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## Gravity with History: On the Aggregate Implications of Incumbency Effects in International Trade

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# Gravity with History: On the Aggregate Implications of Incumbency Effects in International Trade\*

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## Abstract

We analyze how the history of trade liberalizations affects aggregate trade flows today. We develop a dynamic general equilibrium model of international trade with heterogeneous firms. The framework nests the canonical Melitz (2003) model as a special case. The key novelty is that serving a market involves higher fixed cost upfront, i.e., fixed cost of market access are decreasing with tenure. As a consequence, there is less market exit and entry in response to a trade shock. We derive a gravity equation and show that, ceteris paribus, countries that liberalized their trade relationship earlier trade more today. Our theory can thus help explain the “home bias” in international trade, and, more generally, why historic events such as colonial ties or the “Iron Curtain” have large and persistent consequences for trade. We provide supporting evidence for the underlying mechanisms, exploiting the structure of our model and data on average firm sales for a large set of countries.

**Keywords:** home bias · incumbency effects · sunk cost of market access · gravity equation · Melitz model

**JEL Classification:** F12 · F14 · F15

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# 1 Introduction

Countries open up to trade gradually over time. When firms start serving foreign markets, they therefore need to compete against domestic and potentially third-country incumbents. These firms have, e.g., already built up a distribution network, got to know market structures, and established their brand. An extensive literature on industrial organization shows how incumbency effects can deter entry (see, e.g., [Arping and Diaw \(2008\)](#); [Goolsbee and Syverson \(2008\)](#); [Noh and Moschini \(2006\)](#); [Schivardi and Viviano \(2011\)](#)), and it is well-known that sunk market access costs can generate hysteresis effects in international trade (see, e.g. [Alessandria et al. \(2020\)](#); [Baldwin \(1988\)](#); [Baldwin and Krugman \(1989\)](#); [Dixit \(1989\)](#) ). It is less well understood what this implies for aggregate trade and “gravity” models of international trade. In this paper, we seek to contribute to closing this gap by introducing incumbency effects into a tractable dynamic trade model with heterogeneous firms that nests the canonical (static) version of a [Melitz \(2003\)](#) model as a special case.

The key novelty in our framework is that a firm’s market access costs are (weakly) decreasing with its tenure in the market. When confronted with market entry by foreign competitors, incumbent firms therefore weigh discounted future profits against lower market access costs. This leads to less exit by (low-productive) incumbents and, hence, less entry vis-à-vis a the canonical [Melitz \(2003\)](#) model.<sup>1</sup> We derive a gravity equation that explicitly accounts for potential incumbency effects. It implies that, ceteris paribus, countries trade less if they liberalized their trade relation later. Accordingly, trade flows are not only shaped by trade frictions today—as (implicitly) assumed in standard gravity equations—but they also depend on the history of trade liberalizations. In other words, we argue that there is strong path dependence in international trade.<sup>2</sup> Incumbency effects may thus help to explain the “home bias” in international trade, and, more generally, why historic events such as colonial ties or the “Iron Curtain” have long-lasting consequences for trade flows. The model’s implications are also in line with novel indirect evidence on the response of fixed market access costs

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<sup>1</sup>This is in line with e.g. [Schivardi and Viviano \(2011\)](#), who show that entry barriers are empirically associated with lower productivity of incumbent firms.

<sup>2</sup>The term “path dependence” is sometimes used to refer to different things, and it has become a “trendy way to say that history matters” ([Page, 2006](#), p. 87). In economics, it is often used to refer to situations where random shocks can have long-lasting effects. A prominent example are agglomeration effects, where small random differences in the initial allocation can have long-lasting and large consequences. In this paper, we apply a more literal use of the term “path dependence.” In particular, we use it to refer to a situation where today’s outcomes are not only shaped by where we are today (in terms of trade costs), but also by which route we took to get to this point.

to a shock on variable trade costs.

Our key assumption of decreasing fixed market access costs and, hence, sunk upfront investments is in line with persistence in firms’ export status (Alessandria et al., 2020; Eaton et al., 2007; Roberts and Tybout, 1997; Ruhl and Willis, 2017)). It is also consistent with Krishna et al. (2021), who show that the fixed (documentation) costs of using preferential trade agreements are decreasing with firms’ experience of exploiting the agreement. To further motivate our analysis, we consider market exit of Colombian firms in response to a large negative trade shock with Venezuela in Section 2. We show that firms are less likely to stop exporting a product in response to the shock the longer their tenure, controlling for firm and product fixed effects and very flexibly for a firm’s sales of a product. This suggests that fixed market access costs are indeed decreasing with tenure.

We start our theoretical analysis of tenure-dependent market access costs with a simple example in Section 3. In this example, firms are myopic and there are two perfectly symmetric countries with free trade—i.e. no variable trade costs and symmetric market access costs. We use this example to show that incumbency effects can give rise to selection into exporting and a “home bias” of international trade flows even with free trade between perfectly symmetric countries. In the remainder of the paper, we generalize this basic insight to a set-up with forward-looking firms, many asymmetric countries, arbitrary trade frictions, and an arbitrary sequence of trade liberalizations.

In Section 4, we present our model. Analogous to the canonical static version of the Melitz model (see, e.g., Melitz and Redding (2014)) there is a fixed cost of entry. Upon entry firms receive a random productivity draw from a Pareto distribution. Serving a market involves a fixed cost of market access, and a variable iceberg trade cost. The key difference to the canonical set-up is that our model is dynamic, with fixed market access costs that decrease with tenure in a market. Firms are forward-looking: in their (market) entry decision, they weigh the present value of future profits against the present value of fixed costs. They do not anticipate any changes to the exogenous trade costs, but have otherwise perfect foresight.

These dynamics notwithstanding, our model is tractable enough to analytically characterize the equilibrium. We show this in Section 5, where we derive a gravity equation for international trade. First, we solve the equilibrium for the case where all trade liberalizations happen simultaneously in the very first period. In this scenario, tenure effects trivially play no role, and the gravity equation is identical to that in the canonical Melitz model. Second, we allow for an arbitrary sequence of trade liberal-

izations. In this case, our theory predicts that, *ceteris paribus*, countries trade more if they liberalized their trade relationship earlier. Our work reveals a novel, multiplicatively separable “incumbency term” in the nominator of the gravity equation, which captures the impact of “history” on current trade flows.

This gravity equation can be estimated following standard steps from the literature. It implies, however, that in addition to proxies for fixed and variable trade costs today, we need to control for the history of trade liberalizations. To illustrate the potential relevance of this novel term, we include indicators for major historic events—colonial ties and the “Iron Curtain”—in a standard gravity regression in Section 6.1. It is well known that colonial ties are, *ceteris paribus*, associated with larger trade flows today. As a new insight, we document that countries which were separated by the Iron Curtain in the past trade significantly less today. The differences compared to non-separated relations are large, persistent, and stable across different specifications for bilateral trade costs. We also obtain the same conclusions when considering sea and air trade only, *i.e.*, trade that should be less affected by pair-specific infrastructure investments. Our theory provides a mechanism that can help explain these empirical patterns: incumbency effects that may prevent firm entry and exit upon trade liberalizations.

Yet, there may be other channels through which the Iron Curtain and colonial ties impact trade today. In Section 6.2, we therefore turn to our underlying mechanism. We derive a structural estimator that maps changes in the importance of tenure for trade to average firm sales (*i.e.*, total exports divided by the number of firms serving a market). With that, we are able to empirically test the model’s predictions using data on average firm exports for a large set of countries. Specifically, our theory predicts that in response to a trade liberalization between an exporter  $i$  and a destination  $j$ , incumbency effects become less important for firms from  $i$  relative to firms from other countries that serve  $j$ . Intuitively, if  $i$  liberalizes its trade relationship with  $j$ , the profit potential of firms from  $i$  in  $j$  increases, which facilitates survival in the market with or without incumbency benefits. Considering relatively large tariff cuts, we find evidence in support of this theoretical prediction. In turn, this implies that the trade effects of a decrease in variable trade costs are partly offset by the strength of incumbents from other source countries.

**Relation to the Literature.** Our paper is related to several strands of literature.

We develop a dynamic variant of the canonical “gravity” version of the Melitz

model. Our paper is thus closest related to the extensive gravity literature in international trade. The majority of the literature in this area is static.<sup>3</sup> A series of recent papers introduces dynamics into gravity models of trade and migration (see, e.g., [Allen and Donaldson, 2020](#); [Atkin et al., 2021](#); [Buera and Oberfield, 2020](#); [Caliendo et al., 2020](#)). In these papers, history can impact outcomes today through technological diffusion, agglomeration, or the evolution of country capability. These mechanisms have in common that they impact an exporter (or city / region) “fixed effect”, i.e., the impact of history is not pair specific. As opposed to that, we present a simple dynamic framework and derive a gravity equation where trade flows are not only shaped by trade frictions today, but also by the history of trade liberalizations. In this regard, our paper is closer to [Morales et al. \(2019\)](#), who show that the probability of an exporter entering a new market hinges on how similar this new destination is to destinations which the firm already served in past periods. In our model, countries who liberalized their trade relationship earlier trade more today. Interestingly, with countries opening up to trade gradually over time, our framework thus also provides a novel mechanism that can help explain a home bias in international trade even with free trade and between perfectly symmetric countries.<sup>4</sup>

Our analysis is centered on fixed costs of market access which are decreasing with tenure. It is well-known at least since [Baldwin \(1988\)](#); [Baldwin and Krugman \(1989\)](#); [Dixit \(1989\)](#) that sunk entry costs can give rise to hysteresis in international trade. Motivated by empirical evidence on firm entry and exit in export markets—see also [Section 2](#)—, a growing literature introduces sunk costs of market access into theoretical models to analyze exporter dynamics (see, e.g., [Costantini and Melitz \(2007\)](#); [Das et al. \(2007\)](#); [Eaton et al. \(2014\)](#); [Fitzgerald et al. \(2016\)](#); [Ruhl and Willis \(2017\)](#), or

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<sup>3</sup>See, e.g. the seminal contributions by [Eaton and Kortum \(2002\)](#), [Anderson and van Wincoop \(2003\)](#), [Melitz \(2003\)-Chaney \(2008\)](#), [Arkolakis et al. \(2012\)](#), and the review in [Head and Mayer \(2014\)](#).

<sup>4</sup>A “border puzzle” was originally documented in [McCallum \(1995\)](#). While the exact size of the border effect is heavily debated, there appears to be a consensus that it tends to be relatively large. In other words, the empirically observed low shares of trade relative to production are hard to rationalize using standard trade theories. Several explanations have been proposed such as multilateral resistance terms ([Anderson and van Wincoop, 2003](#)), technical barriers to trade (e.g., [Chen, 2004](#); [Manchin and Pinna, 2009](#)), multi-stage production ([Yi, 2010](#)), or non-homothetic preferences ([Caron et al., 2014](#)). We complement this literature by showing how tenure effects can naturally induce a home bias, which can help explain a home bias even among U.S. states ([Wolf, 2000](#)). Importantly, large home shares and low gains from trade are intimately linked in standard trade theory ([Arkolakis et al., 2012](#)).

Alessandria et al. (2020) for a survey article).<sup>5</sup> This literature largely focuses on partial equilibrium models and firm-level transitional dynamics. Notable exceptions are, e.g., Alessandria and Choi (2014); Alessandria et al. (2014); Burstein and Melitz (2013); Impullitti et al. (2013), who consider general equilibrium environments, but can only allow for two symmetric countries. Compared to this literature, our dynamics are much simpler, and after a shock our economy immediately jumps to a new steady state. In turn, this allows introducing incumbency effects into a general equilibrium trade model with numerous asymmetric countries, arbitrary bilateral fixed and variable trade costs, and an arbitrary sequence of trade liberalizations, while maintaining tractability.

## 2 Motivating Evidence

Before turning to the model, we motivate our setup by looking at the exiting behavior of Colombian exporters in response to a large negative trade shock. Our goal is to measure the exit propensity of firms depending on their market-specific tenure levels while controlling for size. To do so, we use transaction-level data in USD at the 10-digit HS level from ADUANAS for the years 1994 to 2013 provided by the Colombian tax authority (DIAN). We aggregate this data to yearly firm-level exports at the 2-digit HS level, and then consider firm exit by product-destination. This or similar datasets have previously been used to document exporter dynamics (see, e.g. Alessandria et al. (2020); Eaton et al. (2007); Roberts and Tybout (1997); Ruhl and Willis (2017)). We add to prior findings (i) by flexibly controlling for log-sales at the product-destination level to emphasize a potential role of tenure-dependent fixed costs, and (ii) by focusing on exit in response to a large negative shock to Colombia’s trade with Venezuela rather than on general exporter dynamics.

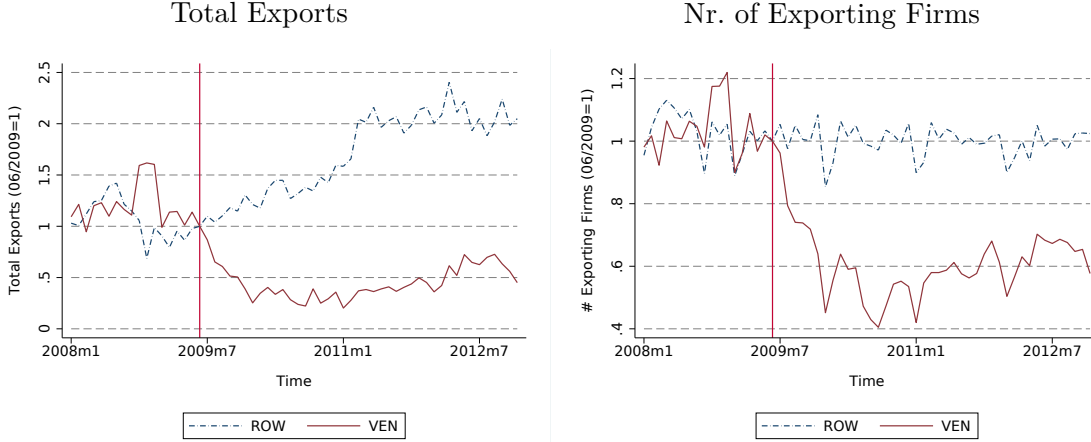
On July 28, 2009, in response to a dispute over American anti-drug campaigns in Colombia and the supply of weapons to Colombian rebels, the by then president of Venezuela Hugo Chavez declared a freeze on diplomatic ties with Colombia, and expressed the wish to decrease bilateral trade.<sup>6</sup> While this shock did not entirely close

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<sup>5</sup>An alternative mechanism to create incumbency effects would be to introduce increasing sales over time, which have been found to be important for explaining some of the micro-patterns in the data (see, e.g., Fitzgerald et al., 2016; Ruhl and Willis, 2017). In our model, this would have qualitatively similar implications as tenure-dependent fixed costs for aggregate trade and its dependence on the history of trade liberalizations. We therefore focus on tenure-dependent fixed costs, which are analytically more tractable and the pre-dominant assumption in the literature. In Section 2, we provide evidence to corroborate our setup.

<sup>6</sup>See <https://www.economist.com/the-americas/2009/09/10/politics-versus-trade>, accessed on March 26, 2021.

Figure 1: The Venezuela Shock on Colombian Firm Exports



*Notes:* These figures illustrate monthly total exports from Colombia to Venezuela vs. the rest of the world (left panel), and the number of firms exporting to Venezuela vs. the rest of the world (right panel). Both graphs depict indexed values such that June 2009 is equal to one. See Section 2 for further details.

*Data source:* ADUANAS (DIAN)

*Graph:* Authors' representation.

the border, it had a major impact on bilateral trade, as illustrated in Figure 1. From July 2009 to December 2009 Colombian exports to Venezuela fell by over 50%, whereas exports to the rest of the world slightly increased. The number of firms that exported to Venezuela fell by over 40%. By contrast, the number of firms that served the rest of the world remained fairly constant. These are sizable shocks, especially considering the pre-crisis importance of Venezuela as a trading partner. In 2008, the last full year before the crisis, more than 15% of Colombian exports went to Venezuela, and about one third of all exporters served that market.

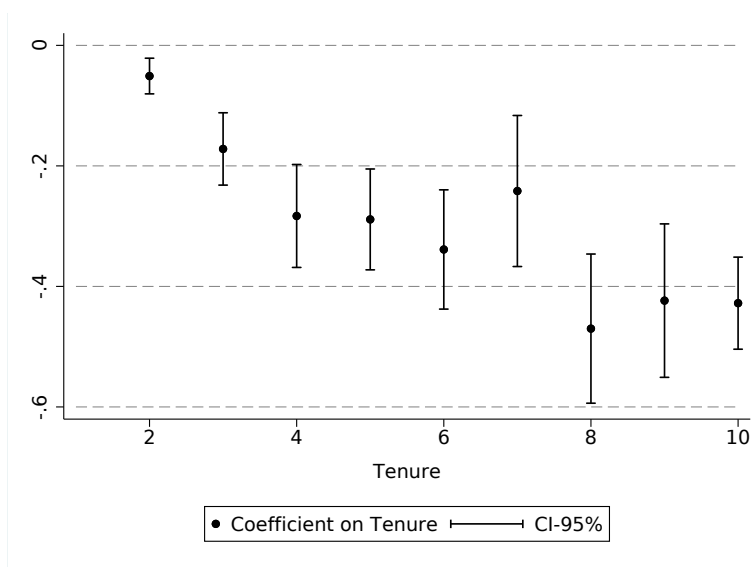
To analyze the exit response of Colombian firms to this (exogenous) shock, we restrict our sample to all firm-product pairs with positive exports to Venezuela in the period July 2008 to June 2009. In our baseline specification, we then treat a firm-product pair as an exit if the firm does no longer export that product to Venezuela in the period from January 2010 to December 2010. This allows comparing pre-crisis levels to post-crisis levels, allowing for the shock to manifest itself gradually over time, as suggested by Figure 1. We run the following linear probability model

$$y_{fp} = \boldsymbol{\lambda}_{fp}'\boldsymbol{\alpha} + \mathbf{x}_{fp}'\boldsymbol{\beta} + \mathbf{d}_{fp}'\boldsymbol{\gamma} + \epsilon_{fp} , \quad (1)$$

where  $y_{fp}$  is our exit indicator that takes on a value of one if firm  $f$  stops exporting product  $p$  in response to the shock, and zero otherwise.  $\boldsymbol{\lambda}$  is a set of tenure dummies



Figure 2: Firm Exit in Response to Venezuela Shock



*Notes:* These figures summarize the tenure coefficients from estimating equation (1) using OLS. Standard errors are clustered at both, the product and the firm level. All tenure levels of 10 years and above have been summarized in one category “tenure 10.” Omitted category is tenure=1. Further details are provided in the main text.

*Data source:* ADUANAS (DIAN)

*Graph:* Authors’ representation.

$[\lambda^1, \dots, \lambda^{10}]$ , where  $\lambda_{fp}^k$  equals one if at the time of the shock firm  $f$  exports product  $p$  to Venezuela for the  $k^{th}$  consecutive period.<sup>7</sup>  $\mathbf{x}$  is a (set of) size controls and  $\mathbf{d}$  a set of fixed effects as specified momentarily. The error term is denoted by  $\epsilon_{fp}$ , and we apply two-way clustering at the product and firm levels.

In our main—most conservative—specification, we order all firms that export a product to Venezuela by their exports, group them into quintiles, and then control for (i) a full set of product-quintile fixed effects, and (ii) the firm’s log-sales of that product with a product-quintile-specific coefficient. This allows to flexibly control for a firm’s size in a given product. We add a full set of firm fixed effects to control for general firm-level trends. In Appendix C.2, Table C.1, we show that less restrictive specifications with fewer fixed effects yield the same basic insights.

Figure 2 summarizes the coefficients on the tenure dummies, which measure tenure effects relative to the omitted category of firms with tenure 1 (i.e., of firms who had

<sup>7</sup>To measure tenure in July 2008–June 2009, we aggregate trade flows in preceding years over twelve-month periods from July in a year  $t-1$  to June in year  $t$ . Table O.C.1 of the Online Appendix shows that the basic pattern is the same when aggregating data from August in a year  $t-1$  to July in year  $t$  and then looking at exit immediately after the shock (i.e., no exports in the period from August 2009 to July 2010).

started exporting to Venezuela in the year before the shock). This figure clearly reveals sizable effects of tenure on exit: the exit probability decreases by more than 40 percentage points when a firm is highly experienced ( $\text{tenure} \geq 8$ ), flexibly controlling for sales prior to the shock.

In what follows we analyze what these tenure effects imply for aggregate trade, and how it is shaped by the history of trade liberalizations.

### 3 A Simple Example

To illustrate our main point of interest, it is instructive to start off with a stylized example, before introducing our entire set-up in the next section.

Consider a Melitz model with two perfectly symmetric countries and free trade. Hence, for the purpose of this example, let us assume that upon trade opening there are no variable trade costs and market access costs  $f$  are the same at home and abroad. In the textbook case of the Melitz model, we then trivially have that the cutoff productivity is the same for every destination market and that

$$\frac{X_{ij}}{X_j} = \frac{1}{2},$$

where  $X_{ij}$  denotes trade flows from country  $i$  to destination country  $j$ , and  $X_j$  denotes total expenditure in country  $j$ .

Now, suppose that both countries start out under autarky at time  $t = 0$ , and open up to free trade at some time  $t > 0$ . Economically, this implies that when firms start to export, they need to compete against incumbent local firms. How is that going to affect international trade? The answer is, of course, not at all if we are willing to assume that fixed costs of market access are constant over time. This is, however, no longer true if these costs are decreasing with tenure in a market. In particular, to keep things simple for now, suppose that firms already serving any given market for  $t$  periods have to pay a fraction  $\alpha < 1$  of fixed costs only, and that they are myopic in their entry decision. Then, in both countries domestic firms will continue serving their home market whenever

$$\pi_{ii}^v(\varphi) \geq \alpha f,$$

where  $\pi_{ij}^v(\varphi)$  denotes the variable profits that a firm in country  $i$  with productivity  $\varphi$  makes from serving country  $j$ . By contrast, firms from country  $i$  will enter market  $j$  whenever

$$\pi_{ij}^v(\varphi) \geq f.$$

It follows that the sequential opening to trade in itself gives rise to selection into exporting and a home bias. In particular, it is straightforward to show that

$$\left(\frac{\varphi_d}{\varphi_x}\right)^{\sigma-1} = \alpha,$$

where  $\varphi_d$  is the cutoff productivity for serving the home market,  $\varphi_x$  the cutoff productivity for serving the foreign market, and  $\sigma > 1$  the constant elasticity of substitution.

In what follows, we will develop this argument more carefully and show how it impacts aggregate trade flows between a large set of heterogeneous countries with forward-looking firms, arbitrary variable trade costs, and arbitrary fixed market access costs that are weakly decreasing with tenure.

## 4 Model

To analyze how the history of trade liberalizations affects international trade flows today, we now develop a dynamic general equilibrium model of international trade. We build on the canonical static single-sector Melitz model (as in, e.g., [Melitz and Redding \(2014, Section 6\)](#)). Analogous to a standard Melitz model, there is free entry, subject to a fixed cost of entry, and serving a market involves a fixed cost. Forward-looking firms decide which markets to serve. The key novelty in our setup is that fixed cost of serving a market are decreasing with tenure in that market. That is, serving a market involves higher fixed cost upfront (e.g., in order to establish a brand or a distribution network), and lower fixed cost in the future (e.g., in order to sustain the brand or the distribution network). In the case where these fixed costs are constant over time, our model reduces to the canonical baseline framework.

**Households.** There are  $I$  countries, indexed by  $i, j \in \mathcal{I}$ . Country  $i$  is populated by a continuum of measure  $L_i$  of infinitely lived households. In every period, each household is endowed with one unit of labor that it inelastically supplies to the labor market. Households receive utility from consuming a continuum of horizontally differentiated varieties with preferences given by

$$U_i = \sum_{t=0}^{\infty} (\beta)^t C_i^t \tag{2}$$

$$C_i^t := \left[ \int_{\omega \in \Omega_i^t} q_i^t(\omega)^{(\sigma-1)/\sigma} d\omega \right]^{\sigma/(\sigma-1)}, \quad \sigma > 1,$$

where a superscript  $t$  indicates period  $t$ ,  $\beta < 1$  is the discount factor,  $\Omega_i^t$  denotes the set of varieties available in country  $i$  at time  $t$ , and  $q_i^t(\omega)$  denotes the quantity of variety  $\omega$  consumed by a representative household in country  $i$  at time  $t$ . Households can invest in an aggregate asset of domestic firms, as we will detail later on. For now, it suffices to note that this asset yields a rate of return which we denote by  $r_i^t$ . The representative household in country  $i$  then maximizes (2) subject to the flow budget constraint

$$\mathbb{E}_t \left[ \frac{a_i^{t+1}}{1 + r_i^{t+1}} \right] = a_i^t + w_i^t - x_i^t, \quad (3)$$

where  $a_i^t$  denotes (pre-determined) asset holdings at the beginning of the period,  $w_i^t$  the wage rate, and  $x_i^t$  total spending of the representative household in period  $t$ .  $\mathbb{E}_t[\cdot]$  denotes the expectation operator.

Following standard steps to solve the household's intra-temporal optimization problem yields its demand for variety  $\omega$  in country  $i$  at time  $t$

$$q_i^t(\omega) p_i^t(\omega) = p_i^t(\omega)^{1-\sigma} (P_i^t)^{\sigma-1} x_i^t,$$

where  $p_i^t(\omega)$  denotes the price of variety  $\omega$  and where

$$P_i^t := \left[ \int_{\omega \in \Omega_i^t} p_i^t(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$$

is the ideal price index. Intertemporal optimization further requires that in equilibrium we must have

$$1 = \beta \mathbb{E}_t \left[ (1 + r_i^{t+1}) \frac{P_i^t}{P_i^{t+1}} \right] \quad (4)$$

at all times, i.e., the interest rate adjusts such that households are exactly indifferent between consuming the CES aggregator either today or in the next period.

**Firms and production.** The competitive environment and production are analogous to the baseline Melitz model, with the only changes in assumptions that fixed costs of serving a market vary with tenure in that market. Firms anticipate the evolution of fixed costs when deciding on whether or not to enter a market.

There is free entry into the market for final consumption goods. Upon entry, a firm is equipped with a new variety  $\omega$ , and it receives a productivity draw  $\varphi$  from a random distribution with CDF  $G(\varphi)$ , PDF  $g(\varphi)$ , and positive and unbounded support  $\Phi$ . To derive a gravity equation, we will later consider the case of a Pareto distribution of

productivities, i.e.,

$$G(\varphi) = 1 - \left(\frac{\varphi}{\underline{\varphi}}\right)^{-\theta}, \quad \text{for } \varphi \geq \underline{\varphi}$$

and  $g(\varphi) = \theta \underline{\varphi}^\theta \varphi^{-\theta-1}$

where  $\underline{\varphi} > 0$  is the lowest productivity level, and the shape parameter  $\theta$  is assumed to satisfy  $\theta > \sigma - 1$ .<sup>8</sup>

Entry in country  $i$  entails a fixed cost. For simplicity, we assume that this fixed cost is paid in form of a perpetual annuity of  $f_{ei}$  units of domestic labor.

A firm with productivity  $\varphi$  needs  $1/\varphi$  units of domestic labor in order to produce one unit of its variety. In addition, firms face fixed costs of serving a market: A firm based in country  $i$  needs to employ  $f_{ij}$  units of domestic labor in every period it is serving market  $j$ . These labor units need to be equipped with tenure-dependent units of the CES aggregator.<sup>9</sup> In Section 5, we will show that—in the absence of trade shocks—the CES price index is constant over time. In anticipation of this result, we simplify the exposition by assuming that the resources needed for market access simply scale the market access costs. In particular, suppose that a firm from country  $i$  has *continuously* served market  $j$  for  $\lambda \geq 0$  periods, where we use  $\lambda$  to denote tenure in a market. Then its fixed costs of serving that market in period  $t$  are

$$f_{ij}^t(\lambda) := f_{ij} w_i^t f(\lambda), \tag{5}$$

where  $f(\lambda)$  is a tenure-dependent scaling factor satisfying  $f(\lambda) \geq 1$  and  $f'(\cdot) \leq 0$ . Out of these fixed costs,  $f_{ij} w_i^t$  are spent on labor in country  $i$ , while  $[f(\lambda) - 1] f_{ij} w_i^t$  are spent on the CES aggregator. Note that equation (5) nests the common assumption of constant-over-time market access costs in terms of labor as a special case (with  $f(\lambda) = 1 \forall \lambda$ ).

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<sup>8</sup>We assume that  $\underline{\varphi}$  is the same across countries. This is for expositional convenience only.

<sup>9</sup>We introduce this hybrid market access cost for two reasons. First, economically, it is reasonable to assume that accessing a market requires both personnel and financial resources for, e.g., a marketing campaign, and that the marketing budget needed to maintain a brand is smaller than the budget needed to establish a brand. Second, this choice largely improves the tractability of our model. For one thing, with parts of the fixed market access costs in terms of labor, we can leverage the well-known result that—with a Pareto distribution of firm productivities—the mass of firms is independent of the trade environment. For another, expressing the time-varying part of fixed cost in terms of the consumption aggregator implies that—in the absence of trade shocks—all prices and aggregate trade flows are constant over time. In turn, this allows us to study long-run implications of incumbency effects for aggregate trade while otherwise staying as close as possible to static microfoundations of the gravity equation.

Trade is further subject to an iceberg trade cost, that is,  $\tau_{ij}^t \geq 1$  units of a variety have to be shipped from country  $i$  for one unit to arrive at destination country  $j$ . Variable trade costs satisfy the triangle inequality, and  $\tau_{ii}^t = 1$  for all  $i$  and  $t$ . We note that the labor requirements for accessing a market,  $f_{ij}$ , and for entering,  $f_{ei}$ , are constant over time, while the variable trade costs  $\tau_{ij}^t$  may potentially change, with any such change being unexpected. Hence, to study the effects of sequential trade openings on trade flows today, we focus on shocks to variable trade costs. This will allow disentangling tenure effects from the direct effects of changes in the trade environment.

In summary, a firm in country  $i$  with productivity  $\varphi$  that started serving households in country  $j$   $\lambda$  periods ago and that wants to sell  $q$  units of its variety, faces a total cost of

$$\mathbb{C}_{ij}^t(q; \varphi, \lambda) = f_{ij}^t(\lambda) + \frac{\tau_{ij}^t w_i^t}{\varphi} q.$$

**Firm behavior.** Firms in country  $i$  can borrow or lend at the prevailing market interest rate  $r_i^t$  as given by equation (4). Firms are forward-looking. In their (market) entry decision, they weigh discounted future costs against benefits, perfectly anticipating the tenure-dependent evolution of market access cost and any potential endogenous evolution of equilibrium outcomes. They do not, however, anticipate any potential changes in the exogenous trade environment. That is, firms expect all  $\tau_{ij}$  and  $f_{ij}$  to remain constant over time, analogous to static gravity equations. We will later on examine how the sequence of past shocks to these exogenous trade costs impact trade flows today.

Given the forward-looking behavior of firms, it will come in handy to introduce the following notation

$$\begin{aligned} \tilde{f}_{ei}^t &:= \left( f_{ei} \sum_{\varsigma=t}^{\infty} \mathbb{E}_t [w_i^\varsigma R_i^{t,\varsigma}] \right) \left( \sum_{\varsigma=t}^{\infty} \mathbb{E}_t [R_i^{t,\varsigma}] \right)^{-1} \\ \tilde{f}_{ij}^t(\lambda) &:= \left( f_{ij} \sum_{\varsigma=t}^{\infty} f(\lambda + (\varsigma - t)) \mathbb{E}_t [w_i^\varsigma R_i^{t,\varsigma}] \right) \left( \sum_{\varsigma=t}^{\infty} \mathbb{E}_t [R_i^{t,\varsigma}] \right)^{-1}, \end{aligned}$$

where

$$R_i^{t,\varsigma} := \prod_{s=t}^{\varsigma} \frac{1 + r_i^t}{1 + r_i^s}$$

is the discount factor from period  $\varsigma \geq t$  to the beginning of period  $t$ . In words,  $\tilde{f}_{ei}^t$  is an annuity with time  $t$  present value equivalent to that of the upcoming stream of fixed entry costs payable by a firm that entered at time  $t$  or before. Similarly,  $\tilde{f}_{ij}^t(\lambda)$  is the

annuity for the stream of market access costs payable by a firm that accessed market  $j$  for the first time in period  $t - \lambda$ , and continuously served that market ever since.

With CES preferences, firms charge the well-known constant mark-up over marginal cost. A firm from country  $i$  selling to market  $j$  offers its product at a price

$$p_{ij}^t(\varphi) = \frac{\tau_{ij}^t w_i^t}{\varphi} \frac{\sigma}{\sigma - 1}, \quad (6)$$

and it earns variable profits equal to

$$\pi_{ij}^{v,t}(\varphi) = \frac{1}{\sigma} \left( \frac{\sigma}{\sigma - 1} \right)^{1-\sigma} (\tau_{ij}^t w_i^t)^{1-\sigma} (P_j^t)^{\sigma-1} X_j^t \varphi^{\sigma-1}, \quad (7)$$

where  $X_j^t$  denotes aggregate expenditure on the CES aggregator in country  $j$  as further characterized in Lemma 1 below. Analogous to the above, let  $\tilde{\pi}_{ij}^{v,t}(\varphi)$  denote an annuity that has the same time  $t$  present value as the infinite stream of variable profits associated with serving market  $j$  from period  $t$  onward.<sup>10</sup> Then, a firm in country  $i$  with productivity  $\varphi$  and tenure  $\lambda$  in market  $j$  will find it profitable to continue (or start in case of  $\lambda = 0$ ) serving  $j$  whenever

$$\tilde{\pi}_{ij}^{v,t}(\varphi) \geq \tilde{f}_{ij}^t(\lambda). \quad (8)$$

For a given  $\lambda$ , this allows defining a cutoff productivity similar to a canonical Melitz model. In particular, in any period  $t$ ,  $\pi_{ij}^{v,t}(\varphi)$  is increasing in  $\varphi$ , and hence so is  $\tilde{\pi}_{ij}^{v,t}(\varphi)$ . By contrast, for a given  $\lambda$ , the right-hand-side of condition (8) is independent of the firm. Accordingly, we can define a cutoff productivity  $\underline{\varphi}_{ij}^{\lambda,t}$  for firms in country  $i$  that started serving market  $j$   $\lambda$  periods ago. This cutoff is implicitly defined by

$$\tilde{\pi}_{ij}^{v,t}(\underline{\varphi}_{ij}^{\lambda,t}) = \tilde{f}_{ij}^t(\lambda), \quad (9)$$

i.e., firms with  $\varphi \geq \underline{\varphi}_{ij}^{\lambda,t}$  find it optimal to serve market  $j$ . In case  $\lambda = 0$ , they start serving the market, and equation (9) is analogous to the counterpart of the Melitz model. In case  $\lambda > 0$ , however, it is typically the case that the least productive firm with tenure  $\lambda$  has productivity  $\varphi > \underline{\varphi}_{ij}^{\lambda,t}$ . As a consequence, condition (8) is strictly non-binding for all such firms. This is because the right-hand side of equation (9) is (weakly) decreasing in  $\lambda$ . Therefore, all else equal, tenure in a market introduces a buffer between future profits and future market access costs. This buffer gives rise to tenure effects in aggregate trade.

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<sup>10</sup>In principle, it is possible for a firm to anticipate its own market exit in the future. However, as we will show in Section 5, this will not be the case in equilibrium. Firms either exit at time  $t = 0$  or they expect to be operating forever.

As long as firms can make positive profits from entering, they will do so. Free entry then requires that in every period the expected profits from entering in country  $i$  must be non-positive, and they must be exactly equal to zero in every period with strictly positive entry. Using the fact that  $(\tilde{\pi}_{ij}^{v,t}(\varphi)/\tilde{\pi}_{ij}^{v,t}(\underline{\varphi}_{ij}^{0,t})) = (\varphi/\underline{\varphi}_{ij}^{0,t})^{\sigma-1}$  and equation (9), we obtain the following free entry condition

$$\sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,t}}^{\infty} \left[ \left( \frac{\varphi}{\underline{\varphi}_{ij}^{0,t}} \right)^{\sigma-1} - 1 \right] \tilde{f}_{ij}^t(0) g(\varphi) d\varphi \begin{cases} \leq \tilde{f}_{ei}^t & \text{if } M_{ei}^t = 0 \\ = \tilde{f}_{ei}^t & \text{if } M_{ei}^t > 0 \end{cases}, \quad (10)$$

where  $M_{ei}^t$  denotes the mass of entrants in period  $t$ .

**Sequence of events.** Before analyzing the equilibrium in Section 5, it is instructive to clarify the sequence of events in our economy. In any period  $t$ , the government first announces changes to the (exogenous) trade environment, if there are any. As all such changes are unanticipated, this will result in an instantaneous updating of all asset values in the economy and of future expectations. We use  $\mathbb{E}_t$  to denote time- $t$  expectations *after* this updating has occurred. Analogously,  $a_i^t, r_i^t$  (and firm values detailed in the appendix) capture updated values *after* announcement. Finally, firms simultaneously decide on their production and exporting, households on their consumption and savings, prices are determined, and all markets clear.

## 5 Equilibrium

In this section, we derive the equilibrium in our economy. We start with some preliminary considerations on aggregate demand, adjustments to trade cost shocks, and firm entry. We then derive gravity equations, first for the case of simultaneous trade liberalizations, and then for the general case of sequential liberalizations.

### 5.1 Preliminary Considerations

In our model, aggregate demand on the CES aggregator comprises household expenditure on consumption plus a share of firm expenditure on fixed market access costs, which are both time varying. Yet, in the absence of future entry or changes in firms' market access strategies, aggregate demand in country  $i$  is a constant-over-time multiple of its wage rate. In particular, firms in our economy are identified by a triple  $(i, s, \varphi)$ . Accordingly, let  $\mathcal{I}^t(i, s, \varphi)$  denote the set of destinations that the firm with productivity  $\varphi$  that was born in period  $s$  in country  $i$  serves in period  $t \geq s$ . With this notation, we can show the following:



**Lemma 1** *Aggregate—firm plus household—expenditure in country  $i$  on the CES aggregator is given by*

$$X_i^t = \frac{\sigma}{\sigma - 1} w_i^t \left[ L_i - \sum_{s=0}^t \left[ M_{ei}^s \left[ f_{ei} + \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i,s,\varphi)} f_{ij} g(\varphi) d\varphi \right] \right] \right]. \quad (11)$$

**Proof** See Appendix A.1. □

The intuition behind Lemma 1 is as follows. The value of the firms, and with it the aggregate asset, changes over time for two reasons. First, due to any unanticipated shocks to the trade environment which may trigger entry, exit, and in general will impact the net present value of domestic firms. Second, due to the time-varying component of fixed market access cost. Potential shocks to expected future earnings of firms simply represent a valuation gain (or loss) on the aggregate asset, and they are therefore one-for-one reflected in households' asset holdings. As opposed to that, time-varying fixed costs are associated with net investments by the representative household. In equilibrium, however, any variations over time in households' net investments are offset by variations over time in the fixed cost of the firms. As a consequence, they do not have a direct effect on aggregate demand.

Lemma 1 implies that—with a constant set of operating firms—aggregate expenditure in country  $i$  is a constant-over-time multiple of the wage rate, analogous to the canonical Melitz model. In our model, this implies that in response to a shock all prices and trade flows adjust in the period of the shock and are constant thereafter.

**Lemma 2** *Let there be a shock to trade costs at time  $t$ . Then firm sales, prices, wages, and interest rates adjust at time  $t$ , and remain constant thereafter.*

**Proof** See Appendix A.2. □

Firms are forward-looking in their entry and market access decisions. Nevertheless, the equilibrium is highly tractable thanks to Lemmata 1 and 2. These lemmata imply that entry and market-access costs are exogenously given multiples of the wage rate

$$\begin{aligned} \tilde{f}_{ei}^t &= f_{ei} w_i^t \\ \tilde{f}_{ij}^t(0) &= f_{ij} w_i^t \tilde{f}(0), \end{aligned}$$

where

$$\tilde{f}(0) := \left[ \sum_{\lambda=0}^{\infty} f(\lambda) \left( \frac{1}{1+r} \right)^\lambda \right] \frac{r}{1+r}.$$

is an annuity for the tenure-dependent multiplier of market access costs, evaluated at the equilibrium interest rate  $r := \frac{1}{\beta} - 1$ . In turn, this allows solving for the mass of entering firms.

**Lemma 3** *All firms are born at  $t = 0$ . The mass of entrants in country  $i$  is*

$$M_{ei}^0 = \frac{L_i}{f_{ei}} \frac{\tilde{f}(0)(\sigma - 1)}{(\sigma - 1) [(\theta + 1)\tilde{f}(0) - 1] + \theta}, \quad (12)$$

**Proof** See Appendix A.3. □

According to Lemma 3, all firms enter at  $t = 0$  (the very first period). Intuitively, this is because the mass of entering firms is independent of the trade environment, analogous to the canonical Melitz model with fixed market access cost in terms of labor and a Pareto distribution of firm productivities. In fact, with  $f(\lambda) = 1 \forall \lambda$ , and therefore  $\tilde{f}(0) = 1$ , equation (12) reduces to the well-known expression for the canonical Melitz model with free entry (Melitz and Redding, 2014). With  $\tilde{f}(0) > 1$ , there are more entrants, reflecting the fact that with higher costs of market access, fewer firms will find it profitable to start operating.<sup>11</sup>

With these insights at hand, we will now characterize equilibrium trade flows. We begin with considering the case of trade opening to all countries at time  $t = 0$ , which is the counterpart of the canonical Melitz model and will form our benchmark for the analysis of sequential liberalizations below.

## 5.2 Gravity Equation

Our theory gives rise to a gravity equation for aggregate trade flows, as we now explain.

**Simultaneous trade liberalization.** To highlight the importance of incumbency effects for aggregate trade, it is instructive to first consider the special case where all trade costs are determined at time  $t = 0$  and then held constant forever. In particular, from the previous section we know that all firms enter at  $t = 0$  (Lemma 3), and that the equilibrium is constant over time (Lemma 2). As a consequence, all market entry is simultaneous and incumbency effects—which are our main focus here—trivially have

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<sup>11</sup>Fixed cost of market access feed back into the mass of entrants in our model because they are partly paid in terms of the CES aggregator. In equilibrium, this implies that labor demand of the average operating firm is smaller when compared to the labor demand involved in entering, which translates into a larger labor-market-clearing mass of entering firms. See Appendix A.3 for further details.

no impact on trade flows. Indeed, the following proposition shows that in this special case, the gravity equation is identical to the one in the canonical Melitz model.

**Proposition 1** *Let  $\tau_{ij}^\varsigma = \tau_{ij}$  for all  $0 \leq \varsigma \leq t$ . Then time- $t$  bilateral trade shares are given by*

$$\frac{X_{ij}^t}{X_j^t} = \frac{\frac{L_i}{f_{ei}} (\tau_{ij})^{-\theta} (w_i^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{ij})^{\frac{\sigma-1-\theta}{\sigma-1}}}{\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (\tau_{kj})^{-\theta} (w_k^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{kj})^{\frac{\sigma-1-\theta}{\sigma-1}}}. \quad (13)$$

**Proof** See Appendix A.4. □

According to Lemma 2, in the absence of further shocks, all prices and firms' market access strategies are constant over time and, hence, so are bilateral trade shares. With Proposition 1 as our benchmark, we now turn to characterizing the general case of sequential trade liberalizations.

**Gravity with history.** In an economy with sequential trade liberalizations, the order of trade openings matters for trade flows today. This is because pioneering firms have sunk investments in market access, and they are therefore less prone to exit a market upon trade liberalizations. In aggregate, this implies that—*ceteris paribus*—countries who started trading earlier trade more today, as we now explain.

Suppose there is a trade shock at time  $t \geq 0$ . Then, there is a unique productivity cutoff  $\underline{\varphi}_{ij}^t$  such that all firms in  $i$  with productivity  $\varphi \geq \underline{\varphi}_{ij}^t$  serve  $j$  at  $t$ , while all firms with  $\varphi < \underline{\varphi}_{ij}^t$  do not.<sup>12</sup> Incumbency effects may, however, imply that the cutoff firm is *not* indifferent between serving market  $j$  or not. To analyze equilibrium trade flows in our economy, it will therefore be convenient to introduce a (hypothetical) tenure level  $\hat{\lambda}_{ij}^t$  such that

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t) = w_i^t f_{ij} \tilde{f}(\hat{\lambda}_{ij}^t). \quad (14)$$

In words,  $\hat{\lambda}_{ij}^t$  is the tenure level with which the least productive firm that serves  $j$  from  $i$  would just be indifferent to exiting. In response to a sufficiently large positive shock (e.g., a drop in trade barriers), there is market entry, implying that  $\hat{\lambda}_{ij}^t = 0$ . Incumbency effects have no direct impact on  $i$ 's exports to  $j$  in this case, because all firms serving  $j$  from  $i$  would also have done so without market tenure. By contrast, in response to a sufficiently large negative trade shock, some firms from  $i$  stop serving market  $j$ . In that case,  $\hat{\lambda}_{ij}^t$  is exactly equal to the time- $t$  tenure of the least productive

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<sup>12</sup>This is true for an arbitrary sequence of trade liberalizations because at all times firms with a higher productivity earn higher variable profits and, hence, they must have a weakly longer tenure in that market. Recall that there is only one firm cohort (Lemma 3).

firm that continues to serve  $j$ ,  $\lambda_j^t(i, 0, \varphi_{ij}^t)$ . In general, we have  $\hat{\lambda}_{ij}^t \in [0, \lambda_j^t(i, 0, \varphi_{ij}^t)]$ .  $\hat{\lambda}_{ij}^t$  indicates the minimum tenure level needed to sustain the level of aggregate trade from  $i$  to  $j$  after the shock. We will henceforth simply refer to  $\hat{\lambda}_{ij}^t$  as the *tenure effect* in trade from  $i$  to  $j$ .

**Proposition 2** *For any history of trade liberalizations, suppose that at time  $t$  there is a shock to the trade environment. Then bilateral trade shares are*

$$\frac{X_{ij}^t}{X_j^t} = \frac{\frac{L_i}{f_{ei}} (\tau_{ij}^t)^{-\theta} (w_i^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{ij} \tilde{f}(\hat{\lambda}_{ij}^t))^{\frac{\sigma-1-\theta}{\sigma-1}}}{\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (\tau_{kj}^t)^{-\theta} (w_k^t)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{kj} \tilde{f}(\hat{\lambda}_{kj}^t))^{\frac{\sigma-1-\theta}{\sigma-1}}} \quad \forall i, j, \quad (15)$$

where  $\hat{\lambda}_{ij}^t$  is as defined in equation (14) and measures the tenure effect in trade from  $i$  to  $j$ . In the absence of further shocks, trade shares remain unchanged in future periods.

**Proof** See Appendix A.5. □

Proposition 2 carries the main message of our paper. It generalizes the basic insight from our simple example in Section 3 to a world with many, asymmetric countries and forward-looking firms. Specifically, it shows how aggregate trade flows are not only influenced by trade costs today, as captured by  $\tau_{ij}^t$  and  $f_{ij}$ , but also by the history of trade liberalizations that resulted in today's trade costs. The latter effect is summarized by the terms  $\tilde{f}(\hat{\lambda}_{kj}^t)$  in equation (15). This term implies that, ceteris paribus, countries trade more with each other if they liberalized earlier, as  $\tilde{f}(\hat{\lambda}_{ij}^t)$  is smaller for these relations. This is because firms with longer tenure in a market are less prone to exit in response to a negative trade shock.<sup>13</sup>

## 6 Empirical Application

In the previous sections, we have shown how tenure effects imply that the history of trade liberalizations can have lasting effects on international trade. In this section, we provide suggestive evidence that is in line with this theoretical prediction. A key benefit of our analysis is that it gives rise to a gravity equation for trade flows. In turn, this makes the tenure effects very transparent, and allows contrasting our results with the large theoretical and empirical literature that is centered on gravity equations. To that end, we begin our empirical analysis with running standard gravity regressions in Section 6.1, but where we exploit two historical events: colonial ties and the fall of

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<sup>13</sup>Note that if  $\hat{\lambda}_{ij}^t$  is the same across all exporters  $i$ , equation (15) reduces to the standard gravity equation (13).

the Iron Curtain. Across a series of robustness checks, we find lasting effects of these historic events on trade flows today. While this is in line with our theory, there are channels other than tenure effects through which these events may impact trade today. In Section 6.2, we therefore corroborate our findings by inspecting the underlying mechanisms. Specifically, we derive a structural expression for the response of average firm sales to trade liberalizations, and how they depend on tenure. We estimate this using data from the World Bank’s Exporter Dynamics Database. The data for both exercises are described in Appendix C.1.

## 6.1 Tenure Effects and Gravity

**Theory and estimation.** As shown in Proposition 2, our theory gives rise to a gravity equation for bilateral trade. This equation can be estimated following standard steps from the literature. In particular, taking logs of equation (15), rearranging terms, and omitting time superscripts for simplicity, we obtain

$$\log(X_{ij}) = \overbrace{\log\left(\frac{L_i}{f_{ei}}(w_i)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}}\right)}^{\equiv E_i} + \overbrace{\log\left(X_j \left[\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (\tau_{kj})^{-\theta} (w_k)^{\frac{\sigma-1-\sigma\theta}{\sigma-1}} (f_{kj} \tilde{f}(\hat{\lambda}_{kj}))^{\frac{\sigma-1-\theta}{\sigma-1}}\right]^{-1}\right)}^{\equiv M_j} - \left[ \overbrace{\theta \log(\tau_{ij})}^{TC_{var}} + \overbrace{\frac{\theta - (\sigma - 1)}{\sigma - 1} \log(f_{ij})}^{TC_{fix}} + \overbrace{\frac{\theta - (\sigma - 1)}{\sigma - 1} \log(\tilde{f}(\hat{\lambda}_{ij}))}^{history} \right]. \quad (16)$$

Equation (16) additively separates bilateral trade into exporter-specific terms, importer-specific terms, bilateral (fixed and variable) trade costs, and a bilateral tenure term. We estimate this equation, using data on bilateral trade flows (cf. Appendix C.1 for details on the data). To control for exporter- and importer-specific terms, we include exporter ( $E_i$ ) and importer fixed effects ( $M_j$ ), respectively. To control for variable and fixed trade costs, we use standard proxies: the log of geographic distance, the absolute log-difference in GDP per capita, and dummies for contiguity, common language, common currency, a free trade agreement, and common legal origin, respectively.

The key novelty of our paper—and the main focus of our analysis—is the last summand in equation (16). This term implies that it is not sufficient to control for barriers to trade today, but that we need to take into account the history of trade liberalizations as well. Our theory suggests that—due to incumbency effects—trade relations which liberalize later tend to have relatively lower trade flows today. To analyze whether

this theoretical prediction is in line with the data, we would ideally have measures of pair-specific aggregate tenure levels. We are not aware of convincing such measures, and, in either case, they may suffer from endogeneity, as we would expect countries to liberalize earlier with more attractive trading partners. We therefore exploit two sets of historical events with arguably major effects on the history of trade: Colonial ties and the fall of the Iron Curtain. Colonial ties are a common control variable in the literature, and our theory may help interpreting corresponding long-lasting consequences, which we also find in our estimation below.

The focus on the Iron Curtain is—to our knowledge—new. Specifically, we consider trade between pairs of countries that have been on different sides of the Iron Curtain during the Cold War.<sup>14</sup> This provides a relevant set-up for our purposes for two reasons. First, the Iron Curtain was a major impediment to international trade, and its fall was associated with a dramatic shift in the trade environment (cf. Figure C.2 of Appendix C.2). Second, the original trade barriers—as well as the subsequent liberalization—between members and non-members of the Comecon were mostly a matter of geopolitics rather than a matter of strategic trade policy.

To analyze the effects of these historic events on trade today, we include two dummies as additional controls in our gravity regression: a dummy that indicates whether  $(i, j)$  had colonial ties,  $\mathbb{1}[\text{Colonial Ties}]_{ij}$ , and a dummy that indicates whether  $(i, j)$  had been separated by the Iron Curtain,  $\mathbb{1}[\text{Sep. by Iron Curtain}]_{ij}$ , where  $\mathbb{1}[\cdot]$  is the indicator function that takes on value of 1 if the term in brackets is true and 0 otherwise. We consider countries to have colonial ties if they had a colonial relationship or a common colonizer after 1945 according to the [CEPII Gravity database](#). In summary, we run the following regression

$$\begin{aligned} \log(X_{ij}) &= E_i + M_j + \zeta'_{ij}\boldsymbol{\beta} + \phi_1 \times \mathbb{1}[\text{Sep. by Iron Curtain}]_{ij} \\ &\quad + \phi_2 \times \mathbb{1}[\text{Colonial Ties}]_{ij} + v_{ij}, \end{aligned} \tag{17}$$

where  $\zeta_{ij}$  is a (column) vector of the controls for bilateral trade frictions, and  $v_{ij}$  is an error term. The remaining variables are as previously discussed. Our main coefficients of interest are  $\phi_1$  and  $\phi_2$ , which measure the semi-elasticity for the Iron-Curtain and Colonial-Ties indicator, respectively. Our theory predicts  $\phi_1 < 0$  and  $\phi_2 > 0$ . We run this regression for 2015 using OLS, and cluster standard errors at both the importer

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<sup>14</sup>We classify countries as having been behind the Iron Curtain if they were members of the Council for Mutual Economic Assistance (Comecon). The (full) members of this economic association were Albania, Bulgaria, Cuba, Czechoslovakia, East Germany, Hungary, Mongolia, Poland, Romania, the Soviet Union, and Vietnam (cf. [Encyclopædia Britannica](#)).

and the exporter level.<sup>15</sup> A robustness check using PPML is provided in the Online Appendix, Table O.C.5.

**Results.** The results are summarized in Table 1. The full set of coefficients is reported in the Online Appendix, Table O.C.3. The left-most column shows the coefficient on our two indicators of interest, controlling only for distance, contiguity, and the fixed effects. The second column depicts the outcome from including our full set of controls. The main insight from these results is twofold. First, country pairs that were separated by the Iron Curtain trade substantially less even 25 years after the fall of the Iron Curtain, while country pairs connected through colonial ties trade substantially more. The point estimate for the Iron Curtain indicator in column (2), for example, implies that countries that were separated by the Iron Curtain trade about 47 percent ( $\approx 1 - \exp(-.63)$ ) less today, controlling for standard trade frictions. Second, most of the suggested discrepancies are not picked up by standard gravity controls, suggesting that these historic events have effects on trade that are orthogonal to conventional proxies for bilateral frictions.

Our theory provides a mechanism that can explain these patterns, as both the Iron Curtain and colonial ties have had a major impact on past trade flows. There may, however, likely be other effects at play. In particular, both colonial ties and the Iron Curtain may plausibly impact pair-specific trade policy and transport costs even today. In columns (3) to (6) we seek to control for these. In column (3), we control for trade policy, by including average tariffs and non-tariff measures (in addition to the RTA dummy). In column (4) we further proxy for trade costs by adding the CIF/FOB ratio from *ITIC*. Adding these controls has little effect on our main coefficients of interest. Finally, in column (6), we take a different approach: We consider trade via sea or air transport only, using data from *Comext*. The idea being that such trade should not be affected by pair-specific investments in transportation infrastructure. The *Comext* dataset reports trade between EU members and non-members only. In column (5) we therefore repeat our baseline regression using this dataset as a reference point. Comparing columns (5) and (6) reveals that the coefficient on colonial ties is virtually unaffected, while that on the Iron Curtain is smaller when looking at sea and air trade only. Still, the point estimate suggests that trade between pairs of countries that were

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<sup>15</sup>We exclude former Yugoslavia countries, since these countries were (economically) close to both Iron Curtain and other non-Iron Curtain countries. The overall share of relations where the separation indicator equals one is around 23%.

Table 1: Gravity Regressions, Year 2015, OLS

	Main Specification		Robustness			
	(1)	(2)	(3)	(4)	(5)	(6)
Sep. by Iron Curtain	-0.572*** (0.096)	-0.628*** (0.099)	-0.572*** (0.090)	-0.553*** (0.087)	-0.930*** (0.142)	-0.418*** (0.124)
Colonial Ties	0.781*** (0.095)	0.534*** (0.096)	0.507*** (0.096)	0.497*** (0.098)	0.949*** (0.232)	0.935*** (0.240)
Baseline Controls		✓	✓	✓	✓	✓
Tariffs & NTMs			✓	✓		
CIF/FOB Ratio				✓		
Comext Data					✓	✓
Mean of Dep. Var.	2.469	2.682	2.742	2.918	2.347	2.024
Adj. R-squared	0.737	0.765	0.782	0.796	0.802	0.799
Nr. of Observations	19,847	17,153	16,195	14,511	6,954	6,849

*Notes.* This table reports OLS results for regression (17). Standard errors clustered at both the importer and exporter levels are reported in parentheses. All regressions include importer and exporter fixed effects. “Sep. by Iron Curtain” refers to a dummy variable equal to one if the country pair was historically separated by the Iron Curtain and zero otherwise (see footnote 14). “Colonial Ties” refers to a dummy variable equal to one if the country pair either had a colonial relationship or a common colonizer after 1945. Dependent variable is the log of aggregate trade flows, measured in million USD (columns (1) to (4)) or Euros (columns (5) and (6)). Additional controls have been added as indicated in the respective column, but are not shown for clarity. A long table with coefficients on all controls is provided in the Online Appendix, Table O.C.3. In column (1) only the log-distance, weighted by population, and a dummy for contiguity are included as additional controls. The “baseline controls” in columns (2) to (6) further include the absolute log-difference in GDP per capita, and dummies for common language, common currency, a free trade agreement, and common legal origin, respectively. “Tariffs” is the log of the simple average of bilateral gross tariffs. “NTMs” refers to non-tariff measures. “CIF/FOB Ratio” is the ratio of CIF to FOB prices. Columns (5) and (6) use data from [Comext](#). Column (6) includes only trade via air or sea transport.

\* significant at 10%-level; \*\* significant at 5%-level; \*\*\* significant at 1%-level.

*Data source.* [Atlas of Economic Complexity](#) (trade data), [CEPII/Head et al. \(2010\)](#) (covariates), [WITS](#) (import tariffs), [GTA](#) (NTMs), [ITIC](#) (CIF/FOB), [Comext](#) (trade data in (5)–(6)).

*Results.* Authors’ computations.

separated by the Iron Curtain during the Cold War is about 35% lower today, even when looking at sea and air trade only.<sup>16</sup>

In summary, these regressions point to sizable, long-lasting, and pair-specific implications of history for trade that seem not to be captured by conventional proxies for trade frictions or be entirely attributable to differences in pair-specific transportation infrastructure. These differences call for a better understanding. Our theory provides one channel that can help explain such patterns: incumbency effects that may pre-

<sup>16</sup>In Figure C.3 of Appendix C.2 we reproduce the coefficients of interest from our main specification (column (2) in Table 1) for each of the years 1995 to 2015 separately. While both coefficients attenuated at the beginning of the period, they remained remarkably stable since the early 2000s, pointing to persistent differences, in line with our theory.



vent firm entry and exit upon trade liberalizations. Yet, our Iron Curtain and colonial ties dummies likely capture other effects as well. We therefore turn to our underlying mechanism next.

## 6.2 Average Firm Sales

In our model, history matters for trade flows today because market access costs decline with tenure, implying that there is less exit and entry in response to a trade shock. We cannot directly observe the fixed market access costs. In this section, we therefore exploit the structure of our model and use average firm sales to provide indirect evidence in support of these effects.

**Theory and estimation.** In our model, there is a tight connection between the fixed costs of serving a market and the average firm sales in that market, analogous to the canonical Melitz model. In particular, it is straightforward to show—see Appendix B—that average firm sales from country  $i$  to  $j$  in period  $t$ ,  $\bar{r}_{ij}^t$ , are equal to

$$\bar{r}_{ij}^t = \frac{\sigma\theta}{\theta - (\sigma - 1)} f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^t), \quad (18)$$

where, recall,  $\hat{\lambda}_{ij}^t$  captures the *tenure effect* in trade from  $i$  to  $j$ . Taking log-differences yields

$$\Delta \log [\bar{r}_{ij}^t] = \Delta \log [w_i^t] + \Delta \log [\tilde{f}(\hat{\lambda}_{ij}^t)] \quad \forall (i, j) \in \mathcal{I} \times \mathcal{I} \quad (19)$$

where  $\Delta \log(x^t) := \log(x^t) - \log(x^{t-1})$ . Now, suppose that at time  $t$  there is a drop in  $\tau_{ij}^t$  for some country  $i \in \mathcal{I}$ . Then, controlling for exporter wages (and market size in the destination),  $\tilde{f}(\hat{\lambda}_{ij}^t)$  weakly increases. This is because in the wake of a positive trade shock, the profit potential of firms from  $i$  in  $j$  increases. Hence, incumbency effects are less important for the decision of firms from  $i$  to serve  $j$ . In fact, in response to a sufficiently large positive shock there is market entry by new firms (who do not have any incumbency advantages), and tenure has no direct effect on trade from  $i$  to  $j$ . In our model, this is reflected in larger average firm sales. This is in contrast to the canonical Melitz model, where controlling for general equilibrium effects on wages, a shock to  $\tau_{ij}$  would not impact average firm sales.

The key advantage of equation (19) is that it allows studying these mechanisms using data on average firm sales, which we combine with data average tariffs at the HS2-digit level—the “sector” level (cf. Appendix C.1 for details on the data). We then

study the implications of tariff cuts on average firm sales at the exporter-importer-sector level. We consider tariff changes, as they are arguably an observed shock to  $\tau_{ij}$  without an (obvious) effect on  $f_{ij}$ .<sup>17</sup> In Online Appendix O.B, we consider a more general event instead: the EU Eastern enlargement. This analysis confirms our main insights presented here.

To test whether average firm sales from  $i$  to  $j$  increase in response to a tariff cut, we consider country pairs with sizable tariff cuts and compare these to country pairs with non-negative tariff changes. The latter allows controlling for general exporter and importer trends as suggested by our theory. To include only relatively large tariff changes, we consider tariff cuts in the top quartile of all tariff reductions in our baseline specification. This yields a still fairly modest cutoff of  $-2.3\%$ , with a mean decline of gross tariffs of  $6.7\%$ . In order to mitigate concerns regarding mid-year reporting, we further consider changes in average firm sales from  $t$  to  $t+2$  in response to a tariff cut at  $t$ .<sup>18</sup> We then estimate the following empirical counterpart of equation (19)

$$\begin{aligned} \Delta^2 \log \left[ \bar{r}_{ij,g}^{t+2} \right] &= \phi \times \mathbb{1}[\text{Tariff Cut in the Top Quartile from } t \text{ to } t+1]_{ij,g} \\ &\quad + E_{i,g}^{t+2} + M_{i,g}^{t+2} + \varepsilon_{ij,g}^{t+2}, \end{aligned} \quad (20)$$

where a subscript  $_g$  denotes sector  $g$ ,  $\Delta^2 \log \left[ \bar{r}_{ij,g}^{t+2} \right] := \log \left[ \bar{r}_{ij,g}^{t+2} \right] - \log \left[ \bar{r}_{ij,g}^t \right]$  is the log-change in average firm sales from  $t$  to  $t+2$ , and  $E_{i,g}^{t+2}$  and  $M_{i,g}^{t+2}$  are exporter-sector-year and importer-sector-year fixed effects to capture exporter-sector trends in production costs and importer-sector trends in market size.  $\varepsilon_{ij,g}^{t+2}$  is an error term. The coefficient of interest is  $\phi$ . The previous discussions imply that in response to the tariff cut incumbency effects should become less important and, hence, our theory predicts  $\phi > 0$ . We estimate (20), and cluster the standard errors at the exporter-sector, importer-sector, and exporter-importer levels.

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<sup>17</sup>One potential concern could be the introduction of a free trade agreement between two parties, which often requires additional effort for firms to benefit from preferential tariffs. To alleviate this concern we keep for each exporter only those destinations where the exporter’s preferential status did not change within our period of analysis. For instance, when we look at changes of average firm sales from year  $t$  to  $t+2$ , the exporter either has preferential tariffs throughout  $t$  to  $t+2$ , or it faces MFN tariffs for this entire time span.

<sup>18</sup>This implies that we need to define how tariffs can evolve from  $t+1$  to  $t+2$  for the “treatment” (with tariff cut of at least  $2.3\%$  at time  $t$ ) and the control groups (with non-negative tariff changes at  $t$ ). We allow for a partial rebound of up to one third of the tariff reduction between  $t+1$  and  $t+2$  for the “treatment group,” and omit observations where average tariffs recover by more than that. Moreover, we verify that the observations in the “control group” did not experience any tariff cuts between  $t-1$  and  $t+2$ , where  $t-1$  is also chosen because of potential mid-year reporting effects. All importer-exporter-sector-year observations that did not meet either of these criteria were excluded from the sample. We use “treatment” and “control group” for ease of reference, which should not indicate that we claim to estimate a causal effect of tariff reductions.

**Results.** Table 2 presents the results. The first three columns in the top panel depict the coefficients from our main specification with sector-year FEs, exporter-sector-year FEs, and both exporter-sector-year and importer-sector-year FEs, respectively. The coefficient of interest is stable and statistically significantly larger than zero throughout, as our model predicts. Through the lens of our model, the point estimates suggest that (relatively large) tariff cuts are associated with an 8% relative decline in the importance of incumbency effects for trade from  $i$  to  $j$ , in accordance with our predictions. In other words, the benefit from the drop in  $\tau_{ij}$  was partly offset by a relative increase in  $\tilde{f}(\hat{\lambda}_{ij})$ .

To conclude, we present several robustness tests (columns (4)–(10) in Table 2). In column (4) we apply 90% winsorizing to our dependent variable to test whether our results are driven by few large changes in average firm sales. This somewhat reduces our estimate but leaves it within one standard error deviation from our main coefficient in the third column. We also control for exporter-importer-year-specific trends, the results of which are reported in the fifth column of the top panel. The coefficient is still in the same ballpark, although the standard error increases substantially. This is due to the fact that there is little variation in our tariff indicator within a country pair in a given year across sectors.<sup>19</sup> In the bottom panel we document the sensitivity of our results with respect to (i) the time span we choose to measure the growth in average firm sales, and (ii) how long the reference group without tariff cuts should maintain at least the same tariff level. The results look similar in all specifications, with the coefficient slightly increasing for longer time horizons.<sup>20</sup> Additional robustness checks with respect to our data cleaning and variable definitions are provided in Tables O.C.6 and O.C.7 of the Online Appendix.

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<sup>19</sup>Only about 1% of the observations in the regression sample have variation in the treatment dummy within all three sets of fixed effects.

<sup>20</sup>Boehm et al. (2020) document that tariff changes at the HS6-digit level have a ramp-up phase of up to seven years. Unfortunately, average tariffs at the sector level fluctuate substantially more often than those at the product level, and thus our aggregation level impedes investigating tariff shocks over such a long time span.

Table 2: Impact of Tariff Changes on Average Firm Sales

Dep. Var.: Log-Change in Av. Firm Sales from $t$ to $t+2$					
Control Group: No Tariff Cuts from $t-1$ to $t+2$					
	Main Specification			Robustness	
				90% Wins.	Pair-Year FE
$\mathbb{1}[\text{Tariff Cut}]$	0.098*** (0.016)	0.089*** (0.016)	0.075** (0.033)	0.059** (0.026)	0.063 (0.072)
Sector-Year FE	✓				
Exp-Sector-Year FE		✓	✓	✓	✓
Imp-Sector-Year FE			✓	✓	✓
Mean of Dep. Var.	0.094	0.093	0.091	0.090	0.089
Adj. R-squared	0.023	0.081	0.091	0.100	0.106
Nr. of Observations	191,979	187,429	151,694	151,694	145,762
Dep. Var.: Log-Change in Av. Firm Sales from $t$ to $t+\bar{t}$					
Control Group: No Tariff Cuts from $t-\underline{t}$ to $t+\bar{t}$					
	Robustness				
	$\bar{t}=2, \underline{t}=0$	$\bar{t}=2, \underline{t}=2$	$\bar{t}=3, \underline{t}=1$	$\bar{t}=3, \underline{t}=2$	$\bar{t}=3, \underline{t}=3$
$\mathbb{1}[\text{Tariff Cut}]$	0.058** (0.029)	0.101*** (0.039)	0.108** (0.045)	0.131** (0.052)	0.141** (0.057)
Exp-Sector-Year FE	✓	✓	✓	✓	✓
Imp-Sector-Year FE	✓	✓	✓	✓	✓
Mean of Dep. Var.	0.100	0.082	0.121	0.103	0.093
Adj. R-squared	0.091	0.089	0.099	0.098	0.100
Nr. of Observations	187,631	124,313	108,518	88,235	73,128

*Notes.* This table reports OLS results from regressing log-changes in average firm sales on an indicator for relatively large tariff reductions, as described in Section 6.2. The regression is outlined in equation (20). Standard errors clustered at the exporter-sector, importer-sector, and exporter-importer levels are reported in parentheses. The full sample spans the years 1997–2014. The “treatment group” consists of observations with tariff reductions belonging to the top quartile of overall tariff cuts. The “control group” had non-negative changes in average tariffs between the years  $t - \underline{t}$  and  $t + \bar{t}$ . The analysis is conducted at the sector level (HS2-digit).

\* significant at 10%-level; \*\* significant at 5%-level; \*\*\* significant at 1%-level.

*Data source.* EDD (average firm exports), WITS (import tariffs).

*Results.* Authors’ computations.

## 7 Conclusion

In this paper, we have introduced incumbency effects into a Melitz model of international trade that nests the canonical (static) version of this model as a special case. We derive a gravity equation for international trade that shows how trade is not only shaped by trade frictions today—as typically assumed in the literature—, but also by the history of trade liberalizations. Our theory can thus help explain a home bias and, more generally, why historic events can have long-lasting implications for international trade. Our theoretical predictions are in line with the relevance of colonial ties and the

Iron Curtain for trade flows today, and with novel, indirect evidence on the response of fixed cost of exporting to trade liberalizations.

Our paper provides a first attempt to integrating sunk market access costs into a dynamic general equilibrium model of international trade with many asymmetric countries. In our model, the economy immediately jumps to a new steady state upon a trade liberalization. This allows introducing incumbency effects into the canonical (static) version of the Melitz model, while maintaining its tractability. Future work may set out to allow for richer dynamics, thereby providing additional insights on the persistence of incumbency effects in international trade.

## References

- Alessandria, G. and Choi, H. (2014). Establishment heterogeneity, exporter dynamics, and the effects of trade liberalization. *Journal of International Economics*, 94(2):207–223.
- Alessandria, G., Choi, H., and Ruhl, K. (2014). Trade Adjustment Dynamics and the Welfare Gains from Trade. Working Paper 20663, NBER Working Paper Series.
- Alessandria, G. A., Arkolakis, C., and Ruhl, K. J. (2020). Firm Dynamics and Trade. Working Paper 27934, NBER Working Paper Series.
- Allen, T. and Donaldson, D. (2020). Persistence and Path Dependence in the Spatial Economy. Technical Report w28059.
- Anderson, J. E. and van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American Economic Review*, 93(1):170–192.
- Arkolakis, C. (2010). Market Penetration Costs and the New Consumers Margin in International Trade. *Journal of Political Economy*, 118(6):1151–1199.
- Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New Trade Models, Same Old Gains? *American Economic Review*, 102(1):94–130.
- Arkolakis, C., Ramondo, N., Rodríguez-Clare, A., and Yeaple, S. (2018). Innovation and Production in the Global Economy. *American Economic Review*, 108(8):2128–73.
- Arping, S. and Diaw, K. M. (2008). Sunk Costs, Entry Deterrence, and Financial Constraints. *International Journal of Industrial Organization*, 26(2):490–501.
- Atkin, D., Costinot, A., and Fukui, M. (2021). Globalization and the Ladder of Development: Pushed to the Top or Held at the Bottom? Working Paper 29500. Series: Working Paper Series.
- Baldwin, R. (1988). Hysteresis in Import Prices: The Beachhead Effect. *The American Economic Review*, 78(4):773–785. Publisher: American Economic Association.
- Baldwin, R. and Krugman, P. (1989). Persistent Trade Effects of Large Exchange Rate Shocks. *The Quarterly Journal of Economics*, 104(4):635–654. Publisher: Oxford University Press.

- Boehm, C. E., Levchenko, A. A., and Pandalai-Nayar, N. (2020). The Long and Short (Run) of Trade Elasticities. Working Paper 27064, NBER Working Paper Series.
- Buera, F. J. and Oberfield, E. (2020). The Global Diffusion of Ideas. *Econometrica*, 88(1):83–114. [\\_eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA14044](https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA14044).
- Burstein, A. and Melitz, M. J. (2013). Trade Liberalization and Firm Dynamics. In *Advances in Economics and Econometrics Tenth World Congress. Applied Economics, Econometric Society Monographs.*, volume 2. Cambridge University Press, Cambridge, UK. DOI: 10.3386/w16960.
- Caliendo, L., Opromolla, L. D., Parro, F., and Sforza, A. (2020). Goods and Factor Market Integration: A Quantitative Assessment of the EU Enlargement. page 113.
- Caron, J., Fally, T., and Markusen, J. R. (2014). International Trade Puzzles: A Solution Linking Production and Preferences. *The Quarterly Journal of Economics*, 129(3):1501–1552.
- Chaney, T. (2005). Productivity Overshooting: The Dynamic Impact of Trade Opening with Heterogeneous Firms. Unpublished manuscript.
- Chaney, T. (2008). Distorted gravity: The intensive and extensive margins of international trade. *American Economic Review*, 98(4):1707–1721.
- Chen, N. (2004). Intra-National versus International Trade in the European Union: Why Do National Borders Matter? *Journal of international Economics*, 63(1):93–118.
- Costantini, J. A. and Melitz, M. J. (2007). The Dynamics of Firm-Level Adjustment to Trade Liberalization. In *The Organization of Firms in a Global Economy*. Harvard University Press, Cambridge, Ma.
- Das, S., Roberts, M. J., and Tybout, J. R. (2007). Market Entry Costs, Producer Heterogeneity, and Export Dynamics. *Econometrica*, 75(3):837–873.
- Dixit, A. (1989). Hysteresis, Import Penetration, and Exchange Rate Pass-Through. *The Quarterly Journal of Economics*, 104(2):205–228. Publisher: Oxford University Press.

- Eaton, J., Eslava, M., Krizan, C. J., Kugler, M., and Tybout, J. (2014). A Search and Learning Model of Export Dynamics. *mimeo*.
- Eaton, J., Eslava, M., Kugler, M., and Tybout, J. (2007). Export Dynamics in Colombia: Firm-Level Evidence. page 47.
- Eaton, J. and Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, 70(5):1741–1779.
- Eaton, J., Kortum, S., and Kramarz, F. (2011). An anatomy of international trade: Evidence from french firms. *Econometrica*, 79(5):1453–1498.
- Felbermayr, G., Teti, F., and Yalcin, E. (2019). Rules of origin and the profitability of trade deflection. *Journal of International Economics*, 121:103248.
- Fitzgerald, D., Haller, S., and Yedid-Levi, Y. (2016). How Exporters Grow. Working Paper 21935, NBER Working Paper Series.
- Goolsbee, A. and Syverson, C. (2008). How Do Incumbents Respond to the Threat of Entry? Evidence from the Major Airlines. *The Quarterly Journal of Economics*, 123(4):1611–1633.
- Head, K. and Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In Gopinath, G., Helpman, E., and Rogoff, K., editors, *Handbook of International Economics*, volume 4, chapter 3, pages 131–195. Elsevier.
- Head, K., Mayer, T., and Ries, J. (2010). The Erosion of Colonial Trade Linkages after Independence. *Journal of International Economics*, 81(1):1–14.
- Helpman, E., Melitz, M., and Rubinstein, Y. (2008). Estimating trade flows: Trading partners and trading volumes. *The Quarterly Journal of Economics*, 123(2):441–487.
- Impullitti, G., Irarrazabal, A. A., and Opromolla, L. D. (2013). A theory of entry into and exit from export markets. *Journal of International Economics*, 90(1):75–90.
- Krishna, K., Salamanca, C., Suzuki, Y., and Volpe Martincus, C. (2021). Learning to Use Trade Agreements. Working Paper 29319, NBER Working Paper Series.
- Manchin, M. and Pinna, A. M. (2009). Border Effects in the Enlarged EU Area: Evidence from Imports to Accession Countries. *Applied Economics*, 41(14):1835–1854.



- McCallum, J. (1995). National Borders Matter: Canada-U.S. Regional Trade Patterns. *The American Economic Review*, 85(3):615–623.
- Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. *Econometrica*, 71(6):1695–1725.
- Melitz, M. J. and Ottaviano, G. I. P. (2008). Market size, trade, and productivity. *The Review of Economic Studies*, 75(1):295–316.
- Melitz, M. J. and Redding, S. J. (2014). *Handbook of International Economics*, chapter Heterogeneous Firms and Trade, pages 1–54. Elsevier, 4 edition.
- Miao, G. and Fortanier, F. (2017). Estimating Transport and Insurance Costs of International Trade. Working Paper 2017/04, OECD Statistics Working Papers.
- Morales, E., Sheu, G., and Zahler, A. (2019). Extended Gravity. *The Review of Economic Studies*, 86(6):2668–2712.
- Noh, Y.-H. and Moschini, G. (2006). Vertical Product Differentiation, Entry-Deterrence Strategies, and Entry Qualities. *Review of Industrial Organization*, 29(3):227–252.
- Page, S. E. (2006). Path Dependence. *Quarterly Journal of Political Science*, 1(1):87–115.
- Redding, S. J. (2011). Theories of heterogeneous firms and trade. *Annual Review of Economics*, 3(1):77–105.
- Roberts, M. J. and Tybout, J. R. (1997). The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs. *The American Economic Review*, 87(4):545–564. Publisher: American Economic Association.
- Ruhl, K. J. and Willis, J. L. (2017). New Exporter Dynamics. *International Economic Review*, 58(3):703–726.
- Sampson, T. (2014). Selection into Trade and Wage Inequality. *American Economic Journal: Microeconomics*, 6(3):157–202.
- Schivardi, F. and Viviano, E. (2011). Entry Barriers in Retail Trade. *The Economic Journal*, 121(551):145–170.

- Tinbergen, J. (1962). *Shaping the World Economy. Suggestions for an International Economic Policy*. Twentieth Century Fund, New York, NY.
- Wolf, H. C. (2000). Intranational Home Bias in Trade. *Review of Economics and Statistics*, 82(4):555–563.
- Yi, K.-M. (2010). Can Multistage Production Explain the Home Bias in Trade? *American Economic Review*, 100(1):364–93.

# Appendix

## A Proofs

### A.1 Proof of Lemma 1

To derive the desired expression, note that aggregate expenditures in country  $i$  on the CES aggregator are equal to household consumption plus firm expenditure to cover the fixed cost of market access, i.e.,

$$X_i^t = X_i^{h,t} + X_i^{f,t}, \quad (\text{A.1})$$

where  $X_i^{h,t} := L_i x_i^t$  denotes aggregate household expenditure and  $X_i^{f,t}$  aggregate firm expenditure. The remainder of the proof proceeds in three steps. We first characterize household expenditure, then firm expenditure, and finally derive aggregate demand.

**Step 1.** Households in country  $i$  can invest in an aggregate asset comprising ownership of all domestic firms (entrants and operating firms).<sup>21</sup> Hence, asset markets are in equilibrium if we have

$$L_i a_i^t = V_i^t \quad (\text{A.2})$$

at all time  $t$ , where  $a_i^t$  denotes asset holdings of the representative household at the beginning of the period—after announcement of any potential changes to the trade environment but before payments of the per-period interest rate.  $V_i^t$  is the total value of all firms in country  $i$  as detailed momentarily. Using equation (A.2) in equation (3) yields

$$X_i^{h,t} = L_i w_i^t - \left[ \mathbb{E}_t \left[ \frac{V_i^{t+1}}{1 + r_i^{t+1}} \right] - V_i^t \right], \quad (\text{A.3})$$

i.e., in equilibrium households exactly absorb any changes in the value of the aggregate asset. With the rate of return on the aggregate asset given by equation (4), this is optimal.

The total value of all firms in country  $i$  at time  $t$  is given by

$$V_i^t \equiv \sum_{s=0}^t M_{ei}^s \int_{\varphi \in \Phi} v^t(i, s, \varphi) g(\varphi) d\varphi, \quad (\text{A.4})$$

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<sup>21</sup>We assume that households can invest in domestic firms only. This is to simplify the exposition, but not essential. In particular, in equilibrium, the interest rate is the same in all countries, which immediately implies that our equilibrium would also apply to a case with investment in a global asset.

where  $v^t(i, s, \varphi)$  denotes the value of firm  $(i, s, \varphi)$ , i.e., of a firm with productivity  $\varphi$  that entered country  $i$  in period  $s \leq t$ .  $M_{ei}^s$  denotes the mass of firms that entered in  $s$ .<sup>22</sup> This value is given by the present value of expected future earnings net of fixed costs

$$v^t(i, s, \varphi) = \mathbb{E}_t \left[ \sum_{\varsigma=t}^{\infty} \left[ -f_{ei}w_i^\varsigma + \sum_{j \in \mathcal{I}^\varsigma(i, s, \varphi)} \pi_j^\varsigma(i, s, \varphi) \right] R_i^{t, \varsigma} \right], \quad (\text{A.5})$$

where, recall,  $R_i^{t, \varsigma}$  is the discount factor from period  $\varsigma \geq t$  to the beginning of period  $t$ ,  $\mathcal{I}^\varsigma(i, s, \varphi)$  denotes the set of markets that the firm serves at time  $\varsigma$ , and

$$\pi_j^\varsigma(i, s, \varphi) := \pi_{ij}^{v, \varsigma}(\varphi) - f_{ij}^\varsigma(\lambda_j^\varsigma(i, s, \varphi)) \quad (\text{A.6})$$

are the firm's profits net of fixed market access cost from serving destination  $j$  in period  $\varsigma$ .  $\lambda_j^\varsigma(i, s, \varphi)$  denotes the firm's tenure in destination  $j$  at time  $\varsigma$ . Equation (A.5) can be written recursively as

$$\begin{aligned} \mathbb{E}_t \left[ \frac{v^{t+1}(i, s, \varphi)}{1 + r_i^{t+1}} \right] - v^t(i, s, \varphi) &= \sum_{\varsigma=t+1}^{\infty} \left\{ \mathbb{E}_t \left[ \left( -f_{ei}w_i^\varsigma + \sum_{j \in \mathcal{I}^\varsigma(i, s, \varphi)} \pi_j^\varsigma(i, s, \varphi) \right) R_i^{t, \varsigma} \right] \right. \\ &\quad \left. - \mathbb{E}_t \left[ \left( -f_{ei}w_i^\varsigma + \sum_{j \in \mathcal{I}^\varsigma(i, s, \varphi)} \pi_j^\varsigma(i, s, \varphi) \right) R_i^{t, \varsigma} \right] \right\} \\ &\quad - \left[ -f_{ei}w_i^t + \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \pi_j^t(i, s, \varphi) \right] \\ &= - \left[ -f_{ei}w_i^t + \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \pi_j^t(i, s, \varphi) \right]. \end{aligned} \quad (\text{A.7})$$

Combining equations (A.3), (A.4), and (A.7) yields

$$X_i^{h, t} = L_i w_i^t - \sum_{s=0}^t \left[ M_{ei}^s \left[ f_{ei}w_i^t - \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \pi_j^t(i, s, \varphi) g(\varphi) d\varphi \right] \right]. \quad (\text{A.8})$$

**Step 2.** The period- $t$  demand for the CES aggregator of firm  $(i, s, \varphi)$  is

$$\sum_{j \in \mathcal{I}^t(i, s, \varphi)} \left( f_{ij}^t(\lambda_j^t(i, s, \varphi)) - f_{ij}w_i^t \right).$$

Aggregating over all firms yields

$$X_i^{f, t} = \sum_{s=0}^t \left[ M_{ei}^s \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \left( f_{ij}^t(\lambda_j^t(i, s, \varphi)) - f_{ij}w_i^t \right) g(\varphi) d\varphi \right]. \quad (\text{A.9})$$

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<sup>22</sup>The value of the firm depends on the time of entry,  $s$ , because firms in country  $i$  with productivity  $\varphi$  that entered in different periods potentially face different fixed costs of market access and—a consequence—may find it optimal to serve different sets of destinations.

**Step 3.** Combining equations (A.1), (A.6), (A.8), and (A.9) and simplifying terms yields

$$X_i^t = L_i w_i^t - \sum_{s=0}^t \left[ M_{ei}^s \left[ f_{ei} w_i^t - \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} (\pi_{ij}^{v,t}(\varphi) - f_{ij} w_i^t) g(\varphi) d\varphi \right] \right].$$

Using equations (6), (7), labor market clearing in  $i$

$$L_i = \sum_{s=0}^t \left[ M_{ei}^s \left[ f_{ei} + \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \left( \frac{y_{ij}^t(\varphi) \tau_{ij}^t}{\varphi} + f_{ij} \right) g(\varphi) d\varphi \right] \right],$$

and total sales in  $j$ —conditional on serving the market—of a firm from  $i$  with productivity  $\varphi$

$$y_{ij}^t(\varphi) p_{ij}^t(\varphi) = p_{ij}^t(\varphi)^{1-\sigma} (P_j^t)^{\sigma-1} X_j^t,$$

yields after rearranging terms the expression in Lemma 1. □

## A.2 Proof of Lemma 2

Let there be a trade shock at time  $t$ . To show the desired result, we proceed in three steps. We first show that if (i) any potential firm entry in response to the shock is at time  $t$ , and (ii) all firms revise their market access decisions at time  $t$  and then continue following this decision, equilibrium wages, prices, and aggregate demand are constant over time. We then show that if all potential firm entry in response to the shock is at time  $t$ , all firms will indeed perpetually follow their initial market access decision. We finally show that in such case no firm has an incentive to enter at a later stage.

**Step 1.** With the trade shock at time  $t$  and no future changes in the trade environment, we have  $\tau_{ij}^\varsigma = \tau_{ij}^t$  for every  $i, j$ , and  $\varsigma \geq t$ . Similarly, with all firm entry in response to the shock (if any) at time  $t$  and all market access decisions fixed at time  $t$ , we have  $M_i^\varsigma = M_i^t := \sum_{s=0}^t M_{ei}^s$ , and  $\mathcal{I}^\varsigma(i, s, \varphi) = \mathcal{I}^t(i, s, \varphi) \forall (i, s, \varphi)$ . Hence,

$$Y_i^\varsigma = \sum_{s=0}^t \left[ M_{ei}^s \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \left( \frac{\sigma}{\sigma-1} \right)^{1-\sigma} (\tau_{ij}^t w_i^\varsigma)^{1-\sigma} (P_j^\varsigma)^{\sigma-1} X_j^\varsigma \varphi^{\sigma-1} g(\varphi) d\varphi \right], \quad (\text{A.10})$$

where  $(P_j^\varsigma)^{\sigma-1}$  is given by

$$(P_j^\varsigma)^{\sigma-1} = \left[ \sum_{i \in \mathcal{I}} \sum_{s=0}^t M_{ei}^s \int_{\varphi \in \Phi} \mathbb{1}[j \in \mathcal{I}^t(i, s, \varphi)] \left( \frac{\sigma}{\sigma-1} \frac{\tau_{ij}^t w_i^\varsigma}{\varphi} \right)^{1-\sigma} g(\varphi) d\varphi \right]^{-1}. \quad (\text{A.11})$$

$\mathbb{1}[\cdot]$  is an indicator function that takes on value one if the term in brackets is correct, and zero otherwise. Moreover, Lemma 1 implies

$$X_i^\varsigma = \frac{\sigma}{\sigma - 1} w_i^\varsigma \left[ L_i - \sum_{s=0}^t \left[ M_{ei}^s \left[ f_{ei} + \int_{\varphi \in \Phi} \sum_{j \in \mathcal{I}^t(i,s,\varphi)} f_{ij} g(\varphi) d\varphi \right] \right] \right]. \quad (\text{A.12})$$

Invoking balanced trade, equations (A.10) to (A.12) can be reduced to a system of  $I$  equations in the  $I$  wage rates. This system of equations is the same in every period  $\varsigma \geq t$ , i.e., indeed wages and, hence, prices, interest rates, and aggregate demand in each country are constant over time.

**Step 2.** With all prices and aggregate demand constant over time, so are variable profits of all firms serving  $j$  from  $i$ . Moreover, all wages and interest rates constant implies that  $\tilde{f}_{ij}(\cdot)$  is weakly decreasing over time for all firms serving a market (i.e., for whom  $\lambda$  is increasing), while it is constant over time for any given  $\lambda$ . The former implies that all firms who found it optimal to start serving a market at time  $t$  also find it optimal to continue doing so in future periods. The latter implies that for all firms for whom it was optimal *not* to serve market  $j$  at  $t$ , it is also optimal not to do so in future periods. Hence, indeed, all firms perpetually follow their market access decision.

**Step 3.** Finally, free entry implies that

$$\sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,t}}^{\infty} (\tilde{\pi}_{ij}^{v,t}(\varphi) - \tilde{f}_{ij}^t(0)) g(\varphi) d\varphi \leq \tilde{f}_{ei}^t, \quad (\text{A.13})$$

where in case of strictly positive entry in response to the shock the condition holds with equality. Condition (A.13) also remains unchanged in all periods  $\varsigma \geq t$ . Therefore, the fact that additional entry is not profitable at the time of the shock implies that it is also not profitable in all subsequent periods. □

### A.3 Proof of Lemma 3

To show the result, we first derive the mass of entrants in the first period, equation (12), and then proceed by contradiction.

**Step 1.** Labor market clearing at time  $t = 0$  requires

$$M_{ei}^0 \left[ \sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,0}}^{\infty} \left( \frac{y_{ij}^0(\varphi) \tau_{ij}^0}{\varphi} + f_{ij} \right) g(\varphi) d\varphi + f_{ei} \right] = L_i,$$

which, using equations (6) and (7), and the fact that variable profits are a constant fraction of revenues, can be rewritten as

$$M_{ei}^0 \left[ \sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,0}}^{\infty} \left( \frac{\pi_{ij}^{v,0}(\underline{\varphi}_{ij}^{0,0})}{w_i} \left( \frac{\varphi}{\underline{\varphi}_{ij}^{0,0}} \right)^{\sigma-1} (\sigma-1) + f_{ij} \right) g(\varphi) d\varphi + f_{ei} \right] = L_i. \quad (\text{A.14})$$

By Lemma 2 we know that—in the absence of shocks—the equilibrium is constant. Hence, equation (9) implies

$$\begin{aligned} \pi_{ij}^{v,0}(\underline{\varphi}_{ij}^{0,0}) &= \tilde{f}_{ij}^0(0) \\ &= f_{ij} w_i^0 \tilde{f}(0), \end{aligned} \quad (\text{A.15})$$

where in the second line we used

$$\tilde{f}(0) := \left[ \sum_{\lambda=0}^{\infty} f(\lambda) \left( \frac{1}{1+r} \right)^\lambda \right] \frac{r}{1+r}.$$

$r := \frac{1}{\beta} - 1$  is the equilibrium interest rate, which is the same in all countries. Using equation (A.15) in (A.14) yields

$$M_{ei}^0 \left[ \sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,0}}^{\infty} \left[ \left( \frac{\varphi}{\underline{\varphi}_{ij}^{0,0}} \right)^{\sigma-1} (\sigma-1) \tilde{f}(0) + 1 \right] f_{ij} g(\varphi) d\varphi + f_{ei} \right] = L_i. \quad (\text{A.16})$$

Free entry—equation (10)—implies

$$\sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,0}}^{\infty} \left[ \left( \frac{\varphi}{\underline{\varphi}_{ij}^{0,0}} \right)^{\sigma-1} - 1 \right] f_{ij} \tilde{f}(0) g(\varphi) d\varphi = f_{ei}. \quad (\text{A.17})$$

Using the Pareto distribution of productivities in equations (A.16) and (A.17), and rearranging terms yields the expression shown in equation (12).

**Step 2.** From Lemma 2, we know that—in the absence of trade shocks—there will be no firm entry after  $t = 0$ . To show that this is also the case after a trade shock, we proceed by contradiction.<sup>23</sup>

Suppose, by way of contradiction, that in response to a trade shock at time  $t > 0$  a mass  $M_{ei}^t > 0$  of firms entered in country  $i$ . Let  $\mathcal{M}_i^t$  denote the set of all firms born

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<sup>23</sup>From Step 1 we know that the mass of entrants at  $t = 0$  is independent of the trade environment in the initial period. We note that in our case this is not sufficient to conclude that there will be no entry upon a future trade shock. This is because—due to the tenure effects—the zero-profit cutoff condition is not necessarily binding for the incumbent firm with lowest productivity after a trade shock. We will get back to this point when deriving the general gravity equation for sequential trade liberalizations in Appendix A.5.

in  $i$  up to and including time  $t$ . Firms in this set can uniquely be identified by a triple  $(i, s, \varphi)$ . Let

$$l^t(i, s, \varphi) := f_{ei} + \sum_{j \in \mathcal{I}^t(i, s, \varphi)} \left( \frac{y_{ij}^t(\varphi) \tau_{ij}^t}{\varphi} + f_{ij} \right)$$

denote the total time- $t$  demand for labor of firm  $(i, s, \varphi)$ . Then, for every pair of firms  $(i, 0, \varphi), (i, t, \varphi) \in \mathcal{M}_i^t$ , i.e., for every pair of firms with equal productivity but born in periods 0 and  $t$ , respectively, it holds that  $l^t(i, 0, \varphi) \geq l^t(i, t, \varphi)$ . In words, the firm born at  $t = 0$  demands weakly more labor. This is because (i) conditional on serving a market  $j$ ,  $(i, 0, \varphi)$  and  $(i, t, \varphi)$  demand the same amount of labor to serve  $j$ . (ii) For every market  $j$ , it holds that  $\lambda_j^t(i, 0, \varphi) \geq \lambda_j^t(i, t, \varphi)$  and, hence,  $\mathcal{I}^t(i, t, \varphi) \subseteq \mathcal{I}^t(i, 0, \varphi)$ . That is, firm  $(i, t, \varphi)$  serves a subset of the markets that firm  $(i, 0, \varphi)$  serves, due to (potential) tenure effects.

Now, equations (A.15) and (A.17) hold for the new entrants with their respective cutoffs, i.e.,

$$\begin{aligned} \pi_{ij}^{v,t}(\underline{\varphi}_{ij}^{0,t}) &= f_{ij} w_i^t \tilde{f}(0) \\ f_{ei} &= \sum_{j \in \mathcal{I}} \int_{\underline{\varphi}_{ij}^{0,t}}^{\infty} \left[ \left( \frac{\varphi}{\underline{\varphi}_{ij}^{0,t}} \right)^{\sigma-1} - 1 \right] f_{ij} \tilde{f}(0) g(\varphi) d\varphi. \end{aligned}$$

Derivations along the lines of Step 1 then imply that the labor market in country  $i$  would clear if (i) we were in the limiting case where  $\mathcal{I}^t(i, t, \varphi) = \mathcal{I}^t(i, 0, \varphi)$  and, hence,  $l^t(i, t, \varphi) = l^t(i, 0, \varphi)$  for every  $(i, 0, \varphi), (i, t, \varphi) \in \mathcal{M}_i^t$ , and (ii) if  $M_i^t = M_{ei}^0$ . This, however, contradicts  $M_{ei}^t > 0$ . □

## A.4 Proof of Proposition 1

From Lemma 3 we know that all firms enter at  $t = 0$ . Lemma 2 implies that they keep constant over time their market-access strategies. Hence, all firms in  $i$  with productivity  $\varphi \geq \underline{\varphi}_{ij}^{0,0}$  serve market  $j$  at time  $t$ , and total exports of  $i$  to  $j$  are given by

$$X_{ij}^t = M_{ei}^0 \int_{\underline{\varphi}_{ij}^{0,0}}^{\infty} \left( \frac{\sigma}{\sigma-1} \right)^{1-\sigma} (\tau_{ij} w_i^t)^{1-\sigma} (P_j^t)^{\sigma-1} X_j^t \varphi^{\sigma-1} g(\varphi) d\varphi.$$

Solving the integral with the Pareto distribution of firm productivities, using equation (12) for the mass of entrants, and rearranging terms, we get

$$\frac{X_{ij}^t}{X_j^t} = \frac{\frac{L_i}{f_{ei}} (w_i^t \tau_{ij})^{1-\sigma} (\underline{\varphi}_{ij}^{0,0})^{\sigma-1-\theta}}{\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (w_k^t \tau_{kj})^{1-\sigma} (\underline{\varphi}_{kj}^{0,0})^{\sigma-1-\theta}}. \quad (\text{A.18})$$



Equations (7), (9), and the fact that  $\tilde{f}_{ij}^t(0) = f_{ij}w_i^t\tilde{f}(0)$  imply

$$(\underline{\varphi}_{ij}^{0,0})^{\sigma-1-\theta} = \left[ (w_i^t)^\sigma (\tau_{ij})^{\sigma-1} f_{ij} \tilde{f}(0) \sigma \left( \frac{\sigma}{\sigma-1} \right)^{\sigma-1} (P_j^t)^{1-\sigma} (X_j^t)^{-1} \right]^{\frac{\sigma-1-\theta}{\sigma-1}}.$$

Using this expression in equation (A.18) and simplifying terms yields equation (13). By Lemma 2, in the absence of further trade shocks all prices and firms' market access strategies are constant over time and, hence, so are bilateral trade shares.  $\square$

## A.5 Proof of Proposition 2

We proceed in two steps. We first characterize firms' market access strategies and then use these to derive the gravity equation.

**Step 1.** By Lemma 3, all firms are born at time  $t = 0$ . This implies that for each  $(i, j) \in \mathcal{I} \times \mathcal{I}$  there is a unique productivity  $\underline{\varphi}_{ij}^t$  such that all firms in  $i$  with productivity  $\varphi \geq \underline{\varphi}_{ij}^t$  serve  $j$  at  $t$ , while all firms with  $\varphi < \underline{\varphi}_{ij}^t$  do not.<sup>24</sup> Let  $\lambda_j^t(i, \underline{\varphi}_{ij}^t) \geq 0$  denote the time- $t$  tenure of the least productive firm in  $i$  serving  $j$ , where here and below we make use of Lemma 3 and simplify the notation by omitting the entry period  $s$  from the firm identifier. Accordingly, we henceforth identify firms by a pair  $(i, \varphi)$ . The cut-off firm must make non-negative profits over its lifetime, i.e.,

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t) \geq w_i^t f_{ij} \tilde{f}(\lambda_j^t(i, \underline{\varphi}_{ij}^t)), \quad (\text{A.19})$$

where we used the fact that by Lemma 2 future profits are constant, and where  $\tilde{f}(\lambda) := \left[ \sum_{\varsigma=\lambda}^{\infty} f(\varsigma) \left( \frac{1}{1+r} \right)^\varsigma \right] \frac{r}{1+r}$ . Due to the tenure effect, condition (A.19) may be strictly non-binding. Let us therefore define a hypothetical tenure level,  $\hat{\lambda}_{ij}^t$ , at which condition (A.19) holds with equality, i.e.,<sup>25</sup>

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t) = w_i^t f_{ij} \tilde{f}(\hat{\lambda}_{ij}^t). \quad (\text{A.20})$$

For all  $(i, j, t) \in \mathcal{I} \times \mathcal{I} \times [0, \infty)$ , it must hold that  $\hat{\lambda}_{ij}^t \in [0, \lambda_j^t(i, \underline{\varphi}_{ij}^t)]$ .<sup>26</sup>

<sup>24</sup>This is true for an arbitrary sequence of trade liberalizations because at all times firms with a higher productivity earn higher variable profits and, hence, they must have a weakly longer tenure in that market.

<sup>25</sup>If condition (A.19) holds with equality for more than one  $\lambda$  because  $\tilde{f}(\cdot)$  is constant for these  $\lambda$ , we take  $\hat{\lambda}_{ij}^t$  to be the smallest  $\lambda$  for which condition (A.19) holds with equality.

<sup>26</sup>This follows by contradiction. In particular, (i) if  $\hat{\lambda}_{ij}^t > \lambda_j^t(i, \underline{\varphi}_{ij}^t)$  it would not be optimal for  $(i, \underline{\varphi}_{ij}^t)$  to serve  $j$ . And (ii) if condition (A.20) would be strictly non-binding for  $\hat{\lambda}_{ij}^t = 0$ , it would be optimal for some firms with productivity  $\varphi < \underline{\varphi}_{ij}^t$  to start serving  $j$ , and  $(i, \underline{\varphi}_{ij}^t)$  would not be the least productive such firm.

**Step 2.** The remainder of the proof is analogous to the proof of Proposition 1. In particular, using the productivity cutoff  $\underline{\varphi}_{ij}^t$ , the Pareto distribution of firm productivities, equation (12) for the mass of entrants, and rearranging terms yields

$$\frac{X_{ij}^t}{X_j^t} = \frac{\frac{L_i}{f_{ei}} (w_i^t \tau_{ij}^t)^{1-\sigma} (\underline{\varphi}_{ij}^t)^{\sigma-1-\theta}}{\sum_{k \in \mathcal{I}} \frac{L_k}{f_{ek}} (w_k^t \tau_{kj}^t)^{1-\sigma} (\underline{\varphi}_{kj}^t)^{\sigma-1-\theta}}. \quad (\text{A.21})$$

Equations (7), and (A.20) imply

$$(\underline{\varphi}_{ij}^t)^{\sigma-1-\theta} = \left[ (w_i^t)^\sigma (\tau_{ij}^t)^{\sigma-1} f_{ij} \tilde{f}(\hat{\lambda}_{ij}^t) \sigma \left( \frac{\sigma}{\sigma-1} \right)^{\sigma-1} (P_j^t)^{1-\sigma} (X_j^t)^{-1} \right]^{\frac{\sigma-1-\theta}{\sigma-1}}.$$

Using this expression in equation (A.21) and simplifying terms yields equation (15). Lastly, Lemma 2 implies again that—in the absence of further shocks—bilateral trade shares are constant over time.  $\square$

## B Details on Average Firm Exports

In this appendix, we provide further details on the response of average firm sales to trade shocks. This forms the basis of our regressions in Section 6.2.

Using the Pareto distribution of firm productivities, it is straightforward to show that average firm sales from country  $i$  to destination  $j$  in period  $t$ ,  $\bar{r}_{ij}^t$ , are equal to

$$\bar{r}_{ij}^t = \frac{\sigma\theta}{\theta - (\sigma - 1)} \pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t), \quad (\text{B.1})$$

where, recall,  $\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t)$  are variable profits of the least productive firm in  $i$  that is serving market  $j$  in period  $t$

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t) = \frac{1}{\sigma} \left( \frac{\sigma}{\sigma-1} \right)^{1-\sigma} (\tau_{ij}^t w_i^t)^{1-\sigma} (P_j^t)^{\sigma-1} X_j^t (\underline{\varphi}_{ij}^t)^{\sigma-1}.$$

Suppose there is a trade shock at time  $t$ . Analogous to the proof of Proposition 2 in Appendix A.5, we can define a hypothetical tenure level  $\hat{\lambda}_{ij}^t \in [0, \lambda_j^t(i, \underline{\varphi}_{ij}^t)]$  such that

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^t) = f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^t). \quad (\text{B.2})$$

Using equation (B.2) in equation (B.1) yields equation (18)

$$\bar{r}_{ij}^t = \frac{\sigma\theta}{\theta - (\sigma - 1)} f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^t). \quad (\text{B.3})$$

As before,  $\hat{\lambda}_{ij}^t$  measures the importance of tenure for  $i$ 's exports to  $j$ .

Now, suppose that at time  $t$ ,  $\tau_{ij}^t$  decreases.  $\underline{\varphi}_{ij}^{t-1}$  is the productivity of the least productive firm serving  $j$  from  $i$  prior to the shock. Holding constant  $w_i^t$  and the market size and competition in  $j$ , the decline in  $\tau_{ij}^t$  implies that  $\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^{t-1})$  increases, and hence

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^{t-1}) > f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^{t-1}).$$

Then, there are two possibilities. Either (i) there is a  $\hat{\lambda}_{ij}^t \in [0, \hat{\lambda}_{ij}^{t-1})$  such that

$$\pi_{ij}^{v,t}(\underline{\varphi}_{ij}^{t-1}) = f_{ij} w_i^t \tilde{f}(\hat{\lambda}_{ij}^t),$$

in which case  $\underline{\varphi}_{ij}^{t-1} = \underline{\varphi}_{ij}^t$ , i.e., there is no market entry by firms from  $i$  in  $j$ , and  $\tilde{f}(\hat{\lambda}_{ij}^t) > \tilde{f}(\hat{\lambda}_{ij}^{t-1})$ . Or (ii) there is market entry by firms from  $i$  in  $j$ , implying that  $\underline{\varphi}_{ij}^{t-1} > \underline{\varphi}_{ij}^t$ ,  $0 = \hat{\lambda}_{ij}^t \leq \hat{\lambda}_{ij}^{t-1}$ , and  $\tilde{f}(\hat{\lambda}_{ij}^t) \geq \tilde{f}(\hat{\lambda}_{ij}^{t-1})$ . In either case,  $\tilde{f}(\hat{\lambda}_{ij}^t)$  weakly *increases* and, hence, the importance of incumbency effects for exports from  $i$  to  $j$  weakly *declines*. In turn this implies that average firm sales from  $i$  to  $j$  weakly increase as stated in Section 6.2.

## C Empirics

### C.1 Data

In this appendix, we provide further details on our data.

**Gravity regression.** To run our gravity regressions, we use data on bilateral goods trade flows for the years 1995 to 2015 from the [Atlas of Economic Complexity](#).<sup>27</sup> Data on distance, GDP per capita, colonial ties, contiguity, common language, common currency, free trade agreements, and common legal origin are obtained from the widely-used [CEPII Gravity database](#).

The tariff data in column (4) are from the World Integrated Trade Solution ([WITS](#)), which provides us with most-favored-nation (MFN) and preferential tariffs at the HS6-digit level. Whenever preferential tariffs are available, we set the tariff between two countries to that value, and we take the MFN import tariff for all remaining exporters

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<sup>27</sup>Since trade flows are mostly reported twice (i.e., as imports by the importer and as exports by the exporter), researchers have to decide which information to use, given that these statistics rarely coincide (not only due to discrepancies between reporting imports including costs of insurance and freight (CIF), and exports free on board (FOB)). The [Atlas of Economic Complexity](#) has developed a unique methodology to extract arguably more consistent flows out of the raw COMTRADE data.

that are WTO members in a given year. We restrict the sample to WTO members to make sure that we set the correct non-preferential tariff rates. However, most countries do not report tariffs in every year. Following [Felbermayr et al. \(2019\)](#), we fill in missing tariff observations by using the closest preceding year we observe. This accounts for the fact that countries tend to report only upon policy changes. To aggregate tariffs to the country-pair-year level, we use simple averages.

Data on non-tariff measures (NTMs) in column (4) are from the Global Trade Alert ([GTA](#)). The GTA data documents NTMs at the country-pair-product level. We use all 29 measures that are categorized according to the [MAST chapters](#), and include those barriers that were in force in 2015. For the exporter-related measures, we attribute the non-tariff barrier to exports from  $i$  to  $j$  if  $i$  is the implementing jurisdiction while  $j$  is the affected one. For all other measures, we attribute the NTM to exports from  $i$  to  $j$  if  $j$  is the implementing jurisdiction and  $i$  the affected one. We then add the log of one plus the number of affected products as a covariate. This yields 29 different control variables for NTMs that are included in column (4). We exclude the coefficients on the NTMs in [Table 1](#) for readability, and report them instead in [Table O.C.4](#) of the Online Appendix.

CIF/FOB ratios in column (5) of [Table 1](#) are from the OECD International Transport and Insurance Costs ([ITIC](#)) database.<sup>28</sup>

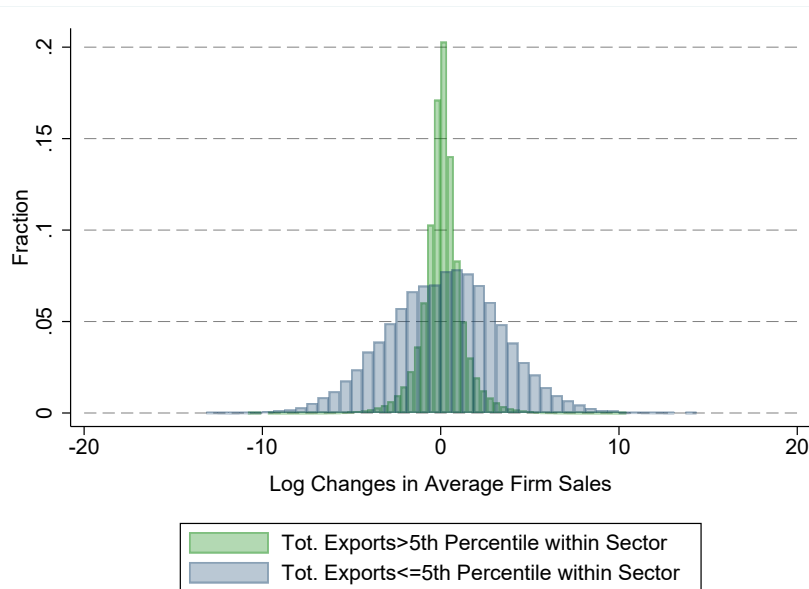
Finally, the data on trade by mode of transportation used in columns (6) and (7) is from [Comext](#), which reports trade between EU members and non-members.

**Average firm sales.** Data on average firm exports at the exporter-importer-HS2-digit-year level are from the Exporter Dynamics Database ([EDD](#)). This dataset provides us with an unbalanced panel of average firm exports for 62 exporting countries and 95 sectors for the years 1997–2014. Since we are interested in the aggregate implications of trade liberalizations, we verify that these data are in line with aggregate trends. In particular, we compare total exports from country  $i$  to  $j$  in the EDD to those reported in the [Atlas of Economic Complexity](#), and require the two series to be positively correlated over time within an exporter-importer-sector cell. For our baseline results, we chose a minimum correlation of 0.6, and dropped observations with a lower value (roughly 20% of the observations). Moreover, for our main results, we omit

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<sup>28</sup>Many of these values were imputed using a gravity model ([Miao and Fortanier, 2017](#)), and we thus prefer omitting this variable for our main results, but reassuringly, adding it has little effect on our main coefficients of interest.

Figure C.1: Log-Changes in Average Firm Sales – Very Small Country Pairs vs. Rest



*Notes.* This figure depicts log-changes in average firm sales from year  $t$  to  $t + 2$  for very small country pairs (i.e., those with total exports belonging to the bottom 5% within a sector) vs. the remaining relations. The sample spans the years 1997–2014. Sectors are defined as the HS2-digit level. Details are given in Section 6.

*Data source.* EDD.

*Graph.* Authors' representation.

observations where total exports belong to the bottom 5% within a sector. We do this because country pairs with very small exports (the median cutoff value is around 2,000 USD) add a lot of noise when we compute log-changes in average firm sales (cf. Figure C.1). In the Online Appendix, Table O.C.7 we show that our results are robust to altering both of these steps.

The tariff data are as detailed above. We take the simple average of import tariffs within HS2-digit sectors for each country pair to have the same aggregation level as the average firm sales from the EDD.

## C.2 Further results

In this part of the Appendix, we provide additional results for our empirical analyses.

**Motivating evidence.** Table C.1 shows robustness of our insights from Figure 2 to using fewer fixed effects and controls. Column (1) shows the raw correlations in the data, Columns (2)–(4) and (5)–(7) results from regressions without and with firm fixed

effects, respectively. In Columns (2) and (5), we add product fixed effects and control for log-sales, allowing for the coefficient to differ at the product level. In Columns (3) and (6), we control for product-quintile fixed effects. Lastly, in Columns (4) and (7) we control for product-quintile fixed effects and log-sales, allowing the coefficient to differ at the product-quintile level. Column (7) replicates the regression summarized in Figure 2. In all regressions, we find a systematic negative relation between tenure levels and exit propensities in response to the shock. Further robustness checks considering the immediate response to the shock and considering exports to all destinations and across several years, respectively, are provided in the Online Appendix, Tables O.C.1 and O.C.2.

**Gravity regressions.** Figure C.2 shows the evolution over time of trade between (former) Council for Mutual Economic Assistance (Comecon) members and (former) OECD members relative to trade between OECD members, normalized by GDP. The group of OECD countries in Figure C.2 includes only members that joined before 1991. For the graph, we lump former Soviet Union countries back together after 1991, and merge the Czech Republic and the Slovak Republic. This figure not only reveals much less Comecon-OECD trade in the 1970s and 80s, but also a dramatic rise after the fall of the Iron Curtain in the course of the 1990s.

In Figure C.3 we reproduce the coefficients of interest from our main specification (second column in Table 1) for each of the years 1995 to 2015 separately. Both coefficients attenuated at the beginning of the sample period but remained remarkably stable since the early 2000s, pointing to persistent effects.

Table C.1: Impact of Firms' Tenure Levels on Market Exit Probabilities – Venezuela Shock

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Tenure=2	-0.105*** (0.020)	-0.096*** (0.019)	-0.092*** (0.020)	-0.088*** (0.021)	-0.053*** (0.016)	-0.055*** (0.015)	-0.051*** (0.015)
Tenure=3	-0.232*** (0.026)	-0.210*** (0.028)	-0.211*** (0.027)	-0.211*** (0.027)	-0.164*** (0.031)	-0.180*** (0.030)	-0.172*** (0.031)
Tenure=4	-0.342*** (0.041)	-0.304*** (0.042)	-0.303*** (0.041)	-0.307*** (0.042)	-0.260*** (0.038)	-0.276*** (0.040)	-0.283*** (0.044)
Tenure=5	-0.429*** (0.037)	-0.388*** (0.037)	-0.385*** (0.037)	-0.384*** (0.038)	-0.281*** (0.037)	-0.291*** (0.038)	-0.289*** (0.043)
Tenure=6	-0.515*** (0.044)	-0.481*** (0.046)	-0.478*** (0.045)	-0.487*** (0.045)	-0.288*** (0.056)	-0.321*** (0.053)	-0.339*** (0.050)
Tenure=7	-0.519*** (0.060)	-0.461*** (0.060)	-0.459*** (0.059)	-0.468*** (0.057)	-0.235*** (0.058)	-0.253*** (0.061)	-0.242*** (0.064)
Tenure=8	-0.447*** (0.056)	-0.388*** (0.058)	-0.382*** (0.061)	-0.386*** (0.061)	-0.457*** (0.052)	-0.478*** (0.060)	-0.470*** (0.063)
Tenure=9	-0.545*** (0.050)	-0.476*** (0.052)	-0.451*** (0.053)	-0.443*** (0.057)	-0.419*** (0.058)	-0.446*** (0.057)	-0.424*** (0.065)
Tenure=10	-0.661*** (0.027)	-0.583*** (0.032)	-0.577*** (0.035)	-0.569*** (0.035)	-0.419*** (0.038)	-0.440*** (0.036)	-0.428*** (0.039)
Mean of Dep. Var.	0.715	0.714	0.713	0.713	0.719	0.718	0.718
Nr. of Observations	6,382	6,375	6,286	6,286	4,826	4,732	4,732
Adj. R-squared	0.212	0.243	0.251	0.255	0.560	0.556	0.566
Size by p	No	Yes	No	No	Yes	No	No
Size by pq	No	No	No	Yes	No	No	Yes
FES	-	p	pq	pq	p, f	pq, f	pq, f

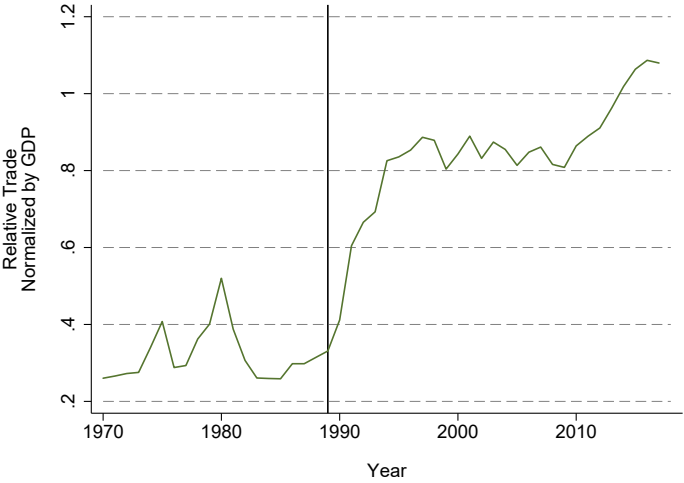
*Notes.* This table summarizes results from estimating equation (1) using OLS. Standard errors clustered at the product and firm levels are reported in parentheses. “size by p” (“size by pq”) indicates whether the regression allows for heterogeneous effects of log sales at the product (product-sales quintile) level. *p* indicates product fixed effects, *pq* product-sales quintile fixed effects, where the quintiles are computed at the product level. *f* denotes firm fixed effects. All tenure levels of 10 years and above have been summarized in one category “tenure  $\geq 10$ .”

\* significant at 10%-level; \*\* significant at 5%-level; \*\*\* significant at 1%-level.

*Data source.* ADUANAS (DIAN)

*Results.* Authors' computations.

Figure C.2: Average Trade Flows between OECD and Iron Curtain Countries relative to Average Intra-OECD Trade

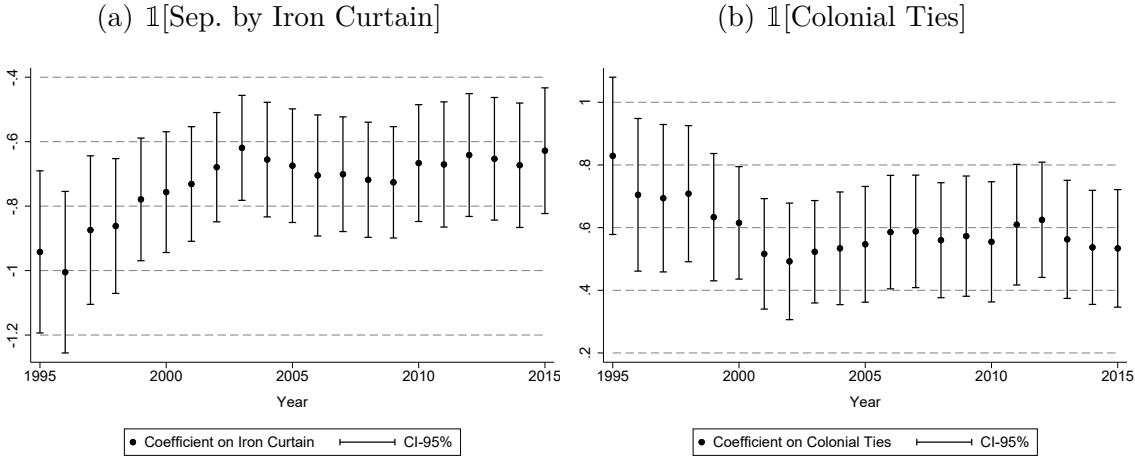


*Notes.* This figure shows how average trade flows between OECD and Iron Curtain countries evolved over time relative to average within-OECD flows. Trade flows are normalized by the product of importer and exporter GDPs. Iron Curtain countries are listed in footnote 14. Details on the sample selection for this graph are given in Appendix C.2. The vertical line is drawn at 1989.

*Data source.* Atlas of Economic Complexity (trade data), UNdata (GDP data).

*Graph.* Authors' representation.

Figure C.3: Main Coefficients in Table 1 over Time



*Notes.* This figure reproduces the main coefficients in Column (2) of Table 1 for 1995 to 2015. Further details are provided in the notes to Table 1.

*Data source.* Atlas of Economic Complexity (trade data), CEPII/Head et al. (2010) (covariates).

*Graph.* Authors' representation.