakis (2010), Eaton, Kortum, and Kramarz (2011), and multi-product firms, see Arkolakis and Muendler (2010) and Bernard, Redding, and Schott (2011). The paper most closely related to this one is Eaton, Kortum, and Kramarz (2011). Using a monopolistic competition model of heterogeneous firms with CES preferences and fixed costs, Eaton, Kortum, and Kramarz (2011) argue that the variation in the number of French exporters with respect to destination market size informs on fixed costs of exporting at the firm level. This paper builds on their basic empirical insight, looking at the elasticity of firm penetration, and questions whether fixed costs operate at the firm or product level. My results suggest that once we depart from Eaton, Kortum, and Kramarz (2011)'s assumption of one firm produces one product, product fixed costs offer an alternative view consistent their empirical result.

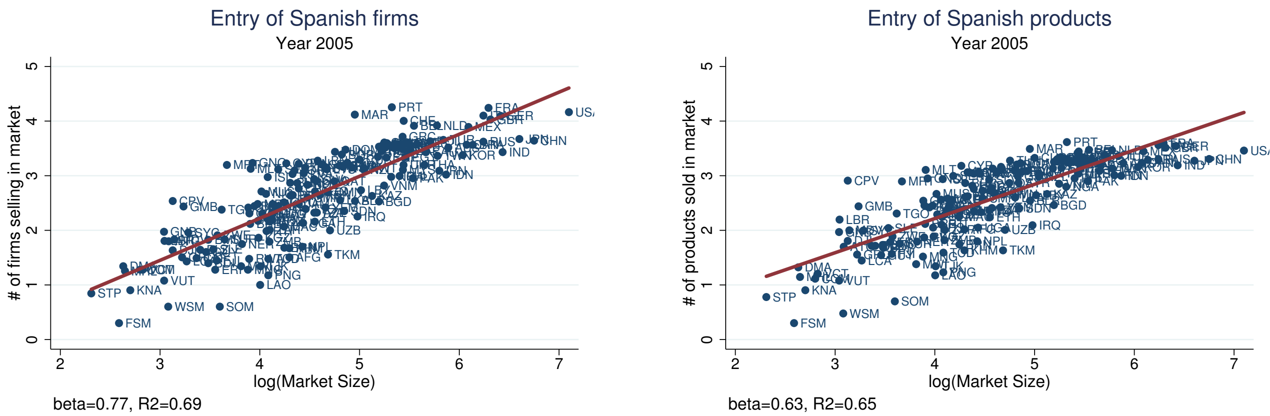
Arkolakis and Muendler (2010) and Bernard, Redding, and Schott (2011) focus on multi-product firms and the determinants of their product scope with respect to destination characteristics. They generalize the cost structure of Eaton, Kortum, and Kramarz (2011) by introducing firm specific product fixed costs. In comparison to these papers, this paper considers product fixed costs that are independent of the firm. Once an export pioneer pays the product fixed cost and introduces the product in an export destination, she creates a spillover that lowers fixed costs for rival firms within the same product category. Note that if fixed costs are parameterized accordingly, the framework of Arkolakis and Muendler (2010) and Bernard, Redding, and Schott (2011) can account for differences in the firm and product elasticity. The key difference with respect to this paper is that their analysis does not allow for spillover effects across firms once new products enter export markets. My empirical evidence suggests that these spillover effects are quantitatively important in explaining the entry behavior of firms.

The rest of the paper is organized as follows. Section 2 describes the conceptual framework. Section 3 presents the methodology together with the testable implications. Section 4 presents the data with the relevant summary statistics and the empirical results. Section 5 illustrates an empirical framework to shed further light on the presence of spillovers induced by product fixed costs. Section 6 concludes.

2 Empirical framework

I start my investigation with an assessment of the destinations that exporting firms reach and the characteristics of the destinations that attract many exporters. First, I take the perspective of the largest exporting country in my sample, Spain, and its firms. Following Eaton, Kortum, and Kramarz (2011), Figure 1(a) plots the log of the number of Spanish firms selling to a particular market d against the log of destination market size proxied by GDP. The number of firms selling to a market tends to increases with the size of the market. A regression line establishes a slope of 0.77 and an $R^2 = 0.69$. Eaton, Kortum, and Kramarz (2011) interpret the positive relationship between firm penetration and market size as evidence of market specific fixed cost. Larger markets offer more demand and thus it is easier for firms to recover fixed costs. As Bernard, Eaton, Jenson, and Kortum (2003) show, other trade models based on variable trade costs without fixed costs can also account for the fact that market size matters for the export decision of firms. However, the authors also note that these models are not able to generate both the observed relative size of total revenues of exporters, compared to non-exporters, and the strong selection with respect to destination market size into exporting. To account for these empirical regularities, international trade models assume additional exporting costs in the form of a market specific fixed costs to export.

An alternative view of the relationship in Figure 1(a) is that fixed costs operate at the product rather than on the firm level. To investigate this idea further, Figure 1(b) repeats the previous graph but instead of the log number of firms, it plots the log number of products that Spain exports to a destination against the market size of the destination along the horizontal axis. The number of products exported to a destination increases systematically with market size, $R^2 = 0.65$, and an elasticity of 0.63. Following the argument of Eaton, Kortum, and Kramarz (2011), an explanation that reconciles the relationship in Figure 1(b) is the presence of market specific fixed costs at the



(a) Firm entry by market size for Spain in 2005

(b) Product entry by market size for Spain in 2005

Figure 1: Number of Spanish exporting firms and number of Spanish products exported versus market size in destination *d*. Sources: Exporter Dynamics Database World Bank. Figure (1a) number of firms, Figure (1b) number of 6 digit HS products per destination. Note: Market size is absorption of a country's manufacturing sector. The slopes of the fitted lines are 0.77 (standard error 0.038) for firms from Spain and 0.63 (0.034) for exported products from Spain.

product level. Exporting products is only possible at a huge expense in fixed costs and the demand for most of the products in the destination is not sufficient to export all of them profitable.

While the positive relationship between entry and market size remains, the slope of the log number of products with respect to market size is significantly lower than in the case of firms. The difference in the elasticities implies that international trade models based on the assumption of one firm produces one product are inadequate in addressing the number of exporters and exported products in destination markets. This paper departs from Eaton, Kortum, and Kramarz (2011) and considers a framework where firms can produce multiple products and a product can be produced by multiple firms. Within this framework, I then ask the following questions: To what extent prevent fixed costs the entry of firms and products in international trade? Are they more prevalent on the firm or on the product margin? To answer these questions, I evaluate how the number of firms and products varies with destination market size controlling for origin, time and bilateral characteristics. I attribute differences in the entry behavior across markets due to fixed cost operating either at the firm or product level. Before describing the empirical model, I define the cost structure and derive testable implications.

2.1 Fixed cost at the firm level

Under entry barriers to export at the firm level, I consider market specific fixed costs that the firm needs to pay in order to export its products to a destination market. Such costs can take the form of information costs to acquire knowledge about the market in a destination (Chaney (2011)), advertising costs to establish the firm brand (Arkolakis (2010)) or adaptation costs in the form of building a distribution network. Additional sources of adaptation costs may be to accommodate to business practices in the export destination (Artopoulos, Friel, and Hallak (2013)), or legal fees in order to establish eligibility of an exporting firm/company by the importing country (Khanna, Palepu, Knoop, and Lane (2009)). The key characteristic of the firm fixed cost is that incurring the cost only benefits the firm and there are no spillovers across firms.

The presence of fixed costs at the firm level implies cost advantages for multi-product firms because they can spread these costs across more products, see Feenstra and Ma (2007) and Eckel and Neary (2010) for theoretical models emphasizing the described effect. This lowers the firm's average costs per product and increases its competitiveness relative to single product firms. Multi-product firms benefit from economies of scope. Larger markets offer more demand, increase the cost advantage and attract relative more multi-product firms than in smaller markets. The presence of economies of scope may be one explanation of why multi-product firms are dominant in international trade.[4]

To summarize, in larger markets the expected firm revenue is higher allowing the firm to run down their average costs curve. The lower costs spurs firm entry and each firm produces at a larger scale. Given that some of the firms are multi-product firms, the larger market gives them an additional cost advantage. As market size increases, relative more products enter because multi-product firms either expand their product range or participate more in international trade relative to single product firms. Given this reasoning, *one should observe more product entry in comparison to firm entry resulting in more products per firm in larger markets.*

2.2 Fixed cost at the product level

Fixed costs at the product level can take the form of technical barriers to trade (in the form of products standards or certification procedures to ensure the quality) or product advertising. Technical barriers to trade imply modifications to the offered product in order to customize it to particular local tastes or legal requirements imposed by national consumer protection laws. Costs also arise from the translation of foreign regulations, hiring of technical experts to explain foreign regulations, and adjustment of production facilities to comply with the requirements. Additional examples of fixed cost to export at the product level are obtaining an export and/or import license. The use of technical barriers to trade is subject to Agreement on Technical Barriers to Trade administered by the WTO.

The key characteristic of the product fixed costs is that once the product is established in an ex-

[4]Based on U.S. trade data in 2000,Bernard, Redding, and Schott (2011)) show that firms exporting more than five products at the HS 10-digit level make up 30 percent of exporting firms and account for 97 percent of all exports. Looking at Brazilian exporter data in the year 2000, Arkolakis and Muendler (2010) find that 25 percent of all manufacturing exporters ship more than ten products at the internationally comparable HS 6-digit level and account for 75 percent of total exports.

port market many firms start to export differentiated varieties of that product. Incurring the fixed cost to introduce a new product induces a spillover that lowers fixed costs for all firms within the product category. One reason is that ex ante consumers are unaware of the existence of the product. Once a firm introduces the product successfully in the destination market, consumers demand the product allowing firms to export differentiated varieties of that product. To access the export market, firms can share the fixed product costs in the form of setting up common distribution networks to promote their products jointly (for example, a US car dealerships that sells different brands of German cars). Another form of cooperations are trade associations formed to foster collaboration between companies within a specific product category in order to define common product standards, to advertise their products to foreign consumers or to lobby governments for favorable trade policy, i.e. through export promotion policies, see Lederman, Olarreaga, and Payton (2010) and Görg, Henry, and Strobl (2008) for the empirical evidence.

Instead of many firms sharing the product fixed cost, also a single firm can introduce a product into an export market. By doing so this export pioneer creates a spillover/externality for other firms producing the same product. Product market rivals benefit from lower fixed costs because the export pioneer opened up a foreign market, established contacts and/or distribution chains and invested in other costly activities which they can use. Rival firms may also acquire knowledge about the potential demand of their own products in the foreign market once they observe the success of the pioneer. Khanna, Palepu, Knoop, and Lane (2009) study the concrete example of Metro Group a German retail company that fought years to have access to the Indian market. Once the Foreign Direct Investment permit was granted, rival retail firms like Wal-Mart and Tesco entered immediately by benefiting from the created legal framework and the observed business opportunities in the Indian retail market.

To summarize, under the presence of fixed costs at the product level, the entry of a product is associated with many firms. Due to the higher demand in larger markets, we expect more cooperation among firms in paying the fixed. Also, the first entrant is more likely to create a positive externality for rival firms in larger markets because the expected firm revenue is higher despite the following entry of rival firms. The product fixed cost implies that multi-product firms do not have a cost advantage in larger markets. Under all scenarios, we expect that there is substantially more firm entry than product entry once the market size increases. The testable implication is that *the entry elasticity of firms with respect to market size should be greater than for products implying that the number of firms per product is higher in larger markets.*

In the next section, I explain how I distinguish empirically the nature of fixed costs, namely whether they operate at the firm or at the product level. The key element for this distinction relies on the comparison of firm entry and product entry elasticities as market size increases.

3 Methodology

To analyze the nature of fixed costs, proceed as follows. First, decompose export revenues from country c to destination d in year t, $X_{d,c,t}$, into the following firm components. Note that the same decomposition also holds for products.

$$X_{d,c,t} = \pi_{d,c,t} X_{d,t} = N_{d,c,t} \bar{x}_{d,c,t} \tag{1}$$

$X_{d,t}$ is the market size measured by GDP of destination d in year t, $\pi_{d,c,t} = X_{d,c,t}/X_{d,t}$ is the import expenditure of destination d on goods from country c, $N_{d,c,t}$ is the number of firms (or the number of products) that export from c to d and $\bar{x}_{d,c,t}$ is the average export revenue per firm (or per product) from c to d in t.

To investigate the relationship with exports and market size on the different margins, rewrite equation 1 as:

$$X_{d,t} = \left(\frac{N_{d,c,t}}{\pi^{b}_{d,c,t}} \right) \left(\frac{\bar{x}_{d,c,t}}{\pi^{1-b}_{d,c,t}} \right)$$

and taking logs, we get

$$\log X_{d,t} = \log N_{d,c,t} - b \log \pi_{d,c,t} + \log \bar{x}_{d,c,t} - (1-b) \log \pi_{d,c,t} \tag{2}$$

We can split equation 2 into two expressions and evaluate how the extensive margins (the number of exporters)

$$\log N_{d,c,t} = b \log \pi_{d,c,t} + \gamma \log X_{d,t} \tag{3}$$

and the intensive margin (the average export revenue per firm)

$$\log \bar{x}_{d,c,t} = (1-b) \log \pi_{d,c,t} + (1-\gamma) \log X_{d,t} \tag{4}$$

change with market size.

The parameter of interest is γ. Consider the following two possibilities:

1. If $\gamma = 0$: In the absence of fixed costs and given positive demand for a product or a brand, any firm will find it worthwhile to enter. In this case, we expect that the number of firms and products does not change with market size. Models in international trade that feature this setting are of the Armington type, i.e. Anderson and Van Wincoop (2003). In these models only the intensive margin matters since the number of exporters per market is assumed to be fixed.
2. If $\gamma > 0$: Under the presence of such costs, firms operate under increasing returns to scale. Firms enter the market until the expected profit is zero, i.e. expected export revenue equals

fixed costs. This free entry condition determines the number of firms per market. In larger markets, firms can take advantage of the higher demand by sliding down the average cost curve and sell at lower prices. Thus, the number of firms will be increasing in market size .

To assess differences in firm level and product level entry barriers, we test for significant differences in the estimated elasticities with respect to market size using the following regression specification

$$\log N_{d,c,t} = \alpha + b \log \pi_{d,c,t} + \gamma \log X_{d,t} + d_{c,t} + \epsilon_{d,c,t} \tag{5}$$

which restates equation 3 and includes origin country-year dummies. The import expenditure variable $\pi_{d,c,t}$ captures the taste that a particular destination d may have for goods from country c. We expect that the higher the expenditure share, the higher the propensity to export in a market. In this basic specification, it proxies also for all other factors, like distance, that determine market entry other than market size. In the robustness section I enrich the model and include further control variables that maybe correlated with market size and the entry decision. Equation 5 is estimated separately for products and firms as dependent variables in order to obtain separate entry elasticities (gamma parameter) with respect to market size for each of these two components.

- If product entry (P) is larger than firm entry (F), i.e. $(\hat{\gamma}^P > \hat{\gamma}^F)$, then I interpret this as evidence suggestive of fixed costs operating at the firm level
- If firm entry (F) is larger than product entry (P), i.e $(\hat{\gamma}^F > \hat{\gamma}^P)$, then I interpret this as evidence suggestive of fixed costs operating at the product level

If the entry elasticities are not significantly different from each other, then within this framework we cannot distinguish whether fixed costs operate on the firm or on the product level.

4 Data and descriptive statistics

To build the empirical evidence, I use the Exporter Dynamics Database from the World Bank, see Cebeci, Fernandes, Freund, and Pierola (2012). It contains firm characteristics per destination and per product for 40 exporting countries for the period 1997 to 2010.[5] Following the literature, see Broda and Weinstein (2006), I consider a 6 digit HS code per country as a product category and refer to individual firm products within the product category as varieties of the same product. Given this perspective, a product can be exported by multiple firms and a firm can potentially export multiple products. Firms can be viewed as providing their brand and the brand in turn provides the platform for specific products to be launched. The Exporter Dynamic Database does

[5] I exclude Botswana, Brazil, Egypt, New Zealand and Kuwait because of missing firm characteristics by export destinations. The appendix contains a complete list of the countries used.

not contain information on the "Oil and Fuels" sector, HS code 27, leaving a total of 4912 tradable products for each country.

To examine product and firm entry into export markets, I include distance, common border, market size, income per capita and total import expenditure as destination characteristics. Distance and border measures come from Centre d'Etudes Prospectives et d'Informations Internationals (see Mayer and Zignago (2011)) and are in kilometers from capital city in country i to capital city in country j, calculated by the great circle method. Openness, market size and income measurements, defined as GDP and GDP per capita, are taken from the Penn World Table, see Heston, Summers, and Aten (2009). Data on total c.i.f. import expenditure spend by destination on exporters goods is taken from the Comtrade data set collected by the United Nations.[6] In total the baseline sample covers 40 exporting countries and 180 destination markets.

Table 7 in the appendix describes the summary statistics of the combined dataset. The average number of exporters in a destination across all 40 exporting countries is 344 and the average number of exported products per destination is 298. Since firms can export multiple products and a product can be exported by multiple firms we can decompose the extensive margin of exports further. Line 3 in Table 7 shows the average number of products per firm is 2.5 suggesting that the majority of firms are multi-product firms. The average number of firms per products is 2.1 implying that strategic interactions between exporters from the same origin country are important. An export pioneer has to take into account the effect of a potential spillover/externality on product market rivals when opening up an export market. Overall, under the assumption of each firm exports a unique product we neglect important interaction between products and firms. In the majority of destinations, a firm sells more than one product and a product is exported by more than one firm.

Table 1 displays the results from the estimation of specification 3. Focusing on columns (1) and (2), we see that both, the number of firms and products, are increasing in destination market size and import expenditure share. In comparison to the literature, the firm entry elasticity of 0.40 wrt to destination market size is significantly lower than values found in other papers. Bernard, Redding, and Schott (2011) report a value of 0.70 for the United States in the year 2002 and Eaton, Kortum, and Kramarz (2011) report an elasticity of 0.66 for France in the year 1992 and

[6] To construct import expenditure shares, I use data from the Penn World Table and the Comtrade database. To avoid any potential measurement errors in the exchange rate when combining nominal values from the 2 dataset, I compute the import expenditure share of destination d on goods from country c, $\pi_{d,c}$, as follows. Using the Comtrade data set, I first compute the share of imports with respect to total trade flows. More precisely, I divide bilateral cif imports, $X_{d,c}$, by the sum of total fob exports plus total cif imports for each country, $(Imp_p + Ex_p)$. From the Penn World table, I then take openness defined as total exports plus total imports divided by GDP. Hence, I can calculate the share of total cif imports expenditure with respect to GDP as:

$$\pi_{d,c} = \left(\frac{X_{d,c}}{Imp_d + Exp_d} \right) \left(\frac{Imp_d + Exp_d}{X_d} \right)$$

Table 1: Entry of firms and products with respect to market size

Dependent variable	log(Number of firms) (1)	log(Number of products) (2)	log(Number of firms) (3)	log(Number of products) (4)
log(Market Size)	0.403***	0.317***	0.439***	0.357***
	[0.0116]	[0.0115]	[0.00595]	[0.00560]
log(Expenditure Share)	0.366***	0.360***	0.205***	0.199***
	[0.00631]	[0.00724]	[0.00475]	[0.00478]
log(Distance)			-0.828***	-0.847***
			[0.0232]	[0.0263]
log(GDP per capita)			0.139***	0.0953***
			[0.0113]	[0.0113]
Border			0.347***	0.311***
			[0.0225]	[0.0290]
Observations	30164	30164	30164	30164
R-squared	0.661	0.618	0.764	0.723

Note: The results from ordinary least squares regressions for the dependent variable normalized by the import expenditure share are noted at the top of each column projected on the covariates listed in the first column. All regressions include origin country, time and origin country-time fixed effects. Robust standard errors in parentheses: ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

0.68 for Denmark and Uruguay in 1993.[7] The results are more comparable to Bernard, Redding, and Schott (2011) as I also use total GDP as a measure of market size whereas Eaton, Kortum, and Kramarz (2011) use manufacturing absorption.[8] Although there are significant differences in the point estimate of the entry elasticity with respect to the literature, all values are significantly below 1 implying that average export revenues increase with market size.[9]

Focusing on differences in the elasticities with respect to market size, the entry elasticity for firms is higher than for products suggesting that fixed costs at the product level are the dominant form of entry barriers, i.e. $(\gamma^F > \gamma^P)$. To test for significant differences, I estimate equation 5 with the dependent variable being number of firms and the number of products jointly within a Seemingly Unrelated Regressions (SUR) model. This estimation method allows for correlation in the entry determinants of firms and products. I reject the null hypothesis of no differences at the 1

[7] I do not have data for the countries mentioned and can not compare the results by running the same regression for the respective countries.

[8] If I use manufacturing absorption as a proxy for market size I obtain a firm entry elasticity of 0.45. Absorption is calculated from gross manufacturing output plus imports minus exports. Due to data limitations on gross manufacturing output the number of destinations shrinks to 150.

[9] Below, I provide a sensitivity analysis where I investigate differences in the entry elasticities. The analysis shows that the entry elasticities increase with home market size implying that larger economies have higher entry elasticities. The reason why my estimate of firm entry is lower compared to the literature lies in the fact that my sample consists predominately of small economies compared to the literature and therefore biasing the estimate downwards. Taking the estimated relationship between home market size and entry elasticity from below, the results imply a firm entry elasticity of 0.74 for the United States and 0.62 for France.

percent level.

In column (3) and (4) in Table 1, I include additional control variables to see how entry behavior varies with respect to destination characteristics. We run the following regression

$$\begin{aligned} \log(N_{d,c,t}) &= \alpha + b_1 \log(\pi_{d,c,t}) + \gamma_1 \log(X_{d,t}) + \beta_1 \log(y_{d,t}) \\ &+ \beta_2 \log(dist_{d,c}) + \beta_3 \log(b_{d,c}) + d_{c,t} + \epsilon_{d,c,t} \end{aligned} \tag{6}$$

where entry of firms and products depends now on GDP per capita in destination d, $y_{d,t}$, the distance between trading partners, $dist_{d,c}$, and whether the countries share a common border, $b_{d,c}$. We expect that richer countries spend more per product and hence entry rates should increase in GDP per capita, $\beta_1 > 0$. Similarly, sharing a border and being close to each other increases the demand for products because of lower transportation costs. We expect entry decrease in distance, $\beta_2 < 0$, and increase when sharing a border, $\beta_3 > 0$.

Columns (3) and (4) in Table 1 confirm previous results. All coefficients are statistically significant. Based on equation 6, more firms and products enter in markets with a higher level of GDP per capita. Note that GDP is the product of population and GDP per capita. Thus, the effect of the log of population on entry is γ_1 and the effect of the log of income per capita is $\gamma_1 + \beta_1$. Since $\beta_1 > 0$, income per capita is more important than population for firm and product entry. Distance has a negative effect on entry implying that less firms enter in distant markets. Overall, column (3) and (4) show that the entry elasticity of firms is statistically significantly higher than for products even after controlling for income per capita and geography. Interestingly, the effects of expenditure shares, distance and sharing a border on firm entry are not significantly different from product entry.

4.1 Discussion of results

A firm can produce multiple products and a product can be produced by multiple firms. Depending on the ratio of firms to product in the small market, the reason for a higher firm than product elasticity can have two potential explanations in relation to product and firm fixed costs.

One explanations is that the number of firms per product increases with market size, which is consistent with fixed costs at the product level. Because of the low demand in small markets, firms export few products to these destinations. Also, export pioneers pay the product fixed cost only for product categories where they face little competition. The subsequent lower costs for rival firms would vanish all its profits. Larger markets offer more demand for each product and the number of firms per product increases.

An alternative explanations is that the number of products per firm decreases with market size. Suppose few multi-product firms export many products to small markets. As market size increases, more firms are able to pay the firm fixed cost. Most of these firms are single product firms and they enter in product categories that multi-product firms export to the small market. This intensifies competition and forces multi-product firms to reduce their product range. Mayer, Melitz, and Ottaviano (2011) emphasize this mechanism. In this case the firm elasticity is higher than the product elasticity but the implication would be consistent with fixed costs at the firm level.

To distinguish between the two effects, I use equation 5 and regress the average number of firms per product and the average number of products per firm on market size and other destination characteristics. Column (3) and (4) in Table 8 of the appendix contain the results. I find that the number of products per firm is independent of market size, in accordance with the findings of Arkolakis and Muendler (2010) in the case of Brazil. On the other hand, the number of firms per product increases significantly in larger markets. Higher demand in larger economies reduces average costs of firms and leads to more entry. These findings support the claim that entry barriers operate on the product level.

The decomposition of exports into extensive and intensive margin, (equations 3 and 4), offers an alternative view on the mechanism behind fixed costs. Consider for a moment a model with free entry. Firms enter the market until the expected profit is zero, i.e. expected export revenues equal marginal costs plus fixed costs. This condition determines the number of exporters per market. The fact that entry elasticities are smaller than 1 implies that export revenues increase in market size, see equation 4. If average export revenues increase with market size, then the model implies, under the assumption of constant markups, that revenues are higher in larger markets because fixed costs are higher, for example setting up a distribution network is costlier. In this case we would have a positive correlation between entry and market size because market size proxies for fixed costs. To analyze whether the positive entry elasticities are triggered by a correlation between market size and fixed costs, I use additional control variables ($F_{d,t}$) that proxy for fixed costs. The resulting regression equation becomes:

$$\begin{aligned} \log\left(N_{d,c,t}\right) &= \alpha + b_1 \log\left(\pi_{d,c,t}\right) + \gamma_1 \log\left(X_{d,t}\right) + \beta_1 \log\left(y_{d,t}\right) \\ &+ \beta_2 \log\left(dist_{d,c}\right) + \beta_3 \log\left(b_{d,c}\right) + \beta_4 \log\left(F_{d,t}\right) + d_{c,t} + \epsilon_{d,c,t} \end{aligned} \tag{7}$$

We expect that the coefficient β_4 is negative, i.e. higher fixed costs decrease the presence of firms. Important is the coefficient on γ_1. If $\hat{\gamma}_1$ differs from $\tilde{\gamma}_1$ previously estimated in Table 1 then fixed costs are correlated with market size. To assess the relationship between market size and the proxies of fixed costs, we use the fact that $\tilde{\gamma}_1 = \hat{\gamma}_1 + Corr(F_{d,t}, X_{d,t})$. If larger markets have higher fixed costs, then the estimated coefficient of market size should be lower given the presence of fixed costs.

To proxy fixed costs, I include Urban population (% of total), Land area (sq. km), Container port traffic (TEU: 20 foot equivalent units), Rail lines (total route-km), number of internet and cell phone subscribers (per 100 persons) and Electric power consumption (kWh per capita) from the World Development Indicators dataset provided by the World Bank. Urban population and land area proxy for retail distribution costs. A higher percentage of urban population facilitates distribution. On the other hand a larger land increases the costs to reach consumers. Rail and container port traffic proxy for transportation infrastructure. While transportation costs are also part of marginal costs, I use them as proxies for infrastructure fixed costs.[10] The number of internet subscribers controls for networking and communication costs. Finally, energy consumption proxies for higher retail costs. Due to missing observations, the sample reduces to 11096 observations.

Table 9 in the appendix reports the detailed results for each dependent variables. Note that better infrastructure proxied by container port traffic and km of rail lines increases entry both entry of firms and products. Land size and energy consumption reduce the entry of firms and products. A larger area requires more distribution costs and a higher energy consumption points to more fixed costs. Note that the elasticities of the number of firms and products with respect to destination market size decrease significantly. The reason is that market size is positively correlated with distribution costs, i.e. larger market have higher fixed costs and thus reduce the importance of market size on fixed costs. Overall, the firm elasticity is still significantly higher than the product elasticity suggesting that fixed costs operate preliminary on the product rather than firm level even when we control for "observable" fixed costs.

This paragraph contains alternative explanations for the positive relationship between firm entry and market size. Following Eaton, Kortum, and Kramarz (2011), I argue that the number of firms increases in market size because of exogenously given fixed costs. Arkolakis (2010) provides an alternative theory based on marginal costs in form of a market access costs. Arkolakis and Muendler (2010) extend his analysis by relaxing the assumption of one firm produces one product. To reconcile the product and firm margin within the Arkolakis and Muendler (2010) framework, one needs to assume that a firm has to incur a marketing cost for each product it wants to export to each destination. Note that my results indicate that the marketing effort spend in one product does not facilitate entry of other products within the firm. Otherwise, firms would benefit from economics of scope. While in Arkolakis (2010) firms choose the marketing cost, Chaney (2011) develops a model based on information frictions. Firms have to search for foreign trading partners in order to trade. This characterizes a dynamic formation of an international network of importers and exporters. Because larger markets have more contacts, the number of exporting firms will increase in markets size. However, firms have to find buyers implying that the search costs occur at the firm level and not at the product level. One might expect that in the case of a match, the

[10] Removing rail lines and container port traffic from regression 7 does not change the results.

exporters will sell all its products. The finding that product fixed costs are the dominant entry barrier suggests that also demand considerations are an important factor in the entry decision of firms. Armenter and Koren (2009) develop a model where demand for products is uncertain. Eaton, Eslava, Jinkins, Krizan, and Tybout (2012) develop a model with search and demand uncertainty. Exporters have to search for potential buyers in destination markets. The success in selling to a buyer reveals information about the appeal of the seller's product in the market, affecting the incentive to search for more buyers, so importers learn about the product. The combination of search and demand uncertainty is likely to replicate the above results.

The key aspect of my analysis is that the product fixed cost is not firm specific. Bernard, Redding, and Schott (2011) consider product fixed costs at the firm level. While their analysis focuses on multi-product firms and the determinants of their product scope after trade liberalization, their model allows for differences in the elasticities of firms and products with respect to market size. Parameterized accordingly, the quantitative model of Bernard, Redding, and Schott (2011) can account for differences in the firm and product elasticity. The central difference with respect to this paper is that their analysis does not allow for spillover effects across firms once new products enter export markets. In the following section, I present empirical evidence suggestive of spillovers and show that these effects are quantitatively important in explaining the entry behavior of firms.

5 Firm entry within products

In the previous part I presented evidence consistent with fixed costs operating at the product level. An important implication is that product fixed costs cause spillover effects that lower costs for subsequent exporters once the product entered a destination market. To shed light upon this mechanism, I analyze how firm entry evolves over time after a product enters a destination for the first time. Based on the results, I then present additional empirical evidence supportive of product fixed costs inducing spillovers that facilitate firm entry through lower fixed costs.

Given the definition of product fixed costs, we expect that once a firm successfully introduces a product in a destination market many firms will follow. To test the effect, I investigate how the entry rate of firms from an exporting country within a product category in a particular country varies over time. I define entry of a new product k from country c in a destination d at time t if the product is not exported in any period prior to the year of the first entry. The first year of product data I observe is 1995 and the first year of firm entry is 1998. Therefore, I will focus only on products that have not been exported to a destination prior to 1998. Another issue with the data is that the Exporter Dynamics Dataset does not contain information that is origin - destination - product - year specific, i.e. we do not know how many exporters from a particular country sell a particular product in a particular destination in a given year. To address this problem, I specify 2 regression models. In the first regression I analyze the firm entry rate aggregated over all products within a destination. In the second model I consider the firm entry rate per product aggregated over all destinations.

The first regression model analyzes the entry rate of firms from country c exporting to destination d at time t:

$$n_{d,c,t} = \sum_{s=1}^{8} \beta_s t_{s,k,d,c,t} + d_{c,d} + d_{c,t} + d_{k,t} + \epsilon_{k,d,c,t}$$

The firm entry rate, $n_{d,c,t}$, is defined by the number of new entrants divided by the total number of exporters. I regress the firm entry rate on the a set of dummies, $(t_{s,k,d,c,t})$, that capture the firm entry rate over time after a product is exported for the first time to a destination. I set the dummy $t_{s,k,d,c,t}$ equal to 1 if product k from country c is exported to destination d at time t s years after the product is introduced. The coefficient β_s captures the difference to the average firm entry rate in year s after the product is introduced. Given this specification, we expect that the entry rate increases significantly right after a product is introduced in an export market, i.e. $\beta_1 > 0$. To test whether $\beta_1 > 0$, I include a large set of control dummies: destination-origin $(d_{c,d})$, origin-time $(d_{c,t})$ and product-time $(d_{k,t})$ specific dummies. Origin-destination dummies control for geography. The origin-time dummies control for any origin country specific effects that generates easier firm entry into international markets, for example institutions, infrastructure, etc. Product-time dummies account for product demand effects common across countries .

In the second regression model, I analyze the firm entry rate within a product group across destinations. I estimate the following equation:

$$n_{k,c,t} = \sum_{s=1}^{8} \beta_s t_{s,k,d,c,t} + d_{c,k} + d_{d,t} + d_{c,t} + \epsilon_{k,d,c,t}$$

The firm entry rate, $n_{k,c,t}$, is defined by the number of new exporters divided by the total number of exporters of product k from country c in year t. I regress the firm entry rate on the same set of time dummies $(t_{s,k,d,c,t})$. The only difference is that I include origin-product $(d_{k,c})$ and destination-time $(d_{d,t})$ fixed effects instead of destination-origin $(d_{c,d})$ and product-time $(d_{k,t})$ dummies. The origin-product dummies account for supply side effects. For example, firm entry may be higher because a country is very productive in producing a particular product. The destination-time dummies control for macroeconomic conditions in the destination common to all products.

Table 2 plots the results of the 2 regression specifications. The average firm entry is given by the constant. The year dummies describe the estimated time effects on firm entry after a product is exported for the first time. Looking at the coefficient of year_1 and year_2, firm entry increases significantly the first 2 years and then becomes either negative (column (1)) or insignificant (column (2)). Dividing the estimated coefficient by the average, we obtain that the entry rate in a destination increases by 2.5 percent and by 7 percent within the product group one year after a product is introduced. Given that the average number of firms per destination is 343, as shown in

Table 2: Fixed costs and the number of exporters per destination

Dependent variable	Firm entry per destination (1)	Firm entry per product (2)
year_1	0.0170***	0.0342***
	[0.00071]	[0.00189]
year_2	0.00599***	0.00699**
	[0.000107]	[0.00283]
year_3	-0.00402***	-0.000734**
	[0.00138]	[0.000363]
year_4	-0.0133***	-0.00393
	[0.00167]	[0.00439]
year_5	-0.0232***	-0.00139
	[0.00196]	[0.00515]
year_6	-0.0266***	-0.00152
	[0.00227]	[0.00595]
year_7	-0.0312***	-0.00954
	[0.00264]	[0.00688]
year_8	-0.0400***	-0.00307
	[0.00307]	[0.00797]
Constant	0.655***	0.490***
	[0.00531]	[0.0142]
Observations	3297489	2703038
R-squared	0,883	0,629

Note: The dependent variable is the number of entrants divided by the total number of exporters in a destination (column (1)) or within a product group (column (2)). The results are based on ordinary least squares regressions. All regressions include origin country - time fixed effects. The destination specific regression in column (1) includes product-time and origin-destination fixed effects whereas the product specific regression in column (2) includes product-country and destination-time fixed effects. Robust standard errors in parentheses (clustered by country time): ***, **, * marks statistically significant difference from zero at the 1***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

the summary statistics, the number of new firms in a destination increases on average by 8.6 firms. On the other hand, the average number of exporters per product is 27 implying that 2 additional new firms start to export after a product is exported for the first time. These results suggest that the increase in firm entry is not driven by the entry of 1 firm.

Overall, the entry pattern is consistent with the interpretation that part of the fixed cost is sunk. Once a firm introduces a product into a destination, firms enter at a significant higher rate the following 2 years. These findings point to spillover effects from lower fixed costs for following exporters and are consistent with the definition of product fixed costs. To strengthen the evidence of spillovers across firms, the next paragraph discusses additional empirical implications.

Higher firm entry rates after product entry as shown in Table 2 may lead to business stealing effects. An export pioneer who opens up international markets reduces fixed costs for product market rivals and thus spurs entry. More entry increases competitive pressure and results in lower prices. Based on this argument, products with a higher number of exporters per destination should be negatively correlated with export prices. Also, the willingness of the pioneer to bear the product fixed costs increases in market size because of the higher demand in larger markets. If this effect dominates, the pioneer may not be willing to pay the fixed cost in the small market. We would expect a negative correlation between the number of exporters per product and the number of export markets penetrated. Because the number of destinations does not control for the market size of the export markets penetrated, I also include the rank of the export market with the largest and the lowest size as additional control variables. The business stealing effect predicts that products with lots of firms export only to lower ranked markets, i.e. the markets with the largest size.

To investigate business stealing effects at the product level, I use the following regression specification:

$$\log N_{k,c,t} = \beta_1 \log \bar{p}_{k,c,t} + \beta_2 \log s_{k,c,t} + \beta_3 \log \bar{q}_{k,c,t} + \beta_4 \log M_{k,c,t} + d_k + d_{c,t} + \epsilon_{d,c} \qquad (8)$$

where $N_{k,c,t}$ is the average number of exporters per destination in product class k from country c in period t, $\bar{p}_{k,c,t}$ is the unit value our proxy for the export price of the product, $s_{k,c,t}$ is the survival probability of an exporter remaining an exporter the following year, $\bar{q}_{k,c,t}$ represents the per firm average quantity exported and $M_{k,c,t}$ stands for the number of destinations product k is exported to. d_k and $d_{c,t}$ are product and country-time fixed effects. Country-time fixed effects control for institutional differences and macroeconomic trends that are common across products. Product fixed effects control for any characteristics that are common across export destinations like demand, substitutability and potentially common fixed costs.[11] Note that the fixed effects will not capture the effect of pioneers on the product differentiability and revenues of rivals because these firms

[11] I assume that product demand is common across countries, i.e. that consumers in different destination markets have the same demand for a product. Under this assumption, product fixed effects will control for demand effect.

Table 3: Fixed costs and the number of exporters per destination

Dependent variable	log(Av. Nr. Exporters per destination) (1)	(2)
log(Av. Unit value)	-0.01025***	-0.01085***
	[0.000703]	[0.000702]
Log(Av. Quantity)	0.0399***	0.0394***
	[0.000619]	[0.000625]
log(Nr. of destinations)	0.127***	0.117***
	[0.00154]	[0.00163]
Survival Probability	0.225***	0.224***
	[0.00443]	[0.00443]
Rank of largest market		-0.000786***
		[3.14e-05]
Rank of smallest market		0.000322***
		[4.06e-05]
Observations	201,788	201,788
R-squared	0.495	0.497

Note: The dependent variable is the average number of exporters per destination. The results are based on ordinary least squares regressions. All regressions include origin country, product and time fixed effects. Robust standard errors in parentheses (clustered by country time): ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

operate in different product categories in different countries.

Table 3 plots the results. The number of firms per destination for a given product is significantly negative correlated with the average export price. Since we control for demand by product fixed effects, the number of export destinations and the firm's average quantity exported, I consider this as supportive evidence for business stealing effects. Lower fixed costs spur firm entry and results in more product market competition.

Table 3 also shows that contrary to our expectations products with many firms per destination are exported to more destinations, column (1) and (2). A potential explanation is that the number of destinations proxies for comparative advantage. In the Eaton and Kortum (2002) model a country has a stronger comparative advantage in a product group if that product is exported to many destinations. Given this interpretation, countries export a product to many destinations because the average productivity of firms within this product category is high. Firm export participation is positively correlated with the number of destinations not because of lower fixed cost but due to lower average costs caused by comparative advantage.

The quantity coefficient in Table 3 is significantly and positive. Because of lower fixed costs, firms slide down the average cost curve, increase production efficiency and export on average a larger quantity. Note that the quantity effect is significantly larger than the price effect implying that efficiency gains from lower fixed costs dominate business stealing effects from more entry. Artopoulos, Friel, and Hallak (2013) provide anecdotal evidence that export pioneers acquire knowledge about foreign markets through their embeddedness in the business community of destination markets. The generated knowledge diffuses to rival firms within the same sector in the domestic market, lowers fixed costs to export and increases their efficiency. Firm participation and export sales per firm increase significantly. My finding is consistent with this argument. An addition implication of the knowledge spillover is that firms learn to conduct international business allowing them to remain an exporter in the next period. Including the survival probability of staying an exporter next period as an additional regressors, confirms this conjecture. Firms exporting products with many rival firms have on average a 22 percent higher probability of survival in export markets.

Artopoulos, Friel, and Hallak (2013) argue that spillover effects are particular pronounced in sectors with a high degree of product differentiation. In product categories that allow for more product differentiation, firms can react to more product market competition by upgrading their own product through quality. The higher the degree of product differentiation, the lower is the competition pressure form product market rivals. We expect the negative relationship between export price and firm entry to be weakened, i.e. differentiated product groups should experience relative more product entry. In regression 8, I control for product differentiation by including product fixed effects. In a sensitivity analysis I re-estimate equation 8 for different types of products classified according to Rauch (1999)'s product differentiation index. The three groups are: homogeneous goods, reference priced goods and differentiated goods. Index 1 refers to homogeneous goods, 2 to reference prices goods and 3 to differentiated goods.

Table 4 contains the results. I test whether the sensitivity of price on the number of firms per destination is lower for differentiated products than for homogeneous products. In differentiated product the effect of price on the number of firms per destination is significantly lower than in the other 2 groups. Also, the probability of staying in export markets and the average export revenues are higher for firms exporting differentiated products. This is additional evidence for the argument of Artopoulos, Friel, and Hallak (2013) that positive spillover effects are stronger in differentiated products.

In sum, the results suggest that consistent with product fixed costs, once a firm introduces a product into a market subsequent exporters face lower fixed costs. The time analysis shows that most firms enter the year right after a product was exported the first time. This finding is consistent with lower fixed costs due to the removal of part of the fixed cost to export. I also find that the associated spillover form the lower fixed costs leads not only to higher entry rates but is

Table 4: Fixed costs and the number of exporters per destination for differentiated, less differentiated and homogeneous products

Dependent variable:	log(Av. Nr. Exporters per destination)		
Differentiation index	1	2	3
log(Av. Unit value)	-0.0389***	-0.0138***	-0.0046***
	[0.0033]	[0.0016]	[0.0005]
Log(Av. Quantity)	0.0145***	0.0173***	0.0237***
	[0.0017]	[0.0005]	[0.0009]
log(Nr. of destinations)	0.0333***	0.0342***	0.146***
	[0.0073]	[0.0037]	[0.0018]
Survival Probability	0.129***	0.152***	0.263***
	[0.0147]	[0.0081]	[0.0055]
Rank of largest market	0.000753***	0.000990***	0.000723***
	[0.0001]	[7.06e-05]	[3.61e-05]
Rank of smallest market	-0,000273	0.000360***	0.000295***
	[0.0001]	[8.49e-05]	[4.76e-05]
Observations	9682	40573	151369
R-squared	0,386	0,424	0,532

Note: The dependent variable is the average number of exporters per destination. The product differentiation index assigns a value of 1 to homogeneous goods, 2 to reference prices goods and 3 to differentiated goods. The results are based on ordinary least squares regressions. All regressions include origin country, product and time fixed effects. Robust standard errors in parentheses (clustered by country time): ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

also accompanied by a business stealing effect, i.e. the higher firm entry reduces export prices. At the same time, lower fixed costs allow firm to produce at a more efficient scale and export a larger quantity. Overall, the larger quantity offsets the negative price effects and average export revenues per firm increase.

6 Conclusion

This paper develops an empirical framework to analyze constraints that prevent firms from participating in international markets. The analysis distinguishes between entry barriers on the firm and product level. In the first part I study the presence of fixed costs by evaluating how the entry of firms and products varies with destination market size. The second part describes potential spillover effects at the firm and product level caused by fixed costs and presents empirical evidence consistent with these effects.

The results indicate that entry barriers operate at the product and not at the firm level. Taking cross country evidence into account, product fixed costs are even more important relative to firm fixed costs in countries with a large home market. Small countries have often only one firm within a product category, thus product fixed costs are identical to firm fixed costs. Overall, the results suggest that small economies are particularly affected from fixed costs. The low level of domestic demand implies that firms are not able to benefit from economies of scale resulting in relative high prices and a disadvantage in comparison to firms from larger economies. Moreover, because of low demand, few firms find it profitable to export to them. The limited entry results in even higher prices due to the lack of competitive pressure.

To investigate the effects of fixed costs on the entry decision of firms further, I analyze how firms change their product range with market size. The results show that the average number of products per firms does not change with the size of the destination market pointing to no cost advantages of expanding the product range in larger markets. I consider this as supportive evidence of product fixed costs. Including information on the timing of entry of products, I find consistent with product fixed costs that the entry of firm increases significantly the year after a product is introduced to a destination market. The higher entry of rival firms indicates lower entry barriers due to the removal of the product fixed costs. The additional entry introduces competitive pressure and lowers export prices, i.e. business stealing effects. The lower fixed cost allows rival firms to produce at a more efficient scale, increases their export revenues and results in a higher probability of staying in international markets the next period.

In conclusion, my findings have important policy implications. For the exporting country policies encouraging new product entry, for example advertising new products in destination markets through export promotion agencies, rather than firm entry would potentially lead to spillover effects that translate into higher level of firm participation and export growth. By paying part of the product fixed costs, the government increases incentives for firms to explore new export destinations and offsets part of the negative effects due to free riding of rival firms. The importing country can lower product fixed costs by reducing technical-barriers to trade. As a result, consumer surplus increases because of lower product prices due to competitive pressure. More generally, the existence of entry barriers to export implies that trade policy can effect market structure. When conducting policy experiments in the form of a reduction in trade costs, it is standard in the international trade literature to consider only a fall in marginal costs and evaluate the resulting impact on the patterns of trade and consumer welfare. However, an important component of the current EU-US free trade negotiations is the reduction of technical-barriers to trade by negotiating common product standards. Neglecting the existence of entry barriers and the resulting industry reallocations underestimates the impact of trade reforms.

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7 Appendix

7.1 Robustness

I conduct robustness tests to support the empirical result that product fixed costs are the dominant entry barrier. I also look at origin market characteristics. In particular, following the argument of Hummels and Klenow (2005) I suspect that the size of the home market is important to overcome fixed costs to export.

Cross-country differences

In this subsection, I analyze cross-country differences in the estimated entry elasticities. In regression 5, I pooled all observations across countries and reported a common entry elasticities for all countries. Now I impose less restrictions and allow for different entry elasticities depending on the origin country c. Instead of running country by country OLS regressions, I pool all observations to explicitly account for potential correlation across origin countries in the destination. I then test whether entry elasticities differ across exporting countries. I reject the hypothesis of a common slope coefficients on market size at the 1 percent level.[12] Given cross country differences, I test for differences between the product and the firm elasticity on a country per country basis. The results show that for 37 countries the entry elasticity of products with respect to market size is smaller than for firms, in 2 cases I do not find any significant differences and in the case of Niger the entry elasticity of firms is lower than for products. Overall, the results that fixed costs at the product level is the main entry barrier applies to the majority of the countries in the sample.

Digging deeper into cross-country differences, I investigate whether entry elasticities vary with the market size of the exporting country. Hummels and Klenow (2005) suggest that the size of the home market is important to overcome fixed costs to export. Economies of scale imply that firms make more profits in larger markets. Thus, if home sales are important to pay for fixed costs, firms from a larger home market have a competitive advantage over firms from a smaller market simply because they operate at a larger scale. As a result, firms from a larger home market will have higher entry rates than firms from smaller economies. To investigate whether home market size matters, I estimate regression 5 and include an interaction term of the log of destination market size with the log of home market size. We expect that the entry elasticity of firms with respect to destination market size is higher for countries with a larger home market. If there is no home market effect, only export sales are relevant and the change in the number of firms and products should be independent of home market size.[13]

I find that entry elasticities increase significantly with origin market size. Given an increase in

[12] This finding is contrary to Eaton, Kortum, and Kramarz (2011), who do not find significant differences in the entry elasticity of firms for France, Denmark and Uruguay.

[13] Table 10 in the appendix shows the results.

demand (i.e. increasing the destination market size), relative more firms and products from larger home markets enter. The larger revenue in domestic markets facilitates firm and product entry in all destinations. This interpretation implies that products from larger markets have a production efficiency advantage over products from smaller markets because the exporting firms operate at a larger scale. Small economies are particularly affected from fixed costs. The low level of domestic demand implies that relative few firms are able to benefit from economies of scale resulting in less export activity and relative high prices for domestic consumers. Moreover, because of the low demand, few foreign firms find it profitable to export to them. The limited entry results in even higher prices due to the lack of competitive pressure.

Poisson Maximum Likelihood

Silva and Tenreyro (2006) argue that in the presence of heteroskedasticity the elasticity estimates in Table 1 are biased. Consider equation 3 with the respective elasticities. To allow for deviations from the theory, we write

$$N_{d,c,t} = \pi^{b}_{d,c,t} X^{\gamma}_{d,t} \eta_{d,c,t} \tag{9}$$

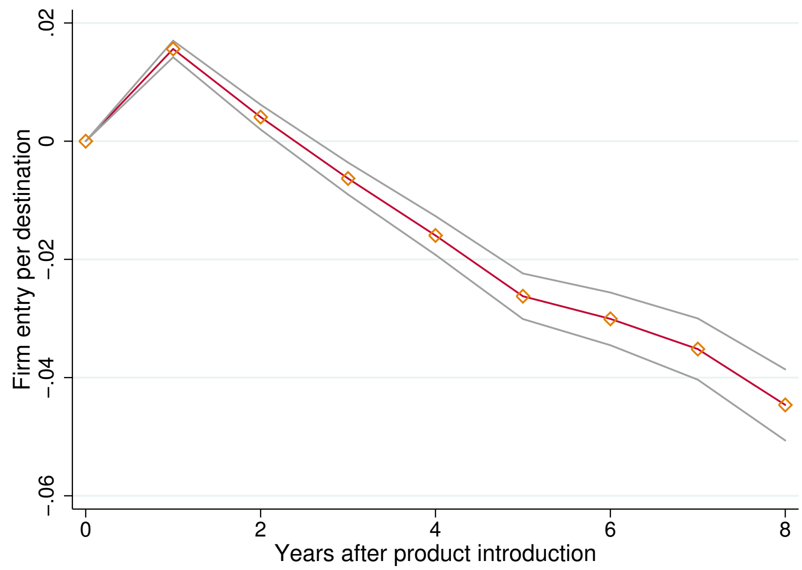
where $\eta_{d,c,t}$ is an error factor with $E(\eta_{d,c,t}|X_d, \pi_{d,c}) = 1$. As Silva and Tenreyro (2006) show the standard practice of log-linearizing equation 9 and estimating γ by OLS is inappropriate for mainly two reasons. First, $N_{d,c}$ can be 0, in which case log-linearization is infeasible. This is not an issue. If there are no exporters, then there is no trade. Second, even if all observations of $N_{d,c}$ are strictly positive, the expected value of the log-linearized error will in general depend on the covariates, and hence OLS will be inconsistent. To see the point more clearly, notice that equation 9 can be expressed as $y_{d,c,t} = \exp(\beta Z_{d,c,t})\eta_{d,c,t}$, with $E(\eta_{d,c,t}|Z_{d,c,t}) = 1$. Assuming that $y_{d,c,t}$ is positive, the model can be made linear in the parameters by taking logarithms of both sides of the equation, leading to $\log y_{d,c,t} = \beta Z_{d,c,t} + \log \eta_{d,c,t}$. To obtain consistent estimates of β, it is necessary that $E(\log \eta_{d,c,t}|Z_{d,c,t})$ does not depend on $Z_{d,c,t}$. Notice that the expected value of the logarithm of a random variable depends both on its mean and on the higher-order moments of the distribution. However under the presence of heteroskedasticity, the expected value of $\log \eta_{d,c,t}$ will also depend on the regressors, rendering the estimates of β inconsistent. For example, suppose that $\eta_{d,c,t}$ is log normally distributed with $E(\eta_{d,c,t}|Z_{d,c,t}) = 1$ and variance $\sigma^2_{d,c,t} = f(Z_{d,c,t})$. The error term of the log linearized representation will then follow a normal distribution, with $E(\log \eta_{d,c,t}|Z_{d,c,t}) = -1/2 \log(1 + \sigma^2_{d,c,t})$, thus implying inconsistency.

To estimate the elasticities, i.e. β, in equation 9 consistently, Silva and Tenreyro (2006) suggests a Poisson pseudo-maximum-likelihood estimator. Before applying the Poisson pseudo-maximum-likelihood estimator, I test for the presence of heteroskedasticity in equation 5 for each of the two different dependent variables. In all tests, I reject the null hypothesis of homoskedasticity at the 1 precent level.

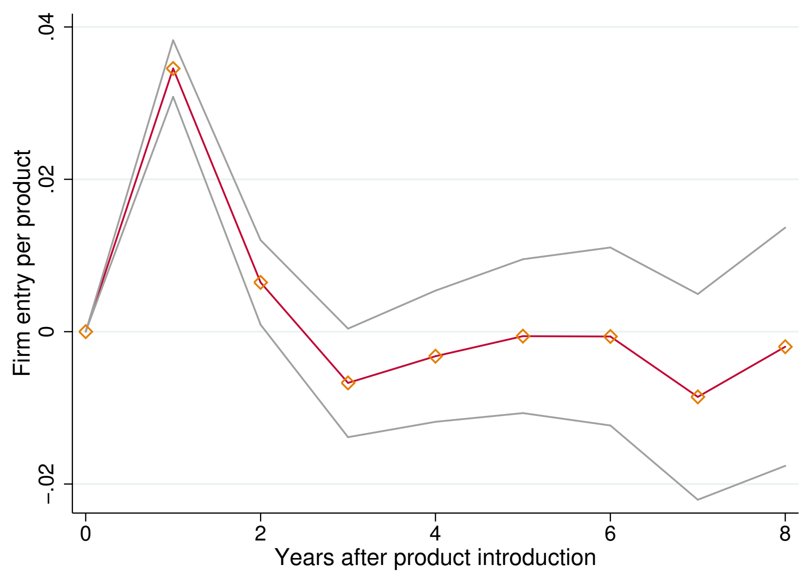
Table 11 plots the results for Poisson pseudo-maximum-likelihood approach. Qualitatively the results do not change. The signs of the coefficients do not change with respect to the log linear results. The elasticity of firms with respect to market size is significantly higher than for products implying that firm fixed costs are more important than product fixed costs. The key differences are quantitatively. All estimated elasticities slightly increase. The estimated entry elasticity of firms is 1.05 and 0.62 for products.

8 Figures

Figure 2: The firm entry rate over time after a product is exported to a market for the first time.



(a) Firm entry within a destination



(b) Firm entry within a product group

9 Tables

Table 5: Exporting countries in the sample

Albania	Domenican Republic	Macedonia	Peru
Bangladesh	Ecuador	Malawi	Portugal
Belgium	El Salvador	Mali	Senegal
Bulgaria	Estonia	Mauritius	South Africa
Burkina Faso	Guatemala	Mexiko	Spain
Cambodia	Iran	Morocco	Sweden
Cameron	Jordan	Nicaragua	Turkey
Chile	Kenya	Niger	Uganda
Colombia	Laos	Norway	United Rep. Tanzania
Costa Rica	Lebanon	Pakistan	Yemen

Note: Data from the Exporter Dynamics Database provided by the World Bank

Table 6: Importing countries in the sample

Afghanistan	Denmark	Kyrgyzstan	Samoa
Albania	Djibouti	Laos	Sao Tome and Principe
Algeria	Dominica	Latvia	Saudi Arabia
Angola	Dominican Republic	Lebanon	Senegal
Antigua and Barbuda	Ecuador	Liberia	Seychelles
Argentina	Egypt	Libya	Sierra Leone
Armenia	El Salvador	Lithuania	Singapore
Australia	Equatorial Guinea	Macao	Slovak Republic
Austria	Eritrea	Macedonia	Slovenia
Azerbaijan	Estonia	Madagascar	Solomon Islands
Bahamas	Ethiopia	Malawi	Somalia
Bahrain	Fiji	Malaysia	South Africa
Bangladesh	Finland	Maldives	Spain
Barbados	France	Mali	Sri Lanka
Belarus	Gabon	Malta	St. Kitts & Nevis
Belgium	Gambia, The	Marshall Islands	St. Lucia
Belize	Georgia	Mauritania	St.Vincent & Grenadines
Benin	Germany	Mauritius	Sudan
Bermuda	Ghana	Mexico	Suriname
Bhutan	Greece	Micronesia, Fed. Sts.	Sweden
Bolivia	Grenada	Moldova	Switzerland
Bosnia and Herzegovina	Guatemala	Mongolia	Syria
Brazil	Guinea	Morocco	Taiwan
Brunei	Guinea-Bissau	Mozambique	Tajikistan
Bulgaria	Guyana	Nepal	Tanzania
Burkina Faso	Haiti	Netherlands	Thailand
Burundi	Honduras	New Zealand	Togo
Cambodia	Hong Kong	Nicaragua	Tonga
Cameroon	Hungary	Niger	Trinidad & Tobago
Canada	Iceland	Nigeria	Tunisia
Cape Verde	India	Norway	Turkey
Central African Republic	Indonesia	Oman	Turkmenistan
Chad	Iran	Pakistan	Uganda
Chile	Iraq	Palau	Ukraine
China	Ireland	Panama	United Arab Emirates
Colombia	Israel	Papua New Guinea	United Kingdom
Comoros	Italy	Paraguay	United States
Congo, Dem. Rep.	Jamaica	Peru	Uruguay
Congo, Republic of	Japan	Philippines	Uzbekistan
Costa Rica	Jordan	Poland	Vanuatu
Cote d'Ivoire	Kazakhstan	Portugal	Venezuela
Croatia	Kenya	Qatar	Vietnam
Cuba	Kiribati	Romania	Yemen
Cyprus	Korea, Republic of	Russia	Zambia
Czech Republic	Kuwait	Rwanda	Zimbabwe

Note: Data from Comtrade, Penn World Table and CEPII

Table 7: Summary Statistics

	Observations	Mean	Median	St. Dev.	Min	Max
Number of exporters	30164	343,8	39	1112,9	2	28981
Number of products	30164	297,1	55	564,8	1	4163
Number of exporters per product	30164	2,12	1,46	1,87	1	43,23
Number of products per exporter	30164	2,54	1,97	2,87	1	104,80
Av. revenues per exporter	30164	1,29	0,58	4,38	8,92E-06	755,4
Av. revenues per product	30164	1,27	0,49	4,57	2,85E-06	645,6
GDP in destination	1560	451909	65967	1358439	145	14400000
GDP per capita in destination	1560	13303	92395	14071	192	91707
Expenditure share	30164	0,00125	0,00026	0,00783	1,97E-09	0,40083
Distance	30164	6873	6177	4343	86	19812
GDP in origin country	182	275916	165278	351089	8247	1516755
GDP per capita in origin	182	12105	7978	12090	559	54927

Note: Statistics are aggregated over all export destinations. Average expenditure per firm is total imports of destination per exporting country divided by number of exporting firms. Average expenditure per product is total imports of destination per exporting country divided by number of exported products. Average expenditure per firm and per product as well as GDP are measured in million International dollars. Expenditure shares are defined as a country's total value of imports per exporting country divided by the country's total expenditure, i.e. GDP. GDP per capita is measured in International dollars. Distances are in kilometers from capital city in country i to capital city in country j.

Table 8: Relationship of market size and the number of firms and products including the decompostion of the extensive margin

Dependent variable	log(Number of firms) (1)	log(Number of products) (2)	log(Av. # Products per firm) (3)	log(Av. # Firms per product) (4)
log(Market Size)	0.439***	0.357***	0.0181	0.100***
	[0.00595]	[0.00560]	[0.00979]	[0.00292]
log(Expenditure Share)	0.205***	0.199***	0.0210***	0.0269***
	[0.00475]	[0.00478]	[0.00206]	[0.00179]
log(Distance)	-0.828***	-0.847***	-0.185***	-0.166***
	[0.0232]	[0.0263]	[0.00937]	[0.00860]
log(GDP per capita)	0.139***	0.0953***	0.0112***	0.0546***
	[0.0113]	[0.0113]	[0.00401]	[0.00374]
border	0.347***	0.311***	0.0870***	0.123***
	[0.0225]	[0.0290]	[0.00890]	[0.00852]
Observations	30164	30164	30164	30164
R-squared	0,764	0,723	0,346	0,482

Note: Total firm-product combinations (T) are decomposed into $T_{d,c} = P_{d,c}\bar{p}_{d,c}$, where $P_{d,c}$ is the number of exported products from country c to destination d and $\bar{p}_{d,c}$ is the average number of firms per products exported. Equivalently, $T_{d,c}$ can also be decomposed into $T_{d,c} = F_{d,c}\bar{f}_{d,c}$ the number of exporting firms in c with shipments to destination d and the average number of products per exporter from c to d, $\bar{f}_{d,c}$. The results from ordinary least squares regressions for the dependent variable normalized by the import expenditure share are noted at the top of each column projected on the covariates listed in the first column. All regressions include origin country, time and origin country fixed effects. Robust standard errors in parentheses: ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

Table 9: Relationship between market size and the number firms and products including proxies for fixed costs

Dependent variable	log(Number of firms) (1)	log(Number of products) (2)
log(Market size)	0.195***	0.108***
	[0.0169]	[0.0178]
log(Expenditure Share)	0.240***	0.252***
	[0.00591]	[0.00622]
log(Distance)	-0.662***	-0.632***
	[0.0149]	[0.0156]
log(GDP per capita)	0.502***	0.574***
	[0.0285]	[0.0300]
Border	0.162***	0.0632***
	[0.0221]	[0.0233]
% of urban population	0.00263***	0.00391***
	[0.000294]	[0.000309]
log(Landsize km^2)	-0.0577***	-7,82E-05
	[0.00834]	[0.00878]
log(Container Traffic)	0.234***	0.225***
	[0.0102]	[0.0107]
log(Rail km)	0.156***	0.140***
	[0.0120]	[0.0126]
log(Nr. of internet subscribers)	0.03739	0.05841
	[0.04124]	[0.04183]
log(Electricity per capita)	-0.392***	-0.487***
	[0.0212]	[0.0223]
Observations	11.096	11.096
R-squared	0,867	0,843

Note: All regressions include time and origin country fixed effects. Robust standard errors in parentheses (clustered by country time): ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

Table 10: Relationship between market size and the number firms and products taking into account cross-country differences

Dependent variable	log(Number of firms) (1)	log(Number of products) (2)
log(Market Size - Destination)	-0.215***	-0.0890***
	[0.0243]	[0.0262]
log(Market Size - Destination) * log(Market Size - Origin)	0.127***	0.0868***
	[0.00469]	[0.00505]
log(Distance)	-0.792***	-0.822***
	[0.00866]	[0.00933]
log(Expenditure Share)	0.200***	0.196***
	[0.00294]	[0.00317]
log(GDP per capita)	0.144***	0.0992***
	[0.00488]	[0.00526]
Border	0.332***	0.301***
	[0.0157]	[0.0169]
Constant	2.234***	2.675***
	[0.04]	[0.05]
Observations	28.978	28.978
R-squared	0,678	0,635

Note: All regressions include time and origin country fixed effects. Robust standard errors in parentheses (clustered by country time): ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.

Table 11: Pseudo Poisson Maximum Likelihood

Dependent variable	log(Number of firms) (1)	log(Number of products) (2)	log(Number of firms) (3)	log(Number of products) (4)
log(Market Size)	1.049***	0.619***	0.866***	0.557***
	[0.0177]	[0.00806]	[0.0155]	[0.00874]
log(Expenditure Share)	1.244***	0.966***	0.732***	0.594***
	[0.0244]	[0.0102]	[0.0189]	[0.0109]
log(Distance)			-0.836***	-1.036***
			[0.0357]	[0.0220]
log(GDP per capita)			0.371***	0.0785***
			[0.0252]	[0.0143]
Border			0.380***	-0,021
			[0.0566]	[0.0345]
Observations	30164	30164	30164	30164
R-squared	0,612	0,679	0,661	0,694

Note: The results from Poisson maximum likelihood regressions for the dependent variable noted at the top of each column projected on the covariates listed in the first column. All regressions include origin country, time and origin country - time fixed effects. Robust standard errors in parentheses: ***, **, * marks statistically significant difference from zero at the 1%, 5% and 10% level respectively.