The Extensive Margin of Exporting Products: 
A Firm-level Analysis*

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Abstract
We examine multi-product exporters to quantify the benefits of product scope expansions under market-access barriers. We develop a general-equilibrium model of multi-product firms that generalizes earlier models and offers flexibility for estimation. To understand market-access costs we study the product sales profiles within firms and across destinations. We document a set of facts using Brazilian firm-product-destination data and adopt a simulated method of moments estimator under rich demand and market-access cost shocks consistent with those facts. The estimates show that additional products farther from a firm’s core competency come at higher production costs, but there are substantive economies of scope in market-access costs. The market-access costs differ across destinations, falling more rapidly in nearby regions and at destinations with fewer non-tariff barriers. We evaluate a counterfactual scenario that reduces differential market-access costs to their observed minima and find welfare gains similar to eliminating all current tariffs.

Keywords: International trade; heterogeneous firms; multi-product firms; firm and product panel data; Brazil

JEL Classification: F12, L11, F14

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1 Introduction

Multi-product exporters dominate global trade and their study offers novel precision for micro-foundations of aggregate trade patterns.\(^1\) The analysis of product entry at the firm level trains the research focus on market-access costs as barriers to trade, and on non-tariff measures (NTMs) in particular. NTMs are now arguably similarly important for trade openness as are import tariffs.\(^2\) The export entry of a firm with its first product and its subsequent market access with additional products offers insight into the nature of market-access costs—including policy-driven non-tariff measures as well as geography and product-related barriers—which have proven elusive objects for rigorous quantification to date. Our model provides market-access cost estimates that can complement alternative approaches.

We build a model of multi-product exporters that generalizes earlier multi-product models and offers a flexible setup to rigorously quantify the relevance of market-access costs for exporter expansion. We use Brazilian data to empirically recover the market-access costs in a multi-product model and relate them to welfare. Our framework extends the monopolistic competition model of Melitz (2003) by embedding a multi-product setup into a conventional constant elasticity of substitution (CES) demand system. We model within-firm product heterogeneity with two key mechanisms. First, we assume as in Eckel and Neary (2010, henceforth EN) that a firm faces declining efficiency in supplying additional products that are farther from its core competency. Second, we introduce local product appeal shocks (similar to Eaton, Kortum and Kramarz 2011) and thus nest a version of the Bernard et al. (2011, henceforth BRS) model that attributes within-firm product heterogeneity to local demand shocks. In our framework, the firm faces two extensive margins and one intensive margin: it chooses its presence at export destinations, its exporter scope (the number of products) at each destination, and the...

\(^1\)On multi-product exporters see, for example, Eckel and Neary (2010); Goldberg, Khandelwal, Pavcnik and Topalova (2010); Bernard, Redding and Schott (2010, 2011). Bernard, Jensen and Schott (2009) document for U.S. trade in 2000 that firms that export more than five products at the HS 10-digit level make up 30 percent of exporters but account for 97 percent of all exports. In our Brazilian exporter data for 2000, 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. Similar findings are reported by Iacovone and Javorcik (2012) for Mexico and Álvarez, Faruq and López (2013) for Chile.

\(^2\)For comprehensive policy reports on non-tariff measures see OECD (2005); UNCTAD (2010); WTO (2012). Kee, Nicita and Olarreaga (2009) estimate that, for a majority of HS-6 tariff lines in 78 countries around the year 2000, the ad-valorem equivalent of the NTMs exceeded the import tariff. Niu, Liu, Gunessee and Milner (2018, Table 6) extend Kee et al.’s coverage to the period 1997-2015, to 97 countries in later years, and to additional measures, and document that in 1997 the ad-valorem equivalent of NTMs weakly exceeded import tariffs in about 56 percent of HS-6 product lines but by 2015 NTMs surpassed tariffs in 73 percent of HS-6 products. Ganapati and McKibbin (2018) document the importance of NTMs for exporters of pharmaceuticals. Surveys of exporting firms in numerous countries document that “technical measures and customs rules and procedures . . . are . . . among the five most reported categories of [trade] barriers” (OECD 2005, p. 24). Our specific definition of market-access costs will not include tariffs, in contrast to an occasionally broader use of the term in the trade policy discourse.
quantities (prices) for each individual product at each destination.

We consider three types of costs. First, there are product-specific production costs at the firm level similar to EN (core competence). Second, there are variable trade costs (shipping costs in the form of iceberg trade costs and ad-valorem tariffs), which vary with sales but do not depend on the exporter’s scope. Both production costs and variable trade costs deter trade at all margins. Third, to capture the specificities of non-tariff barriers for market access, we consider a flexible schedule of fixed exporting costs by firm, product, and destination market, generalizing the firm-destination level exporting costs in Chaney (2008). This market-access cost schedule can vary by firm-product and accommodates the possible cases of economies and diseconomies of scope. The market-access cost schedule affects only the two extensive margins: a firm’s entry into a destination with the first product and its exporter scope there. The first exported item to a particular destination may face higher importer costs than a subsequent item. Examples of such barriers include the financial cost and time required for both paperwork and border compliance (as measured in World Bank Doing Business surveys), sanitary and phytosanitary as well as other technical regulations that can affect approval of a first export product differently from subsequent products (collected by UNCTAD), and price or quantity control measures with differential importance (also collected by UNCTAD).

The micro-foundation of market-access costs allows us to use data on multi-product exporters to estimate these costs and to relate them to existing estimates of non-tariff measures. Our approach thus differs from firm-level research, including Arkolakis (2010), in that we give substance to market-access costs and directly estimate those costs from product entry and product sales. Most importantly, while differences in market penetration costs in that paper affect the exporter sales distribution by destination, that distribution is largely invariant across destinations in the data, therefore leaving no room for policy related to market penetration costs. In contrast, we explicitly exploit the variation of the relationship between exporter scale and scope by destination to identify policy relevant differences in market-access costs.

To inform theory we document individual product sales and exporter scope by destination. We elicit three main facts. First, within firms and destinations, we look at the sales distribution by product. Wide-scope exporters sell large amounts of their top-selling products. Moreover, 

\[ C(x + y) < C(x) + C(y), \]

that is if the cost function is subadditive.

The parametrization of our estimation model fully nests the Arkolakis (2010) market penetration costs for an exporter’s product composite. In an Online Supplement, we present a generalization of our model to nest market penetration costs as in Arkolakis (2010). We demonstrate that the stochastic components in our simulated method of moments estimator fully absorb the market penetration costs that firms choose to incur for their product lines at a destination, rendering our estimation consistent with Arkolakis (2010).
they sell considerably smaller amounts of their lowest-selling products than do narrow-scope exporters. Second, within destinations and across firms, we look at exporter scope: there are a few dominant exporters with wide scope but many narrow-scope firms. The median exporter only ships one or two products per destination. We also find that the average exporter scope is larger at geographically closer destinations, indicating varying incremental market-access costs. Finally, within destinations and across firms, firm average sales per product and exporter scope exhibit a strong positive covariation in distant destinations, but no clear relationship in close-by destinations. When discerning countries by the prevalence of NTMs we find that more NTMs at a destination depress product sales and reduce exporter scope in a similar manner as does a destination’s remoteness, and more NTMs at a destination also strengthen the positive association between sales per product and exporter scope similar to a destination’s remoteness.

These facts have a number of implications for theory. For a wide-scope firm to profitably sell minor amounts of its lowest-selling products, incremental market-access costs must be low at wide scope. The finding is at odds with models of multi-product firms where market-access costs are constant for additional products and underlies our flexible market-access cost schedule that allows for potential economies of scope. For example, market-access costs are constant in BRS, EN and Mayer, Melitz and Ottaviano (2014). Our combination of scope-dependent production costs and market-access costs delivers variation in average exporter scope on the one hand and generates the correlation of average sales and exporter scope across destinations on the other hand, consistent with our second and third facts.

For our quantification we adopt a simulated method of moments (SMM) estimator in order to handle the three stochastic elements of the model. These elements—Pareto distributed firm-level productivity, a stochastic firm-level market-access cost component, and local product appeal shocks—are needed to match the empirical regularities in the Brazilian exporting transaction data. We also document, for practical purposes, that results from ordinary least squares under only one stochastic element (firm-level productivity) provide a useful approximation to the full SMM estimation. In the main estimation, we target our first two facts, which the estimated model closely matches. We also illustrate the success of this estimation by showing that the estimated model fits the third fact (on the destination-specific correlation of average product sales and exporter scope), which we deliberately do not target in the estimation. A decomposition of the variance in product sales shows that product- and firm-level heterogeneity accounts for two-fifths of the variation in product sales, while idiosyncratic product appeal shocks abroad account for three-fifths. This finding highlights both the relevance of our extended framework of multi-

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5In the Online Supplement we vary the productivity distribution, using a log normal specification instead of Pareto. While we lose analytic tractability in the model, the quantitative results under the SMM estimation remain similar.
product exporting and the important interplay of a firm’s core competency with local demand conditions abroad.

The estimation reveals that additional products farther from a firm’s core competency incur higher unit production costs but also speaks to differences in the economies of scope in market-access costs between destinations. We empirically relate our estimates of the market-access cost schedules across destinations to destination-country characteristics, including the prevalence of NTMs at a destination, and find that NTMs are a salient predictor of the convexity of market-access costs for added products. Given the apparent empirical relevance of NTMs for market-access cost schedules, we simulate a reduction in market-access costs for additional products and its effect on global trade. To capture only components of market-access costs that appear amenable to policy, we hypothetically reduce market-access costs worldwide to the schedules observed in nearby destinations with low incremental market-access costs. This counterfactual harmonization of incremental market-access costs highlights the potential importance of reducing NTMs on exporters’ additional products. Our simulation generates welfare gains similar to eliminating today’s remaining observable tariffs.

Our approach to countries’ market-access costs asks how their protection affects a typical country’s exports, and global welfare, and is therefore closely related to trade restrictiveness measurement by Kee et al. (2009) and Niu et al. (2018) in partial equilibrium.\footnote{Earlier indexes of trade restrictiveness ask how harmful protection is to a country itself (for surveys see Feenstra 1995; Anderson and Neary 2005). An index of a country’s trade restrictiveness is akin to a single hypothetical ad-valorem tariff that would be equivalent either in terms of welfare (Anderson and Neary 1996) or import volumes (Anderson and Neary 2003) to the country’s overall set of protectionist measures.} We adopt a general-equilibrium framework and allow for rich micro-foundations for the incidence of market-access costs on firm and product entry. However, our complementary approach foregoes NTM survey information by source country and tariff line. Examples of incremental market-access costs among NTMs are product-level health regulations, safety standards, certifications and licenses.\footnote{Some NTMs are arguably market-access costs that an exporter incurs prior to the shipment of the first unit of a product and not again (UNCTAD 2010), while other NTMs such as customs procedures may also act like shipping costs in that they lengthen the duration of export financing. As the empirical literature on NTMs starts to make available more precise NTM variables, they can be embedded into our framework’s shipping cost and market-access cost functions. For now, our market-access cost estimates do not discern individual NTMs from other lasting trade barriers at the border, such as language. Our counterfactual simulations, however, are designed to capture policy relevant market entry and behind-the-border costs.} Baldwin, Evenett and Low (2009) and Egger, Francois, Manchin and Nelson (2015), for example, examine the potential impact of new non-tariff commitments in preferential trade agreements.

Research into multi-product firms has expanded markedly in recent years (see for example, BRS, EN, Mayer et al. (2014), Eckel, Iacovone, Javorcik and Neary (2016), among others).\footnote{Nocke and Yeaple (2013) and Dhingra (2013) study multi-product exporters but do not generate a within-firm}
Related empirical work includes Thomas (2011), Amador and Oromolla (2013), and Álvarez et al. (2013). That body of research stresses the significance of multi-product firms either from an empirical perspective or from a theoretical one. Our work aims to make contact of these two large parts of the literature by bringing together theory and data: we use facts about multi-product firms to understand the costs and benefits of expanding product lines. In turn, we use the general-equilibrium structure of our model to asses the implications of policies related to removing product expansion costs.

Aggregate consequences differ in theoretically important ways under varying market entry cost assumptions. Arkolakis, Costinot and Rodriguez-Clare (2012) show for a wide family of models, which includes ours, that conditional on identical observed trade flows these models predict identical ex-post welfare gains irrespective of firm turnover and product-market reallocation. Their findings also imply, however, that models in that family differ substantively in their implications for trade flows and welfare with respect to ex-ante changes in market-access costs. The predictions as to how trade policy affects global trade therefore crucially depend on the nature of market entry costs. Our framework provides market-specific micro-foundations for such market-access costs, and we use it to compute the impact of the elimination of policy-related entry costs on trade flows and welfare.

The paper is organized in five more sections. In Section 2 we describe the model and its firm-level predictions. Section 3 presents the data and observed empirical patterns. Section 4 introduces the SMM estimator to obtain the model’s parameters. Section 5 closes the model and describes aggregate outcomes in general equilibrium. Counterfactuals involving variations in market-access costs follow in Section ??.. We conclude with Section 7.

## 2 Model

Our model rests on two sources of firm-level heterogeneity: a firm’s productivity and a firm’s set of destination-specific entry cost for the first product. Heterogeneity in productivity generates dispersion in total sales and in exporter scope (the number of products sold). Firm-destination heterogeneity in entry cost for the first product helps our SMM estimator accommodate idiosyncratic variation in firm-product presence patterns.

Additionally, we introduce a stochastic demand component to allow for potentially rich vari-
sales distribution, which lies at the heart of our analysis.

ation in a given firm-product’s sales rank across destinations, and to nest a version of the BRS model as a special case. The remaining parameters for a firm’s product access and local pricing decisions are deterministic. Most important for our generalization of earlier multi-product exporter models, we introduce a flexible market-access cost function that may exhibit economies or diseconomies of scope. To generate overall diseconomies of scope (which are necessary for optimal scope to be finite), and to nest a version of the EN model and Mayer et al. (2014), we let a firm face higher marginal production costs for additional products farther away from its core competency.10

2.1 Setup

There are $N$ countries. The export source country is denoted with $s$ and the export destination with $d$. There is a measure of $L_{d}$ consumers at destination $d$. Consumers have symmetric preferences with a constant elasticity of substitution $\sigma$ over a continuum of varieties. In this multi-product setting, a “variety” offered by a firm $\omega$ from source country $s$ to destination $d$ is the product composite

$$X_{sd}(\omega) \equiv \left( \sum_{g=1}^{G_{sd}(\omega)} \xi_{sdg}(\omega)^{\frac{1}{\sigma}} x_{sdg}(\omega) \right)^{\frac{\sigma}{\sigma-1}},$$

where $G_{sd}(\omega)$ is the exporter scope (the number of products) that firm $\omega$ sells in country $d$, $g$ is the running index of a firm’s product at destination $d$, $\xi_{sdg}(\omega)$ is an i.i.d. shock to firm $\omega$’s $g$-th product’s appeal (with mean $\mathbb{E} [\xi_{sdg}(\omega)] = 1$, positive support and known realization at the time of consumer choice), and $x_{sdg}(\omega)$ is the quantity of product $g$ that consumers consume. In marketing terminology, the product composite is often called a firm’s product line or product mix. We assume that every product line is uniquely offered by a single firm, but a firm may ship different product lines to different destinations.

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10Marginal production costs are constant for a given product in that they do not vary with production volume. For an appropriately defined market-access cost schedule that depends on the choice of consumers reached through marketing, we also nest the Arkolakis (2010) model within our (stochastic) market entry components (see the Online Supplement).
2.2 Consumers

The consumer’s utility at destination \( d \) is

\[
\left( \sum_{k=1}^{N} \int_{\omega \in \Omega_{kd}} X_{kd}(\omega) \frac{\sigma - 1}{\sigma} d\omega \right)^{\frac{\sigma}{\sigma - 1}} \quad \text{for } \sigma > 1,
\]

where \( \Omega_{kd} \) is the set of firms that ship from source country \( k \) to destination \( d \). For simplicity we assume that the elasticity of substitution across a firm’s products is the same as the elasticity of substitution between varieties of different firms.\(^{11}\) It is straightforward to generalize the model to consumer preferences with two nests. If the firm’s products in the inner nest were closer substitutes to each other than product lines are substitutable across firms, then a firm’s additional products would cannibalize the sales of its infra-marginal products.\(^{12}\) We outline in Appendix C why the presence of a cannibalization effect does not alter the estimation relationships for the parameters that we wish to identify (the Online Supplement provides a detailed derivation).

The representative consumer earns a wage \( w_{d} \) from inelastically supplying her unit of labor endowment to producers in country \( d \) and receives a per-capita dividend distribution \( \pi_{d} \) equal to her share \( 1/L_{d} \) in total profits at national firms. We denote total income with \( Y_{d} = (w_{d} + \pi_{d})L_{d} \).

The consumer observes the product appeal shocks \( \xi_{sdg}(\omega) \) prior to consumption choice so that

\[
\left( \sum_{k=1}^{N} \int_{\omega \in \Omega_{kd}} X_{kd}(\omega) \frac{\sigma - 1}{\sigma} d\omega \right)^{\frac{\sigma}{\sigma - 1}} \quad \text{with } X_{kd}(\omega) \equiv \left( \sum_{g=1}^{G_{sd}(\omega)} \frac{p_{sdg}(\omega)}{\xi_{sdg}(\omega)} \right)^{\frac{\sigma}{\sigma - 1}} \quad \text{for } \sigma, \varepsilon > 1.
\]

The consumer’s first-order conditions imply that demand for the \( g \)-th product of firm \( \omega \) in market \( d \) is

\[
x_{sdg}(\omega) = p_{sdg}(\omega)^{-\varepsilon} P_{sd}(\omega; G_{sd})^{\varepsilon - \sigma} P_{d}^{\sigma - 1} \xi_{sdg} T_{d} \quad \text{with } P_{sd}(\omega; G_{sd})^{-(\varepsilon - 1)} = \sum_{g=1}^{G_{sd}(\omega)} p_{sdg}(\omega)^{-(\varepsilon - 1)},
\]

where \( p_{sdg}(\omega) \) is the price of that product. This demand relationship gives rise to a cannibalization effect for \( \varepsilon > \sigma \). The reason is that \( P_{sd}(\omega; G_{sd}) \) strictly decreases in exporter scope for \( \varepsilon > 1 \), so wider exporter scope diminishes infra-marginal sales and reduces \( x_{sdg}(\omega) \) for \( \varepsilon > \sigma \). (For the converse case with \( \sigma > \varepsilon \), wider exporter scope would boost infra-marginal sales and raise \( x_{sdg}(\omega) \).

We show for nested utility in the Online Supplement that markups would still depend on the outer-nest elasticity only and remain constant. In the presence of cannibalization, the interpretation of some composite parameters would change and reflect elasticities in the inner nest while other composite parameters would reflect elasticities of the outer nest. Hottman, Redding and Weinstein (2014) study the cannibalization effect using data on overall expenditure shares and prices; they calculate both intra-firm and inter-firm elasticities of substitution separately.
the first-order conditions of utility maximization imply a product demand

\[ x_{sdg}(\omega) = \left(\frac{p_{sdg}(\omega)}{P_d}\right)^{-\sigma} \xi_{sdg}(\omega) \frac{T_d}{P_d}, \]  

where \( p_{sdg} \) is the price of product \( g \) in destination \( d \) and we denote by \( T_d \) the total expenditure of consumers in country \( d \). In the calibration, we will allow for the possibility that total consumption expenditure \( T_d \) is different from country output \( Y_d \) (allowing for trade imbalances), so we use different notation for the two terms. We define the corresponding ideal price index \( P_d \) as

\[ P_d \equiv \left[ \sum_{k=1}^N \int_{\omega \in \Omega_{kd}} \sum_{g=1}^{G_{kd}(\omega)} \xi_{kdg}(\omega)p_{kdg}(\omega)^{-1} \ d\omega \right]^{-\frac{1}{\sigma-1}}. \]  

2.3 Firms

Firms face three types of costs: variable production costs (which are constant for a given product but higher for products farther away from a firm’s core competency), variable shipping costs (iceberg trade costs), and market-access costs (which depend on a firm’s local exporter scope but do not vary with sales). Each firm draws a productivity parameter \( \phi(\omega) \) and a destination specific market-access cost shock \( c_d(\omega) \in (0, \infty) \). The firm chooses how many products to ship to a given destination and what price to charge for each product at a destination. Following the firms’ choices, consumers learn the product specific taste shocks \( \xi_{sdg}(\omega) \) for each firm-product \( g \) at its potential destination \( d \). Then production and sales are realized. Firms from country \( s \) with identical productivity \( \phi \) and identical market-access cost shock \( c_d \) face an identical optimization problem in every destination \( d \) at the time of their market access and exporter scope decision. A firm produces each product \( g \) with a linear production technology, employing source-country labor given a firm-product specific efficiency \( \phi_g \).

Following Chaney (2008), we assume that there is a continuum of potential producers of measure \( J_s \) in each source country \( s \). When exported, products incur standard iceberg trade costs so that \( \tau_{sd} > 1 \) units must be shipped from \( s \) for one unit to arrive at destination \( d \). We normalize \( \tau_{ss} = 1 \) for domestic sales. This iceberg trade cost is common to all firms and to all firm-products shipping from \( s \) to \( d \). Without loss of generality we order each firm’s products in terms of their efficiency, from most efficient to least efficient, so that \( \phi_1 \geq \phi_2 \geq \ldots \geq \phi_{G_{sd}} \). Under this convention we write the efficiency of the \( g \)-th product of a firm \( \phi \) as

\[ \phi_g \equiv \phi/h(g) \quad \text{with} \quad h'(g) > 0. \]  

(4)
Related to the marginal-cost schedule \( h(g) \) we define the average product efficiency index in destination \( d \) when the firm sells \( G_{sd} \) products there as

\[
\bar{H}(G_{sd}) \equiv \left( \sum_{g=1}^{G_{sd}} h(g)^{-\frac{1}{\sigma-1}} \right)^{-\frac{1}{\sigma-1}}.
\]

(5)

This efficiency index decreases with exporter scope, because firms add less efficient products as they widen scope, and will play an important role in the firm’s optimality condition for scope choice.

### 2.3.1 Firm market-access costs

The firm faces a product-destination specific incremental market-access cost \( c_d f_{sd}(g) \). A firm that adopts an exporter scope of \( G_{sd} \) therefore incurs a total market-access cost of

\[
F_{sd} (G_{sd}, c_d) = c_d \sum_{g=1}^{G_{sd}} f_{sd}(g)
\]

if its idiosyncratic market-access cost is \( c_d \). The firm’s market-access cost is zero at zero scope and strictly positive otherwise:

\[
f_{sd}(0) = 0 \quad \text{and} \quad f_{sd}(g) > 0 \quad \text{for all} \quad g = 1, 2, \ldots, G_{sd}
\]

where \( f_{sd}(g) \) is a continuous function in \([1, +\infty)\).\(^{13}\) Similar to Eaton et al. (2011), we assume that the access cost shock \( c_d \) is i.i.d. across firms and destinations.

The incremental market-access cost \( c_d f_{sd}(g) \) accommodates fixed costs of production (e.g. with \( 0 < f_{ss}(g) < f_{sd}(g) \)). The incremental market-access costs \( c_d f_{sd}(g) \) may increase or decrease with exporter scope in a given destination market \( d \). But the firm’s total market-access costs in the destination market \( F_{sd} (G_{sd}, c_d) \) necessarily increase with exporter scope \( G_{sd} \) because \( f_{sd}(g) > 0 \).\(^{14}\) We assume that the incremental market-access costs \( c_d f_{sd}(g) \) require labor from the destination country \( d \) so that \( F_{sd} (G_{sd}, c_d) \) is homogeneous of degree one in \( w_d \). Combined with the varying firm-product efficiencies \( \phi_g \), this market-access cost structure allows us to endogenize the exporter scope choice at each destination. Whereas the incremental market-

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\(^{13}\)Brambilla (2009) adopts a related specification but its implications are not explored in an equilibrium firm-product model.

\(^{14}\)This specification accommodates a potentially separate firm-level access cost (sometimes referred to as a one-time beachhead cost), which can be subsumed in the first product’s market-access cost. The only requirement is that our later assumptions on the shape of the market-access cost schedule are satisfied. In continuous product space with nested CES utility, in contrast, market-access costs must be non-zero at zero scope because a firm would otherwise export to all destinations worldwide (Bernard et al. 2011; Arkolakis and Muendler 2010).
access cost is meant to capture the barriers to access that may differ for different exporters depending on the number of products sold, the idiosyncratic access cost shock implies that there is no strict hierarchy of destinations across exporters. Some exporters may sell to less popular destinations but not to the most popular ones.

In summary, there are two scope-dependent cost components: the marginal cost schedule $h(g)$ and the incremental market-access cost $f_{sd}(g)$. Suppose for a moment that the incremental market-access cost is constant in destination $d$ and independent of $g$ with $f_{sd}(g) = f_{sd}$. Then a firm in our model faces diseconomies of scope in destination $d$ because the marginal-cost schedule $h(g)$ strictly increases with the product index $g$. But, if incremental market-access costs decrease sufficiently strongly with $g$, our functional form allows for overall economies of scope in destination market $d$.

Before we proceed to firm optimization, we introduce a parameterized example for these functions that will later allow us to quantitatively match the patterns observed in the Brazilian data. For quantification, we will specify

$$
\begin{align*}
  f_{sd}(g) &= f_{sd} \cdot g^{\delta_{sd}} \quad \text{for } \delta_{sd} \in (-\infty, +\infty) \quad \text{and} \\
  h(g) &= g^\alpha \quad \text{for } \alpha \in [0, +\infty).
\end{align*}
$$

(7)

The choice of these two functions is guided by the log-linear relationships that we will present in Section 3. Introducing the example at this stage helps us provide intuition for the role that the parameters $\delta_{sd}$ and $\alpha$ will play in later estimation. The parameter $\delta_{sd}$ is the scope elasticity of market-access cost. The product $\alpha(\sigma - 1) \equiv \tilde{\alpha}$ is the scope elasticity of product efficiency and its estimated value will determine how fast sales drop for additional products farther away from the firm’s core competency. We allow $\delta_{sd}$ to vary across destinations, unlike $\alpha$. While $\alpha$ governs production of a product within a single source country, market-access costs are paid repeatedly at every destination. We show in the Online Supplement that the market-access cost specification (7) is readily reformulated to accommodate the functional form of Arkolakis (2010) market penetration costs for a firm’s product composite, where $f_{sd}$ may depend on the optimal share of consumers reached. Market penetration costs do not affect our final estimation model because the relevant marketing cost parameters get subsumed in the (stochastic) market-access cost component $c_d f_{sd}$.

2.3.2 Firm optimization

Conditional on destination market access, the firm chooses individual product prices given consumer demand under monopolistic competition. The resulting first-order conditions from the profit maximizing equation produce identical markups over marginal cost $\tilde{\sigma} \equiv \sigma / (\sigma - 1) > 1$
for $\sigma > 1$.\footnote{After a firm observes each product $g$’s appeal shock at a destination $\xi_{sdg}(\omega)$, its total profit from selling an optimal number of products $G_{sd}$ to destination market $d$ is}

Firms with the same productivity $\phi$ and the same access cost shock for a given destination $c_d$, make identical product entry decisions in equilibrium. It is therefore convenient to name firms selling to a given destination $d$ by their common characteristic $(\phi, c_d)$. We will suppress the $\omega$ notation whenever there is no risk of confusion. A type $(\phi, c_d)$ firm chooses an exporter scope $G_{sd}(\phi, c_d)$. Plugging the optimal pricing decision into the firm’s profit function we obtain expected profits at a destination $d$ for a firm $\phi$ selling $G_{sd}$ products,

$$\pi_{sd}(\phi, c_d) = \max_{G_{sd}} D_{sd} \phi^{\sigma-1} \bar{H}(G_{sd})^{-(\sigma-1)} - c_d \sum_{g=1}^{G_{sd}} f_{sd}(g),$$

with the revenue shifter

$$D_{sd} \equiv \left( \frac{P_d}{\sigma \bar{T}_{sd} w_s} \right)^{\sigma-1} \frac{T_d}{\sigma}.$$

For profit maximization with respect to exporter scope to be well defined, we make the following assumption.

**Assumption 1** (Strictly increasing combined incremental scope costs). Combined incremental scope costs $z_{sd}(G, c_d) \equiv c_d f_{sd}(G) h(G)^{\sigma-1}$ strictly increase in exporter scope $G$.

Under this assumption, and given the pricing decision, the optimal product choice is the largest $G \in \{0, 1, \ldots\}$ such that operating profits from that product $G$ equal (or exceed) the

$$\pi_{sd}(\phi, c_d) = \max_{G_{sd}} \sum_{g=1}^{G_{sd}} \left[ \max_{\{p_{sdg}\}_{g=1}^{G_{sd}}} \left( p_{sdg} - \tau_{sd} \frac{w_s}{\phi} h(g) \right) \left( \frac{p_{sdg}}{F_d} \right)^{-\sigma} \xi_{sdg} \frac{T_d}{F_d} \right] - F_{sd}(G_{sd}, c_d).$$

Suppose the firm sets every individual price $p_{sdg}$ after it observes the appeal shocks. Its first-order conditions with respect to every individual price $p_{sdg}$ imply an optimal product price

$$p_{sdg}(\phi) = \ddot{\sigma} \tau_{sd} w_s h(g)/\phi$$

with an identical markup over marginal cost $\ddot{\sigma} \equiv \sigma/(\sigma - 1) > 1$ for $\sigma > 1$. Importantly, product price does not depend on the appeal shock realization because the shock enters profits multiplicatively; it is therefore not relevant for the firm’s choice problem whether prices are set before or after the firm observes the product appeal shocks. In other words, maximizing total expected profit would result in the same first-order conditions for individual price. We adopt the convention that a firm commits to its price prior to the realization of product appeal shocks, and then ships the demanded quantities given price. The price commitment is credible and renegotiation proof because price choice remains optimal ex post. Firms may face a loss in the market if the demand shock realization implies that sales fail to cover the market entry costs, as market entry costs are sunk prior to the demand shock realization. Under the common assumption that households invest in a representative portfolio of the continuum of domestic firms, firm owners to not suffer individual losses by the law of large numbers.
incremental market-access costs:

\[ \pi_{sd}^q(\phi) = D_{sd} \phi^{\sigma-1} \geq c_d f_{sd}(G) h(G)^{\sigma-1} \equiv z_{sd}(G, c_d), \quad (9) \]

where \( \pi_{sd}^q(\phi) \) are the operating profits from the core product. In our parameterized example, Assumption 1 requires that the sum \( \delta_{sd} + \alpha (\sigma - 1) \) is larger than zero since \( z_{sd}(G, c_d) = c_d f_{sd}(1) G^{\delta_{sd} + \alpha (\sigma - 1)} \).

We can express the condition for optimal scope more intuitively and evaluate optimal exporter scope of different firms. A given firm \( \phi \) with access cost shock \( c_d \) exports from \( s \) to \( d \) if and only if \( \pi_{sd}(\phi, c_d) \geq 0 \). At the break-even point \( \pi_{sd}(\phi, c_d) = 0 \), the firm is indifferent between selling its first product in destination market \( d \) or not selling at all. Equivalently, reformulating the break-even condition and using the above expression for minimum profitable scope, the productivity threshold \( \phi^*_sd(c_d) \) for exporting at all from \( s \) to \( d \) is given by

\[ \phi^*_sd(c_d) \sigma^{-1} = c_d f_{sd}(1) / D_{sd}. \quad (10) \]

In general, using the above definition, we can define the productivity threshold \( \phi^*_sd^G(c_d) \) such that firms with \( \phi \geq \phi^*_sd^G(c_d) \) sell at least \( G \) products at destination \( d \) with

\[ \phi^*_sd^G(c_d) \sigma^{-1} = \frac{z_{sd}(G, c_d)}{c_d f_{sd}(1)} \phi^*_sd(c_d) \sigma^{-1} = \frac{z_{sd}(G, c_d)}{D_{sd}} \quad \text{with} \quad z_{sd}(G, c_d) \equiv c_d f_{sd}(G) h(G)^{\sigma-1}, \quad (11) \]

adopting the notational simplification \( \phi^*_sd(c_d) \equiv \phi^*_sd^1(c_d) \). Note that if Assumption 1 holds then \( \phi^*_sd(c_d) < \phi^*_sd^2(c_d) < \phi^*_sd^3(c_d) < \ldots \) so that more productive firms introduce more products in a given destination. As a result, \( G_{sd}(\phi, c_d) \) is a step-function that weakly increases in \( \phi \) for any given \( c_d \).

The firm’s optimal price choice for each product precedes the realization of the appeal shock \( \xi_{sdg} \). Once the vector \( \xi \) of appeal shocks for a firm \( \omega \) is realized, the firm supplies the market-clearing quantity of each product under the product’s constant marginal cost. Using consumer demand (2) and the above definitions, we can express each individual product’s sales by a firm of type \( (\phi, c_d) \) in equilibrium as\(^{16}\)

\[ y_{sdg}(\phi, c_d, \xi_{sdg}) = \sigma z_{sd}(G_{sd}(\phi, c_d), c_d) \left( \frac{\phi}{\phi^*_sd^G(c_d)} \right)^{\sigma-1} h(g)^{-(\sigma-1)} \xi_{sdg}. \quad (12) \]

\(^{16}\)The shocks \( \xi_{sdg} \) and \( \xi \) could be written as \( \xi_{sdg}(\omega) \) and \( \xi(\omega) \) to emphasize that they are firm specific.
Summing over $g$, the firm’s total sales at a destination become

$$t_{sd}(\phi, c_d, \xi) = \sigma \int_{\phi} \left( \frac{\phi}{\phi^*_d(c_d)} \right)^{\sigma-1} H(G_{sd}(\phi, c_d), \xi)^{-(\sigma-1)},$$

(13)

where

$$H(G_{sd}(\phi, c_d), \xi) \equiv \left( \sum_{g=1}^{G_{sd}(\phi, c_d)} h(g) \right)^{-(\sigma-1)}.$$

The firm’s realization of total sales $t_{sd}(\phi, c_d, \xi)$ in equilibrium and optimal exporter scope $G_{sd}(\phi, c_d)$ determine its exporter scale

$$a_{sd}(\phi, c_d, \xi) \equiv t_{sd}(\phi, c_d, \xi) / G_{sd}(\phi, c_d)$$

at destination $d$, the average sales per product, conditional on exporting from $s$ to $d$.

**Proposition 1** If Assumption 1 holds, then for all $s, d \in \{1, \ldots, N\}$

- exporter scope $G_{sd}(\phi, c_d)$ is positive and weakly increases in $\phi$ for $\phi \geq \phi^*_sd(c_d)$, and
- total firm exports $t_{sd}(\phi, c_d, \xi)$ are positive and strictly increase in $\phi$ for $\phi \geq \phi^*_sd(c_d)$.

**Proof.** The first statement follows immediately from the discussion above. The second statement follows because $H(G_{sd}(\phi, c_d), \xi)$ strictly increases in $G_{sd}(\phi, c_d)$ a.s., given the positive support of $\xi_{sdg}$, but $G_{sd}(\phi, c_d)$ weakly increases in $\phi$, so $H(G_{sd}(\phi, c_d), \xi)$ weakly increases in $\phi$. By (13), $t_{sd}(\phi, c_d, \xi)$ also monotonically depends on $\phi$ itself, so $t_{sd}(\phi, c_d)$ strictly increases in $\phi$. □

### 2.4 Structural equations

To take the firm’s choices of destinations, products, and export production to the data we use closed form solutions, conditional on a firm’s productivity, market access, and product appeal shocks. We assume that firm productivities $\omega$ are drawn from a general distribution $A(\cdot)$, market-access costs $c_d$ are drawn from distribution $B(\cdot)$, and product appeal shocks are drawn from distribution $C(\cdot)$. These distributions are unknown to the econometrician and will be recovered under parametric form restrictions in Section 4.

The optimal exporter scope for firms with $\phi \geq \phi^*_sd(c_d)$ is given by (9) and can be written as

$$G_{sd}(\phi, c_d) = \text{integer} \left\{ \left[ \phi / \phi^*_sd(c_d) \right]^{\frac{\sigma-1}{\tau_{sd}+\alpha}} \right\},$$

(14)
where we define \( \tilde{\alpha} \equiv \alpha(\sigma - 1) \). Using this relationship and equation (12) we can express optimal sales of the \( g \)-th product in destination \( d \) for a firm \((\phi, c_d)\) as a function of the total number of products that the firm sells in \( d \):

\[
y_{sdg}(\phi, c_d, \xi_{sdg}) = \sigma c_d f_{sd}(1) G_{sd}(\phi, c_d)^{\delta_{sd} + \tilde{\alpha}} g^{-\tilde{\alpha}} \left( \phi / \phi_{sd}^* G(c_d) \right)^{\sigma - 1} \xi_{sdg}. \tag{15}
\]

Summing over a firm’s products \( g \), we find its total sales \( t_{sd}(\phi, c_d, \xi) = \sum_{g} y_{sdg}(\phi, c_d, \xi_{sdg}) \) and, dividing total sales by exporter scope, we obtain average sales per product, or average exporter scale. Given (15), exporter scale takes the form

\[
a_{sd}(\phi, c_d, \xi) = \sigma c_d f_{sd}(1) G_{sd}(\phi, c_d)^{\delta_{sd} + \tilde{\alpha} - 1} \left( \phi / \phi_{sd}^* G(c_d) \right)^{\sigma - 1} H(G_{sd}(\phi, c_d), \xi)^{-(\sigma - 1)}, \tag{16}
\]

where \( H(G_{sd}, \xi)^{-(\sigma - 1)} \equiv \sum_{g=1}^{G_{sd}} g^{-\tilde{\alpha}} \xi_{sdg} \).

Given these firm relationships, we now describe the data and the empirical analogues to these equations. We defer the discussion of existence and closed form general-equilibrium results to Section 5.

### 3 Data and Regularities

Our Brazilian exporter data originate from all merchandise exports declarations for the year 2000. From these customs records we construct a three-dimensional panel of exporters, their destination countries, and their export products at the Harmonized System (HS) 6-digit level. In this section, we bring together a set of systematically selected regularities about multi-product firms and elicit novel aspects of known facts (Eaton, Kortum and Kramarz 2004; Bernard et al. 2011; Arkolakis and Muendler 2013). We arrive at these stylized facts guided by two principles. First, none of the regularities could be generated by mere random shocks (balls thrown at bins as in Armenter and Koren (2014) would not suffice). Second, the regularities must characterize the novel extensive margin of product entry (exporter scope) or the remaining novel intensive margin of sales per product (average exporter scale), or both, at varying levels of aggregation. We pay particular attention to differences between nearby and far-away destinations to discipline

\[\text{Un} \quad \text{der our parametrization } f_{sd}(G) = f_{sd}(1)G^{\delta_{sd} - 1}, \text{ average sales per firm become } T_{sd} = \left[ \theta \sigma / (\theta - 1) \right] f_{sd}(1) \sum_{G=1}^{\infty} G^{-\delta_{sd} (\theta - 1)} H(G)^{-\theta} \text{ and the access costs } f_{sd}(1) \text{ can be recovered from } \]

\[
\frac{T_{sc}}{T_{sd}} = \frac{f_{sd}(1)}{f_{sd}(1)}
\]

for any pair of countries \( c \) and \( d \), after normalizing \( f_{sd}(1) \) for one destination.
market-access costs. These regularities form a body of facts that any theory of multi-product firms with heterogeneous productivity should match.

We also aim to disentangle policy-driven non-tariff measures (NTMs) from other components of market-access barriers. For this purpose, we draw on the raw NTM data underlying the Kee et al. (2009) estimates of NTM ad-valorem equivalents.

### 3.1 Data sources and preparations

Products in the original SECEX (Secretaria de Comercio Exterior) exports data for 2000 are reported using 8-digit codes (under the common Mercosur nomenclature), of which the first six digits coincide with the 6-digit Harmonized System (HS) codes. We aggregate the data to the HS 6-digit product and firm level so that the resulting dataset is comparable to data for other countries.\(^{18}\)

We restrict our sample to manufacturing firms and their exports of manufactured products, removing intermediaries and their commercial resales of manufactures. The restriction makes our findings closely comparable to BRS and Eaton et al. (2011). Manufacturing firms ship 86 percent of Brazil’s manufactured product exports. The resulting manufacturing firm sample has 10,215 exporters selling 3,717 manufactured products at the 6-digit HS level to 170 foreign destinations, and a total of 162,570 exporter-destination-product observations. Appendix B describes the Brazilian data in additional detail.

For the year 2000, UNCTAD’s TRAINS (Trade Analysis and Information System) data offer the arguably most comprehensive coverage of NTMs. Kee et al. (2009) augment these data in two ways. First, for the comparably protective textiles, apparel, and footwear industries in the EU, they bring in NTM information from the EU Standards Database as prepared by Shepherd (2007). Second, beginning in 1992 they update TRAINS information globally using the individual records from the WTO’s Trade Policy Reviews and manually add accordingly identified NTMs.\(^{19}\) There is a large number of NTM types. We follow Kee et al. (2009) and Niu et al. (2018) and consider four core NTMs: price control measures designed to affect the prices of imported goods including so-called para-tariff measures to raise the import price (TRAINS two-digit codes 61–63), quantity restrictions intended to limit trade through licences and import

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\(^{18}\)Our findings are similar at the common Mercosur nomenclature 8-digit level (see Online Supplement).

\(^{19}\)UNCTAD has meanwhile improved coverage of NTMs and reports additional detail of NTMs using a new classification by UNCTAD’s MAST (Multi-Agency Support Team), still at the HS 6-digit product level (for an implementation see Niu et al. 2018). For the year 2000, however, we opt for the augmented coverage that Kee et al. (2009) provide. The comprehensive Global Trade Alert data by Evenett (2009) include NTMs but only since 2009. Bown (2010) constructs and documents complementary data on temporary trade safeguards and antidumping measures, while our emphasis is on longer-term NTMs and their relationship to the extensive margin of exporting products.
prohibitions other than technical measures (codes 31-33), anti-competitive measures granting exclusive or special preference to one or more limited groups of economic operators in trade (code 70), and technical measures including sanitary and phytosanitary measures to prevent the spread of disease as well as standards on technical specifications or quality requirements to protect human and animal health and the environment (code 81).

We construct an NTM variable that remains deliberately close to the raw data at the level of the HS 6-digit product $j$ and destination country $d$: We first assign NTM information available only at the more aggregate HS 2-digit or HS 4-digit level to the HS 6-digit level, following Kee et al. (2009). For lower-level HS 8-digit codes we consider the maximal count of NTMs within the 6-digit HS code. (For a conversion of HS 1992/H0 and HS 2002/H2 codes to HS 1996/H1 we use WITS product concordances from the World Bank.) Second, we use information for the year 2000 to assess whether there is a core NTM or not. When information on an HS 6-digit product and country is missing, we use information from 2001. For the remaining missing products and countries, we use the year 1999, so our NTM coverage reflects the best available information in the period 1999-2001. Third, similar to Kee et al. (2009), we construct a single indicator variable for the presence of at least one core non-tariff barrier $NTM_{jd}$ that takes the value 1 when country $d$ imposes at least one of the four core NTMs in an HS 6-digit product, and zero otherwise. We do not estimate the ad-valorem equivalent of the $NTM_{jd}$ variable (as do Kee et al. 2009; Niu et al. 2018) and instead use its observed value.

NTMs and conventional tariffs may be related, as substitutes or complements, in trade policy. To control for tariffs empirically, we collect average tariff rates for Brazilian exporters by export destination and product category from the WTO’s Integrated Database. In contrast to the multilateral NTM data, these tariff rates are available at the bilateral level and therefore more precisely measured than the $NTM_{jd}$ variable. We define the region Latin America and the Caribbean (LAC) as does the World Bank (including the North American country Mexico and Central America).

### 3.2 Regularities

To characterize firms, we decompose a firm $\omega$’s total exports to destination $d$, $t_d(\omega)$, into the number of products $G_d(\omega)$ sold at $d$ (the exporter scope in $d$) and the average sales per export product $a_d(\omega) \equiv t_d(\omega) / G_d(\omega)$ in $d$ (the exporter scale in $d$). We elicit three major stylized facts from the data at three levels of aggregation, ranging from the individual product level within firms to the exporter scope and exporter scale distributions across firms.

**Fact 1** Within firms and destinations,
**Figure 1: Firm-product Sales Distributions by Exporter Scope**


*Note:* Products at the HS 6-digit level, shipments to Argentina. We group firms by their exporter scope $G_{ARG} = G$ in Argentina (Argentina is the most common export destination). The product rank $g$ refers to the sales rank of an exporter’s product in Argentina. Mean product sales is the average of individual firm-product sales $\sum_{\omega \in \{\omega: G_{ARG}(\omega) = G\}} y_{\omega ARG}^{G} / M_{ARG}^{G}$, computed for all firm-products with individual rank $g$ at the $M_{ARG}^{G}$ firms exporting to Argentina with scope $G_{ARG} = G$.

1. *wide-scope exporters sell large amounts of their top-selling products, with exports concentrated in a few products, and*

2. *wide-scope exporters sell small amounts of their lowest-selling products.*

Figure 1 documents this fact. For the figure, we limit our sample to exporters at a single destination and show only firms that ship at least one product to Argentina (the most common export destination). We group the exporters by their exporter scope $G_{ARG} = G$ in Argentina. Results at other export destinations are similar.\(^{20}\) For each scope group $G$ and for each product rank $g$, we then take the average of the log of product sales $\log y_{\omega ARG}^{G}$ for those firm-products in Argentina. The graph plots the average log product sales against the log product rank by exporter scope group. The figure shows that a firm’s sales within a destination are concentrated in a few core products consistent with the core competency view of EN. In the model, the degree of concentration is regulated by how fast $f_{d}(g)$ and $h(g)$ change with $g$ (the elasticities $\delta_{d}$ and $\tilde{\alpha} \equiv \alpha(\sigma - 1)$). Figure 1 also documents that wide-scope exporters sell more of their top-selling products than firms with few products. The model’s equation (15) matches this aspect under Assumption 1.

The product ranking of sales within firms need not be globally deterministic, as $f_{d}(g)$ and $h(g)$ would suggest, but the local product rankings can differ across destinations in reality, which

\(^{20}\)We present plots for the United States and Uruguay in Appendix B (Figure B.1). Argentina, the United States and Uruguay are the top three destinations in terms of presence of Brazilian manufacturing exporters in 2000.
we model with product-specific taste shocks similar to BRS. Comparing ranks across destinations, we can assess the relative importance of core competency versus product-specific taste shocks: for each given HS 6-digit product that a Brazilian firm sells in Argentina, we can correlate the firm-product’s rank elsewhere with the firm-product’s Argentinean rank. We find a correlation coefficient of .785 and a Spearman’s rank correlation coefficient of .860, indicating an important role for core competency.

To assess the first statement of Fact 1 for all export destinations, we regress the logarithm of the revenues of the best-selling products $y_{ωd1}$ for firm $ω$ to destination $d$ on log exporter scope $G_{ωd}$, discerning effects separately for Latin American and Caribbean (LAC) and non-LAC destinations and conditional on a firm fixed effect $χ_ω I_ω$:

$$\log y_{ωd1} = -1.16 (0.04) I_d \in \text{LAC} + 1.30 (0.04) \log G_{ωd} - 0.18 (0.05) I_d \in \text{LAC} \times \log G_{ωd} + χ_ω I_ω + ϵ_{ωd}. \quad (17)$$

This regression is a version of the model’s equation (15) for a firm’s core product $g = 1$. The goodness of fit $R^2$ is .54 (standard error in parentheses clustered at firm level) for 170 destinations and 7,096 firms (46,208 observations). The coefficient estimate on $\log G_{ωd}$ shows that sales of the best-selling product increase with an elasticity of 1.3 as exporter scope in a market widens. However, for LAC destinations, the elasticity is only 1.12 (1.30-0.18). In light of the model’s equation (15) for $g = 1$, this coefficient can be interpreted as an estimate of the sum $δ_{\text{LAC}} + \tilde{α}$. This variation by destination is closely related to our later estimation finding that there are destination-specific elasticities of incremental market-access costs with respect to exporter scope. In subsection 3.3 below, we will assess the first statement of Fact 1 yet more rigorously and estimate the model’s equation (15) at the individual product $g$ level (not just for the first product).

The regional indicator for LAC destinations arguably captures both policy-amenable market-access costs and lasting cultural and geographic market-access barriers, so we adopt a modified specification of the regression and add an NTM proxy. Equation (17) reflects product sales of firms that ship one or multiple products to a destination, so we aggregate the $NTM_{jd}$ variable over the HS 6-digit products $j$ to the firm level $ω$: $NTM_{ωd} \equiv \sum_{j \in J_{ωd}} NTM_{jd}/|J_{ωd}|$. This NTM proxy varies between zero and one and reflects the share of HS-6 product lines with at least one core NTM that an exporter $ω$ faces when shipping its products to destination $d$. Import tariffs may be correlated with NTMs, so we also control for the firm-level mean of the log of one plus the tariff rate $\ln(1 + τ_{ωd})$ for an exporter $ω$, where $τ_{ωd}$ is the HS 6-digit average tariff on a product that the firm sells at the destination. We include firm fixed effects $χ_ω$ and
product-destination fixed effects $\chi_{jd}$:

$$
\log y_{\omega d} = 0.04 \text{NTM}_{\omega d} + 1.27 \log G_{\omega d} + 0.13 \text{NTM}_{\omega d} \times \log G_{\omega d} - 1.11 \mathbb{I}_{d \in \text{LAC}} - 0.23 \mathbb{I}_{d \in \text{LAC}} \times \log G_{\omega d} + X_{\omega d} \gamma + \chi_{\omega} \mathbb{1} + \epsilon_{\omega d},
$$

where we collect the coefficients on tariffs and the product-destination effects in the $\gamma$ vector (the product $j$ is the HS-6 line of the firm’s top-selling product at the destination). The NTM variable is only available for a subset of destinations, so we have 32,486 observations. The $R^2$ is .54. The coefficient estimate for $\log G_{\omega d}$ shows that in the absence of observable NTMs, the sales of the best-selling product increase with an elasticity of 1.27 as exporter scope widens. However, for exports to countries where the share of an exporter’s products that face core NTMs is larger, the elasticity becomes 1.40 (1.27+0.13). In other words, more core NTMs at a destination depress product sales in a similar manner as do non-LAC destinations, while the LAC-indicator remains a statistically significant predictor at conventional significance levels. An interpretation is that policy-amenable market-access costs such as NTMs discourage product sales markedly, in addition to lasting market-access barriers reflected in regional indicators. Further results and robustness checks are available in Online Supplement S3.

The second statement in Fact 1 that wide-scope exporters sell their lowest-ranked products for small amounts is also consistent with our model’s equation (15). The equation implies for a firm’s least-selling product $g = G_{\omega d}$ that its sales fall with a firm’s scope if and only if market-access costs decline with additional products ($\delta_d$ is negative). The finding is at odds with models of multi-product firms where access costs are product-invariant or absent, such as in BRS or Mayer et al. (2014), and underlies our choice of product-specific market-access costs. The second statement in Fact 1 closely relates to our later simulation result that falling access costs induce more trade mostly through the entry of new exporters with their first product, whereas falling barriers to product entry raise trade by less than similar relative declines in variable trade costs.

To assess the second statement in Fact 1 quantitatively, we regress the lowest-ranked product’s log sales $y_{\omega d G}$ on a firm’s log exporter scope $G_{\omega d}$ in a destination, conditioning on fixed effects for firm $\omega$ and destination $d$, and obtain an elasticity of $-2.07$ under an $R^2$ of .39 (standard error of .02 clustered at firm level) for 170 destinations and 7,096 firms (46,208 observations). The coefficient estimate on $\log G_{\omega d}$ shows that sales of the lowest-selling product fall with an elasticity of 2.1 as exporter scope at a destination widens. In light of the model’s equation (15) for $g = G_{\omega d}$, this coefficient can be interpreted as an estimate of $\delta_{\text{LAC}}$.

**Fact 2** At each destination, there are a few wide-scope and many narrow-scope exporters.
Figure 2: Exporter Scope Distribution

Note: Products at the HS 6-digit level. The percentile of exporters by scope is calculated within a given destination. Exporter scope is the corresponding scope for a given percentile averaged across the five most common destinations within each of the two regions (LAC and non-LAC called Rest of World).

Figure 2 plots average exporter scope in the top five destinations of a region (LAC or non-LAC) against the percentile of an exporter in terms of scope at the destination. The median firm, conditional on exporting, only ships one or two products to any given destination. Within a destination, the exporter scope distribution exhibits a concentration in the upper tail reminiscent of a Pareto distribution.

The exporter scope distribution varies between destinations. Plotted in open dots is the average exporter scope at top LAC destinations, and with solid dots the exporter scope at non-LAC destinations. Brazilian exporters have a wider exporter scope at LAC destinations than at non-LAC destinations. To quantify the difference in exporter scope across destinations, we run a simple regression of log exporter scope \( G_{ωd} \) on an indicator for LAC destinations and condition on firm fixed effects \( χ_{ω}I_{ω} \):

\[
\log G_{ωd} = .35I_{d∈LAC} + χ_{ω}I_{ω} + ε_{ωd}.
\]

The \( R^2 \) is .55 (standard error in parentheses clustered at firm level) for 170 destinations and 7,096 firms (46,208 observations). In light of the model’s equation (14), a wider exporter scope in nearby LAC countries, conditional on the common firm effects across destinations, is consistent with a lower sum \( δ_{LAC} + ˜α \) than in the rest of the world, similar to evidence on the first statement in Fact 1.

As with Fact 1 before, we can show for Fact 2 that the cross-regional differences are also reflected in a continuous measure of core NTMs for products shipped to a destination. We
augment the previous specification with the variable $NTM_{wd} \in [0, 1]$, the mean log of one plus the tariff rate $\ln(1 + \tau_{wd})$ and product-destination fixed effects $\chi_{jd}$:

$$\log G_{wd} = .45\mathbb{I}_{d \in \text{LAC}} - .05 NTM_{wd} + X_{wd}\gamma + \chi_{\omega}I_{\omega} + \epsilon_{wd},$$

where we collect the coefficients on tariffs and the product-destination effects in the $\gamma$ vector (the product $j$ is the HS-6 line of the firm’s least-selling product at the destination). As before, the NTM variable is only available for a subset of destinations, so we have 32,486 observations. The $R^2$ is .36. The regression shows that exporter scope is lower at destinations where exporters face more NTMs, a discouraging impact on exports echoing the effect for non-LAC destinations. Further results and robustness checks are available in Online Supplement S3.

**Fact 3** Average sales per product (exporter scale) and exporter scope exhibit varying destination-specific degrees of correlation, with the correlation positive and highest in distant destinations.

On average across destinations, exporter scale is increasing in the number of exported products. When comparing across destinations, an exporter’s average product sales exhibit a stronger positive correlation with exporter scope in more distant destinations. For Brazilian exporters to LAC destinations, for example, the estimated elasticity of average product sales with respect to
exporter scope is just .02 in a regression of log exporter scope on log exporter scale, conditional on industry fixed effects (and the elasticity is not statistically significantly different from zero). However, among exporters to non-LAC destinations, the elasticity of exporter scale with respect to exporter scope is markedly higher, reaching .15, and statistically significantly different from zero (at conventional significance levels).

Figure 3 illustrates these findings. The logarithm of average exporter scale $a_{\omega d}$ at the top-five destinations in a region is plotted against average exporter scope $G_{\omega d}$ at the top-five destinations in the region. In light of our model’s equation (16), a consistent explanation is that $\delta_d$ is negative and in absolute magnitude larger in nearby countries, similar to evidence from the previous two facts. Exporters to a nearby destination experience a rapid decline in market-access costs for additional products, permitting low-selling products into a nearby market more easily than into remote markets.

We can relate an exporter’s average sales per product and exporter scope across destinations to a destination’s share of products facing NTMs, in addition to the LAC indicator. Similar to earlier specifications, we regress the logarithm of average sales per product for firm $\omega$ to destination $d$, $a_{\omega d}$, on exporter scope $G_{\omega d}$ and its interaction with the variable $NTM_{\omega d} \in [0, 1]$ as well as with a LAC dummy, while controlling for the average tariff rate, firm and product-destination fixed effects:

$$
\log a_{\omega d} = .04 NTM_{\omega d} + .51 \log G_{\omega d} + .16 NTM_{\omega d} \times \log G_{\omega d} - .09 \mathbb{I}_{d \in LAC} - .23 \mathbb{I}_{d \in LAC} \times \log G_{\omega d} + X_{\omega d}^\gamma + \epsilon_{\omega d},
$$

where we collect the coefficients on tariffs and the product-destination effects in the $\gamma$ vector (the product $j$ is the HS-6 line of the firm’s top-selling product at the destination). As before, the NTM variable is only available for a subset of countries, resulting in 32,486 observations. The $R^2$ is .51. Mirroring the evidence from Figure 3, the predicted elasticity of exporter scale with respect to exporter scope is significantly higher at destinations where products face more core NTMs and at non-LAC destinations. Further results and robustness checks are available in Online Supplement S3. These facts are consistent with the interpretation that exporters to distant countries and to destinations with more NTMs face higher incremental market-access costs for additional products. Firms therefore mostly add high-selling products in distant and

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21 The absence of a strong correlation between exporter scale and exporter scope among Brazilian firms exporting to close-by LAC countries is reminiscent of the finding by BRS that scale and scope hardly correlate among U.S. exporters to Canada. Montinari, Riccaboni and Schiavo (2017) report similar scale-scope relationships for French exporters by discerning between EU and non-EU destinations, comparable to our scale-scope relationships for Brazil and LAC vs. non-LAC destinations.
NTM-protected markets. As a result, wide-scope exporters at more distant and NTM-protected markets have, on average, higher sales per product.

3.3 Scale-scope-rank regression

We conclude our descriptive exploration of the data with an empirical assessment of Fact 1 (Figure 1) at the product level. For this purpose, we simplify the model and set both the market-access cost and the local product appeal to unity across all firms and destinations: \( c_d = \xi_{dg} = 1 \). The only structural heterogeneity comes from a firm’s productivity \( \phi \). Using equation (15), we can express firm \( \omega \)’s log sales \( y_{\omega dg} \) of the \( g \)-th product in destination \( d \) as a function of the firm’s log exporter scope \( G_{\omega d} \) and the log local rank of the firm’s product \( g \):

\[
\ln y_{\omega dg} = (\delta_d + \bar{\alpha}) \ln G_{\omega d} - \bar{\alpha} \ln g - f(1 - Pr_{\omega,d}^G) + \ln \sigma[f_d(1)/f(1)] \mathbb{I}_{d \in \text{LAC}} + \chi_{\omega} \mathbb{I}_{\omega} + \epsilon_{\omega dg},
\]

(18)

The function \( f(1 - Pr_{\omega,d}^G) = (\sigma - 1) \ln(\phi_{\omega}/\phi_d^*) \) maps a firm’s sales percentile to its underlying relative productivity. To measure \( 1 - Pr_{\omega,d}^G \), we compute a Brazilian firm’s local sales percentile among the Brazilian exporters with minimum exporter scope \( G \). We adopt a functional form where \( f(x) = \tilde{\theta}^{-1} \log(x) \) and include the log percentile as a regressor.\(^{22}\) We augment the estimation equation with a combined disturbance \( \chi_{\omega} \mathbb{I}_{\omega} + \epsilon_{\omega dg} \), simply recognizing that the equation will only hold with some empirical error, and condition out a firm’s worldwide fixed effect \( \chi_{\omega} \). The (exhaustive) set of firm effects absorbs the worldwide average log fixed cost \( \ln \sigma f(1) \).

There are concerns using estimation equation (18). The equation is misspecified if local sales shocks \( \xi_{dg} \) permutate the global rank order of a firm’s products and turn the order into different location-specific rankings. This misspecification makes the equation “memoryless” in that estimation does not register a firm-product’s identity across locations and therefore loses account of the firm-product’s ranking outside a given location \( d \). Moreover, the estimation equation suffers an omitted variable bias because unobserved positive firm-destination product appeal shocks will both tend to raise exporter scope and to systematically permutate the local rank order of firm products; this omitted variable bias would expectedly distort the estimates of \( \delta_d \). To mitigate the concerns, we estimate equation (18) in two parts by restricting the estimation sample: (i) we isolate the intercept of the graphs in Figure 1 by restricting the sample just the best selling (or second-best selling) product, \( g = 1 \) (or \( g = 2 \)), and estimate how the intercept varies with exporter scope for two location groups \( G_{\omega,d} \in \text{LAC} \) (LAC) and \( G_{\omega,d} \in \text{ROW} \) (non-LAC destinations); (ii) we measure the slope of the graphs in Figure 1 by restricting the sample to

\(^{22}\)This is equivalent to assuming that productivity is drawn from a Pareto distribution with shape parameter \( \theta \) and where \( \tilde{\theta} = \theta/(1 - \sigma) \).
Table 1: Fit of Individual Product Sales

<table>
<thead>
<tr>
<th></th>
<th>$\delta_{LAC}$</th>
<th>$\delta_{ROW}$</th>
<th>$\tilde{\alpha}$</th>
<th>$\tilde{\theta}$</th>
<th>$\delta_{LAC} - \delta_{ROW}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: $g = 1; G = 2$</td>
<td>-1.82</td>
<td>-1.61</td>
<td>3.04</td>
<td>2.35</td>
<td>-0.21</td>
</tr>
<tr>
<td></td>
<td>(.09)</td>
<td>(.11)</td>
<td>(.08)</td>
<td>(.31)</td>
<td>(.10)</td>
</tr>
<tr>
<td>Variant 1: $g = 2; G = 2$</td>
<td>-1.23</td>
<td>-1.13</td>
<td>3.04</td>
<td>2.10</td>
<td>-0.10</td>
</tr>
<tr>
<td></td>
<td>(.10)</td>
<td>(.12)</td>
<td>(.08)</td>
<td>(.29)</td>
<td>(.14)</td>
</tr>
<tr>
<td>Variant 2: $g = 1; G = 16$</td>
<td>-1.41</td>
<td>-1.19</td>
<td>2.62</td>
<td>2.35</td>
<td>-0.22</td>
</tr>
<tr>
<td></td>
<td>(.11)</td>
<td>(.12)</td>
<td>(.10)</td>
<td>(.31)</td>
<td>(.10)</td>
</tr>
</tbody>
</table>


Note: Products at the HS 6-digit level. OLS-FE firm fixed effects estimation of equation (18) for firm $\omega$’s individual product $g$ sales at destination $d$ in two parts, (i) under a rank restriction such as $g = 1$ with

$$\ln y_{\omega dg} = 1.22 \ln G_{\omega,d \in LAC} + 1.43 \ln G_{\omega,d \in ROW} - 0.43 \ln (1 - Pr_{G_{\omega d}}^{G}) - 0.32 I_{d \in LAC} + \chi\omega\beta + \epsilon_{\omega dg},$$

and (ii) under a scope restriction such as $G_{\omega d} = 2$ with

$$\left[ \ln y_{\omega dg} - 0.43 \ln (1 - Pr_{G_{\omega d}}^{G}) - 0.32 I_{d \in LAC} \right] = -3.04 \ln g_{\omega d} + \chi\omega\beta + \epsilon_{\omega dg}.$$

Robust standard errors from the delta method, clustered at the HS 2-digit industry level, in parentheses. Estimates of $\delta_{LAC}$ measure the scope elasticity of market-access costs for Brazilian firms shipping to other LAC destinations, $\delta_{ROW}$ for Brazilian firms shipping to destinations outside LAC.

$G_{\omega,d \in LAC} = G_{\omega,d \in ROW} = 2$ (or $G_{\omega,d} = 16$). To obtain mutually consistent results from this two-part estimation, we use the estimated coefficients on $I_{d \in LAC}$ and $\ln (1 - Pr_{G_{\omega d}}^{G})$ from the first part (i) as constraints on the second part (ii). Given the potential misspecification under any pair of restrictions, the regressions merely offer a descriptive exploration of the data.

Table 1 reports results from the two-part regression exercise under three combinations of restrictions. The baseline specification uses the restrictions $g = 1$ and $G_{\omega d} = 2$ for a pair of regressions under firm fixed effects (standard errors clustered at the level of 259 industries). The first variation uses the restrictions $g = 2$ and $G_{\omega d} = 2$ for a separate pair of firm fixed effects regressions and the second variation combines the restrictions $g = 1$ and $G_{\omega d} = 16$ for a final pair of firm fixed effects regressions. (Results remain broadly similar when including destination and HS 2-digit industry fixed effects.) As expected from the different relationships between exporter scope and scale outside LAC and within LAC (Figure 3), $\delta_{LAC}$ exceeds $\delta_{ROW}$ in absolute magnitude. Overall $\delta_{d}$ falls in the range between $-1.13$ and $-1.82$ across specifications and regions, while $\tilde{\alpha}$ lies in the range from $2.62$ to $3.04$ and $\tilde{\theta}$ between $2.10$ and $2.35$. In the baseline specification, the magnitudes of the $\delta_{d}$ estimates imply that incremental market-access costs drop at an elasticity of $-1.61$ when manufacturers introduce additional products in markets outside LAC, and with $-1.82$ within LAC. But firm-product efficiency drops off even faster with
an elasticity of around 3.04 in the baseline. Adding the two fixed scope cost coefficients suggests that there are net overall diseconomies of scope with a scope elasticity of 1.22 in LAC and 1.43 in non-LAC destinations. The coefficient estimates suggest that Assumptions 1 and 2 are satisfied in our data.

We now turn from descriptive explorations to an internally consistent estimator and will use the measured parameter magnitudes to assess the importance of each margin for overall trade.

4 Estimation

We adopt a method of simulated moments for parameter estimation. We specify the product appeal shocks $\xi_{dg}$ and the market-access costs shocks $c_d$ to be distributed log-normally with mean zero and variance $\sigma_c$ and $\sigma_\xi$, respectively. Firm productivities $\phi$ are drawn from a Pareto distribution with shape parameter $\theta$. We need to identify five parameters $\Theta = \{\delta, \tilde{\alpha}, \tilde{\theta}, \sigma_\xi, \sigma_c\}$, where $\tilde{\alpha} \equiv \alpha(\sigma - 1)$ and $\tilde{\theta} \equiv \theta/(\sigma - 1)$. These five parameters fully characterize the relevant shapes of our functional forms and the dispersion of the three stochastic elements—Pareto distributed firm-level productivity $\phi$, the random firm-level market-access cost component $c_d$, and local product appeal shocks $\xi_{dg}$. Our moments are standardized relative to the median firm or top firm-product at a destination. This convention results in an estimator that is invariant to two deterministic shifters in the firms’ cost and revenue functions: a destination-specific market-access cost shifter $\sigma_f d(1)$ and a destination-specific revenue shifter $D_d$, which are both common across exporters at a destination. Moreover, we specify the domestic access cost components $\xi_{BRA,g}$ and $c_{BRA}$ to be deterministic so that every exporter sells in the home market with certainty. In our ultimate implementation of the SMM estimator, we adopt an extension to destination-specific scope elasticities of market-access costs with $\delta$ varying between LAC and non-LAC countries.

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23 The presence of overlaying market-access cost and product appeal shocks renders conventional estimators problematic, as they would involve the numeric evaluation of integrals. Both a firm’s market-access cost shock $c_{\omega d}$ is potentially widely dispersed and a firm-product’s rank $y_{\omega}$ in production can differ from the firm-product’s observed local rank in sales ($\hat{y}_{\omega d} = 1 + \sum_{k=1}^{12} 1[y_{\omega,dk}(\xi_{dk}) > y_{\omega,dg}(\xi_{dg})]$), especially if the product appeal shock $\xi_{dg}$ is widely dispersed. The implied stochastic permutations of exporter scopes and product ranks introduce an exacting dimensionality that is hard to handle with a maximum likelihood estimator and the need for numerical computation of higher moments makes a general method of moments difficult to implement.

24 We relax the Pareto assumption in Appendix F and suppose that firm productivity is drawn from a log-normal distribution. We find that our parameter estimates are largely unchanged. The log-normal distribution may do a better job in describing small firm behavior, but we focus on large, productive firms, and the Pareto distribution allows for the counterfactual simulation in Section 5.

25 This choice effectively removes the levels of fixed costs from the estimation, a principal object of interest in Fernandes, Klenow, Meleshchuk, Pierola and Rodríguez-Clare (2018). We do not use moments that aggregate across all firms in the data set, such as the average firm’s sales or the total export sales.
4.1 Moments

At any iteration of the simulation, we use the candidate parameters \( \hat{\Theta} \) to compute a simulated vector of moments \( \mathbf{m}^{\text{sim}}(\hat{\Theta}) \), analogous to moments in the data \( \mathbf{m}^{\text{data}} \). We use five sets of simulated moments. Each set is designed to characterize select parameters and to capture a salient fact from Section 3 or from the literature. However, we exclude moments related to Fact 3 from our set of targeted moments. Instead, we will use Fact 3 to assess the fit of our estimates to that regularity after estimation. We now summarize the simulated moments and discuss how they contribute to parameter identification. Additional details on the moment definitions as well as the simulation algorithm can be found in Appendix D.

1. **Sales of the top-selling product across firms within destinations.** Based on the first statement of Fact 1, we characterize the top-selling products’ sales across firms with the same exporter scope. Among firms exporting three or four products to Argentina, for example, we take the ratio of the top-selling product at the 95th percentile across firms and the top-selling product of the median firm. Our restriction to the top product and our standardization by the median firm with the same scope isolate the stochastic components from equation (15) and therefore help identify the dispersion of product appeal shocks (and partly the dispersion of the market-access cost shock).

2. **Within-destination and within-firm product sales concentration.** We use the second statement in Fact 1 and the ratios between the sales of given lower-ranked products and the sales of the top product to characterize the concentration of sales within firms. The comparison of sales within firms neutralizes a firm’s global productivity ranking and eliminates the role of exporter scope as well as destination-specific determinants from equation (15). The within-firm within-destination sales ratios therefore help pin down the scope elasticity of product efficiency \( \tilde{\alpha} \) and help identify the dispersion of product appeal shocks.

3. **Within-destination exporter scope distribution.** We turn to Fact 2 and compute, within destinations, the shares of exporters with certain exporter scopes. For example, we calculate the proportion of exporters to Argentina, shipping three or four products. The frequencies of firms with a given exporter scope help identify the shape parameter \( \tilde{\theta} \) of the Pareto firm size distribution (and partly the dispersion of the market-access cost shock) and help pin down the scope elasticity \( \delta + \tilde{\alpha} \), which translates productivity into exporter scope by equation (14).

4. **Market presence combinations.** Mirroring similar regularities documented in Eaton et al. (2011), we use the frequency of firms shipping to any permutation of Brazil’s top five
export destinations in LAC and the top five destinations outside of LAC. For example, we target the number of exporters that ship to Argentina and Chile, but not to Bolivia, Paraguay and Uruguay. Matching these market presence patterns helps us identify the dispersion of market-access cost shocks.

5. Within-firm export proportions between destination pairs. It is a widely documented fact that a firm’s sales are positively correlated across destinations. For each firm, we pair its total sales to a given destination with its sales to Brazil’s respective top destination in LAC or outside LAC. The ratio of a firm’s total sales to two destinations depends on the firm’s respective exporter scopes by equation (16) and therefore helps pin down the scope elasticity of sales $\delta + \tilde{\alpha}$. The pairwise sales ratios also help identify the dispersion of product appeal shocks and market access shocks.

4.2 Inference

Inference proceeds as follows. To find an estimate of $\Theta$, we first stack the differences between observed and simulated moments $\Delta m(\Theta) = m_{\text{data}} - m_{\text{sim}}(\hat{\Theta})$.

In the population, the parameter $\Theta_0$ satisfies $E[\Delta m(\Theta_0)] = 0$, so we search for the $\hat{\Theta}$ that minimizes the weighted sum of squares, $\Delta m(\Theta)'W\Delta m(\Theta)$, where $W$ is a positive semi-definite weighting matrix. In the population, $W = V^{-1}$ where $V$ is the variance-covariance matrix of the moments. The population matrix is unknown, so we use the empirical analogue

$$\hat{V} = \frac{1}{N_{\text{sample}}} \sum_{n=1}^{N_{\text{sample}}} (m_{\text{data}}^n - m_{\text{sample}}^n)' (m_{\text{data}}^n - m_{\text{sample}}^n)' ,$$

where $m_{\text{sample}}^n$ are the moments from a random sample drawn with replacement of the original firms in the dataset and $N_{\text{sample}}$ is the number of those draws.\footnote{Currently, we use $N_{\text{sample}} = 1,000$. Due to adding up constrains, we cannot invert this matrix \( \hat{V} \). Instead, we take a Moore–Penrose pseudo-inverse.} To search for $\hat{\Theta}$ we use a derivative-free Nelder-Mead downhill simplex search. We compute standard errors using a bootstrap method that allows for sampling and simulation error.\footnote{For the bootstrap we repeat the estimation process 30 times, replacing $m_{\text{data}}$ with $m_{\text{bootstrap sample}}$ to generate standard errors. The bootstrapped standard errors are not centered.}

4.3 Results

We simulate one million firms so that we obtain approximately thirty-thousand exporters. The number of simulated firms is roughly three times as large as the number of 331,528 actual
Table 2: Estimation Results

<table>
<thead>
<tr>
<th>Scenario</th>
<th>$\delta_{LAC}$</th>
<th>$\delta_{ROW}$</th>
<th>$\tilde{\alpha}$</th>
<th>$\tilde{\theta}$</th>
<th>$\sigma_{\xi}$</th>
<th>$\sigma_{c}$</th>
<th>$\delta_{LAC} - \delta_{ROW}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>-1.16</td>
<td>-0.86</td>
<td>1.76</td>
<td>1.72</td>
<td>1.82</td>
<td>0.58</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.04)</td>
<td>(0.08)</td>
<td>(0.04)</td>
<td>(0.02)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>No product appeal shocks ($P_{\xi} = 0$)</td>
<td>-1.40</td>
<td>-1.19</td>
<td>2.42</td>
<td>1.00</td>
<td>0.99</td>
<td>0.22</td>
<td>-0.22</td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td>(0.06)</td>
<td>(0.04)</td>
<td>(0.004)</td>
<td>(0.01)</td>
<td>(0.05)</td>
<td>(0.05)</td>
</tr>
<tr>
<td>No market access, cost shocks ($P_{c} = 0$)</td>
<td>-1.20</td>
<td>-0.91</td>
<td>1.78</td>
<td>1.76</td>
<td>2.00</td>
<td>0.28</td>
<td>-0.28</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.09)</td>
<td>(0.04)</td>
<td>(0.12)</td>
<td>(0.03)</td>
<td>(0.05)</td>
<td>(0.05)</td>
</tr>
</tbody>
</table>


Note: Products at the HS 6-digit level. Standard errors from 30 bootstraps in parentheses. Estimates of $\delta_{LAC}$ measure the scope elasticity of market-access costs for Brazilian firms shipping to other LAC destinations, $\delta_{ROW}$ for Brazilian firms shipping to destinations outside LAC.

Brazilian manufacturing firms and 10,215 exporters. We use an excess number of simulated firms to reduce the noise in our simulation draws and smooth out our simulated moments. Our bootstrapped standard errors are based on sampling with replacement from the original set of 10,215 exporters.

To allow for cross-destination variation, we estimate separate scope elasticities of market-access costs for LAC destinations ($\delta_{LAC}$) and the rest of the world ($\delta_{ROW}$). Table 2 presents our baseline estimates in the first row. The baseline estimates for $\delta_{LAC}$ and $\delta_{ROW}$ are both negative, significantly different from zero, and also significantly different from each other. The negative sign implies that exporting an additional product to a destination is less costly in terms of market-access costs than any previous product. The difference in the estimated scope elasticities between LAC and ROW (non-LAC) destinations means that incremental market-access costs to LAC destinations fall almost 30 percent faster than incremental market-access costs to the rest of the world. The scope elasticity of production efficiency $\tilde{\alpha}$ is positive and significantly different from zero. The estimate of $\tilde{\alpha} = 1.76$ implies that an additional product has more than proportionally higher unit production costs than any infra-marginal product. In both the LAC region and the rest of the world, the combined scope elasticity $\delta_{d} + \tilde{\alpha}$ is strictly positive and implies strictly increasing incremental scope costs (Assumption 1 is therefore empirically sat-

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28 We observe a concentration of exporter presence at specific pairs of destinations within regions. For example, exporters to Paraguay frequently also export to Argentina; exporters to the United Kingdom frequently also ship to the United States. However, there is no clear association between exporting to the United Kingdom and Paraguay. In reality, there is a complex set of factors that might connect market-access costs between destinations. For example, customs unions, common markets, shared destination languages, and unified distribution systems could link market-access costs between countries. Our model does not explicitly take those potential connections into account. Instead, we implement a simplification and jointly simulate firms to identify separate moments for LAC export destinations and the rest of the world (ROW).
isfied). Overall, the estimates from SMM are similar in broad terms to those from our baseline descriptive data exploration in the preceding section (Table 1) but all coefficients are smaller in absolute magnitude in the current baseline specification.

Our baseline estimate for $\tilde{\theta}$ is statistically significantly above 1 and significantly below 2 (at conventional significance levels). The baseline estimate of the variance of firm-product appeal shocks $\sigma_\xi$ is approximately 2 and implies that, conditional on market-access cost shocks and firm productivity, the ratio of the 75th firm sales percentile to the 25th firm sales percentile is over 10. This large disparity stands in contrast to the implications of our baseline estimates for $\sigma_c$, which imply that the ratio of the 75th firm sales percentile to the 25th firm sales percentile is only about 2, far less than 10.

To explore the implications of our baseline estimates for the sources of variation in firm-product sales more systematically, we apply a log decomposition to equation (15) at the product level:

$$\log y_{\omega dg} = \left(\sum_{A_p} A_p + \sum_{B_p} B_p + \sum_{C_p} C_p \right)$$

Our estimates for LAC destinations imply that component $A_p$, which reflects the combined market-access costs shock and productivity for firms with identical exporter product scope, accounts for 17 percent of sales variation at LAC destinations. These shocks are exogenous, but known to a firm before it chooses its export profile. Component $B_p$, which accounts for both a firm-product’s global production rank $g_\omega$ as well as the firm’s local exporter scope $G_{\omega d}$, explains 37 percent of sales variation. Individual firm-product appeal shocks in component $C_p$ account for 50 percent of sales variations in LAC countries. This shock arrives after the firm makes export decisions. The breakdown is slightly different for non-LAC destinations, where component $A_p$ accounts for 19 percent of firm-product sales, component $B_p$ for 21 percent, and component $C_p$ for the remaining 60 percent. The disparity between LAC and non-LAC destinations is due to the difference between $\delta_{LAC}$ and $\delta_{ROW}$, which for LAC destinations augments the importance of exporter scope and reduces the dependence on individual product appeal shocks.

An interpretation of component $B_p$ is that it shows firm-level competency (core competency

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29 Estimates of $\tilde{\theta}$ can also be compared to those from Section 3.3 and are quantitatively similar.

30 Eaton et al. (2011), in a similar model but without multi-product firms and under slightly different sources of heterogeneity, find $\tilde{\theta} \approx 2.5$, which is larger than our estimate of 1.72. Their estimate of $\tilde{\theta}$ captures the elasticity of substitution between firms, whereas ours reflects the elasticity of substitution between firm-product varieties. Our estimate for $\sigma_\xi$ is inline with Eaton et al. (2011) who find that their firm-specific appeal shock has a variance of 1.69. However, our appeal shock is firm-product specific (not just firm specific), so the estimates are not directly comparable.

31 We standardize firm-product sales by $\sigma f_d(1)$ in estimation.
in a particular firm-product and overall firm capability with regards to exporter scope), whereas component $A_p$ reflects idiosyncratic firm heterogeneity, and component $C_p$ the randomness of individual product appeal. In summary, product appeal shocks play a dominant role in firm sales, while the combination of firm-level competency and firm heterogeneity accounts for a similarly important part of product sales. Our estimates highlight that a reduction in the scope elasticity of incremental market-access costs from their magnitude in non-LAC countries to the magnitude in LAC countries raises the importance of firm-level competency considerably.

Similarly we can run a firm-level decomposition of total sales by firms to a particular destination.

$$\log t_{\omega d}^G = \left( \sigma - 1 \right) \log \left[ \phi_{\omega} / \phi_{\omega}^* \right] \left[ (\delta_d + \tilde{\alpha}) \log G_{\omega d} + \log c_{\omega d} + \log \sum_{g=1}^{G} g^{-\tilde{\alpha}} \xi_{\omega dg} \right].$$

Across all destinations, the first component $A_f$, which reflects firm-level heterogeneity, accounts for 11 percent of variation. The second component $B_f$, which stems from firm-destination heterogeneity, accounts for 5 percent of the firm sales variation. The third component $C_f$ captures destination-product heterogeneity and accounts for 60 percent of the firm sales variation. The remaining firm sales variability (not accounted for by $A_f$, $B_f$ or $C_f$) is attributable to the positive covariance between the three components. These results are partially comparable to Eaton et al. (2011). In particular, Eaton et al. (2011) close the product channel $C_f$ and find that nearly 50 percent of the firm sales variation can be attributed to the destination-specific fixed costs behind $B_f$. By allowing firm-product-destination shocks, much of the variation at the firm level may simply be due to product-specific shocks.

In two departures from our baseline specification, we re-estimate the model dropping one source of heterogeneity at a time: we first omit product appeal shocks and then drop market-access cost shocks. We report the resulting estimates in the second and third row of Table 2. When we omit product appeal shocks (setting $\sigma_\xi = 0$), the estimated dispersion of market-access costs expectedly increases. In addition, the estimated magnitudes of the scope elasticities $\delta_d$ and $\tilde{\alpha}$ markedly increase. The estimate of the shape parameter of the Pareto firm size distribution $\hat{\theta}$ hits a corner solution. Those salient changes in parameter estimates underscore the importance of specifying product appeal shocks. Interestingly, however, the regional difference in the scope elasticity of market-access costs $\hat{\delta}_{LAC} - \hat{\delta}_{ROW}$ remains similar to that under our baseline estimation. Dropping market-access cost shocks has only minor effects on the remain-

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32We again standardize firm-product sales by $\sigma_{f,d}(1)$ in estimation.
Relating our results back to the findings from Table 1, which were based on simple log linear estimators dropping both sources of heterogeneity (product appeal shocks and market-access cost shocks), we find qualitatively similar results. This broad similarity across estimators suggests that both SMM and its simpler counterparts identify comparable principal variation in the data but the quantitative differences indicate the importance of heterogeneity in the product appeal and market-access costs.

To assess the sensitivity of our results to potential heterogeneity in product types and heterogeneity in destinations, we repeat estimation for numerous alternative specifications: we demean firm-product sales at the HS 6-digit level by average Brazilian exports at the HS 2-digit level, we restrict the sample to firms in high-tech manufacturing industries, we separate Mercosur member countries from other LAC destinations, and we drop both Argentina and the United States from the sample. We find our estimates broadly confirmed and report the details of the sensitivity exercises in an Online Supplement. To document the properties of our SMM, we also report results from Monte Carlo simulations of our estimator in the Online Supplement.

4.4 Model fit

To gauge the fit of our estimates, we plot simulated data using the baseline parameter estimates (from the first row of Table 2) alongside the actual data. We first assess how well we capture features of the data that our simulated moments target directly. Figure 4 shows our targeted moments and illustrate the close fit of our simulated data. The simulated data, depicted with lines in Figures 4A and 4B, match our Facts 1 and 2 closely, as shown with individual dots. Figure 4A presents the within-firm distribution of product sales in Argentina for firms with different exporter scopes. Figure 4B shows the exporter scope distributions, averaging over the five most common destinations in the LAC and ROW (non-LAC) regions.

We now turn to regularities in the data that our simulated moments in the estimation routine did not target. We deliberately excluded from our estimation any moments that relate to Fact 3. As Figure 5A documents, our simulated firms nevertheless line up with the observed data. Our estimates detect clearly different scale-scope correlations between LAC destinations and ROW (non-LAC) destinations. Figure 5B plots the distribution of total sales by percentile within destinations. Our estimation routine includes simulated moments that relate to the distribution of

\[ \sigma_e = 0 \]

\[ \sigma_c = 0 \]

We cannot compare the goodness of fit in meaningful ways across specifications because the moments used under the restrictions differ from the baseline estimation. For $\sigma_e = 0$, we have to limit the set of moments 2 to the median because there is no variation by percentile in the simulation. For $\sigma_e = 0$, we have to exclude the set of moments 4 and 5.
Figure 4: Fit of Targeted Moments

(A) Firm-product Sales Distribution

(B) Exporter Scope Distribution


Note: Products at the HS 6-digit level. Data plots replicate those in Figures 1 and 2. Predicted curves based on simulations in Section D.1, using the baseline parameter estimates in Table 2. Panel A shows shipments to Argentina, grouping firms by their local exporter scope and firm-products by their local sales rank. Panel B shows the exporter scope by percentile, averaged across the five most common destinations within each of the two regions (LAC and non-LAC).

Figure 5: Fit of Non-Targeted Moments

(A) Exporter Scope and Scale

(B) Export Sales Distribution


Note: Products at the HS 6-digit level. Panel A replicates Figure 3 and shows exporter scale (a firm’s total sales at a destination divided by its exporter scope at the destination) on a log scale plotted against exporter scope, averaging each variable over the five most common destinations within a region (LAC and non-LAC called ROW) and normalizing scale by the average total sales of single-product exporters at the destination. Predicted curves based on simulations in Appendix D.1, using the baseline parameter estimates in Table 2. Panel B shows total firm exports by percentile, averaging a firm’s total exports over the five most common destinations within each of the two regions (LAC and non-LAC), and normalizes total sales by the median firm’s total at the destination.
sales across firm-products (within firms), to the distribution of exporter scope (within destinations), and to the proportion of total sales between pairs of destinations (within firms). None of those moments fully captures the distribution of total sales across firms (within destinations) because sales depend on all three sources of stochastic variation in the model: firm productivity, market-access cost draws and product appeal shocks. Even though our SMM estimator did consequently not fully target the total sales distribution, Figure 5B documents that we find a close fit between our simulated firms and the data.

4.5 Policy relevance

In our model, fixed costs of exporting $G$ products to destination $d$ take the form of equation (6), which depends on both the fixed cost of introducing the first product at an export market $f_d(1)$ and the elasticity of additional products’ fixed costs with respect to exporter scope $\delta_g$. We take our estimates for $\sigma, \theta,$ and $\alpha$ and minimize deviations between the model and data to find the set of $\delta_d$ that best match our empirical moments for each destination country reached by 60 or more Brazilian exporters. This procedure yields $\delta_d$ estimates for 74 countries.

To evaluate the policy relevance of the $f_d(1)$ and $\delta_d$ estimates, we study the extent to which they are correlated with policy variables or lasting geographic and economic factors. For this purpose, we revisit our measures of the share of HS 6-digit product lines covered by a core NTM from Section 3 and take the unweighted country-level mean at destination $d$: $NTM_d \equiv \sum_{j \in J} NTM_{jd} / |J|$. This NTM proxy varies between zero and one and reflects the share of HS-6 product lines with at least one core NTM that any exporter to the destination faces on average. Similarly for the tariff controls, we use the arithmetic mean of the log of one plus the import tariffs at the destination country level for Brazil as the source country. From the CEPII gravity database we use further bilateral and multilateral variables for Brazil as the source country in the year 2000: the destination’s distance to Brazil, as well as destination population, destination gross domestic product (GDP), and destination area. To capture policy relevant regional characteristics more closely than a geographic dummy such as for LAC can, we use an indicator for Mercosur countries. Mercosur is Brazil’s main preferential trade agreement in 2000. We define Mercosur to include only the original members Argentina, Paraguay and Uruguay (and Brazil) from 1994.\footnote{We exclude the Mercosur associates Chile from 1996 and Bolivia from 1997 because those countries were not full members in 2000. Bolivia is in an accession process since 2012, while Chile never requested membership. Brazil is also part of ALADI (Asociación Latinoamericana de Integración), which seeks to foster trade throughout Latin America since 1980, but there was no substantive progress in harmonizing NTMs by 2000.}

Table 3 reports results from regressions of $f_d(1)$ and $\delta_d$ on the NTM proxy, on the mean of the log of one plus the tariff rate, and on geography controls. The NTM proxy is not a statis-
Table 3: Market-access Costs, NTMs and Geography

<table>
<thead>
<tr>
<th></th>
<th>( f_d(1) )</th>
<th>( f_d(1) )</th>
<th>( f_d(1) )</th>
<th>( \delta_d )</th>
<th>( \delta_d )</th>
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<tr>
<td>mean NTM(d)</td>
<td>-.528</td>
<td>-.1110</td>
<td>.0345</td>
<td>-.480**</td>
<td>-.486**</td>
<td>-.418*</td>
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<td></td>
<td>(.964)</td>
<td>(.943)</td>
<td>(.339)</td>
<td>(.160)</td>
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<td>(.188)</td>
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<td>mean Log (1+Tariff)(BRA,d)</td>
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<td>-.0720</td>
<td>-.0155</td>
<td>.00749</td>
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<td></td>
<td>(.0684)</td>
<td>(.0762)</td>
<td>(.0105)</td>
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<td>Mercosur(d)</td>
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<td>(.384)</td>
<td>(.0584)</td>
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<td>Log Distance(BRA,d)</td>
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<td>(.146)</td>
<td>(.0730)</td>
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<td>(.132)</td>
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<td>Log GDP(d)</td>
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<td>.0495*</td>
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<td>(.0793)</td>
<td>(.0234)</td>
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<td>Log Area(d)</td>
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<td>-.0360</td>
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<td>(.0618)</td>
<td>(.0296)</td>
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<tr>
<td>Constant</td>
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<td>14.02***</td>
<td>12.36***</td>
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<td>-0.998***</td>
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<td>(.384)</td>
<td>(.410)</td>
<td>(1.670)</td>
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<td>(.0739)</td>
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<td>Observations</td>
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<td>.187</td>
<td>.836</td>
<td>.143</td>
<td>.143</td>
<td>.240</td>
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</tbody>
</table>

Sources: SECEX 2000, manufacturing firms and their manufactured products (estimates of \( f_d(1) \) and \( \delta_d \)); UNCTAD TRAINS 1999-2001 as augmented by Kee et al. (2009) for NTM proxy; WTO’s Integrated Database 2000 for import tariff rates; CEPII 2000.

Notes: Destination-country aggregates over products at the HS 6-digit level. Standard errors in parentheses (*: \( p < .05 \), **: \( p < .01 \), ***: \( p < .001 \)).

Tactically significant predictor of firms’ destination-specific market-access cost \( f_d(1) \) for their first product (their initial entry cost), regardless of regression specification. In a short regression, with only the NTM proxy and import tariffs as regressors, lower tariffs at the destination predict higher initial entry cost \( f_d(1) \), but that association is potentially spurious given omitted geographic variables. In a long regression that also controls for destination-country characteristics, import tariffs are no longer statistically significant predictors, while higher GDP predicts higher initial market-entry cost \( f_d(1) \). An interpretation is that Brazil’s exporters face higher market-access cost for their first product in more industrialized countries (where import tariffs tend to be relatively low). In summary, initial entry cost \( f_d(1) \) are not clearly related to our policy-related variables.

In contrast, the scope-elasticity of market-access costs \( \delta_d \) is strongly and statistically significantly related to the NTM proxy (at conventional significance levels). Even after controlling
for a destination country’s import tariffs (which are not statistically significant at conventional levels) and GDP (which is a statistically significant predictor), there is a salient and significant negative relationship between the prevalence of NTMs in a destination country and the scope-elasticity of Brazilian exporter’s market-access cost. The negative sign is consistent with the interpretation that, in a destination with many NTMs, exporters face a more convex market-access cost schedule that discourages the entry of additional products more strongly than at a destination with few NTMs. Strikingly, the scope-elasticity of market-access costs is not significantly related to import tariffs conditional on the presence of NTMs (even though bilateral Brazil-specific import tariffs abroad are arguably more precisely measured than the destination-level NTM proxies). We take these findings as evidence that policy-related foreign market conditions, beyond conventional tariffs, shape the differences between market-access cost schedules across destinations and proceed to study the impact of reducing market-access barriers.

5 Model Aggregation and Equilibrium

To aggregate the model we specify a Pareto distribution of firm productivity following Helpman, Melitz and Yeaple (2004) and Chaney (2008). This assumption yields convenient functional forms that are independent of our other assumptions on the specific functional forms of market-access costs and the marginal cost schedule in equation (7), and the distribution of cost shocks and product appeal shocks. We specify the cumulative distribution function \( Pr = 1 - \frac{(b_s)^\theta}{\phi^\theta} \) over the support \([b_s, +\infty)\), where \( \theta \) is the Pareto shape parameter, common across all source countries, and more advanced countries are thought to have a higher location parameter \( b_s \). We also define \( \tilde{\theta} \equiv \frac{\theta}{(\sigma - 1)} \) to simplify notation. In Appendix F (and in the Online Supplement S7) we discuss an alternative setup where firm productivity is drawn from a log-normal distribution.

The resulting conditional probability density function of the distribution of entrants is then

\[
\mu(\phi|\phi^*_sd, \theta) = \begin{cases} 
\frac{\theta(\phi^*_sd)^\theta}{\phi^{\theta+1}} & \text{if } \phi \geq \phi^*_sd, \\
0 & \text{otherwise.}
\end{cases}
\]

(19)

We use the shorthand \( \phi^*_sd \) for the productivity cutoff but note that \( \phi^*_sd (c_d) \) depends on a firm’s access cost realization by (10). Integrating over the density of the market-access cost distribution, we obtain \( M_{sd} \), the measure of firms that sell to destination \( d \) from source country \( s \)

\[
M_{sd} = \kappa \frac{J_s b_s^\theta}{[f_{sd}(1)/D_{sd}]^\theta}
\]

(20)
by (10). The parameter
\[ \kappa \equiv \int_{c_d} c_d^{-\bar{\theta}} dF(c_d) \]
reflects the expected access deterring effect of the firm-destination specific market-access cost component \( c_d \) on the mass of active exporters at a destination.

We denote aggregate bilateral sales from country \( s \) to \( d \) with \( T_{sd} \). The corresponding average expected sales per firm are defined as \( \bar{T}_{sd} \), so that \( T_{sd} = M_{sd} \bar{T}_{sd} \) and
\[ \bar{T}_{sd} \equiv \int_{c_d} \bar{T}_{sd}(c_d) \, dF(c_d), \tag{21} \]
where \( \bar{T}_{sd}(c_d) \) is the mean expected sales per firm for a given market-access cost draw \( c_d \). Similarly, we define average market-access costs as
\[ \bar{F}_{sd} \equiv \int_{c_d} \bar{F}_{sd}(c_d) \, dF(c_d), \tag{22} \]
where \( \bar{F}_{sd}(c_d) \) is the mean market-access cost for a given draw \( c_d \).

For aggregation we also require the following two assumptions to hold to guarantee that average sales per firm are positive and finite.

**Assumption 2** (Pareto probability mass in low tail). The Pareto shape parameter is such that \( \bar{\theta} > 1 \).

**Assumption 3** (Bounded market-access costs and product efficiency). Incremental market-access costs and product efficiency satisfy
\[ \sum_{G=1}^{\infty} F_{sd}(G)^{-(\bar{\theta}-1)} h(G)^{-\theta} \in (0, +\infty). \]

**Lemma 1** Suppose Assumptions 1, 2 and 3 hold. Then for all \( s, d \in \{1, \ldots, N\} \), average sales per firm are a constant multiple of average market-access costs:
\[ \bar{T}_{sd} = \frac{\bar{\theta} \sigma}{\bar{\theta} - 1} \bar{F}_{sd}. \tag{23} \]

**Proof.** See Appendix A.1. □

Despite our rich micro-foundations at the firm-product level and idiosyncratic shocks by destination, in the aggregate the share of market-access costs in bilateral exports \( \bar{F}_{sd}/\bar{T}_{sd} \) only depends on parameters \( \theta \) and \( \sigma \), while mean market-access costs \( \bar{F}_{sd} \) vary by source and destination country. Bilateral average sales can be summarized with a function only of the parameters \( \theta \) and \( \sigma \) and the properties of mean market-access costs \( \bar{F}_{sd} \).

\[ \bar{F}_{sd}(c_d) \text{ and } \bar{T}_{sd}(c_d) \text{ follow from integrating over firm productivity conditional on exporting.} \]
Finally, we can use the measure of exporters $M_{sd}$ from equation (20), expression (23) for average sales and the definition of the revenue shifter $D_{sd}$ in (8) to derive the share of products from country $s$ in country $d$’s expenditure:

$$\lambda_{sd} = \frac{M_{sd} \bar{T}_{sd}}{\sum_k M_{kd} \bar{T}_{kd}} = \frac{J_s(b_s)^\theta (w_s \tau_{sd})^{-\theta} f_{sd}(1)^{-\tilde{\theta} F_{sd}}}{\sum_k J_k(b_k)^\theta (w_k \tau_{kd})^{-\theta} f_{kd}(1)^{-\tilde{\theta} F_{kd}}}, \quad (24)$$

where $f_{sd}(1)^{-\tilde{\theta} F_{sd}} = \sum_{G=1}^\infty f_{sd}(G)^{-\tilde{\theta} h(G)}$ by Lemma 1 (see equation (A.3) in Appendix A.1). Our framework generates a bilateral gravity equation. As in Eaton and Kortum (2002) and Chaney (2008), the elasticity of trade with respect to variable trade costs is $-\theta$. The difference between our model, in terms of bilateral trade flows, and the framework of Eaton and Kortum (2002) is that market-access costs influence bilateral trade similar to Chaney (2008) in the aggregate. At the firm-product level, however, our framework provides rigorously quantifiable foundations for the relevant market-access costs. The gravity relationship (24) clarifies how those micro-founded market-access cost components relate to aggregate bilateral trade through the weighted sum $\sum_{G=1}^\infty f_{sd}(G)^{-\tilde{\theta} h(G)}$. We thus offer a tool to evaluate the responsiveness of overall trade to changes in individual market-access cost components.

The partial elasticity $\eta_{\lambda,f(g)}$ of trade with respect to a product $g$’s access cost component is $-(\tilde{\theta}-1)$ times the product’s share $h(g)^{-\theta}$ in the weighted sum. To assess the relative importance of the extensive margin of product entry, relative to firm entry with the core product, we can compare elasticities using the ratio

$$\frac{\eta_{\lambda,f(g)}}{\eta_{\lambda,f(1)}} \frac{f_{sd}(1)^{-(\tilde{\theta}-1) h(g)^{-\theta}}}{f_{sd}(1)^{-(\tilde{\theta}-1)}}. \quad (25)$$

This ratio simplifies to the function $g^{-\delta_{sd}(\tilde{\theta}-1)-\alpha \theta}$ in our parametrization. The power is strictly negative if and only if $\delta_{sd} + \alpha (\sigma - 1) > \delta_{sd}/\tilde{\theta}$. It therefore depends on the sign and magnitude of $\delta_{sd}$ whether the elasticity of trade with respect to an additional product’s incremental market-access cost is higher or lower than the elasticity of firm entry.

We can also compute mean exporter scope in a destination. For the average number of products to be finite we will need the following necessary assumption.

**Assumption 4** (Strongly increasing combined incremental scope costs). Combined incremental scope costs satisfy $\sum_{G=1}^\infty z_{sd}(G, c_d)^{-\tilde{\theta}} \in (0, +\infty)$.

This assumption is in general more restrictive than Assumption 1. It requires that combined

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36In our model, as in Chaney (2008), the elasticity of trade with respect to trade costs is the negative Pareto shape parameter, whereas it is the negative Fréchet shape parameter in Eaton and Kortum (2002).
incremental scope costs $Z(G)$ increase in $G$ at a rate asymptotically faster than $1/\tilde{\theta}$ (a result that follows from the ratio rule, see Rudin 1976, ch. 3). Mean exporter scope in a destination is\footnote{The expression is derived (omitting firm access cost $f_{sd}(1)$ and integration over $c_d$ for brevity) using}

$$\bar{G}_{sd} = \kappa f_{sd}(1)^{\tilde{\theta}} \sum_{G=1}^{\infty} z_{sd}(G)^{-\tilde{\theta}}. \quad (26)$$

For our parameterized example, the expression implies that mean exporter scope is invariant to destination market size.\footnote{To directly test that mean exporter scope is largely unresponsive to destination market size we present this relationship in Figure B.2 (Appendix B.1). This implication as well as the robust scope and sales distributions are related to the Pareto assumption. Another implication of the Pareto assumption is that the relationship between the number of exporters shipping to a destination and the destination market size becomes linear in logs—a salient feature of both our Brazilian and French exporter data (Eaton et al. 2004).}

We turn to the model’s equilibrium. Total sales of a country $s$ equal its total sales across all destinations (including domestic sales):

$$Y_s = \sum_{k=1}^{N} \lambda_{sk} T_k, \quad (27)$$

where $T_k$ is consumer expenditure at destination $k$. Additionally, Lemma 1 implies that a country’s total expense for market-access costs is a constant (source country invariant) share of bilateral exports. This result implies that the share of wages and profits in total income is constant (source country invariant) and given by

$$w_s L_s = \frac{\tilde{\theta} \sigma - 1}{\theta \sigma} Y_s \quad \text{and} \quad \pi_s L_s = \frac{1}{\theta \sigma} Y_s. \quad (28)$$

See Appendix A.2 for a derivation.

Assumptions 1 through 4 guarantee that the quantitative predictions in equations (14)-(15) are well defined. Table 4 reports the equivalent parameter restrictions of those necessary assumptions under our functional forms (7).\footnote{Assumption 4 implies Assumption 1 but it depends on the sign of $\delta_{sd}$ whether Assumption 3 implies Assumption 1 (or Assumption 4). The necessary conditions for equilibrium existence can be summarized compactly with}

$$\min \left\{ \delta_{sd} (\tilde{\theta} - 1), \delta_{sd} \tilde{\theta} \right\} + \alpha \theta > 1 \quad \text{and} \quad \tilde{\theta} > 1.$$  

By parametrization (7), the combined market-access cost function $f_{sd}(1)^{-\tilde{\theta}} \bar{F}_{sd}(\nu) \equiv f_{sd}(1)^{-\tilde{\theta} - 1} \sum_{G=1}^{\infty} G^{-\nu}$ con-
Table 4: Parametric Functional Forms

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Parameter values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Strictly increasing combined incremental scope costs</td>
<td>$\delta_{sd} + \tilde{\alpha} &gt; 0$</td>
</tr>
<tr>
<td>2. Pareto probability mass in low tail</td>
<td>$\tilde{\theta} &gt; 1$</td>
</tr>
<tr>
<td>3. Bounded market-access costs</td>
<td>$\delta_{sd} + \tilde{\alpha} &gt; (\delta_{sd}+1)/\tilde{\theta}$</td>
</tr>
<tr>
<td>4. Strongly increasing combined incremental scope costs</td>
<td>$\delta_{sd} + \tilde{\alpha} &gt; 1/\tilde{\theta}$</td>
</tr>
</tbody>
</table>

Note: Functional forms $f_{sd}(g) = f_{sd} \cdot g^{\delta_{sd}}$ and $h(g) = g^{\alpha}$ by (7); definitions $\tilde{\alpha} \equiv \alpha(\sigma - 1)$ and $\tilde{\theta} \equiv \theta/(\sigma - 1)$.

...in Section 3 and to the structural equations for estimation in Section 4. To simplify notation, we define $\tilde{\alpha} \equiv \alpha(\sigma - 1)$ and $\tilde{\theta} \equiv \theta/(\sigma - 1)$.

This concludes the presentation of equilibrium conditions when trade is balanced ($Y_d = T_d$). We relax the assumption of balanced trade in our calibration and defer the discussion of the full solution to Appendix E.

6 General-equilibrium Counterfactuals

We conduct counterfactual simulations to quantify the implied impact of our baseline estimates (first row of Table 2) for changes to bilateral trade when destination-specific market-access costs are brought down. Brazil is close to the world median in terms of exports per capita, so we consider our baseline parameter estimates informative for global trade.\(^{40}\) Our main counterfactual exercise harmonizes market-access cost schedules across destinations. We reduce the market-access cost for an additional product (not counting a firm’s first product) at distant destinations to the level at nearby destinations. In a broad sense, this exercise helps apprise the importance of multi-product exporters when it comes to the reduction of market-access costs for additional products. Examples of relevant market-access costs for additional products are health regulations and safety standards, certifications and licenses.

To perform the counterfactual experiments, we add three elements to the model following Eaton et al. (2011). (i) We introduce intermediate inputs as in Eaton and Kortum (2002). In particular, we assume that the production of each product uses a Cobb-Douglas aggregate of labor and a composite of all other manufactured products with cost $P_d$. The labor share in manufacturing production is $\beta$, and the share of intermediate inputs $1 - \beta$. The total input cost is therefore $w_d = W_d^\beta P_d^{1-\beta}$, where we now think of $w_d$ as the input cost and $W_d$ as the wage.

\(^{40}\)By the WTF and WDI data for all industries and countries, Brazil ranks at the 48th percentile (top 100th country out of 192) in terms of exports per capita in 2000. Brazil’s total exports in 2000 are at the 88th percentile worldwide (top 27th country out of 205).

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### Table 5: Percentage Change in Simulated Welfare ($\theta = 2.59$)

<table>
<thead>
<tr>
<th>Country</th>
<th>Counterfactual (1) $\Delta f(g)$</th>
<th>Counterfactual (2) $\Delta f(g)_C$</th>
<th>Counterfactual (3) $\Delta \delta$</th>
<th>Counterfactual (4) $\Delta \delta_C$</th>
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<td>1.44</td>
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<td>1.83</td>
<td>1.51</td>
</tr>
<tr>
<td>Italy</td>
<td>1.49</td>
<td>0.52</td>
<td>1.66</td>
<td>0.58</td>
</tr>
<tr>
<td>Japan</td>
<td>0.50</td>
<td>0.32</td>
<td>0.56</td>
<td>0.35</td>
</tr>
<tr>
<td>Jordan</td>
<td>1.80</td>
<td>1.17</td>
<td>2.01</td>
<td>1.30</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>2.04</td>
<td>1.46</td>
<td>2.27</td>
<td>1.63</td>
</tr>
<tr>
<td>Kenya</td>
<td>1.31</td>
<td>1.02</td>
<td>1.46</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Note: Counterfactual experiments (1) and (2) reduce $f(g)$ by 15 percent, and experiments (3) and (4) reduce $\delta$ by thirty percent. Counterfactual experiments (1) and (3) reduce market-access costs everywhere, experiments (2) and (4) reduce market-access costs only at destinations outside a source country’s own continent, with ROW treated as a different continent. Experiments use baseline parameter estimates of $\theta = \{\delta, \alpha, \theta\} = \{-1.16, 1.76, 1.72\}$ (see Table 2). Pareto shape parameter $\theta = 2.59$ imputed from Crozet and Koenig (2010) and estimates in Table 2. See Appendix B.2 for data construction. Following Dekle, Eaton and Kortum (2007), we collapse (i) Hong Kong, Macao and mainland China, (ii) Belgium, Luxembourg and the Netherlands, (iii) Indonesia, Malaysia, Singapore, and Thailand and (iv) France and Monaco into single markets.
There is a non-manufacturing sector in each country as in Alvarez and Lucas (2007) that combines manufactures with labor, in a Cobb-Douglas production function, where manufactures have a share $\gamma$ in GDP. The price of final output in country $d$ is proportional to $P_d W_d^{1-\gamma}$. We state the resulting equations in Appendix A. (iii) We allow for a manufacturing trade deficit $B_d$, and for an overall trade deficit $B^T_d$ in goods and services. Both deficits are set to their observed levels in 2000.

We compute the share of manufacturing in GDP for each country using data on GDP, manufacturing production and trade (as described in Appendix B.2). We set the labor share in manufacturing production to $\beta = .330$, the sample average for countries with available information (Appendix B.2). To compute the impact of a counterfactual change in market-access costs, we use the Dekle et al. (2007) methodology (details in Appendix E). The merit of this method is that it requires no information on the initial level of technology, iceberg trade costs, and market-access costs. Instead, we can compute the changes in all equilibrium variables using the percentage change in the underlying parameter of interest (market-access cost parameters in our case).

For our primary results we consider a baseline value of $\theta = 2.59$ from Crozet and Koenig (2010), which we obtain by averaging across 34 industries. For all other starting parameter values, we use our baseline estimates from row 1 in Table 2.

### 6.1 Changes in total market-access costs

We initially decrease all market-access costs for all products ($f_d$) by 15 percent to all international destinations. In this and all following experiments, we do not change any domestic trade costs and set the change in total domestic access costs to $\hat{F}_{ss} = 1$. Table 5 shows the results of the counterfactual exercise in terms of changes in welfare (see Appendix E for derivations). The results of the first experiment are labeled as counterfactual (1) in Table 5.

In a second experiment, we reduce market-access costs only to countries not on the same continent by 15 percent. The results are shown as counterfactual (2) in Table 5. This experiment, while crude, highlights changes in market-access costs to distant locations. In both exercises, we see significant increases in welfare. Considering a simple average across all 58 countries in our sample, welfare increases by 2.0 percent in the first counterfactual experiment and by 1.0

---

41Crozet and Koenig (2010) obtain results for $\sigma$, we obtain $\theta$ using our estimated value for $\hat{\theta}$. Eaton et al. (2011) find an estimate of $\theta = 4.87$. In a related set of models, Eaton and Kortum (2002), Bernard, Eaton, Jensen and Kortum (2003) and Simonovska and Waugh (2014) find estimates of $\theta$ between 3.60 and 8.28.

42While lumping countries by continents is an admittedly imprecise way of classifying nearby and distant locations, preferential trade agreements and trade partnerships to date typically do link countries within continents (think of the European Union, NAFTA or Mercosur).
percent in the second counterfactual experiment.

6.2 Changes in incremental market-access costs

In our third and fourth counterfactual experiments we evaluate scenarios under which market-access costs only for incremental products are brought down. This counterfactual stands in for eliminating various non-tariff measures and directly utilizes our baseline results from Table 2. Those baseline results show that the incremental market-access costs of shipping additional products to LAC destination drop nearly 30 percent faster with exporter scope than the incremental market-access costs elsewhere. We conduct a counterfactual experiment with a 30-percent drop in the scope elasticity of market-access costs. Since $\delta$ is negative, the experiment amounts to a 30-percent increase in the absolute value of $\delta$. Note that we do not alter the cost of a firm’s initial market entry with its first product. This 30-percent increase in the absolute value of $\delta$ is applied to all destinations in counterfactual (3) but only to destinations in other continents, which proxy for distant countries, in counterfactual (4).

In both counterfactual experiments we see results broadly in line with those from dropping overall market-access costs. Dropping the incremental export costs to all foreign destinations increases average welfare by 2.3 percent and to destinations on different continents by 1.1 percent. While these increases in welfare may seem small, they operate only through multi-product firms and are unrelated to the entry costs of exporting the first product. A 30-percent drop in the scope elasticity of incremental market-access costs for multi-product firms has an effect that is broadly similar to reducing market-access costs for all firms by 15 percent.

6.3 Changes in tariffs

Finally, to compare changes in market-access costs to changes in conventional variable trade costs, we evaluate the welfare gains from the elimination of all tariffs. Under the assumption that remaining tariffs today represent around 4 percent of the value of exports, we experiment with a counterfactual decline of 4 percentage points in variable trade costs to mimic the elimination of tariffs. Using our parameter estimates, we find an average welfare gain across markets of approximately 1.8 percent; this is broadly comparable to the gains from reductions in incremental market-access costs.

Our estimate of $\theta = 2.59$ comes from French firm level data used by Crozet and Koenig (2010). Alternatively, we can use Simonovska and Waugh (2014), who aggregate trade flows

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43Novy (2013) finds that the average total variable trade costs for a set of OECD countries in terms of tariff equivalents is 94 percent in 2000; the same countries have ad-valorem tariff rates of approximately 4 percent (Anderson and Neary 2005).
from 123 countries. Their various estimates of $\theta$ range from 2.79 to 4.46, with their preferred specification producing $\theta = 4.41$. Using that latter estimate, our counterfactual experiment (4), in which we reduce only trade costs to distant destinations, results in an average welfare increase of 0.8 percent across destinations. Similarly, eliminating all tariffs increases welfare by 1.7 percent. In summary, our counterfactual experiments with plausible reductions of market-access costs result in welfare gains of a similar magnitude as the elimination of remaining tariffs.

7 Conclusion

We develop a model that accounts for pertinent facts on multi-product exporters, which we document using Brazilian exporting micro-data. The model allows us to estimate market-access costs that regulate the entry of exporters and their products, and are important elements in trade theories with heterogeneous firms. Our estimates indicate that additional products farther from a firm’s core competency incur higher unit production costs but also that the elasticity of market-access costs with respect to additional products declines at an almost one-third faster rate in nearby destinations. We conduct counterfactual exercises that accordingly reduce the scope elasticity of market-access costs by one-third and find welfare gains similar in magnitude to a complete elimination of currently remaining tariffs. Results of these counterfactual exercises are reminiscent of surveys for numerous countries (OECD 2005, Ch. 1) and evidence on product trade (Reyes 2011), which suggest that non-tariff measures deter the market access of small and narrow-scope firms more heavily.

While we have incorporated many available dimensions of the trade data, more can be done. Our approach leaves unexplored recently available information on unit prices and export behavior over time, for example. Such additional information may prove valuable in understanding more precisely the patterns of product market access and exporter expansions. Similarly, we leave specific mechanisms that may shape market-access cost determinants open for further investigation.

References


Appendix

A Proofs

A.1 Proof of Lemma 1

We will show that, conditional on a market-access cost draw \( c_d \), average sales are proportional to average market-access costs:

\[
\bar{F}_{sd}(c_d) = \frac{\bar{\theta} - 1}{\bar{\theta} \sigma} \bar{T}_{sd}(c_d).
\]

We can then integrate (A.1) over the market-access cost distribution to establish Lemma 1 after aggregation across firms:

\[
\bar{F}_{sd} = \int \bar{F}_{sd}(c_d) \, dF(c_d) = \int \frac{\bar{\theta} - 1}{\bar{\theta} \sigma} \bar{T}_{sd}(c_d) \, dF(c_d) = \frac{\bar{\theta} - 1}{\bar{\theta} \sigma} \bar{T}_{sd}.
\]

We now prove (A.1). We drop the argument \( c_d \) for brevity. Expected total sales per firm in \( s \) shipping to \( d \) are

\[
\bar{T}_{sd} = \int_{\phi_{sd}^*} \mathbb{E}[t_{sd}(\phi, \xi)] \, \mu(\phi|\phi_{sd}^*, \theta) \, d\phi
\]

\[
= \int_{\phi_{sd}^*} \sigma f_{sd}(1) \left( \frac{\phi}{\phi_{sd}^*} \right)^{\sigma - 1} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \mathbb{E}[\xi_{sdg}] \cdot \theta \left( \frac{\phi_{sd}^*}{\phi} \right)^{\theta g+1} d\phi
\]

\[
= \int_{\phi_{sd}^*} \sigma f_{sd}(1) \left( \frac{\phi}{\phi_{sd}^*} \right)^{\sigma - 1} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \cdot \theta \left( \frac{\phi_{sd}^*}{\phi} \right)^{\theta g+1} d\phi
\]

by optimal total exports (13) and the independence of product appeal \( \xi_{sdg} \) and firm productivity \( \phi \). Consider the term \( \int_{\phi_{sd}^*} \phi^{\sigma-1-(\theta+1)} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \, d\phi \). Rewrite the term as a piecewise integral

\[
\int_{\phi_{sd}^*} \phi^{\sigma-1-(\theta+1)} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \, d\phi = \int_{\phi_{sd}^*} \phi^{\sigma-2-(\theta+1)} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \, d\phi + \int_{\phi_{sd}^*} \phi^{\sigma-3-(\theta+1)} \sum_{g=1}^{G_{sd}(\phi)} h(g)^{-\sigma} \, d\phi + \ldots
\]

\[
= \frac{1}{h(1)^{\sigma-1}} \int_{\phi_{sd}^*} \phi^{\sigma-2-(\theta+1)} \, d\phi + \frac{1}{h(2)^{\sigma-1}} \int_{\phi_{sd}^*} \phi^{\sigma-3-(\theta+1)} \, d\phi + \ldots
\]

\[
= \frac{1}{h(1)^{\sigma-1} \theta - (\sigma - 1)} + \frac{1}{h(2)^{\sigma-1} \theta - (\sigma - 1)} + \ldots
\]
for \( \theta > \sigma - 1 \). Using the definitions of \( \phi_{sd}^* \), \( \phi_{sd}^{*2} \), etc. from (11), we have

\[
\int_{\phi_{sd}^*}^{G_{sd}(\phi)} \sum_{g=1}^{G_{sd}(\phi)} \frac{\phi^{(\sigma - 1)(\theta - 1)}}{h(g)^{\sigma - 1}} \, d\phi = \frac{1}{\theta - (\sigma - 1)} \left( \frac{f_{sd}(1)}{(\phi_{sd}^*)^{\sigma - 1}} \right)^{\theta - 1} \sum_{G=1}^{\infty} \frac{f_{sd}(G)^{- (\bar{\theta} - 1)}}{h(G)^{\bar{\theta}}},
\]

(A.2)

with \( \bar{\theta} \equiv \theta / (\sigma - 1) \). Therefore

\[
\bar{T}_{sd} = \frac{\bar{\theta} \sigma}{\theta - 1} f_{sd}(1)^{\bar{\theta}} \sum_{G=1}^{\infty} f_{sd}(G)^{- (\bar{\theta} - 1)} h(G)^{-\bar{\theta}},
\]

proving the first equality in (23). The expression is finite by Assumption 3.

Average market-access costs paid by firms in \( s \) selling to \( d \) are

\[
F_{sd} = \int_{\phi_{sd}^*}^{\phi_{sd}^{*2}} F_{sd}(1) \frac{\phi^\theta}{\phi^{\theta + 1}} \, d\phi + \int_{\phi_{sd}^*}^{\phi_{sd}^{*3}} F_{sd}(2) \frac{\phi^\theta}{\phi^{\theta + 1}} \, d\phi +
\]

\( = F_{sd}(1) (\phi_{sd}^*)^{\theta} \left[ (\phi_{sd}^*)^{-\bar{\theta}} - (\phi_{sd}^{*2})^{-\bar{\theta}} \right] + F_{sd}(2) (\phi_{sd}^*)^{\theta} \left[ (\phi_{sd}^{*2})^{-\bar{\theta}} - (\phi_{sd}^{*3})^{-\bar{\theta}} \right] + \ldots. \)

Using the definition \( F_{sd}(G_{sd}) = \sum_{g=1}^{G_{sd}} f_{sd}(g) \) and collecting terms with a common \( \phi_{sd}^{*G} \) we can rewrite the above expression as

\[
\tilde{F}_{sd} = f_{sd}(1) + (\phi_{sd}^{*2})^{-\bar{\theta}} (\phi_{sd}^*)^\theta f_{sd}(2) + (\phi_{sd}^{*3})^{-\bar{\theta}} (\phi_{sd}^*)^\theta f_{sd}(3) + \ldots.
\]

Using the definition of \( \phi_{sd}^{*G} \) from equation (11) in the above equation we get

\[
\tilde{F}_{sd} = f_{sd}(1) + \left( \frac{f_{sd}(2)^{1/\sigma} h(2)}{f_{sd}(1)^{1/\sigma} h(1)} \right)^{-\bar{\theta}} f_{sd}(2) + \ldots
\]

\( = \left[ f_{sd}(1) + f_{sd}(1)^{\bar{\theta}} \left( f_{sd}(2)^{1/\sigma} h(2) \right)^{-\bar{\theta}} f_{sd}(2) + \ldots \right]
\]

\( = f_{sd}(1)^{\bar{\theta}} \left[ f_{sd}(1)^{- (\bar{\theta} - 1)} + f_{sd}(2)^{- (\bar{\theta} - 1)} h(2)^{-\bar{\theta}} + \ldots \right]
\]

\( = f_{sd}(1)^{\bar{\theta}} \sum_{G=1}^{\infty} f_{sd}(G)^{- (\bar{\theta} - 1)} h(G)^{-\bar{\theta}}
\]

(A.3)

This proves the second equality in (23). The ratio \( \tilde{F}_{sd}/\bar{T}_{sd} \) is therefore a destination invariant constant.

**A.2 Share of wages and profits**

We show here that the share of wages and profits in total income is constant (source country invariant). Note that the share of net profits from bilateral sales is the share of gross variable profits in total sales \( 1/\sigma \), less the market-access costs paid, divided by total sales \( (\bar{\theta} - 1)/\bar{\theta} \sigma \).
Thus, using the result of Lemma 1, \( \pi_{sd} L_d / T_{sd} = 1 / \sigma - (\tilde{\theta} - 1) / (\tilde{\theta} \sigma) = 1 / (\tilde{\theta} \sigma) \). Total profits for country \( s \) are \( \pi_s L_s = \sum_k \lambda_{sk} T_k / (\tilde{\theta} \sigma) \), where \( \sum_k \lambda_{sk} T_k \) is the country’s total income by (27) and \( T_k \) is consumer expenditure at destination \( k \). Profit income and wage income can therefore be expressed as constant shares of total income, as in the main text, equation (28).

**B Data**

**B.1 Brazilian exporter-product-destination data**

We identify an exporter’s sector from the firm’s reported CNAE four-digit industry (for 654 industries across all sectors of the economy) in the administrative RAIS records (Relação Anual de Informações Sociais) at the Brazilian labor ministry. The level of detail in CNAE is comparable to the NAICS 2007 five-digit level. To map from the HS 6-digit codes to ISIC revision 2 at the two-digit level we use an extended SITC-to-ISIC concordance, augmenting an OECD concordance for select manufacturing industries to all industries.\(^{44}\)

As Table B.1 shows in columns 5 and 6, our Brazilian manufacturer sample includes 10,215 firms with shipments of 3,717 manufactured products at the 6-digit Harmonized System level to 170 destinations, and a total of 162,570 exporter-destination-product observations.\(^{45}\) Exporters shipping multiple products dominate. They ship more than 90 percent of all exports from Brazil, and their global top-selling product accounts for 60 percent of Brazilian exports worldwide. We report the top exporting products of Brazilian firms in our Online Supplement.\(^{46}\)

To calculate summary medians and means of these variables for regional aggregates and the world as a whole in Table B.1 (columns 3 to 6), we treat each aggregate as if it were a single destination and collapse all product shipments to different countries within the aggregate into a single product shipment. In most data treatments in the text, in contrast, we analyze these variables country by country, consistent with our main hypothesis that market-access determinants of trade matter repeatedly destination by destination.

The median exporter is a relatively small exporter, with sales to the rest of the world totaling around US$ 89,000. The mean exporter, in contrast, sells around US$ 3.7 million abroad, more than 40 times as much as the median exporter. Exporter scope and exporter scale exhibit similarly stark differences between mean and median. The median Brazilian manufacturer sells two products worldwide, but the mean scope per firm is 5.3 products. The median Brazilian exporter has a product scale of around US$ 37,000 per product, but the exporter scale per exporter is US$ 705,000, or around 20 times as high as that for the median firm.

The importance of the top-selling product at multi-product exporters and the mean-median ratios are similar across destinations. To investigate the robustness across countries, we select Brazil’s top two export destinations in terms of presence of Brazilian manufacturing exporters

\(^{44}\)Our SITC-to-ISIC concordance is available at URL econ.ucsd.edu/muendler/resource.

\(^{45}\)We remove export records with zero value from the Brazilian data, which include shipments of commercial samples but also potential reporting errors, and lose 408 of initially 162,978 exporter-destination-product observations. Our results on exporter scope do not materially change when including or excluding zero-shipment products from the product count.

\(^{46}\)The top-5 selling products of Brazilian exporters at the 6-digit level are: 1. Airplanes heavier than 2 tons, 2. Chemical woodpulp, 3. Soybean oilcake, 4. Passenger vehicles with engines above 1,500 cc, 5. Transmissions.
Table B.1: Sample Characteristics by Destination

<table>
<thead>
<tr>
<th>Destination</th>
<th>Argentina</th>
<th>USA</th>
<th>non-OECD</th>
<th>OECD</th>
<th>World</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Firms (M)</td>
<td>4,590</td>
<td>3,083</td>
<td>8,664</td>
<td>5,041</td>
<td>10,215</td>
</tr>
<tr>
<td># of Destinations (N)</td>
<td>1</td>
<td>1</td>
<td>147</td>
<td>23</td>
<td>170</td>
</tr>
<tr>
<td># of HS-6 products (G)</td>
<td>2,814</td>
<td>2,144</td>
<td>3,537</td>
<td>2,772</td>
<td>3,717</td>
</tr>
<tr>
<td># of Observations</td>
<td>21,623</td>
<td>10,775</td>
<td>126,211</td>
<td>36,359</td>
<td>162,570</td>
</tr>
<tr>
<td>Destination share in Tot. exp.</td>
<td>.144</td>
<td>.257</td>
<td>.441</td>
<td>.559</td>
<td>1</td>
</tr>
<tr>
<td>Firm shares in Total exports</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single-prod. firms</td>
<td>.086</td>
<td>.123</td>
<td>.069</td>
<td>.142</td>
<td>.090</td>
</tr>
<tr>
<td>Multi-prod. firms’ top prod.</td>
<td>.555</td>
<td>.662</td>
<td>.573</td>
<td>.625</td>
<td>.597</td>
</tr>
<tr>
<td>Multi-prod. firms’ other prod.</td>
<td>.359</td>
<td>.215</td>
<td>.359</td>
<td>.233</td>
<td>.313</td>
</tr>
<tr>
<td>Median Total exp. ($T_d(m)$)</td>
<td>.068</td>
<td>.120</td>
<td>.066</td>
<td>.137</td>
<td>.089</td>
</tr>
<tr>
<td>Median Exp. scope ($G_d(m)$)</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Median Exp. scale ($a_d(m)$)</td>
<td>.031</td>
<td>.068</td>
<td>.028</td>
<td>.070</td>
<td>.037</td>
</tr>
<tr>
<td>Mean Total exports ($\bar{t}_d$)</td>
<td>1.192</td>
<td>3.170</td>
<td>1.932</td>
<td>4.217</td>
<td>3.720</td>
</tr>
<tr>
<td>Mean Exp. scope ($\bar{G}_d$)</td>
<td>4.711</td>
<td>3.495</td>
<td>5.176</td>
<td>3.933</td>
<td>5.278</td>
</tr>
<tr>
<td>Mean Exp. scale ($\bar{a}_d$)</td>
<td>.253</td>
<td>.907</td>
<td>.373</td>
<td>1.072</td>
<td>.705</td>
</tr>
</tbody>
</table>

Source: SECEX 2000 manufacturing firms and their manufactured products at the HS 6-digit level, destinations linked to WTF (Feenstra, Lipsey, Deng, Ma and Mo 2005) and Unido Industrial Statistics (UNIDO 2005).

Note: Each aggregate region (world, OECD, non-OECD) treated as a single destination, collapsing product shipments to different countries into single product shipment. Products at the HS 6-digit level. Exports in US$ million fob. Firms’ exporter scale (ad in US$ million fob) is the scope-weighted arithmetic mean of exporter scales. OECD includes all OECD members in 1990. Argentina is Brazil’s top export destination in terms of presence of Brazilian manufacturing exporters in 2000, the United States second to top.

(Argentina and United States), as well as the non-OECD and OECD aggregates. Our theory emphasizes the importance of exporting behavior within destinations. Within single countries, the mean manufacturer’s exports exceed the median manufacturer’s exports by similarly large factors as in the aggregate, between 14 (in Argentina, column 1) and 26 (in the United States, column 2). In the non-OECD aggregate (column 3), exports of the mean firm exceed the exports of the median firm by a factor of about 30. The same mean-median ratio of about 30 prevails in the OECD aggregate.

Figure B.1 documents Fact 1 for the United States and Uruguay, complementing Figure 1 for Argentina in the text. In each plot, we limit our sample to exporters and their shipments to the respective destination (Argentina, the United States and Uruguay are the top three destinations in terms of presence of Brazilian manufacturing exporters in 2000) and group the exporters by their local exporter scope $G$. For each scope group $G$ and for each product rank $g$, we then take the average of the log of product sales $\log y_{odg}$ for those firm-products over all destinations. The graphs for the United States and Uruguay confirm Fact 1 that a few core products dominate local sales and that the least-selling products sell for smaller amounts the wider the firm’s exporter
Figure B.1: U.S. and Uruguayan Within-firm Sales Distributions

United States

Export Scope

G = 1
G \in [2, 4]
G \in [5, 8]
G \in [9, 16]
G \in [17, 32]

Mean Sales (US$)

1,000,000
10,000
100

Product Rank within Firm (HS 6-digit)

1
2
4
8
16
32

Uruguay

Export Scope

G = 1
G \in [2, 4]
G \in [5, 8]
G \in [9, 16]
G \in [17, 32]

Mean Sales (US$)

1,000,000
10,000
100

Product Rank within Firm (HS 6-digit)

1
2
4
8
16
32


Note: Products at the HS 6-digit level, shipments to the United States and Uruguay. We group firms by their exporter scope \( G_d = G \) at a destination \( d \) (United States or Uruguay). The product rank \( g \) refers to the sales rank of an exporter’s product in that destination. Mean product sales is the average of individual firm-product sales \( \sum_{\omega \in \{ \omega : G_d(\omega) = G \}} y_{G_d, g} / M_{G_d} \), computed for all firm-products with individual rank \( g \) at the \( M_{G_d} \) firms exporting to the destination with scope \( G_d = G \).

We further investigate the striking similarity of firm scope choices across destinations by relating the mean number of products to destination market size. Figure B.2 shows a scatter plot of the log mean exporter scope \( \bar{G}_{sd} \) against the log of total absorption at the destination \( T_d \). The depicted fitted line, from an ordinary least squares regression, has a slope that is not significantly different from zero at conventional levels. In other words, most of the variation in firms’ exports to destinations of different size is due to variation in the firms’ mean scale per product. At the firm level, the Brazilian data exhibit destination-presence patterns that resemble those in the French and U.S. firm-destination data. Similar to Eaton et al. (2011), for instance, the elasticity of the number of firms with respect to the number of export destinations is about -2.5, just as for French exporters.

B.2 Data for counterfactual analysis

For bilateral trade and trade balances in manufactured products, we use World Trade Flow (WTF) data in U.S. dollars for the year 2000 (Feenstra et al. 2005). To mitigate the effect of entrepot trade, we follow Dekle et al. (2007) and collapse (i) Hong Kong, Macao and mainland China, (ii) Belgium, Luxembourg and the Netherlands, and (iii) Indonesia, Malaysia, Singapore, and Thailand into single entities. In 2000, import information for India is missing from WTF. We obtain information for India in 2000 from UN COMTRADE. We keep only manufactured products from the WTF data, using a concordance from the OECD at the SITC revision-2 4-digit level to determine manufactured products, and exclude agricultural and mining merchandise. By our construction, the world’s trade balance is zero.

For information on GDP, manufacturing value added and the overall trade balances in goods
and services in 2000 we use the World Bank’s World Development Indicators 2009 (WDI). India included, our initial WTF sample has 132 countries that can be matched to the WDI data, and we collapse bilateral trade for the rest of the world by trade partner into a 133rd observation. We compute GDP and manufacturing value added for the rest of the world as the WDI reported world total less the sample total of our 132 matched countries. We set the overall trade balances in goods and services for the rest of the world so that the world total is zero.

We obtain the labor share in manufacturing production $\beta$ from UNIDO (2005) at the ISIC rev. 2 level. UNIDO offers both manufacturing value added and manufacturing gross production for 51 of our sample countries and the rest of the world. Averaging the ratio of manufacturing value added to manufacturing output in 2000 over these countries yields $\beta = .330$. This worldwide $\beta$ estimate enters our computation of $\gamma_d$ by (E.8).

We need information on manufacturing absorption. Following Eaton et al. (2011), we infer manufacturing absorption as manufacturing output (from UNIDO 2005) plus the trade deficit (from WTF). The UNIDO data for manufacturing output are considerably less complete than either WTF or WDI. We obtain manufacturing output for Brazil from the Brazilian statistical agency IBGE (2010). Our final country sample for which we have manufacturing absorption contains 57 countries. By the model in Appendix E, $\gamma_d$ is given by (E.8). We use our WTF-WDI-UNIDO data to calculate $\gamma_d$ for 57 countries. For the rest of the world, we set $\gamma_d$ to the average of our sample ($\gamma = .244$) and back out manufacturing absorption from (E.8).
C Nested Utility

We can generalize the model to consumer preferences

\[
\left( \sum_{k=1}^{N} \int_{\omega \in \Omega_{kd}} \left[ \sum_{g=1}^{G_{kd}} \left( \frac{\varepsilon}{\sigma} \right)^{\frac{\varepsilon-1}{\sigma}} x_{kdg}(\omega) \right] \right) \frac{\varepsilon}{\sigma-1} d\omega.
\]

where \( \varepsilon > 1, \sigma > 1, \varepsilon \neq \sigma. \)

In this case we redefine the product efficiency index and the combined incremental scope costs as:

\[
H(G_{sd}) \equiv \left( \sum_{g=1}^{G_{sd}} h(g)^{-((\varepsilon-1))} \right)^{-\frac{1}{\varepsilon-1}} \quad \text{and} \quad z_{sd}(G_{sd}, c_d) \equiv \frac{c_d f_{sd}(G_{sd})}{H(G_{sd})^{-((\sigma-1))} - H(G_{sd}-1)^{-((\sigma-1))}}.
\]

With these new definitions, the expressions for firm product sales (12) and for aggregate bilateral trade (23) in Lemma 1 remain unaltered. For remaining details on the generalized model see our Online Supplement.

Under this generalization, a firm’s individual products can be less substitutable among themselves than with outside products (if \( \varepsilon < \sigma \)) or more substitutable (\( \varepsilon > \sigma \)). In the latter case, a firm’s additional products cannibalize sales of its infra-marginal products. The cannibalization effect is symmetric for all products, so relative sales of a firm’s existing products are not affected by the introduction of additional products. This constancy of relative sales in our model does not carry over to models with CES-preferences and a countable number of firms such as Feenstra and Ma (2008) or to models with non-CES preferences such as Mayer et al. (2014) and Dhingra (2013).

D Simulation Algorithm and Moments

D.1 Simulation algorithm

Given a candidate estimate \( \Theta \), we simulate the export behavior for \( J_{sim} = 1,000,000 \) hypothetical Brazilian firms \( \omega = 1, \ldots, J_{sim} \) shipping to destinations \( d = 1, \ldots, N \) using our model (\( N \) is the observed number of destinations). In order to maintain the stochastic components unchanged as we search over \( \Theta \), prior to the simulation routine we draw (i) \( J_{sim} \) independent realizations of the firm’s productivity percentile \( (\phi_{\omega}/\phi^*) \) from the standard uniform distribution, (ii) \( J_{sim} \times N \) independent realizations of the firm-specific market-access costs \( c_{wd} \) from the standard log normal distribution, and (iii) \( J_{sim} \times N \times G \) independent realizations of individual product appeal shocks \( \xi_{wdg} \) from the standard log normal distribution (where \( G \) is the maximum observed exporter scope of any firm at any destination).

A given iteration of the model simulation requires a set of candidate parameters \( \Theta \) and the number of Brazilian firms selling to each destination \( M_d \). An iteration of the simulation proceeds in the following steps.
(i). Scale the \( J^{\text{sim}} \times N \) standard log normal market-access cost draws by the current candidate dispersion parameter \( \sigma_c \). Then, for each Brazilian firm \( \omega \) and any destination \( d \), compute the entry-relevant adjusted firm productivity parameter

\[
\phi_{\omega d} \equiv c_{\omega d}^{-1} \cdot (\phi_\omega / \phi^*)^{-1/\theta},
\]

using the standard uniform firm productivity percentile \( (\phi_\omega / \phi^*) \).

(ii). Back out the local entry threshold \( \phi^*_d \) at destination \( d \) using the observed number \( M_d \) of Brazilian exporters at the destination and the known number of Brazilian firms \( M_{\text{BRA}} \),

\[
\frac{M_d}{M_{\text{BRA}}} = \frac{1}{J^{\text{sim}} \sum_{\omega=1}^{J^{\text{sim}}} \mathbb{I} \{ \phi_{\omega d} > \phi^*_d \}}.
\]

The local entry cutoff \( \phi^*_d \) depends on the mean of the \( c_{\omega d} \) realizations. The cutoff is lower when the market-access cost draws are lower on average.

To obtain \( M_{\text{BRA}} \) we merge the RAIS database of the formal-sector universe of Brazilian firms in 2000 with the SECEX export database. We find that 3.1 percent of Brazilian manufacturing firms export a manufactured product.\(^{47}\)

(iii). Generate a firm-product-destination indicator \( 1_{\omega dg} \) for each firm \( \omega \) that exports its \( g \)-th product to destination \( d \). For this purpose, compute the local product-level entry cutoffs

\[
\phi^*_{d, g} \equiv G^{\delta + \tilde{\alpha}} \phi^*_d.
\]

Given the cutoffs, the firm-product-destination indicators are \( 1_{\omega dg} = \mathbb{I} \{ \phi_{\omega d} > \phi^*_d \} \).

Compute the exporter scope for each firm \( \omega \) at a destination \( d \),

\[
G_{\omega d} = \sum_{g=1}^{G} 1_{\omega dg}.
\]

(iv). Scale the \( J^{\text{sim}} \times N \times \bar{G} \) standard log normal product appeal draws by the current candidate dispersion parameter \( \sigma_\xi \). Then generate the sales of a firm \( \omega \)'s \( g \)-th ranked product at destination \( d \), where the firm has an exporter scope \( G_{\omega d} \):

\[
y_{\omega dg}^G = 1_{\omega dg} \cdot G_{\omega d}^{\delta + \tilde{\alpha}} \cdot g_{\omega}^{-\tilde{\alpha}} \cdot \phi_{\omega d} / \phi^*_d \cdot \xi_{\omega dg} = 1_{\omega dg} \cdot g_{\omega}^{-\tilde{\alpha}} \cdot (\phi_\omega / \phi^*)^{-1/\theta} \cdot \phi^*_d / c_{\omega d} \cdot \xi_{\omega dg}.
\]

This expression for product revenue \( y_{\omega dg}^G \) omits the destination-specific market-access cost

\(^{47}\)The exporter share of 3.1 percent may seem low, but the Brazilian RAIS database includes all formal-sector firms and establishments with at least one employee. In contrast, censuses and surveys in most developing and some industrialized countries truncate their target population of firms from below with thresholds up to 20 employees. Truncation of the Brazilian manufacturing firm sample at a threshold of at least 10 employees would raise the exporter share to 10.7 percent. Truncation at a 20-employee threshold would raise the exporter share to 17.9 percent. The estimates in Table 2 are not sensitive to this convention. Using the alternative assumption that 10 percent of Brazilian firms export does not alter the reported results appreciably.
shifter $\sigma f_d(1)$ and the destination-specific revenue shifter $D_d$ (which does not enter $\phi^*_d$ in the simulation). Both shifters are common across exporters at a destination and firm invariant in our simulation, because we normalize relevant moments by the according destination-specific median or extremum. See the following subsection for the definition of moments.

(v). At each destination $d$ and for every firm $\omega$, rank order the firm’s products by their local sales $y^G_{\omega d g}$ and compute the local rank for each firm-product $g$ as

$$\hat{g}_{\omega d} \equiv 1 + \sum_{k=1}^{G_{\omega d}} \mathbb{I}\{y_{\omega d k}(\xi_{dk}) > y_{\omega d g}(\xi_{dg})\}.$$ 

In general, the local rank will differ from the firm-level rank in production $\hat{g}_{\omega d} \neq g_\omega$ due to the product appeal shock $\xi_{\omega d g}$.

D.2 Moments

We now define and discuss the moments used in the simulated method of moments algorithm. To isolate the parameters that are relevant for the shapes of our functional forms and the dispersion of the stochastic components, we adopt moments that are comparable across destinations by neutralizing destination-specific shifters with adequate factors of proportionality, based on the destination median or a destination extremum. To separately identify $\delta_{\text{LAC}}$ and $\delta_{\text{ROW}}$, we use sets of moments for both LAC and ROW (non-LAC) destinations.

D.2.1 Within-destination sales of top-selling products across firms

Our first set of moments compares the sales $y^G_{\omega d 1}$ of the firms’ top-selling products $\hat{g}_{\omega d} = 1$ across firms within a destination $d$. We compute these moments for groups of firms that share the same exporter scope $G_{\omega d} \in G$. Within each destination, we start with single-product firms (firms with an exporter scope $G_{\omega d} = 1$) and rank order the firms by their single product’s sales from largest to smallest within the destination $d$. From the rank order of product sales we pick firms at select percentiles $P(\omega) = p$, overusing higher percentiles to match mostly upper-tail behavior (however still retaining some moments as low as the 25th percentile). Then we repeat the computations for the group of firms with an exporter scope of two or three products sold ($G_{\omega d} \in \{2, 3\}$), and again rank only their top-selling products by sales across firms within destination, and so forth. Normalizing with the sales of the top-product at the median firm $P(\omega) = .5$ within an exporter-scope group $G_{\omega d} = G$, we obtain a first set of moments

$$M^G_{pd} \equiv \log \left( \frac{y^{G}_{P(\omega)=p,d1}}{y^{G}_{P(\omega)=.5,d1}} \right), \quad p \in \{.95, .90, .85, .80, .70, .60, .25\},$$

$$G \in \{\{1\} \{2, 3\} \{4, 5, 6\} \{7, \ldots \}\}.$$

This procedure would provide us with $7 \times 4 \times N$ moments for $N$ destinations. For simplicity, we use the weighted geometric average across LAC and non-LAC destinations and obtain just
The sales dispersion across the firms’ top-selling products is driven by the product appeal realization and partly by a firm’s market-access cost draw because product sales are larger on average in markets with higher access costs (see step (iv) of the algorithm).

**D.2.2 Within-destination and within-firm product sales concentration**

The second set of moments compares the sales $y_{Gωd}^G$ of a firm’s top-selling product and the sales $y_{Gωd}^{^Gωd}$ of the same firm’s $^Gωd$-th ranked product within a destination $d$. We compute these moments for groups of firms that share the same global scope $max_{d\{Gωd\}} \in G$ across all destinations. For all firms that have a global scope of $max_{d\{Gωd\}} \in G$, within each destination we compute the firm $ω$’s sales ratio $y_{Gωd}^{maxG} / y_{Gωd}^{max1}$ for the following three groups of lower-ranked products $^g \in \{\{2, 3\} \{4, 5, 6\} \{7, \ldots \}\}$. For each group of lower-ranked products, we then pool over all destinations within a region and pool over all scope groups the sales ratios $y_{Gωd}^{maxG} / y_{Gωd}^{max1}$, rank order the sales ratios $y_{Gωd}^{maxG} / y_{Gωd}^{max1}$ from highest to lowest and pick firm observations at select percentiles $P(ω) = p$. We obtain the second set of moments

$$M2^{^G}_{pd} ≡ \log \left( \frac{y_{P(ω)=p,dg}^{G}}{y_{P(ω)=p,d1}^{G}} \right), \quad p \in \{.90, .75, .50, .25, .10\},$$

$$^g \in \{\{2, 3\} \{4, 5, 6\} \{7, \ldots \}\}.$$  

We compute the moments separately for LAC and non-LAC destinations, so this procedure generates $5 \times 3 \times 2$ moments.

The comparison of sales within firms of a given global scope implicitly conditions on the firm’s global productivity percentile $(φ_ω/φ^*)$, and the comparison within destinations removes destination specific variation including a firm’s market access shock at a destination (see step (iv) of the algorithm). The within-firm and within-destination sales ratio $y_{Gωd}^{maxG} / y_{Gωd}^{max1}$ therefore varies with $\tilde{\alpha}$ and captures the product appeal shock dispersion.

**D.2.3 Within-destination exporter scope distribution**

The third set of moments characterizes the exporter scope distribution by destination. We count the exporters with an exporter scope of at least $G_ωd \geq G$ at every destination and compute their share in the total number of exporters at the destination. We obtain a third set of moments

$$M3^{G}_{d} ≡ \frac{\sum_{ω\inΩ_d} \mathbb{1}\{G_ωd \geq G\}}{\sum_{ω\inΩ_d} \mathbb{1}\{G_ωd \geq 1\}}, \quad G \in \{2, 4, 6, 8, 12, 16\}.$$  

This procedure would provide us with $6 \times N$ moments for $N$ destinations. For simplicity, we use the weighted geometric average separately across LAC and non-LAC destinations and obtain just $6 \times 2$ moments $M3^{G}_{d}$.

The within-destination share of firms with a given exporter scope addresses the parameter $\tilde{\theta}$ of the firm productivity distribution and also the scope elasticity $δ + \tilde{\alpha}$, which translates productivity into exporter scope (see steps (ii) and (iii) of the algorithm). The share of firms with
Table D.2: Firm Counts of Destination Strings

<table>
<thead>
<tr>
<th></th>
<th>Latin America and Caribbean (LAC)</th>
<th></th>
<th>Rest of World (non-LAC)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination String</td>
<td># Firms</td>
<td>Destination String</td>
<td># Firms</td>
<td></td>
</tr>
<tr>
<td>ARG</td>
<td>1,647</td>
<td>USA</td>
<td>1,651</td>
<td></td>
</tr>
<tr>
<td>ARG–URY</td>
<td>507</td>
<td>USA–DEU</td>
<td>236</td>
<td></td>
</tr>
<tr>
<td>ARG–URY–CHL</td>
<td>296</td>
<td>USA–DEU–ITA</td>
<td>52</td>
<td></td>
</tr>
<tr>
<td>ARG–URY–CHL–PRY</td>
<td>225</td>
<td>USA–DEU–ITA–GBR</td>
<td>87</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4,799</td>
<td>Other</td>
<td>4,777</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>8,074</td>
<td>Total</td>
<td>5,471</td>
<td></td>
</tr>
</tbody>
</table>


Note: Strings denote Argentina (ARG), Uruguay (URY), Chile (CHL), Paraguay (PRY) and Bolivia (BOL); United States (USA), Germany (DEU), Italy (ITA), United Kingdom (GBR) and Spain (ESP). Those are the top five destinations within LAC and within non-LAC in terms of Brazilian manufacturing firm presence with manufactured product exports.

A given exporter scope captures the dispersion of market-access cost draws in addition because exporter scope is larger on average in markets with lower access costs.

D.2.4 Market presence combinations

For the fourth set of moments, we take the top five export destinations within LAC and within non-LAC in terms of the presence of Brazilian manufacturing exporters. We calculate the shares of exporters that sell to any of the permutations of those five destinations. The top five most common destinations within LAC are Argentina (ARG), Uruguay (URY), Chile (CHL), Paraguay (PRY) and Bolivia (BOL), within non-LAC they are the United States (USA), Germany (DEU), Italy (ITA), United Kingdom (GBR) and Spain (ESP). We summarize the possible permutations with strings of up to five destinations. For example, the single-destination string ARG means selling to Argentina but to no other among the top five destinations in LAC; the string ARG–URY means selling to Argentina and Uruguay but not to Chile, Paraguay or Bolivia. See Table D.2 for frequencies of select permutations. This collection of destination combinations produces a total of \(2 \times 2^5 = 64\) moments, denoted \(M_{4\{d\}}\)-COMB.

These moments reflect every firm \(\omega\)’s exact destination combination and therefore help assess the dispersion of market-access cost draws.

D.2.5 Within-firm export proportions between destination pairs

The fifth set of moments compares a firm \(\omega\)’s total exports \(t_{\omega d}\) to a destination \(d\) and its total exports to Argentina for LAC \((t_{\omega ARG})\) or the United States for non-LAC \((t_{\omega USA})\). We compute the total export ratios \(t_{\omega d}/t_{\omega ARG}\) and \(t_{\omega d}/t_{\omega USA}\) by destination \(d\) and firm \(\omega\) for the four destinations Uruguay, Chile, Paraguay and Bolivia in LAC (which together with Argentina are the top five LAC destinations in terms of presence of Brazilian manufacturing exporters) and for the four
destinations Germany, Italy, United Kingdom and Spain in non-LAC (which together with the United are the five most common non-LAC destinations). Within each region LAC and non-LAC we then rank order the firms by their export ratios \( t_{ωd}/t_{ωARG} \) and \( t_{ωd}/t_{ωUSD} \) from largest to smallest for each of the four close-to-top destinations. From the rank order of product sales we pick firms at select percentiles \( P(ω) = p \). Normalizing with the exports ratio at the median firm \( P(ω) = .5 \), we obtain the fifth set of moments

\[
M_{5p_{dLAC}} ≡ \log \left( \frac{t_{P(ω)=p,d}/t_{P(ω)=p,ARG}}{t_{P(ω)=.5,d}/t_{P(ω)=.5,ARG}} \right), \quad p \in \{.95, .90, .85, .70, .60, .25\}, \quad d_{LAC} \in \{URY, CHL, PRY, BOL\}.
\]

and

\[
M_{5p_{dnon-LAC}} ≡ \log \left( \frac{t_{P(ω)=p,d}/t_{P(ω)=p,USA}}{t_{P(ω) = .5,d}/t_{P(ω) = .5,USA}} \right), \quad p \in \{.95, .90, .85, .70, .60, .25\}, \quad d_{non-LAC} \in \{DEU, ITA, GBR, ESP\}.
\]

This procedure generates \( 6 \times 4 \times 2 \) moments.

The exports ratio between destination pairs captures the dispersion of market-access cost draws, which alter exporter scope and therefore total sales, and the ratio captures the dispersion of product appeal shocks, which change product sales directly. A firm’s total sales ratio depends on the firm’s respective exporter scopes with an elasticity of \( δ + \tilde{α} \) by equation (16).

**E Counterfactuals and Calibration**

We follow a procedure similar to Alvarez and Lucas (2007), Dekle et al. (2007) and Eaton et al. (2011), and extend our framework to a setting with:

- immobile labor between countries, but mobile labor between sectors, so there is a single wage \( W_s \) in country \( s \);
- an input bundle that consists of labor and intermediate goods, so such an input costs \( w_s = W_s^β P_s^{1-β} \);
- a non manufacturing, non-traded final-product sector that only requires labor input and produces with a Cobb-Douglas combination of the non-manufacturing and manufacturing sectors, so final good prices are \( P_f^s = P_i^γ W_s^{1-γ} \);
- market-access costs that require labor at the export destination and are homogeneous of degree \( 1 - \tilde{θ} \) in foreign wages, so we can rewrite

\[
f_{sd}(1)\bar{F}_{sd} = W_d^{1-\tilde{θ}} \bar{F}_{sd},
\]

where \( \bar{F}_{sd} \) denotes mean market-access cost costs in terms of labor units;
unchanging trade deficits in manufacturing and non-manufacturing sectors;

- technological parameters and labor endowments that are time invariant.

Using equation (24) for current trade shares $\lambda_{sd}$, we can express counterfactual trade shares as

$$
\lambda'_{sd} = \frac{\lambda_{sd} \left( \hat{W}_s^\beta \hat{P}_s^{1-\beta} \right)^{-\theta} \hat{\tau}_{sd}^{-\theta} \hat{\tilde{F}}_{sd}}{\sum_k \lambda_{kd} \left( \hat{W}_k^\beta \hat{P}_k^{1-\beta} \right)^{-\theta} \hat{\tau}_{kd}^{-\theta} \hat{\tilde{F}}_{kd}}.
$$

(E.5)

The price index (3) can be derived as

$$
P_{1-\sigma}^d = \sum_k \int_{c_d} \left[ \int_{\phi_{kd}(c_d)} \left[ \sum_{g=1}^{G_{kd}(\phi)} \left( \hat{\sigma} - \frac{w_k}{h(g)} \hat{\tau}_{kd} \right)^{1-\sigma} \frac{\theta (\phi^*_{kd}(c_d))^\theta}{\phi^{\theta+1}} \right] d\phi \right] dF(c_d)
$$

$$
= \sum_k (\hat{\sigma} u_k \tau_{kd})^{1-\sigma} J_k b_k^\theta \int_{c_d} \left[ \frac{1}{\theta - (\sigma - 1)} \left( \frac{f_{sd}(1)}{(\phi^*_{kd})^{\sigma - 1}} \right) \sum_{G=1}^{\infty} f_{sd}(G)^{-(\tilde{\theta} - 1)} \right] c_d^{-\tilde{\theta}} dF(c_d)
$$

$$
= \sum_k (\hat{\sigma} u_k \tau_{kd})^{1-\sigma} J_k b_k^\theta \left[ \frac{1}{\theta - (\sigma - 1)} \left( \frac{P_d}{\hat{\sigma} \tau_{sd} w_s} \right)^{\sigma - 1} \frac{T_d}{\sigma} \hat{\tilde{F}}_{kd} f_{kd} (1)^{-\tilde{\theta}} \right] \kappa.
$$

The second step uses equation (20). The third step uses Lemma 1 to replace the integral term. The fourth step uses the log-normal distribution of $c_d$ as well as equations (10) and (20). Finally, collecting terms and solving for $P_{1-\theta}^d$ yields

$$
P_{1-\theta}^d = \kappa \left( T_d \right)^{\tilde{\theta} - 1} \frac{\sigma^{-(\tilde{\theta} - 1)} \hat{\tilde{\sigma}}^{-\theta} \sum_k J_k b_k^\theta \left( W_k^\beta P_k^{1-\beta} \right)^{-\theta} \hat{\tau}_{kd}^{-\theta} W_d^{-(\tilde{\theta} - 1)} \hat{\tilde{F}}_{kd}}{1 - 1/\hat{\tilde{\theta}}},
$$

(E.6)
which can be restated in terms of relative changes as

\[
\hat{P}_d = \left[ \sum_k \lambda_{kd} \left( \hat{W}_k^\beta \hat{P}_k^{1-\beta} \right)^{-\theta} \frac{\hat{\tau}_k - \theta \hat{F}_{kd}}{\hat{\tau}_k} \right]^{-1/\theta} \left( \frac{\hat{T}_d}{\hat{W}_d} \right)^{1/\theta - 1/(\sigma - 1)}. \tag{E.7}
\]

As regards notation, \( \hat{x} \) denotes a gross relative change: \( \hat{x} \equiv x'/x \), where \( x' \) is the new value. The above result is a system of equations that determines relative changes of prices as a function of relative changes in wages. To complete the procedure, we follow Eaton et al. (2011, Appendix E). Total manufacturing absorption is

\[
T_d = \gamma_d \cdot \frac{(Y_d^T + B_d^T)}{\text{final demand (labor income + profits)}} + (1-\beta) \cdot \frac{\sigma - 1}{\sigma} Y_d, \tag{E.8}
\]

where \( Y_d^T \) is total GDP of country \( d \), including labor income and profits, \( B_d^T \) is the current account deficit and \( Y_d \) output of the manufacturing sector. We allow the share \( \gamma_d \) of manufacturing value added in GDP to be country specific. Manufacturing expenditure equals \( T_d = Y_d + B_d \), where \( B_d \) is the trade deficit in the manufacturing sector. We can therefore solve for \( T_d \) and \( Y_d \) and obtain

\[
T_d = \frac{\gamma_d \left( Y_d^T + B_d^T \right) - (1-\beta)(1-1/\sigma) B_d}{1/\sigma + \beta(1-1/\sigma)}, \quad Y_d = \frac{\gamma_d \left( Y_d^T + B_d^T \right) - B_d}{1/\sigma + \beta(1-1/\sigma)}. \tag{E.8}
\]

We assume \( \gamma_d \) is time invariant, so we solve equation (E.8) for \( \gamma_d \) using 2000 baseline data.

To summarize, using the Dekle et al. (2007) algorithm, we can compute how given relative changes in market-access costs \( \hat{F}_{kd} \) lead to \( \hat{\lambda}_{sd}, \hat{P}_d, \hat{W}_d \). Denoting future variables with a prime,

\[\text{We consider } \hat{F}_{dd} = 1 \text{ in our counterfactual exercise, so this expression differs for domestic access costs from a similar one in Arkolakis et al. (2012) inasmuch as changes in the ratio } \frac{\hat{T}_d}{\hat{W}_d} \text{ reflect changes in the ratio of total absorption to wages (which is not one due to non-zero deficits).}\]
we find $T_d', Y_d'$ by inspecting equations (E.5), (E.6) and imposing the market clearing condition

$$Y_s' L_s = \sum_{k=1}^{N} \lambda_{sk} T_k'.$$

(E.9)

F Varying the Productivity Distribution

While we can allow for flexible forms of the firm-destination market-access cost distribution and the firm-product-destination appeal shock distribution, a critical assumption for closed-form general equilibrium (in Section 5) and counterfactuals (in Section 6) is that the firm-specific productivity shock is Pareto distributed. For our SMM estimation routine, however, the Pareto assumption can be easily relaxed to allow for a different and more general distribution of productivity. We show in this Appendix that using the empirically plausible log-normal distribution (Fernandes et al. 2018) in our SMM estimator yields similar parameter estimates for firm scope and scale. In addition, aggregate trade patterns remain similar, arguably because the bulk of trade is conducted by the largest firms.

We first present our computation strategy using a general distribution for firm productivity, and then show the results of our estimation routine using a log-normal distribution. In the Online Supplement S7 we discuss implications for aggregates and counterfactual simulations when changing the firm productivity distribution to a non-Pareto distribution such as the log-normal distribution of productivity.

F.1 Computation strategy

Consider firms in a common source country $s$. Each firm gets a productivity draw $\phi$, destination cost shock $c_d$ and a destination-product product demand shock $\xi_{dg}$.

Firms export to destination $d$ only if $\phi > \phi^*_d (c_d)$, where

$$\phi^*_d (c_d) = c_d \frac{f_d (1)}{D_d}. \quad \text{(1)}$$

We compute $\bar{D}_d$ to match the number of observed exporters at destination $d$. The productivity cutoff for market entry with at least $G$ products is

$$\phi^*_{G} (c_d) = \phi^*_d (c_d) \sigma^{-1} G^{\delta_d} G^{\alpha (\sigma-1)}. \quad \text{(1)}$$

We then compute sales $y_{dg} (\phi, c_d, \xi_{dg})$ of a product of rank $g$ to destination $d$ (for a firm with productivity draw $\phi$, destination cost shock $c_d$ and a destination-product product demand shock $\xi_{dg}$). Following similar derivations as for our main analysis, we find that a firm that sells $G$ products to destination $d$ has product-level sales

$$y_{dg} (\phi, c_d, \xi_{dg}) = \sigma c_d f_d (1) G^{\delta_d} G^{\alpha (\sigma-1)} \left( \frac{\phi}{\phi^*_G (c_d)} \right)^{\sigma^{-1}} G^{\alpha (1-\sigma)} \xi_{dg}. \quad \text{(1)}$$
Table F.3: Estimation Results for Log-normal Productivity

<table>
<thead>
<tr>
<th></th>
<th>$\delta_{LAC}$</th>
<th>$\delta_{ROW}$</th>
<th>$\tilde{\alpha}$</th>
<th>$\tilde{\theta}/\tilde{\sigma}_\phi$</th>
<th>$\sigma_\xi$</th>
<th>$\sigma_c$</th>
<th>$\delta_{LAC} - \delta_{ROW}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>-1.16</td>
<td>-.86</td>
<td>1.76</td>
<td>1.72</td>
<td>1.82</td>
<td>.58</td>
<td>-.30</td>
</tr>
<tr>
<td>Pareto productivity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>-1.21</td>
<td>-.92</td>
<td>1.91</td>
<td>1.88</td>
<td>1.72</td>
<td>.69</td>
<td>-.29</td>
</tr>
</tbody>
</table>


Note: Products at the HS 6-digit level. Standard errors from 30 bootstraps in parentheses. Estimates of $\delta_{LAC}$ measure the scope elasticity of market-access costs for Brazilian firms shipping to other LAC destinations, $\delta_{ROW}$ for Brazilian firms shipping to destinations outside LAC.

Our SMM estimation procedure only uses relative comparisons in sales, so $\sigma_c f_d (1)$ drops from all computations.

As before we can therefore express product sales as:

$$y_{dg} (\phi, c_d, \xi_{dg}) = \sigma_c f_d (1) G^{\delta_{G}} G^{\alpha (\sigma - 1)} \left( \frac{\phi}{\phi^{*} (c_d)} \right)^{\sigma - 1} g^{\alpha (1 - \sigma)} \xi_{dg}$$

For computation we assume that all random variables are drawn from independent log-normal distributions with the following parameters: $\phi \sim \log N (-\sigma_{\phi}^2 / 2, \sigma_{\phi}^2)$, $c_d \sim \log N (-\sigma_{c}^2 / 2, \sigma_{c}^2)$, and $\xi \sim \log N (0, \sigma_{\xi}^2)$. Note that if $\phi$ is log-normal then $\phi^{\sigma - 1}$ is distributed log-normal with $\phi^{\sigma - 1} \sim \log N (0, \sigma_{\phi}^2 (\sigma - 1)^2)$. We define the variance $\tilde{\sigma}_\phi \equiv \sigma_{\phi}^2 (\sigma - 1)^2$ and estimate it in lieu of $\sigma$ and $\sigma_{\phi}$ before.

Table F.3 shows a comparison of the estimates under Pareto distributed and under log-normally distributed firm productivity. The results are relatively similar in general, and the difference between $\delta_{LAC}$ and $\delta_{ROW}$ in particular is virtually unchanged between specifications.

Figures F.3 and F.4 compare the targeted moments between Pareto and log-normally distributed firm productivity. The SMM estimators under either specification of the productivity distribution do a reasonably similar job. Figures F.5 and F.6 compare the non-targeted moments between using Pareto and log-normally distributed firm productivity. Again, both SMM estimators appear to do a reasonably similar job, but SMM for Pareto productivity performs better in matching the relationship between exporter scope and scale for non-LAC countries. The superior performance of SMM under Pareto appears to be driven by the fact that the Pareto distribution can do a better job at explaining extremes, which heavily influence the means.
Figure F.3: Fit of Targeted Moments under Pareto Productivity

(A) Firm-product Sales Distribution

(B) Exporter Scope Distribution


Note: Products at the HS 6-digit level. Data plots replicate those in Figures 1 and 2. Predicted curves based on simulations in Section D.1, using the baseline parameter estimates in Table 2. Panel A shows shipments to Argentina, grouping firms by their local exporter scope and firm-products by their local sales rank. Panel B shows the exporter scope by percentile, averaged across the five most common destinations within each of the two regions (LAC and non-LAC).

Figure F.4: Fit of Targeted Moments under Log-normal Productivity

(A) Firm-product Sales Distribution

(B) Exporter Scope Distribution

Figure F.5: Fit of Non-Targeted Moments under Pareto Productivity

(A) Exporter Scope and Scale

(B) Export Sales Distribution


Figure F.6: Fit of Non-Targeted Moments under Log-normal Productivity

(A) Exporter Scope and Scale

(B) Export Sales Distribution


Note: Products at the HS 6-digit level. Data plot in Panel A replicates that in Figure 3. Predicted curves based on simulations in Section D.1, using the baseline parameter estimates in Table 2. Panel A shows exporter scale (a firm’s total sales at a destination divided by its exporter scope at the destination) against exporter scope, averaging each variable over the five most common destinations within a region (LAC and non-LAC) and normalizing scale by the average total sales of single-product exporters at the destination. Panel B shows total firm exports by percentile, averaging a firm’s total exports over the five most common destinations within each of the two regions (LAC and non-LAC) and normalizing total sales by the median firm’s total at the destination.