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Three essays on international trade

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THREE ESSAYS ON INTERNATIONAL TRADE

By

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THREE ESSAYS ON INTERNATIONAL TRADE

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ABSTRACT

In the first chapter, we develop an estimation procedure to identify the partial (direct) effects of the GATT/WTO membership on variable and fixed trade costs, respectively. This procedure extends the techniques of Anderson and Van Wincoop (2003) on the structural relationship of multilateral resistance terms and of Helpman, Melitz and Rubinstein (2008) on the structural modeling of trade incidence. We then develop a general equilibrium framework (that allows for the presence of zero trade) to simulate the impact of variable, fixed, and total trade cost changes on the firm-level trade structure (including the bilateral export productivity cutoff, the weighted/unweighted extensive margin of export, the intensive margin, and the mass of active firms), the bilateral trade flow, and the aggregate welfare due to the GATT/WTO system (given the trade cost effects estimated in the first stage) for the period 1978–2015.

Information asymmetry can create substantial frictions when importing firms find it difficult to acquire information about foreign products. In the second chapter, I use detailed China Customs Data to show that firms tend to import from countries with which they already have an importing relationship. Motivated by this fact, I develop a dynamic model describing firms' decisions on their choice of sourcing country. This model incorporates both communication cost and satisfaction uncertainty, which are lower with familiar countries than with unfamiliar ones. Using this model,

I estimate the benefits of importing from familiar countries measured by the probability improvement of receiving satisfactory products. I find that this probability can be improved by a maximum of 89.0 percent when importing from familiar countries instead of from unfamiliar ones. These results also support the prediction that the effective unit cost of intermediates is lower when importing from familiar countries.

The third chapter presents a heterogeneous firm model à la Melitz (2003) in which firms suffer from both the agency problem internally and financial constraints externally. We show that conditional on the same raw productivity draw, managers of potential exporting firms around the export cutoff in financially underdeveloped countries exert more effort than their counterparts in financially developed countries, as to induce their owners to export. This finding has very positive policy implications, as firms in financially underdeveloped countries can compete with their peers in financially developed countries by exerting more managerial effort. We find clear empirical evidence for this theoretical prediction using the World Management Survey data for more than 7,000 firms in 20 countries during 2002-2012.

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DEDICATION

This dissertation is dedicated to my grandparents.

TABLE OF CONTENTS

APPENDIX

LIST OF TABLES

LIST OF FIGURES

Chapter One

The Impacts of GATT/WTO on Firm-level Trade Structure: 1978–2015

Authors: Pao-Li Chang, Renjing Chen, Wei Jin

1.1 Introduction

In this paper, we develop an estimation procedure to identify the partial (direct) effects of the GATT/WTO membership on variable and fixed trade costs, respectively. This procedure extends the techniques of Anderson and Van Wincoop (2003) on the structural relationship of multilateral resistance (MR) terms and of Helpman, Melitz and Rubinstein (2008) on the structural modeling of trade incidence. We then develop a general equilibrium framework (that allows for the presence of zero trade) to simulate the impact of variable, fixed, and total trade cost changes on the firm-level trade structure, the bilateral trade flow, and the aggregate welfare due to the GATT/WTO system (given the trade cost effects estimated in the first stage) for the period 1978–2015.

This paper contributes to the literature in three ways. First, studies such as Dutt, Mihov and Van Zandt (2013) have analyzed the effects of GATT/WTO on the intensive and extensive margins of trade. In this literature, the sign of the intensive margin changes is used to infer whether the variable or fixed trade costs play a more prominent role because the fixed and variable trade cost reductions have opposite effects on the intensive margin (under general distributional assumptions about firm productivity). In other words, the relative importance of GATT/WTO in reducing the variable or the fixed trade costs is *indirectly* inferred from the signs of changes in the intensive margins. In Section 1.2.2, we propose a three-stage procedure that allows us to identify/estimate the direct effects of the GATT/WTO membership indicators on (i) the variable trade cost, (ii) the total trade cost, and (iii) the fixed trade cost. This procedure builds on the framework of Helpman, Melitz and Rubinstein (2008) [henceforth HMR] with structural zero trade and generalizes the setup of Anderson and Van Wincoop (2003) [henceforth AvW] to allow zero trade in the construction of multilateral resistance terms. In essence, the identification of the effects on the total and the fixed trade costs are made possible by recovering the standard deviation of the error term in the HMR Probit equation. The identification of the inward multilateral resistance terms (suggested by the AvW-type MR equations) then permits us to isolate the effects of the GATT/WTO membership indicators from the importer-year fixed effects (after the inward multilateral resistance terms and other structural variables are purged from the importer-year fixed effects).

Second, we contribute to the literature by developing a structural general equilibrium framework that allows counterfactual changes in active/inactive bilateral trade relationships. In Helpman, Melitz and Rubinstein (2008), the authors suggested a counterfactual exercise that simulates the impact of variable trade cost on bilateral trade incidence and volume, but the procedure stops short of the general equilibrium. We extend the methodology and fully characterize the response of economies around the world to trade cost shocks in terms of firm-level adjustments (the firm export entry cutoff, the weighted/unweighted extensive margin, the intensive margin, and the mass of active firms), aggregate variables (price, gross production, and expenditure), the bilateral trade flow, the wage rate, and aggregate welfare in each country. These general equilibrium responses take into account goods-market and labor-market clearing conditions, free entry, and input-output production structures. The details of the structure are elaborated in Section 1.2.3.

Third, limited by the difficulty of modeling/simulating counterfactual trade incidence, studies on the GATT/WTO's general-equilibrium impacts typically conduct counterfactual analyses of active trading relationships assuming no changes to zero trade observations. In addition, the policy shocks used to proxy the mechanisms of the GATT/WTO effects are often restricted to the tariff changes observed of members; see, for example, Caliendo et al. (2017). Both of these limitations could underestimate the impacts of the GATT/WTO system via the omission of trade incidence and non-tariff measures. The methodologies proposed above help address the first concern. In the implementation, we use the GATT/WTO membership indicators (whether both are members; whether only the importer is a member) to capture all potential changes in border and domestic policies of the GATT/WTO members toward members and toward nonmembers and their combined effects on the variable and fixed trade costs. The estimation results of the GATT/WTO effects on the trade costs are summarized in Section 1.3. These shocks are used to simulate the counterfactual if the GATT/WTO system were shut down. Section 1.4 reports the impacts on the firm-level and aggregate variables of interest, with the impacts further decomposed by the channel of variable trade cost versus fixed trade cost.

The analysis in this paper also has interesting policy implications for income disparity within countries. Given the estimates of the GATT/WTO shocks to the trade costs, we can simulate the corresponding effects on the firm sales distribution in each country. The findings indicate that the GATT/WTO membership can have very different effects on the distribution of firm sales. If the GATT/WTO reduces mainly fixed trade costs, it dilutes the sales of all existing firms and allows the export entry of weaker firms, thus flattening the sales distribution. The implications could change fundamentally if the GATT/WTO mainly lowers variable trade cost, which has a proportionally larger effect on the sales of larger firms and hence tends to increase the initial firm sales disparity. The results in this study could thus provide us a first look at how the GATT/WTO may affect income disparity within countries through the way it affects the disparity in firm sales.

1.2 Structural Framework

1.2.1 Model

As highlighted by HMR, inactive trade is prevalent in bilateral trading relationships. The HMR framework, by assuming bounded support for firm productivity and the presence of fixed export cost, allows arbitrary patterns of inactive trade across trading relationships in theory.

Following HMR, we allow for asymmetric trade cost and country characteristics and bounded productivity support for firms. Let countries be indexed by i or j. Each country is endowed with a fixed supply of labor L_i. The preferences of consumers in i are characterized by Constant Elasticity of Substitution (CES) utility functions:

$$U_i = \left[\int_{l \in B_i} q_i(l)^{\frac{\sigma-1}{\sigma}} dl \right]^{\frac{\sigma}{\sigma-1}}, \ \sigma > 1, \tag{1.1}$$

where $q_i(l)$ is the consumption of product l, B_i is the set of products available for consumption in country i, and σ corresponds to the elasticity of substitution across products. Let E_i denote the aggregate expenditure of country i. It follows that country i's demand for product l is

$$q_i(l) = \frac{p_i(l)^{-\sigma}}{P_i^{1-\sigma}} E_i, \tag{1.2}$$

where $p_i(l)$ is the price of product l in country i, and P_i is country i's aggregate price index, given by

$$P_i = \left[\int_{l \in B_i} p_i(l)^{1-\sigma} dl \right]^{1/(1-\sigma)}. \tag{1.3}$$

Let c_i denote the cost of an input bundle. Similar to Eaton and Kortum (2002a), the input bundle is modeled to incorporate labor and intermediate inputs (which consist of the same basket of goods as used for consumption) in a Cobb-Douglas manner such that $c_i = w_i^{\alpha_i} P_i^{1-\alpha_i}$, given the wage rate w_i and the labor share α_i in country i.

Let N_i denote the mass of firms in country i. A firm pays a fixed cost of entry $c_i F_i$ to take a productivity draw $1/a$ from a truncated Pareto distribution $G_i(a)$ over the support $[a_{Li}, a_{Hi}]$, where $0 < a_L < a_H$, given by:

$$G_i(a) = \frac{a^k - a_{L_i}^k}{a_{H_i}^k - a_{L_i}^k}, \tag{1.4}$$

with dispersion parameter $k > (\sigma - 1)$. Firms of productivity level $1/a$ located in country i incur a constant marginal cost $\tau_{ij} c_i a$ and a fixed cost $c_i f_{ij}$ to serve country j, where τ_{ij} is the iceberg trade cost and f_{ij} is the fixed trade cost (in terms of input bundles). In other words, τ_{ij} units of goods need to be shipped from country i for one unit of the good to arrive at destination j.

Given CES preferences and monopolistic competition, a firm charges a constant markup $\frac{\sigma}{\sigma-1}$ over its marginal cost. The corresponding profit of a firm with productivity $1/a$ in country i to serve market j is given by

$$\pi_{ij}(a) = \frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{\tau_{ij} c_i a}{P_j} \right)^{1-\sigma} E_j - c_i f_{ij}. \tag{1.5}$$

Firms in country i exit from serving market j if its cost draw is above the cutoff a_{ij} defined by the zero-profit condition:

$$\frac{1}{\sigma} \left(\frac{\sigma}{\sigma - 1} \frac{\tau_{ij} c_i a_{ij}}{P_j} \right)^{1-\sigma} E_j = c_i f_{ij}. \tag{1.6}$$

It is assumed that a_{H_i} is sufficiently large such that not all firms export (as is the case in empirical stylized facts). Define the proportion of firms (weighted by market shares) that export from i to j by

$$V_{ij} \equiv \begin{cases} \int_{a_{L_i}}^{a_{ij}} a^{1-\sigma} dG(a) & \text{when } a_{ij} \geq a_{L_i}; \\ 0 & \text{otherwise.} \end{cases} \tag{1.7}$$

Given the demand function (1.2), the aggregate price index (1.3), and the definition of V_{ij}, the value of trade from country i to country j can be expressed as

$$X_{ij} = \left(\frac{\sigma}{\sigma - 1} \frac{c_i \tau_{ij}}{P_j} \right)^{1-\sigma} N_i E_j V_{ij}, \tag{1.8}$$

where

$$P_j^{1-\sigma} = \sum_i \left(\frac{\sigma}{\sigma - 1} c_i \tau_{ij} \right)^{1-\sigma} N_i V_{ij}. \tag{1.9}$$

The goods-market-clearing condition requires that the total production Y_i of country i equal its total sales across all destinations:

$$Y_i = \sum_j X_{ij} = \sum_j \left(\frac{\sigma}{\sigma - 1} \frac{c_i \tau_{ij}}{P_j} \right)^{1-\sigma} N_i E_j V_{ij}. \tag{1.10}$$

Using the market-clearing condition (1.10) to solve for $\left(\frac{\sigma}{\sigma-1} c_i\right)^{1-\sigma} N_i$ and substitute them in (1.8) and (1.9) with the resulting expression, we have the following structural gravity equation:

$$X_{ij} = \left(\frac{\tau_{ij}}{\Pi_i P_j} \right)^{1-\sigma} Y_i E_j V_{ij}, \tag{1.11}$$

$$\Pi_i^{1-\sigma} \equiv \sum_j \left(\frac{\tau_{ij}}{P_j} \right)^{1-\sigma} E_j V_{ij}, \tag{1.12}$$

$$P_j^{1-\sigma} = \sum_i \left(\frac{\tau_{ij}}{\Pi_i} \right)^{1-\sigma} Y_i V_{ij}, \tag{1.13}$$

where Π_i and P_j are, respectively, the outward multilateral resistance (MR) to export of country i and the inward multilateral resistance to import of country j. Different from the MR terms in AvW, the MR terms in this paper incorporate the term V_{ij}, which characterizes the extensive margin of trade from country i to j and could take a value of zero for some subset of bilateral trading relationships.

Free entry requires that variable profit covers the fixed trade cost and entry cost

$$\frac{1}{\sigma}Y_i - \sum_j N_{ij}c_i f_{ij} = N_i c_i F_i, \tag{1.14}$$

where $N_{ij} = N_i G_i(a_{ij})$ is the mass of firms in country i that export to country j. Given the truncated Pareto distribution in (1.4), N_{ij} can be expressed as

$$N_{ij} = \begin{cases} \frac{N_i a_{L_i}^k}{a_{H_i}^k - a_{L_i}^k}\left[\left(\frac{a_{ij}}{a_{L_i}}\right)^k - 1\right] & \text{when } a_{ij} \geq a_{L_i}; \\ 0 & \text{otherwise.} \end{cases} \tag{1.15}$$

Given (1.14) and the fact that all stages of production use the same input bundle with a constant labor share, the labor-market-clearing condition suggests that labor income is a constant share of gross output:

$$\alpha_i Y_i = w_i L_i. \tag{1.16}$$

Finally, we allow for trade deficit D_i. The aggregate budget constraint for each country requires the following:

$$E_i = Y_i + D_i, \tag{1.17}$$

and the world trade deficit is zero: $\sum_i D_i = 0$.

1.2.2 Identification of the GATT/WTO Effects

In this subsection, we propose strategies to identify the direct partial effects of GATT/WTO on variable and fixed trade costs, respectively. We add the year subscript t to the variables in the context of the panel data structure.

Define $bothwto_{ijt}$ and $imwto_{ijt}$ as two binary indicators of GATT/WTO membership: the former takes the value of one if both exporting and importing countries ij are GATT/WTO members at time t, and zero otherwise; the latter takes the value of one if only the importing country j is a GATT/WTO member (while the exporting country i is not) at time t, and zero otherwise.

GATT/WTO members are required to apply a non-discriminatory basis (i.e., the most-favored-nation principle) on the tariff reductions and/or non-tariff measure liberalizations it has agreed to in its accession packages or in the general trade negotiation sessions to all other members. This approach is expected to lower the variable and fixed trade costs imposed by member j against firms of member i. In contrast, members are not constrained by the GATT/WTO in their trade policies against nonmembers. It is ex ante possible that the trade policy of members may become liberalized against nonmembers (if they extend MFN treatment to nonmembers) or more restrictive (if members realign their optimal tariffs against nonmembers). As a whole, we expect *bothwto* to have a larger trade-promoting effect than *imwto*.

Note that omitting *imwto* from the set of controls for trade costs will lead to biased estimates of *bothwto* in general if GATT/WTO members change their policy (compared to the counterfactual if they were not members) against nonmembers. However, these two indicators *bothwto* and *imwto* together will be multi-collinear with the importer-year fixed effects (FEs) in a parametric framework, as suggested by Cheong, Kwak and Tang (2014). We explain below how we identify the variable and fixed trade costs of any trading relationship in three stages (where the first two stages were built upon HMR) and how we isolate the partial effects of *bothwto* and *imwto* on these two types of trade costs in the last two stages.

Identification of the Extensive Margin

This stage follows HMR to identify the extensive margin of bilateral trade. Given the expression of the truncated Pareto distribution in (1.4) and the definition of V_{ijt}, it follows that $V_{ijt} = \frac{k}{k+1-\sigma}\frac{a_{L_i}^{k+1-\sigma}}{a_{H_i}^k - a_{L_i}^k}\Omega_{ijt}$, where Ω_{ijt} is given by

$$\Omega_{ijt} \equiv \max\left\{\left(\frac{a_{ijt}}{a_{L_i}}\right)^{k+1-\sigma} - 1, 0\right\}. \tag{1.18}$$

Define the latent variable Z_{ijt} as the ratio of the most productive firm's variable profit and the fixed cost of exporting. Using the zero profit condition in (1.6), we have

$$Z_{ijt} \equiv \frac{\frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{\tau_{ijt}c_{it}a_{L_i}}{P_{jt}}\right)^{1-\sigma}E_{jt}}{c_{it}f_{ijt}} = \left(\frac{a_{ijt}}{a_{L_i}}\right)^{\sigma-1}. \tag{1.19}$$

Thus, Ω_{ijt} can be expressed in terms of the latent variable Z_{ijt} as

$$\Omega_{ijt} \equiv \begin{cases} Z_{ijt}^{\frac{k+1-\sigma}{\sigma-1}} - 1 & \text{when} \quad Z_{ijt} > 1; \\ 0 & \text{otherwise.} \end{cases} \tag{1.20}$$

An active bilateral trade relationship corresponds to $\Omega_{ijt} > 0$ and $Z_{ijt} > 1$. Thus, the observed trading status can be used to infer the underlying latent variable. Write (1.19) in log-linear form and allow for idiosyncratic shocks η_{ijt}; we have

$$z_{ijt} \equiv \ln Z_{ijt} = \mathit{constant} + \ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt} + \zeta_{it} + \xi_{jt} + \eta_{ijt}, \tag{1.21}$$

$$\zeta_{it} \equiv -\sigma \ln c_{it} + (1-\sigma)\ln a_{L_i}, \tag{1.22}$$

$$\xi_{jt} \equiv -\ln P_{jt}^{1-\sigma} + \ln E_{jt}. \tag{1.23}$$

Define the indicator variable T_{ijt} to equal 1 when country i exports to j in year t and 0 when it does not. Approximate the total trade cost term with a linear combination of observable trade cost proxies, i.e., $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt} \approx \boldsymbol{\gamma}\mathbf{B}_{ijt}$. The structural relationship (1.21) can be estimated using the Probit estimator:

$$\rho_{ijt} \equiv Pr(T_{ijt} = 1|\mathbf{B}_{ijt}) = \Phi(\boldsymbol{\gamma}^*\mathbf{B}_{ijt} + \zeta_{it}^* + \xi_{jt}^*), \tag{1.24}$$

where $\Phi(\cdot)$ is the c.d.f of the unit-normal distribution, ζ_{it}^* is the normalized exporter-year fixed effect, and ξ_{jt}^* is the normalized importer-year fixed effect, given by $\boldsymbol{\gamma}^* \equiv \boldsymbol{\gamma}/s_\eta$, $\zeta_{it}^* \equiv \zeta_{it}/s_\eta$, and $\xi_{jt}^* \equiv \xi_{jt}/s_\eta$, where s_η is the standard deviation of the error term in (1.21).

A consistent estimator of Ω_{ijt} can be obtained by

$$\widetilde{\Omega}_{ijt} \equiv \max\left\{e^{\delta \widetilde{z}_{ijt}^*} - 1, 0\right\}, \tag{1.25}$$

where $\widetilde{z}_{ijt}^* = \Phi^{-1}(\widetilde{\rho}_{ijt})$ is the predicted value of the latent variable (in log) and δ is a combination of the elasticity of substitution σ, the shape parameter of the Pareto distribution k, and the standard deviation s_η, given by

$$\delta \equiv s_\eta(k + 1 - \sigma)/(\sigma - 1). \tag{1.26}$$

HMR suggested strategies to identify δ together with the coefficients of the main trade flow equation pertinent to variable trade costs, as will be discussed in the next section. To pin down the fixed trade costs, however, we also need to identify s_η. We discuss in Section 1.2.2 how we identify this parameter.

Identification of $\ln \tau_{ijt}^{1-\sigma}$ and GATT/WTO Effects on $\ln \tau_{ijt}^{1-\sigma}$

Given the relationship between V_{ijt} and Ω_{ijt}, the observed trade flow (1.11) in logarithm can be expressed as

$$x_{ijt} \equiv \ln X_{ijt} = constant + \ln \tau_{ijt}^{1-\sigma} + \ln \Omega_{ijt} + \theta_{it} + \lambda_{jt} + u_{ijt}, \quad (1.27)$$

$$\theta_{it} \equiv -\ln \Pi_{it}^{1-\sigma} + \ln Y_{it} + \ln \frac{a_{L_i}^{k+1-\sigma}}{a_{H_i}^{k} - a_{L_i}^{k}}, \quad (1.28)$$

$$\lambda_{jt} \equiv -\ln P_{jt}^{1-\sigma} + \ln E_{jt}. \quad (1.29)$$

As suggested by HMR, the consistent estimation of (1.27) requires controls for both the endogenous number of exporters (via $\omega_{ijt} \equiv \ln \Omega_{ijt}$) and the selection of country pairs into trading partners (which generates a correlation between the unobserved u_{ijt} and the independent variables). In particular, we need estimates for $E[u_{ijt}|., T_{ijt} = 1]$ and $E[\omega_{ijt}|., T_{ijt} = 1]$, given the use of positive trade flows in (1.27). Define $\bar{\eta}_{ijt}^{*} \equiv E[\eta_{ijt}^{*}|., T_{ijt} = 1]$. A consistent estimate for $\bar{\eta}_{ijt}^{*}$ is the inverse Mills ratio $\widetilde{\bar{\eta}}_{ijt}^{*} \equiv \phi(\widetilde{z}_{ijt}^{*})/\Phi(\widetilde{z}_{ijt}^{*})$, since η_{ijt}^{*} has a unit normal distribution. It follows that a consistent estimate for $E[\omega_{ijt}|., T_{ijt} = 1]$ is $\widetilde{\bar{\omega}}_{ijt} \equiv \ln\{\exp[\delta(\widetilde{z}_{ijt}^{*} + \widetilde{\bar{\eta}}_{ijt}^{*})] - 1\}$. In addition, following Heckman (1979), $E[u_{ijt}|., T_{ijt} = 1] = corr(u_{ijt}, \eta_{ijt})(s_u/s_\eta)\bar{\eta}_{ijt}^{*}$, where s_u and s_η are the standard deviations of u and η. The trade flow equation can thus be estimated using the following specification:

$$x_{ijt} \equiv \ln X_{ijt} = constant + \boldsymbol{\beta}\mathbf{B}_{ijt} + \ln\{\exp[\delta(\widetilde{z}_{ijt}^{*} + \widetilde{\bar{\eta}}_{ijt}^{*})] - 1\} + \theta_{it} + \lambda_{jt} + \beta_{u\eta}\widetilde{\bar{\eta}}_{ijt}^{*} + e_{ijt}, \quad (1.30)$$

where $\beta_{u\eta} \equiv corr(u, \eta)(s_u/s_\eta)$ and e_{ijt} is an i.i.d. error term with zero mean conditional on positive trade. We have similarly assumed that the variable trade cost term can be predicted by a linear combination of observable trade cost proxies, that is, $\ln \tau_{ijt}^{1-\sigma} \approx \boldsymbol{\beta}\mathbf{B}_{ijt}$.

As noted previously, it is not feasible to include the two GATT/WTO membership indicators $bothwto_{ijt}$ and $imwto_{ijt}$ in the set of $\mathbf{B}_{ijt}$ because they are jointly multi-collinear with the importer-year fixed effect λ_{jt} in the trade flow equation (1.27). Without including these two GATT/WTO membership indicators, their effects are thus absorbed by the importer-year fixed effect terms. The same problem applies to the estimation of the extensive margin in (1.21). We propose the following iteration procedure to circumvent this multi-collinearity issue and to identify the GATT/WTO effects on the variable trade cost term $\ln \tau_{ijt}^{1-\sigma}$. Section 1.2.2 will revisit the issue after we propose a procedure to identify s_η and the original (not normalized) total trade cost term $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$.

We estimate (1.27) non-linearly to obtain the parameter estimate $\widetilde{\delta}$ (and, in turn, the fitted value for the extensive margin $\widetilde{\Omega}_{ijt}$), the fitted value $\ln \widetilde{\tau}_{ijt}^{1-\sigma} \equiv \widetilde{\boldsymbol{\beta}}\mathbf{B}_{ijt}$, and the fitted value for the importer-year fixed effects $\widetilde{\lambda}_{jt}$.

In the first step, we solve for $\widetilde{\Pi}_{it}^{1-\sigma}$ and $\widetilde{P}_{jt}^{1-\sigma}$ by substituting $\widetilde{\tau}_{ijt}^{1-\sigma}$ into the definition of MR terms in (1.12) and (1.13) expanded with the time subscript and by replacing $\widetilde{V}_{ijt}$ with $\widetilde{\Omega}_{ijt}$. This normalization is without loss of generality because the solution to the system of the MR terms in (1.12) and (1.13) is unique up to normalization.

In the second step, given the definition of the importer-year fixed effect term in (1.29) and the fact that the effects of the two GATT/WTO membership indicators are absorbed by this term, we estimate the GATT/WTO effects by the following specification:

$$\widetilde{\lambda}_{jt} = \beta_1 \times bothwto_{ijt} + \beta_2 \times imwto_{ijt} + \beta_P \ln \widetilde{P}_{jt}^{1-\sigma} + \beta_E \ln E_{jt} + \epsilon_{ijt}, \qquad (1.31)$$

using the Poisson Pseudo-Maximum Likelihood (PPML) estimator, where $\widetilde{\lambda}_{jt}$ and $\ln \widetilde{P}_{jt}^{1-\sigma}$ were obtained in the estimation of (1.30) and in the first step.

In the third step, we then update $\widetilde{\tau}_{ijt}^{1-\sigma}$ by adding the fitted value of $\widetilde{\beta}_1 \times bothwto_{ijt}$ and $\widetilde{\beta}_2 \times imwto_{ijt}$, obtained from the second step, to the original value $\widetilde{\boldsymbol{\beta}}\mathbf{B}_{ijt}$. We then repeat the first step to the third step iteratively until $\widetilde{\beta}_1$ and $\widetilde{\beta}_2$ converge. The final set of estimates of $\widetilde{\beta}_1$ and $\widetilde{\beta}_2$ after convergence are taken to be the GATT/WTO effects on the variable trade cost term $\ln \tau_{ijt}^{1-\sigma}$.

Identification of GATT/WTO Effects on $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$ and on $-\ln f_{ij}$

Recall that the estimation of (1.21) provides us the normalized fitted value of $\ln \tau_{ijt}^{*,1-\sigma} - \ln f_{ijt}^{*} \equiv \widetilde{\boldsymbol{\gamma}}^{*}\mathbf{B}_{ijt}$ and the normalized importer-year fixed effect $\widetilde{\xi}_{jt}^{*}$ in the Probit specification for trade status. We propose strategies below to obtain estimates of s_η and hence the original fitted value without normalization.

First, we use the functional form of δ in (1.26), the estimate of $\widetilde{\delta}$ from Section 1.2.2, and the estimate of $k/(\sigma-1) = 1.5$ from the literature[1] to obtain our benchmark estimate of s_η. Alternatively, we also provide our own estimates of k for each country in every year based on global firm-level data, using the Quantile-Quantile estimator (Head, Mayer and Thoenig, 2014) as robustness checks. Given a typical value of σ (estimated by the literature), the procedure provides an alternative

[1]Melitz and Redding (2015) suggested $k/(\sigma-1) = 1.42$. We tried with both $k/(\sigma-1) = 1.5$ and $k/(\sigma-1) = 1.4$, the results are similar.

set of estimates of s_η. Given s_η, we can recover the fitted value of the total trade cost term $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt} \equiv s_\eta \times \widetilde{\boldsymbol{\gamma}}^{*}\mathbf{B}_{ijt}$ and the importer-year fixed effect terms $\widetilde{\xi}_{jt} = s_\eta \times \widetilde{\xi}_{jt}^{*}$ in their original scale.

The same multi-collinearity issue discussed above applies in the estimation of the Probit equation (1.24). The two GATT/WTO membership indicators cannot be included in the set of observable trade cost proxies $\mathbf{B}_{ijt}$ because they are multi-collinear with the importer-year fixed effect term ξ_{jt} in the Probit equation (1.24). We use a similar strategy as in Section 1.2.2 to identify the GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$. The difference here is that the first step (to calculate the structural MR terms based on $\ln \tau_{ijt}^{1-\sigma}$) has been carried out in the previous section, and we need only to conduct the second step.

In particular, given the definition of ξ_{jt} in (1.23) and the fact that it absorbs the effects of the two GATT/WTO membership indicators on the total trade cost, we estimate the GATT/WTO effects as follows:

$$\widetilde{\xi}_{jt} = \gamma_1 \times bothwto_{ijt} + \gamma_2 \times imwto_{ijt} + \gamma_p \ln \widetilde{P}_{jt}^{1-\sigma} + \gamma_E \ln E_{jt} + \varepsilon_{ijt}, \qquad (1.32)$$

based on PPML estimations, where $\widetilde{P}_{jt}^{1-\sigma}$ is obtained from the previous section. The parameter estimates $\widetilde{\gamma}_1$ and $\widetilde{\gamma}_2$ are taken to be the impacts of the two GATT/WTO membership indicators on the total trade cost term $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$.

With the results of Section 1.2.2 and the results above, it follows that $\widetilde{\gamma}_1 - \widetilde{\beta}_1$ and $\widetilde{\gamma}_2 - \widetilde{\beta}_2$ are consistent estimates of the GATT/WTO effects on $-\ln f_{ijt}$.

1.2.3 Counterfactual Analysis

Given the estimates of the direct effects of the GATT/WTO membership indicators on variable, fixed, and total trade costs, we can simulate how the changes in (each component of these) trade costs due to GATT/WTO affect the variables of interest in general equilibrium. We rewrite the system introduced in Section 1.2.1 using the hat algebra as in Dekle, Eaton and Kortum (2007) and represent changes in the variables by $\widehat{x} \equiv x'/x$, where x' is the counterfactual value of a variable x.

Specifically, we would like to study the change in welfare, trade flow, extensive margin, and intensive margin due to GATT/WTO membership status. Welfare is defined as the ratio of income and price Y_{it}/P_{it}, given the CES preference structure. In the benchmark, we use the mass of varieties, N_{ijt}, to analyze the extensive margin (of the bilateral exports from country i to country j in year t), instead of its theoretical counterpart, Ω_{ijt} or V_{ijt}, because the former is often used in empirical studies (see, for example, Dutt, Mihov and Van Zandt, 2013) and can be directly observed in the data. Correspondingly, the intensive margin is defined as the average sales per variety, i.e., X_{ijt}/N_{ijt}. We will nonetheless also present the change in the structural extensive margin Ω_{ijt} as additional information for policy evaluation.

Starting with a set of initial values of $\{\widehat{w}_{it}, \widehat{P}_{it}\}$ and trade cost shocks $\{\ln \widehat{\tau}_{ijt}^{1-\sigma}, \ln \widehat{f}_{ijt}\}$, we can impute the counterfactual values of the variables of the system as follows. First, given the Cobb-Douglas structure of the composite input bundle, the labor-market-clearing condition in (1.16), and the aggregate budget constraint condition in (1.17), we have

$$\widehat{c}_{it} = \widehat{w}_{it}^{\alpha}\widehat{P}_{it}^{1-\alpha}, \tag{1.33}$$

$$\widehat{Y}_{it} = \widehat{w}_{it}, \tag{1.34}$$

$$\widehat{E}_{it} = \frac{Y_{it}}{E_{it}}\widehat{Y}_{it} + \frac{D_{it}}{E_{it}}\widehat{Y}_{wt}, \tag{1.35}$$

where $\widehat{Y}_{wt} = \sum_i \frac{Y_{it}}{Y_{wt}}\widehat{Y}_{it}$. In deriving (1.35), we have assumed that a country's trade deficit is a constant share of the world gross output. We also consider alternative assumptions about counterfactual trade deficits.

Next, given the latent variable definition in (1.21), we have

$$z_{ijt}^{*\prime} - z_{ijt}^{*} = \frac{\ln \widehat{\tau}_{ijt}^{1-\sigma} - \ln \widehat{f}_{ijt}}{s_\eta} + \frac{-\sigma \ln \widehat{c}_{it} - \ln \widehat{P}_{jt}^{1-\sigma} + \ln \widehat{E}_{jt}}{s_\eta}. \tag{1.36}$$

Given the definition of Ω_{ijt} in (1.18), it follows that

$$\Omega_{ijt}^{\prime} \equiv \max\left\{e^{\delta z_{ijt}^{*\prime}} - 1, 0\right\}. \tag{1.37}$$

Thus, the counterfactual $V_{ijt}^{\prime}$ can be calculated as

$$V_{ijt}^{\prime} = \frac{a_{L_i}^{k+1-\sigma}}{a_{H_i}^{k} - a_{L_i}^{k}}\frac{k}{k+1-\sigma}\Omega_{ijt}^{\prime}. \tag{1.38}$$

It is important to note that the expressions above $\Omega_{ijt}^{\prime}$ and $V_{ijt}^{\prime}$ can accommodate both active and inactive trading relationships in the factual. Naturally, the changes $\widehat{\Omega}_{ijt}$ and $\widehat{V}_{ijt}$ are applicable only when the factual trade status is active:

$$\widehat{\Omega}_{ijt} = \widehat{V}_{ijt} = \Omega_{ijt}^{\prime}/\Omega_{ijt}, \text{ when } V_{ijt} > 0. \tag{1.39}$$

Third, given (1.12), the counterfactual outward MR terms can be obtained by

$$\Pi_{it}^{\prime\,1-\sigma} = \sum_j \left(\frac{\tau_{ijt}^{\prime}}{P_{jt}^{\prime}}\right)^{1-\sigma} E_{jt}^{\prime}V_{ijt}^{\prime}. \tag{1.40}$$

Furthermore, given the definition of trade flow in (1.11), counterfactual trade flow and the change in trade flow are given by

$$X'_{ijt} = \left(\frac{\tau'_{ijt}}{\Pi'_{it}P'_{jt}}\right)^{1-\sigma} Y'_{it}E'_{jt}V'_{ijt}, \tag{1.41}$$

$$\widehat{X}_{ijt} = X'_{ijt}/X_{ijt}, \text{ when } X_{ijt} > 0. \tag{1.42}$$

Fourth, given the free entry condition in (1.14), $\widehat{N}_{it}$ can be inferred by

$$\frac{Y'_{it} - \sum_j X'_{ijt}/\nu'_{ijt}}{Y_{it} - \sum_j X_{ijt}/\nu_{ijt}} = \widehat{N}_{it}\widehat{c}_{it}, \tag{1.43}$$

where

$$\nu_{ijt} \equiv \frac{\frac{k}{k+1-\sigma}\left(a_{ijt}^{k+1-\sigma} - a_{L_i}^{k+1-\sigma}\right)}{a_{ijt}^{1-\sigma}(a_{ijt}^{k} - a_{L_i}^{k})}. \tag{1.44}$$

We explain in Appendix A.3 how the parameters a_{ijt} and a_{Li} are estimated. Given (1.15), $\widehat{N}_{ijt}$ can be calculated by

$$\widehat{N}_{ijt} = \widehat{N}_{it}\frac{\max\left\{[exp(z^{*\prime}_{ijt})]^{\frac{k\, s_\eta}{\sigma-1}} - 1, 0\right\}}{\max\left\{[exp(z^{*}_{ijt})]^{\frac{k\, s_\eta}{\sigma-1}} - 1, 0\right\}}, \text{ when } z^*_{ijt} > 0. \tag{1.45}$$

Strategies to obtain N'_{ijt} for $z^*_{ijt} < 0$ are proposed in Appendix A.4.

Fifth, changes in output and wage can be updated by using the goods-market-clearing condition in (1.10) and the definition of the outward MR term in (1.12)

$$\widehat{w}_{it} = \widehat{Y}_{it} = \widehat{N}_{it}\left(\widehat{c}_{it}^{1-\sigma}\widehat{\Pi}_{it}^{1-\sigma}\right). \tag{1.46}$$

Sixth, we can update the counterfactual price index P'_{jt} and the change of price index $\widehat{P}_{jt}$, given its definition in (1.13)

$$P'^{\,1-\sigma}_{jt} = \sum_i \left(\frac{\tau'_{ijt}}{\Pi'_{it}}\right)^{1-\sigma} Y'_{it}V'_{ijt}, \tag{1.47}$$

$$\widehat{P}_{jt} = \frac{P'_{jt}}{P_{jt}}. \tag{1.48}$$

The new set of values for $\{\widehat{w}_{it}, \widehat{P}_{it}\}$ are fed back into the loop of (1.33)–(1.48) iteratively until convergence. They are the changes in the wage and price index across countries in a given year due to trade cost shocks. The welfare changes $(\widehat{Y}_{it}/\widehat{P}_{it})$, the changes in trade flow (X'_{ijt} for $X_{ijt} = 0$ and $\widehat{X}_{ijt} = X'_{ijt}/X_{ijt}$ for $X_{ijt} > 0$), extensive margins (N'_{ijt} for $N_{ijt} = 0$ and $\widehat{N}_{ijt}$ for $N_{ijt} > 0$), and intensive margins (X'_{ijt}/N'_{ijt} for $N'_{ijt} > 0$) can be obtained accordingly.

To illustrate the algorithm, suppose we consider the counterfactual in which the GATT/WTO had not existed. This is equivalent to turning all the factual values of $bothwto_{ijt}$ and $imwto_{ijt}$ to zeros. Recall that the effect estimates of *bothwto* and *imwto* are $\widetilde{\gamma}_1$ and $\widetilde{\gamma}_2$ on the total trade cost term, respectively, and $\widetilde{\beta}_1$ and $\widetilde{\beta}_2$ on the variable trade cost term, respectively. By shutting down the GATT/WTO system, this implies a counterfactual shock to the total trade cost of $\ln \widehat{\tau}_{ijt}^{1-\sigma} - \ln \widehat{f}_{ijt} = -\widetilde{\gamma}_1 \times bothwto_{ijt} - \widetilde{\gamma}_2 \times imwto_{ijt}$. Meanwhile, the counterfactual variable trade cost term would be $\ln(\tau'_{ijt})^{1-\sigma} = \widetilde{\boldsymbol{\beta}}\mathbf{B}_{ijt}$, where the set of $\mathbf{B}_{ijt}$ excludes the GATT/WTO membership indicators. These shocks can be fed into the system (1.33)–(1.48) to derive the ex post effects of GATT/WTO on welfare and the other variables of interest as discussed.

We will also decompose the GATT/WTO effects due to the variable and fixed trade costs separately. The shocks are $\ln \widehat{\tau}_{ijt}^{1-\sigma} = -\widetilde{\beta}_1 \times bothwto_{ijt} - \widetilde{\beta}_2 \times imwto_{ijt}$ in the case of the variable trade cost and $-\ln \widehat{f}_{ijt} = -(\widetilde{\gamma}_1 - \widetilde{\beta}_1) \times bothwto_{ijt} - (\widetilde{\gamma}_2 - \widetilde{\beta}_2) \times imwto_{ijt}$ in the case of the fixed trade cost. Correspondingly, the counterfactual variable trade cost term would be $\ln(\tau'_{ijt})^{1-\sigma} = \widetilde{\boldsymbol{\beta}}\mathbf{B}_{ijt}$ in the case of variable trade cost shocks only (where again, the set of $\mathbf{B}_{ijt}$ excludes the GATT/WTO membership indicators) and $\ln(\tau'_{ijt})^{1-\sigma} = \ln(\tau_{ijt})^{1-\sigma} = \widetilde{\boldsymbol{\beta}}\mathbf{B}_{ijt} + \widetilde{\beta}_1 \times bothwto_{ijt} + \widetilde{\beta}_2 \times imwto_{ijt}$ in the case of fixed trade cost shocks only.

1.3 Estimation Results

We consider the period 1978-2015 for the analysis. The choice of the beginning year was limited by the availability of data on bilateral trade flows at the product level. The end year of 2015 was chosen because most major trading countries had joined the GATT/WTO by 2015 (identification requires a meaningful size of control group), and most of the significant multilateral trade talks facilitated by the GATT/WTO had taken place before then. The sources and compilation of the data are documented in Appendix A.1. These include bilateral trade flow X_{ijt}, the mass of varieties traded N_{ijt}, GDP, value-added share α_{it} of gross output, gross output Y_{it}, expenditure E_{jt}, and trade cost proxies $\mathbf{B}_{ijt}$.

The sample of countries studied is characterized in Tables 1.1–1.2. We trim the sample such that a country in the sample imports to and exports from at least one other country in a year.[2] We also drop the countries that have negative aggregate expenditures or negative internal trade (due to data measurement errors). Summary statistics for the list of asymmetric trade cost proxies used in the estimation of (1.24) and (1.30) are provided in Tables 1.3–1.4.

The estimations of the Probit equation (1.24) and the trade flow equation (1.30) are performed year by year due to computation constraints. HMR similarly imple-

[2]We do this so that the country's MR terms are not dependent on only the internal trade cost factor (an issue we will address below).

mented this set of non-linear estimations for only a cross section. The resulting importer FEs are then pooled across years to estimate the GATT/WTO effects on the variable trade cost term by (1.31) and on the total trade cost term by (1.32).

1.3.1 Benchmark Results

The benchmark estimation results for the parameters δ and s_η in (1.30) and (1.26) are summarized in Table 1.5 and for the GATT/WTO membership effects in Table 1.6. In the benchmark, we use the full sample and impute s_η assuming $k/(\sigma-1) = 1.5$ based on Eaton, Kortum and Kramarz (2011). As suggested above, the estimations of (1.30) are done year by year. This produces estimates of δ that vary across years and the corresponding estimates of s_η. Table 1.5 suggests a very narrow range of estimates for these two parameters for the period of study. The estimates of δ are on the same order of magnitude as estimated by HMR for a cross-section.

Column (1) and Column (2) in Table 1.6 then report the estimates of the GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. The confidence intervals of GATT/WTO membership indicators are given in square brackets. Column (3) reports the GATT/WTO effects on $-\ln f_{ijt}$, corresponding to the difference between Column (2) and Column (1). The significant and positive coefficient estimates of the GATT/WTO membership indicators suggest that GATT/WTO membership effectively reduces the variable trade cost, total trade cost, and fixed trade cost. The estimates suggest that $bothwto_{ijt}$ has a larger effect on the intensive margin (via the variable trade cost) than $imwto_{ijt}$ and there two estimates are statistically different, as their confidence intervals do not overlap in Column (1). The same ranking applies in their effects on the extensive margin (via the total trade cost) in Column (2). The GATT/WTO membership effects on the total trade cost term in Column (2) are further statistically larger than its effects on the variable trade cost term in Column (1), implying a statistically significant effect on the fixed cost. In Column (3), the effects of $bothwto_{ijt}$ and $imwto_{ijt}$ are found not to be statistically different.

The significant and positive coefficients of $imwto_{ijt}$ imply that GATT/WTO members extend their lower import barriers to goods from nonmembers (although not required by their membership in the GATT/WTO). Such extensions are partial in terms of the reduction in variable trade costs such that the effects of *bothwto* still dominate *imwto* in terms of the intensive margin. In contrast, it is found that the reduction in fixed costs induced by importers' policy changes as a result of membership is applied to imports in a non-discriminatory manner, with respect to member or nonmember trading partners.

We may also further translate the GATT/WTO effects on the intensive and extensive margins to the underlying trade cost by taking a stand on the value of σ. For this purpose, we take the median value of $\sigma = 5$ suggested by the gravity literature Head and Mayer (2015). The results imply that a reduction in the variable trade cost is by 21.04% due to *bothwto* and by 11.75% due to *imwto* (e.g., $1-\exp(0.945/(1-5)) = 21.04\%$). In parallel, the fixed cost is lowered by 30.44% due to *bothwto* and by 38.98% due to *imwto*, although as discussed above, these two estimates are not statistically different. We may therefore conclude that GATT/WTO has a larger impact on the members' fixed trade costs than on variable trade costs.

Dutt, Mihov and Van Zandt (2013) used the alternative measure of intensive margin, X_{ijt}/N_{ijt}, and the argument that a reduction in variable trade costs has a positive effect on this intensive margin and that a reduction in fixed trade costs has a negative effect on the intensive margin to infer that the GATT/WTO effect on fixed trade cost is larger than that on variable trade cost because they found *bothwto* has negative effects on this measure of intensive margin. Our analysis here provides a direct decomposition of changes in the underlying variable and fixed trade costs due to the GATT/WTO (and due to a shock in general). It is not immediately clear how the variable and fixed trade cost factors can be isolated in the framework of Dutt, Mihov and Van Zandt (2013).[3]

1.3.2 Robustness Checks

We verify the robustness of our results to the way we identify k and to the way we treat observations dropped from the Probit estimation in (1.24). First, note that in the estimation of the Probit equation (1.24), some observations are automatically dropped by the estimation software due to identification issues (e.g., perfectly predicted trading status in some observations). In the benchmark analysis, to preserve observations used for the estimations of the GATT/WTO effects in the second step of our procedure, (1.31)–(1.32), we impute the missing observations $\widetilde{z}^*_{ijt}$ by calculating their fitted value given the Probit coefficient estimates.[4] In Table 1.7, we report

[3]Also note that their analysis incorporates the effects of elasticity of substitution $1-\sigma$ in the comparison of the effects on the variable trade cost versus fixed trade cost, i.e., in terms of trade value, and not directly in terms of trade costs.

[4]Following Helpman, Melitz and Rubinstein (2008) and Manova (2013a), we replace those $\widetilde{z}^*_{ijt} > 0.9999999$ to be 0.9999999 and replace those $\widetilde{z}^*_{ijt} < 0.0000001$ to be 0.0000001. Since internal trade

the results by not including the observations dropped by the Probit estimations. In Table 1.8, we report the results if we impute the missing values only for the observations that were dropped in the probit estimation due to perfect prediction. The findings are qualitatively similar to the benchmark discussed in the previous section. However, the GATT/WTO effects on the fixed cost f_{ijt} are not significantly larger than on the variable trade cost τ_{ijt}. Rather, after the confidence intervals of Column (1) are scaled down by $\sigma - 1$, they overlap with the confidence intervals of Column (3) for fixed trade cost in the case of *imwto*, and the ranking is reversed in the case of *bothwto*, i.e., the reduction in the variable trade cost is more significant than that in fixed trade cost for *bothwto* observations.

In the second set of robustness checks, instead of assuming $k/(\sigma - 1) = 1.5$, we estimate k by the QQ estimation approach of Head, Mayer and Thoenig (2014), using the ORBIS global firm-level data. The estimation methodology is documented in Appendix A.2. The resulting estimates of $\widetilde{k}$ and the corresponding $\widetilde{s}_\eta$ (given $\widetilde{\delta}$ estimated previously and assuming $\sigma = 5$) are summarized in Table 1.9. This approach implies a larger range of estimates of s_η.

Given these alternative estimates of $\widetilde{s}_\eta$, we repeat the estimations for Equation (1.32). These estimations provide alternative estimates of the GATT/WTO effects

is always active, we replace $\widetilde{z}^*_{iit}$ with the value 0.9999999. We fill in the missing observations $\widetilde{z}^*_{ijt}$ based on the Probit coefficient estimates as discussed above. If the observation on $\widetilde{z}^*_{ijt}$ is still missing, e.g., because of missing estimates of importer and/or exporter FEs in a year, we fill in the missing $\widetilde{z}^*_{ijt}$ with the average value of the same country pair ij across years. If with this, $\widetilde{z}^*_{ijt}$ is still missing, we fill in the missing value with the corresponding average value of the same exporter in a specific year across its trading partners.

on the extensive margin (via the total trade cost) and the corresponding effects on the fixed cost. The results are reported in Columns (2) and (3) of Tables 1.10, 1.11 and 1.12 for the full sample and the two subsamples, respectively. Note that the results in Column (1) remain the same, as estimations of Equation (1.30) do not depend on s_η. The GATT/WTO effects on the fixed cost are now found to be larger than those in Tables 1.6–1.8. As a result, the ranking of GATT/WTO effects on the fixed cost versus variable cost tilts in favor of the fixed cost. By scaling down the confidence intervals of Column (1) estimates by $(\sigma - 1)$, we find that the effects on the fixed trade cost dominate those on variable trade cost in the full sample by a larger margin for both GATT/WTO membership indicators. In the two restricted subsamples, the GATT/WTO effects on the fixed cost are either statistically equivalent to the effects on the variable cost (in the case of *bothwto*) or larger (in the case of *imwto*).

Overall, the results of these five robustness checks confirm GATT/WTO membership's impacts on reductions in both variable and fixed trade costs. The impacts are weakly larger if both trading partners are members than if only the importing country is a member. GATT/WTO members tend to extend their reductions in trade barriers (variable or fixed) to nonmember sources of imports. Such extensions are statistically indistinguishable from MFN treatments to members in terms of fixed costs, although there is a clear discrimination against nonmembers in terms of variable trade costs. In the latter case, the reduction in variable trade costs against nonmember sources of imports is smaller than those against member sources of imports.

1.4 General Equilibrium Effects

In this section, we analyze the general equilibrium effects of GATT/WTO membership based on the benchmark estimates of the GATT/WTO effects on the trade cost factors in Table 1.6. We consider two counterfactual scenarios: (1) if the whole system were shut down and (2) if China had not entered the GATT/WTO in 2001. For the first counterfactual analysis, we further decompose the total effects into effects due to the variable trade cost channel and the effects due to the fixed trade cost channel. We present the counterfactual changes in welfare (real income) $\widehat{Y}_{it}/\widehat{P}_{it}$, trade flow $\widehat{X}_{ijt}$, extensive margins in terms of $\widehat{N}_{ijt}$ and $\widehat{\Omega}_{ijt}$, and intensive margin $\widehat{X}_{ijt}/\widehat{N}_{ijt}$, due to the shocks.

The parameters required in the simulation, including the value-added share (α_{it}), the (inverse) productivity cutoff (a_{ijt}), and the support of the (inverse) productivity distributions (a_{L_i} and a_{H_i}), are documented in Appendix A.1.2 and A.3.

1.4.1 Shutting Down the GATT/WTO

The first counterfactual scenario we consider is shutting down the GATT/WTO. This scenario is equivalent to turning all the factual values of $bothwto_{ijt}$ and $imwto_{ijt}$ to zeros. The shocks to the status quo are as elaborated at the end of Section 1.2.3, given the estimates of the GATT/WTO effects on total, variable, and fixed trade costs.

Table 1.15 provides the summary statistics of the welfare (real income) changes across years by membership. Shutting down GATT/WTO decreases countries' welfare by 2.09% on average. Figure 1.1 illustrates the range of the GATT/WTO welfare effects in each year. Members generally lose (in the range of -2.5%), while the welfare loss of nonmembers through the general equilibrium effects is in the range of -0.58%. Such losses for nonmembers turned into gains in recent years. This suggests that nonmembers have also benefited from the GATT/WTO system (through the extension of the MFN treatment by members to nonmembers, net of any potential negative general equilibrium effects), but the cost of remaining outside the system has begun to dominate in recent years. Figure 1.2 provides the detailed distribution of the welfare effects across countries by membership status every five years. The most significant losses for members are observed in the period 2005–2010, with a long left tail. The losses have tended to decrease in recent years. In addition, Tables 1.16, 1.17, and 1.18 suggest that the welfare effects tend to be more pronounced for countries in Europe and Asia, developed, and high-income countries.

Next, we report the GATT/WTO effects on trade flows. Since our framework allows for changes in the trade status (active or inactive), we summarize the trade status change across bilateral trading relationships in each year in Figure 1.3, where Panel A reports the frequencies and Panel B reports the fractions of each category (active to active, active to inactive, inactive to active, and inactive to inactive). Since we are considering the counterfactual of shutting down the GATT/WTO (an increase in trade costs), it tends turn trade status from active to inactive, rather than the other way around. Overall, most of the observed trade status remains unchanged (in the range of 84.46%–90.35%). For those relationships where trade status changes (9.65%–15.54%), the majority of them change from being active to inactive (6.55%–11.52%), while only a very small fraction change from being inactive to active (2.48%–4.65%).

We also provide the trade elasticity with respect to total trade cost change in Table 1.19. This exercise takes into account the effect of changes in GATT/WTO status on both variable and fixed trade costs and the trade flows as a results. The table indicates that a 1% increase in the total trade cost is associated with an average reduction of 1.18% in trade flows. The trade elasticity is larger when both countries are members and when countries are more developed.[5] Table 1.20 and Figure 1.4 provide the summary statistics and distribution of trade flow change (in percentage) when shutting down the GATT/WTO. Overall, the impacts on trade flows by shutting down the GATT/WTO are quite substantial for a large majority of trading relationships.

We then look at the GATT/WTO effects on the extensive margin and intensive margin. Tables 1.21, 1.22 and 1.23 present the summary statistics of changes in the extensive margin N_{ijt}, the alternative extensive margin Ω_{ijt}, and the intensive margin X_{ijt}/N_{ijt}, respectively. Figures 1.5, 1.6, and 1.7 provide the distribution of such changes, respectively. The extensive margin generally decreases due to the GATT/WTO shock, and more so in terms of N_{ijt} than in terms of Ω_{ijt}. This finding is expected, as the latter measure is weighted by firm market shares and more productive firms are more likely to survive in the case of negative trade shocks. The median

[5] The average trade elasticity we obtain in the range of 1 to 2 is similar to Helpman, Melitz and Rubinstein (2008), although the pattern of trade elasticity across development stages is different. The latter finding is not surprising, given that the shocks considered are different in nature (distance versus the GATT/WTO).

change in the intensive margin X_{ijt}/N_{ijt} is positive. This finding is in contrast to what we find in the partial-effect estimation that GATT/WTO membership has positive effects on the intensive margin ($\tau_{ijt}^{1-\sigma}$); hence, shutting down the GATT/WTO will reduce the intensive margin. However, as we will discuss below, by considering firm entry and general equilibrium income effects, the net effect of variable and fixed trade cost shocks on the intensive margin, X_{ijt}/N_{ijt}, may be ambiguous. It depends on the firm productivity distribution and the strength of the income effects in general.

In addition, the finding on the intensive margin is sensitive to the sample truncation bias. In particular, given that the intensive margin is defined as X_{ijt}/N_{ijt}, observations with the largest decrease in trade flows (changing from active to inactive with zero X'_{ijt} and N'_{ijt}) do not have counterfactual intensive margins. Thus, the intensive margin in the counterfactual is calculated based on observations with modest decreases in trade flows, implying an upward bias in the estimates of counterfactual intensive margins. If we focus on trading relationships that remain active before and after the shock, the intensive margin for the majority of these observations decreases as a result of the negative trade shock.

The discussions above also point out the potential caveat of using X_{ijt}/N_{ijt} as a measure of intensive margins. In a sense, this measure does not take into account firm heterogeneity in productivity and their exporting propensity and overstates the influence of small firms in the composite of intensive margins.

Finally, we decompose the GATT/WTO effects due to changes in variable trade costs and in fixed trade costs, respectively. Tables 1.24–1.28 and Figures 1.8–1.12

summarize the effects on welfare, trade flows, extensive margins, and intensive margins if we shut down the GATT/WTO-induced changes in variable trade costs. The corresponding tables and figures for the GATT/WTO effects due to changes in fixed trade costs are summarized in Tables 1.29–1.33 and Figures 1.13–1.17. In comparison, the GATT/WTO implies larger welfare effects via the variable trade cost change than via the fixed trade cost change; the corresponding changes in the extensive margins are also more pronounced as a result of shifts in variable trade costs than of those in fixed trade costs.

As suggested by Coughlin and Bandyopadhyay (2017), Dutt, Mihov and Van Zandt (2013), and Lawless (2010), an increase in variable trade cost leads to a reduction in the intensive margin via its direct effect on $\tau_{ijt}^{1-\sigma}$. Meanwhile, the lower revenues and profits induce exit from the destination market (of marginally less productive firms), which in turn has a positive effect on the intensive margin measure X_{ijt}/N_{ijt}. The overall effect of the variable trade cost on the intensive margin depends on the firm productivity distribution. On the other hand, an increase in the fixed trade cost has a direct positive effect on the intensive margin of exports because the surviving exporters after the shock are more productive on average. However, the general equilibrium effects via income reduction may further moderate downward the above effects on the intensive margin. The results in Table 1.28 suggest that shutting down the GATT/WTO has a negative impact on the intensive margin via the variable trade cost, implying that the direct effect of variable trade cost (together with the income effect) dominates the entry effect of the variable trade cost in general equilibrium. The negative effects of shutting down the GATT/WTO on the intensive margin via the fixed cost in Table 1.33 also suggest that the entry effect is dominated by the negative income effects in the general equilibrium.

It is again worthwhile to note the sensitivity of the intensive margin measure X_{ijt}/N_{ijt} to sample truncation in the above analysis. As indicated by Tables 1.24 and 1.29, the changes in variable trade costs have a larger impact on real income than the changes in fixed trade costs. As a result, more trading relationships turn to zero trade, rendering missing intensive margin observations in the counterfactual of shutting down the GATT/WTO via the variable trade cost. This result explains in part the seemingly less negative impacts on the intensive margin in the case of variable trade cost shocks.

1.4.2 Effects of China's Membership in the GATT/WTO

In this subsection, we also analyze the effects of China's membership in the GAT-T/WTO. In the counterfactual, we suppose that China had not entered the GAT-T/WTO in 2001 and its membership indicators remained zero ($bothwto_{ijt} = 0$ and $imwto_{ijt} = 0$ when $j = China$ for $t \geq 2001$). The effects on the variables of interest are evaluated relative to the status quo.

Table 1.34–1.37 provide the summary statistics of welfare effects by membership, region, development stage, and income level, respectively. The results indicate that China's entry into the GATT/WTO had benefited members more than nonmembers, developed countries more than developing countries, and high-income countries more than low-income countries. China itself is the largest beneficiary of its GATT/WTO entry, followed by East and South Asian countries and the OECD countries. Figures 1.18 and 1.19 provide a closer look into the distribution of welfare effects across countries by membership status. China's entry into GATT/WTO has generally imparted small losses among negatively impacted countries but larger dispersed gains for countries that benefited from China's entry into the system. Nonmembers experienced increasingly larger losses from China's GATT/WTO membership in recent years, likely due to the larger general equilibrium impacts the Chinese economy exerted as its size continued to grow.

1.5 Conclusion

In this paper, we develop an estimation procedure to identify the changes in variable and fixed trade costs in bilateral trading relationships due to GATT/WTO for the period 1978–2015. Specifically, the information on trade incidence, trade volume, firm sales distribution parameters, and multilateral resistance are used to isolate these two trade cost factors. The estimation results show that GATT/WTO membership reduces fixed trade cost more than variable trade cost. However, taking into account the trade elasticity with respect to the trade costs, the GATT/WTO system has a greater impact on trade volume via the variable trade cost channel than via the fixed trade cost channel. In particular, the benchmark estimates suggest that both exporter and importer being members raises bilateral imports by 157% via a reduction in variable trade costs, while by 43.8% via a reduction in fixed trade costs. This result corresponds to an estimated reduction in fixed costs of 30.44% and a reduction in variable trade costs of 21.04%. GATT/WTO members also tend to extend such trade cost reductions to nonmembers, especially in the case of fixed trade costs, but much less so in the case of variable trade costs.

In the counterfactual analysis, we then study the changes in welfare, trade flow, extensive margins, and intensive margins, given the estimated trade cost shocks associated with GATT/WTO membership. As discussed in the introduction, the fact that trade flow is truncated at zero prevents most studies in the previous literature from examining the status change of inactive trade in the counterfactual. In this paper, we propose strategies to simulate counterfactual trade incidence and trade volume for both active and inactive trade observations and further take into account general equilibrium adjustments of firm-level and aggregate variables, thus filling in a gap in the literature. According to our analysis, GATT/WTO has significant and dispersed effects on members (especially during the period of 2005–2010). Although the mode of the gains from the GATT/WTO was modest at approximately 3% in 2010, the distribution had a long tail, with some members experiencing benefits of more than 10% in real income due to the system. Further tabulations suggest that developed, high-income, and East and South Asian countries tend to reap the largest gains from their membership in the system. On the other hand, nonmembers also tend to gain in early years from the GATT/WTO system, suggesting that the benefits of MFN extensions from members to nonmembers dominate any potential general equilibrium loss of remaining outside the system. The balance has tilted to the opposite direction over time, however, with the cost of staying outside the system beginning to dominate in recent years.

Table 1.1 Characteristics of countries included in the pseudo world

Year	(a) No. of countries in the raw data	(b) No. of countries in pseudo world	(c) No. of obs. with positive bilateral imports	(d) No. of obs. with zero bilateral imports
1978	55	55	1,968	1,057
1983	83	83	4379	2510
1987	86	86	4979	2417
1991	91	91	5,984	2,297
1995	126	126	9809	6067
1999	146	146	13810	7506
2003	161	161	17,472	8,449
2007	165	165	18843	8382
2011	160	159	18333	6948
2015	145	145	16,745	4,280

Note:

(a) refers to the number of countries: (i) with at least one non-missing bilateral import and one non-missing bilateral export number from WITS, (ii) with trade cost proxy data, and (iii) with GDP data.

(b) refers to the number of countries in the pseudo world after the iterated adjustment described in the data appendix to ensure that every country has positive expenditure and internal trade.

(c) refers to the number of observations in the pseudo world with positive bilateral imports in the pseudo world.

(d) refers to the number of observations in the pseudo world with zero bilateral imports in the pseudo world.

Table 1.2 Characteristics of countries included in the pseudo world (continued)

Year	(a) No. of countries	(b) No. of members	(c) No. of nonmembers	(d) Import share of members	(e) Import share of nonmembers	(f) Import share of *bothwto* obs.	(g) Import share of *imwto* obs.
1978	55	35	20	0.9350	0.0650	0.8855	0.0495
1983	83	54	29	0.9338	0.0662	0.8875	0.0462
1987	86	54	32	0.9459	0.0541	0.8946	0.0513
1991	91	68	23	0.9556	0.0444	0.8881	0.0676
1995	126	98	28	0.9529	0.0471	0.8660	0.0868
1999	146	110	36	0.9428	0.0572	0.8361	0.1067
2003	161	131	30	0.9673	0.0327	0.9421	0.0252
2007	165	136	29	0.9691	0.0309	0.9489	0.0203
2011	159	132	27	0.9651	0.0349	0.9457	0.0194
2015	145	133	12	0.9909	0.0091	0.9870	0.0039

Note:

(a) refers to the number of countries in the pseudo world.

(b) refers to the number of GATT/WTO member countries in the pseudo world.

(c) refers to the number of nonmember countries in the pseudo world.

(d) refers to the total imports of GATT/WTO member countries relative to the total imports of the pseudo world.

(e) refers to the total imports of nonmember countries relative to the total imports of the pseudo world.

(f) refers to the total imports of country pairs in which both countries are GATT/WTO members relative to the total imports of the pseudo world.

(g) refers to the total imports of country pairs in which only the importer is a GATT/WTO member relative to the total imports of the pseudo world.

Table 1.3 Definition of (asymmetric) trade cost proxies

Variables	Definition
$bothwto_{ijt}$	whether both the importer and exporter are GATT/WTO members
$imwto_{ijt}$	whether only the importer is a GATT/WTO member
rta_{ijt}	whether a Regional Trade Agreement (RTA) is in force between two countries
gsp_{ijt}	whether the importer offers the Generalized System of Preferences (GSP) preferential treatment to the exporter
$comcur_{ijt}$	whether two countries use a common currency
$curheg\_o_{ijt}$	whether the exporter is currently a colonizer of the importer
$curheg\_d_{ijt}$	whether the importer is currently a colonizer of the exporter
$comlanguage_{ij}$	whether a language is the official or primary language in both countries
$comlanguage2_{ij}$	whether a language is spoken by at least 9% of the population in both countries
$comcol_{ij}$	whether the two countries have had a common colonizer after the year 1945
$comleg_{ij}$	whether the two countries have a common legal origin indicator
$smctry_{ij}$	whether the two countries were or are the same state or the same administrative entity for a long period of time
heg_o_{ij}	whether the exporter has ever been a colonizer of the importer
heg_d_{ij}	whether the importer has ever been a colonizer of the exporter
$contig_{ij}$	whether the two countries are contiguous
$bothisland_{ij}$	whether both countries are island countries
$bothlandlock_{ij}$	whether both countries are landlocked
$\ln wdistance_{ij}$	logarithm of population-weighted bilateral distance (km)

Note: This table provides the definitions for the asymmetric observable trade proxies we use in Equations (1.24) and (1.30). These trade proxies include both time-variant a
time-invariant variables.

Table 1.4 Summary statistics of (asymmetric) trade cost proxies

Variables	No. of obs.	Mean	Std.	Min	Max	Unit of obs.
$bothwto_{ijt}$	612,002	0.6342	0.4817	0	1	i, j, t
$imwto_{ijt}$	612,002	0.1571	0.3639	0	1	i, j, t
rta_{ijt}	612,002	0.1853	0.3885	0	1	i, j, t
gsp_{ijt}	612,002	0.1241	0.3296	0	1	i, j, t
$comcur_{ijt}$	612,002	0.0193	0.1375	0	1	i, j, t
$curheg\_o_{ijt}$	612,002	0.0003	0.0183	0	1	i, j, t
$curheg\_d_{ijt}$	612,002	0.0003	0.0183	0	1	i, j, t
$comlanguage_{ij}$	34,334	0.1538	0.3607	0	1	i, j
$comlanguage2_{ij}$	34,334	0.1462	0.3533	0	1	i, j
$comcol_{ij}$	34,334	0.1150	0.3190	0	1	i, j
$comleg_{ij}$	34,334	0.3398	0.4737	0	1	i, j
$smctry_{ij}$	34,334	0.0140	0.1174	0	1	i, j
heg_o_{ij}	34,334	0.0059	0.0763	0	1	i, j
heg_d_{ij}	34,334	0.0059	0.0763	0	1	i, j
$contig_{ij}$	34,334	0.0150	0.1214	0	1	i, j
$bothisland_{ij}$	34,334	0.0520	0.2221	0	1	i, j
$bothlandlock_{ij}$	34,334	0.0333	0.1795	0	1	i, j
$\ln wdistance_{ij}$	34,334	8.7549	0.8108	0.6316	9.8902	i, j

Note: This table provides the summary statistics for the asymmetric observable trade proxies we use in Equations (1.24) and (1.30).

Table 1.5 Summary statistics for $\tilde{\delta}$ and $\tilde{s}_\eta$ across years ($\frac{k}{\sigma-1} = 1.5$)

when $k/(\sigma-1) = 1.5$	Min	Median	Max
$\tilde{\delta}$	0.8544	1.1266	1.5983
$\tilde{s}_\eta$	1.7088	2.2532	3.1966

Note: This table provides the summary statistics for $\tilde{\delta}$ and $\tilde{s}_\eta$. $\tilde{\delta}$ is estimated from (1.30). $\tilde{s}_\eta$ is calculated from (1.26), given $k/(\sigma-1) = 1.5$. $\tilde{\delta}$ and $\tilde{s}_\eta$ are year-specific because the estimations of (1.24) and (1.30) are done year by year.

Table 1.6 GATT/WTO effects on variable, total and fixed trade cost (Full sample, $\frac{k}{\sigma-1} = 1.5$)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$-\ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	0.945***	1.308***	0.3630
	(0.0334)	(0.0173)	(0.0376)
	[0.8795,1.0105]	[1.2741,1.3419]	[0.2893, 0.4367]
$imwto_{ijt}$	0.500***	0.994***	0.4940
	(0.0462)	(0.0310)	(0.0556)
	[0.4094, 0.5906]	[0.9332,1.0548]	[0.3850,0.6030]
$\ln E_{jt}$	1.013***	0.791***	
	(0.00806)	(0.00936)	
$\ln Y_{wt}$	-0.528***	-0.322***	
	(0.00872)	(0.0108)	
$\ln P_{jt}^{1-\sigma}$	-0.764***	-0.369***	
	(0.0143)	(0.0183)	
Observations	423,337	602,820	

Note: Given $k/(\sigma-1) = 1.5$ and the full regression sample, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $-\ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 1.7 GATT/WTO effects on variable, total and fixed trade cost (Subsample 1, $\frac{k}{\sigma-1} = 1.5$)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$-\ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	1.196***	1.367***	0.1710
	(0.0203)	(0.0186)	(0.0275)
	[1.1562,1.2358]	[1.3305,1.4035]	[0.1171,0.2249]
$imwto_{ijt}$	0.762***	1.063***	0.3010
	(0.0379)	(0.0316)	(0.0493)
	[0.6877,0.8363]	[1.0011,1.1249]	[0.2044,0.3976]
$\ln E_{jt}$	1.102***	0.876***	
	(0.00973)	(0.0101)	
$\ln Yw_t$	-0.619***	-0.398***	
	(0.0102)	(0.0116)	
$\ln P_{jt}^{1-\sigma}$	-0.827***	-0.406***	
	(0.0153)	(0.0193)	
Observations	403,712	587,863	

Note: Given $k/(\sigma-1) = 1.5$ and the subsample in which observations dropped from the Probit estimation are not used, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $-\ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 1.8 GATT/WTO effects on variable, total and fixed trade cost (Subsample 2, $\frac{k}{\sigma-1} = 1.5$)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$-\ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	1.164***	1.332***	0.1680
	(0.0205)	(0.0182)	(0.0274)
	[1.1238,1.2042]	[1.2963,1.3677]	[0.1143,0.2217]
$imwto_{ijt}$	0.727***	1.019***	0.2920
	(0.0380)	(0.0316)	(0.0494)
	[0.6525,0.8015]	[0.9571,1.0809]	[0.1952,0.3888]
$\ln E_{jt}$	1.036***	0.793***	
	(0.00822)	(0.00958)	
$\ln Y_{wt}$	-0.563***	-0.325***	
	(0.00889)	(0.0111)	
$\ln P_{jt}^{1-\sigma}$	-0.824***	-0.375***	
	(0.0145)	(0.0188)	
Observations	417,681	601,793	

Note: Given $k/(\sigma-1) = 1.5$ and the subsample in which only the missing values $\tilde{z}_{ijt}^{*}$ for perfectly predicted observations in the Probit estimation are imputed but not the other missing observations, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $-\ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and *** indicate

Table 1.9 Summary statistics of $\tilde{\delta}$, $\tilde{s}_\eta$, and $\tilde{k}$ from the QQ estimation

Variables	Min	Median	Max
$\tilde{\delta}$	0.8544	1.1266	1.5983
$\tilde{k}$	4.1032	4.4255	11.7750
$\tilde{s}_\eta$	0.4974	10.5269	33.1227

Note: This table provides the summary statistics for $\tilde{\delta}$, $\tilde{k}$, and $\tilde{s}_\eta$. $\tilde{\delta}$ is estimated from Equation (1.30). $\tilde{k}$ is estimated using the QQ estimation approach. $\tilde{s}_\eta$ is calculated from Equation (1.26). $\tilde{\delta}$ is year-specific. Both k and $\tilde{s}_\eta$ are country-year-specific.

Table 1.10 GATT/WTO effects on variable, total and fixed trade cost (Full sample, k is from QQ estimation)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$-\ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	0.945***	1.586***	0.6410
	(0.0334)	(0.0846)	(0.091)
	[0.8795,1.0105]	[1.4202,1.7518]	[0.4626,0.8194]
$imwto_{ijt}$	0.500***	1.248***	0.7480
	(0.0462)	(0.122)	(0.1305)
	[0.4094,0.5906]	[1.0089,1.4871]	[0.4922,1.0038]
$\ln E_{jt}$	1.013***	0.202***	
	(0.00806)	(0.0161)	
$\ln Y_{wt}$	-0.528***	2.218***	
	(0.00872)	(0.0171)	
$\ln P_{jt}^{1-\sigma}$	-0.764***	-0.468***	
	(0.0143)	(0.0255)	
Observations	423,337	586,003	

Note: Given k from the QQ estimation and the full sample, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $-\ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and ***

Table 1.11 GATT/WTO effects on variable, total and fixed trade cost (Subsample 1, k is from QQ estimation)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$- \ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	1.196***	1.650***	0.4540
	(0.0203)	(0.0851)	(0.0875)
	[1.1562,1.2358]	[1.4832,1.8168]	[0.2825,0.6255]
$imwto_{ijt}$	0.762***	1.308***	0.5460
	(0.0379)	(0.123)	(0.1287)
	[0.6877,0.8363]	[1.0669,1.5491]	[0.2937,0.7983]
$\ln E_{jt}$	1.102***	0.213***	
	(0.00973)	(0.0167)	
$\ln Y_{wt}$	-0.619***	2.206***	
	(0.0102)	(0.0177)	
$\ln P_{jt}^{1-\sigma}$	-0.827***	-0.482***	
	(0.0153)	(0.0260)	
Observations	403,712	571,177	

Note: Given k from the QQ estimation and the subsample in which observations dropped from the Probit estimation are not used, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $- \ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 1.12 GATT/WTO effects on variable, total and fixed trade cost (Subsample 2, k is from QQ estimation)

	(1)	(2)	(3)
GATT/WTO effects identified	$\ln \tau_{ijt}^{1-\sigma}$	$\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$	$-\ln f_{ijt}$
Dependent variables	$\tilde{\lambda}_{jt}$	$\tilde{\xi}_{jt}$	
$bothwto_{ijt}$	1.164***	1.620***	0.4560
	(0.0205)	(0.0852)	(0.0876)
	[1.1238,1.2042]	[1.4530,1.7870]	[0.2843,0.6277]
$imwto_{ijt}$	0.727***	1.282***	0.5550
	(0.0380)	(0.123)	(0.1287)
	[0.6525,0.8015]	[1.0409,1.5231]	[0.3027,0.8073]
$\ln E_{jt}$	1.036***	0.206***	
	(0.00822)	(0.0163)	
$\ln Y_{wt}$	-0.563***	2.212***	
	(0.00889)	(0.0173)	
$\ln P_{jt}^{1-\sigma}$	-0.824***	-0.479***	
	(0.0145)	(0.0257)	
Observations	417,681	584,981	

Note: Given k from the QQ estimation and the subsample in which only the missing values $\tilde{z}_{ijt}^{*}$ for perfectly predicted observations in the Probit estimation are imputed but not the other missing observations, Column (1) and Column (2) report the estimation results of GATT/WTO effects on $\ln \tau_{ijt}^{1-\sigma}$ and $\ln \tau_{ijt}^{1-\sigma} - \ln f_{ijt}$, respectively. Column (3) provides the calculated GATT/WTO effects on $-\ln f_{ijt}$. The robust standard errors are reported in parenthesis. 95% confidence intervals of $bothwto_{ijt}$ and $imwto_{ijt}$ are presented in the square brackets. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 1.13 Estimates of a_{L_i} and a_{H_i} for selected economies

Country Name	$1/a_{L_i}$	Country Name	$1/a_{H_i}$
Austria	2403.53	Denmark	61.29
Norway	2348.39	Norway	42.77
Bermuda	2314.21	Bermuda	42.15
Denmark	2155.93	Switzerland	39.04
Switzerland	2143.59	Qatar	36.25
Qatar	1990.56	Macau (Aomen)	34.31
Macau (Aomen)	1883.82	Luxembourg	29.81
Netherlands	1789.46	Austria	28.35
Germany	1751.01	Australia	27.39
Ireland	1668.86	Netherlands	26.44
Luxembourg	1580.09	Belgium	26.41
Australia	1503.79	United States of America	25.95
Belgium	1466.71	Iceland	25.78
United States of America	1424.95	Singapore	25.50
⋮	⋮	⋮	⋮
Sierra Leone	13.84	Sierra Leone	0.25
Mozambique	13.39	Mozambique	0.24
Eritrea	12.33	Eritrea	0.22
Madagascar	11.84	Madagascar	0.22
Central African Republic	11.29	Central African Republic	0.21
Liberia	11.16	Liberia	0.20
Malawi	10.21	Malawi	0.19
Niger	10.12	Niger	0.18
Somalia	7.71	Somalia	0.14
Burundi	7.10	Burundi	0.13

Note: This table provides the highest and lowest TFP ($1/a_{L_i}$ and $1/a_{H_i}$) of selected economies (the top twenty countries and the bottom ten economies).

Table 1.14 Summary statistics of N'_{ijt} for $z^*_{ijt} < 0$ (shutting down the GATT/WTO)

	No. of obs.	Mean	Min	Max
Nonlinear Least Square Estimation	181,118	2.40e-08	0	0.0003
Alternative Method 1	181,118	0.004	0	56.240
Alternative Method 2	181,118	1.33e-07	0	0.002

Note: This table provides the summary statistics for N'_{ijt} when $z^*_{ijt} < 0$ based on three alternative estimation methods of N_{it}, as documented in Appendix A.4.

Table 1.15 Welfare effects of GATT/WTO by membership status (shutting down GATT/WTO)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (1978-2015)						
Nonmember	1008	-0.58	-0.25	1.10	-11.84	4.38
Member	3602	-2.52	-1.90	2.20	-20.63	7.86
Total	4610	-2.09	-1.56	2.16	-20.63	7.86
Panel B. Welfare Effects of GATT/WTO (1978)						
Nonmember	20	-0.44	-0.20	0.54	-2.06	-0.02
Member	35	-1.33	-1.18	0.80	-4.17	-0.24
Total	55	-1.01	-0.95	0.83	-4.17	-0.02
Panel C. Welfare Effects of GATT/WTO (2015)						
Nonmember	12	0.05	0.12	0.29	-0.64	0.37
Member	133	-1.44	-1.08	1.31	-11.72	-0.12
Total	145	-1.32	-1.01	1.32	-11.72	0.37

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects of GATT/WTO (based on real income) are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.16 Welfare effects of GATT/WTO by regions (shutting down GATT/WTO)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (1978-2015)						
OECD	829	-2.52	-1.86	2.42	-20.63	-0.04
East Europe and Cent. Asia	240	-3.72	-2.72	3.65	-17.36	0.54
East and South Asia	629	-2.45	-1.84	2.28	-14.50	0.53
Latin America and Caribbean	945	-2.12	-1.71	1.96	-20.25	7.86
Middle East and North Africa	607	-1.14	-0.64	1.65	-11.06	1.03
Sub-Saharan Africa	896	-1.56	-1.49	1.07	-8.06	2.01
Other	464	-2.24	-1.52	2.23	-14.57	0.75
Panel B. Welfare Effects of GATT/WTO (1978)						
OECD	18	-1.45	-1.26	1.00	-4.17	-0.24
East Europe and Cent. Asia	.	.	.	.	.	.
East and South Asia	6	-0.90	-0.75	0.64	-1.90	-0.28
Latin America and Caribbean	5	-0.34	-0.16	0.30	-0.79	-0.12
Middle East and North Africa	5	-0.65	-0.22	0.93	-2.24	-0.03
Sub-Saharan Africa	16	-1.01	-1.11	0.54	-1.96	-0.02
Other	5	-0.55	-0.19	0.85	-2.06	-0.07
Panel C. Welfare Effects of GATT/WTO (2015)						
OECD	23	-1.58	-0.87	2.34	-11.72	-0.16
East Europe and Cent. Asia	11	-1.78	-1.47	1.35	-5.03	0.03
East and South Asia	22	-1.68	-1.07	1.47	-5.72	0.16
Latin America and Caribbean	27	-1.37	-1.01	0.92	-4.32	0.17
Middle East and North Africa	20	-0.63	-0.50	0.60	-1.72	0.37
Sub-Saharan Africa	27	-1.11	-1.12	0.58	-2.38	0.29
Other	15	-1.25	-1.13	0.98	-3.25	0.36

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects of GATT/WTO (based on real income) are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.17 Welfare effects of GATT/WTO by development stages (shutting down GATT/WTO)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (1978-2015)						
Developing	3076	-1.85	-1.49	1.78	-17.36	4.38
Developed	1534	-2.57	-1.77	2.71	-20.63	7.86
Panel B. Welfare Effects of GATT/WTO (1978)						
Developing	32	-0.82	-0.72	0.63	-2.24	-0.02
Developed	23	-1.27	-0.97	1.01	-4.17	-0.03
Panel C. Welfare Effects of GATT/WTO (2015)						
Developing	89	-1.24	-1.06	0.99	-5.72	0.37
Developed	56	-1.44	-0.96	1.73	-11.72	0.36

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects of GATT/WTO (based on real income) are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.18 Welfare effects of GATT/WTO by income levels (shutting down GATT/WTO)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (1978-2015)						
High Income	1393	-2.52	-1.75	2.60	-20.63	2.88
Middle Income	2306	-1.97	-1.46	2.07	-20.25	7.86
Low Income	911	-1.75	-1.60	1.43	-11.84	2.01
Panel B. Welfare Effects of GATT/WTO (1978)						
High Income	21	-1.25	-0.97	1.04	-4.17	-0.03
Middle Income	24	-0.77	-0.56	0.69	-2.24	-0.02
Low Income	10	-1.05	-1.15	0.50	-1.96	-0.11
Panel C. Welfare Effects of GATT/WTO (2015)						
High Income	55	-1.51	-1.04	1.73	-11.72	0.17
Middle Income	71	-1.24	-1.00	1.07	-5.72	0.37
Low Income	19	-1.02	-1.00	0.62	-2.29	0.29

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects of GATT/WTO (based on real income) are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.19 Trade elasticity w.r.t. trade cost change (shutting down GATT/WTO)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Trade elasticities w.r.t. trade cost change by membership						
bothwto	263365	1.20	1.16	1.82	-11.70	11.81
imwto	39910	1.06	1.09	2.86	-13.00	14.65
Panel B. Trade elasticities w.r.t. trade cost change by development						
DD	50970	1.30	1.23	1.81	-11.73	11.54
DL	73400	1.23	1.15	1.83	-10.19	13.21
LD	86489	1.13	1.14	1.99	-12.30	11.75
LL	92416	1.12	1.11	2.17	-13.00	14.65
Total	303275	1.18	1.15	1.99	- 14.65	13.00

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the trade elasticity with respect to the total trade cost change (due to GATT/WTO effects) is calculated for the counterfactual had GATT/WTO not existed, relative to the status quo total trade cost. “D” denotes the developed countries, while “L” denotes the developing countries. ”DL" denote a trading relationship involving a developed country’s exports to a developing country.

Table 1.20 GATT/WTO effects on trade flow (shutting GATT/WTO)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	423337	-82.94	710394.40	-100	440000000
1978	1968	-71.93	19543.89	-100	782983.90
2015	16745	-88.97	109649.90	-100	12100000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on trade flow are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.21 GATT/WTO effects on extensive margin N_{ijt} (shutting down GATT/WTO)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-82.13	181.17	-100	57519
1978	1991	-72.08	76.33	-100	1983.40
2015	17231	-86.39	40.39	-100	2545.40

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin N_{ijt} are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.22 GATT/WTO effects on extensive margin Ω_{ijt} (shutting down GATT/WTO)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-48.21	143.30	-100	43423.37
1978	1991	-39.13	54.67	-100	1443.12
2015	17231	-54.55	35.06	-100	1614.43

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin W_{ijt} are simulated for the counterfactual had GATT/WTO not existed, relative to the observed membership status.

Table 1.23 GATT/WTO effects on intensive margin X_{ijt}/N_{ijt} (shutting down GATT/WTO)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	363456	17.09	1878609	-100	1070000000
1978	1770	17.15	24423.54	-99.98	643090.10
2015	14482	-3.07	829423.60	-99.99	89200000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the intensive margin X_{ijt}/N_{ijt} are simulated for the counterfactual had GATT/WTO not existed, relative to the status quo.

Table 1.24 Welfare effects of GATT/WTO (via variable trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	4610	-1.47	2.06	-19.70	8.05
1978	55	-0.87	0.79	-3.96	-0.01
2015	145	-0.94	1.26	-11.14	0.34

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO welfare effects are simulated for the counterfactual of shutting down the GATT/WTO effects on variable trade cost, relative to the status quo.

Table 1.25 GATT/WTO effects on trade flow (via variable trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	423337	-78.16	750215.10	-100	465000000
1978	1968	-65.25	18809.57	-100	739773.70
2015	16745	-84.72	127785.30	-100	14200000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on trade flows are simulated for the counterfactual of shutting down the GATT/WTO effects on variable trade cost, relative to the status quo.

Table 1.26 GATT/WTO effects on extensive margin N_{ijt} (via variable trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-68.53	173.32	-100	47333
1978	1991	-52.97	69.76	-100	1812.90
2015	17231	-75.31	94.13	-100	10784

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin N_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on variable trade cost, relative to the status quo.

Table 1.27 GATT/WTO effects on extensive margin Ω_{ijt} (via variable trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-35.64	142.89	-100	39367.28
1978	1991	-25.81	49.78	-100	1344.66
2015	17231	-42.29	83.10	-100	9748.74

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin Ω_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on variable trade cost, relative to the status quo.

Table 1.28 GATT/WTO effects on intensive margin X_{ijt}/N_{ijt} (via variable trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	372833	-10.46	1343039	-100	778000000
1978	1810	-4.26	19764.08	-99.98	650968
2015	14976	-28.33	589489.60	-99.99	61800000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the intensive margin X_{ijt}/N_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on variable trade cost, relative to the status quo.

Table 1.29 Welfare effects of GATT/WTO (via fixed trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	4610	-0.03	0.87	-2.71	19.57
1978	55	0.02	0.33	-0.71	1.08
2015	145	-0.02	0.77	-1.15	4.94

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO welfare effects are simulated for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost, relative to the status quo.

Table 1.30 GATT/WTO effects on trade flow (via fixed trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	423337	-70.06	824315.30	-100	5.13E+08
1978	1968	-59.10	19061.24	-100	751183.80
2015	16745	-76.77	172568.60	-100	18800000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on trade flows are simulated for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost, relative to the status quo.

Table 1.31 GATT/WTO effects on extensive margin N_{ijt} (via fixed trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-38.91	474.87	-100	302850
1978	1991	-33.46	47.44	-100	1134.10
2015	17231	-42.72	210.15	-100	26761

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin N_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost, relative to the status quo.

Table 1.32 GATT/WTO effects on extensive margin Ω_{ijt} (via fixed trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	430882	-17.42	404.49	-100	258323.70
1978	1991	-14.27	34.60	-100	911.78
2015	17231	-20.14	163.92	-100	20948.68

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the extensive margin Ω_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost, relative to the status quo.

Table 1.33 GATT/WTO effects on intensive margin X_{ijt}/N_{ijt} (via fixed trade cost)

Period	No. of obs.	Median	Std.	Min	Max
1978-2015	382088	-39.21	846899.70	-100	493000000
1978	1832	-28.90	19923.05	-99.98	660543.50
2015	15539	-54.79	353103.90	-100	35300000

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the GATT/WTO effects on the intensive margin X_{ijt}/N_{ijt} are simulated for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost, relative to the status quo.

Table 1.34 Welfare effects by membership status (if China had not joined the GATT/WTO in 2001)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (2001-2015)						
Nonmember	380	-0.02	0.03	0.55	-7.09	3.12
Member	1998	-0.18	-0.03	0.69	-14.98	11.31
Total	2378	-0.15	-0.02	0.67	-14.98	11.31
Panel B. Welfare Effects of GATT/WTO (2001)						
Nonmember	28	-0.03	0.05	0.39	-1.42	0.76
Member	130	-0.09	0.01	0.41	-2.02	0.54
Total	158	-0.08	0.02	0.40	-2.02	0.76
Panel C. Welfare Effects of GATT/WTO (2015)						
Nonmember	12	0.25	0.19	0.21	0.03	0.71
Member	133	-0.14	-0.03	0.40	-2.37	0.73
Total	145.00	-0.11	-0.02	0.40	-2.37	0.73

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects (based on real income) are simulated for the counterfactual if China had not joined the GATT/WTO in 2001, relative to the status quo.

Table 1.35 Welfare effects by regions (if China had not joined the GATT/WTO in 2001)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (2001-2015)						
China	15	-2.06	-1.84	1.05	-4.96	-0.47
OECD	345	-0.12	-0.05	0.33	-2.04	0.32
East Europe and Cent. Asia	164	-0.01	0.02	0.25	-1.11	0.56
East and South Asia	291	-0.64	-0.40	0.83	-5.07	0.90
Latin America and Caribbean	461	-0.17	-0.03	1.04	-14.98	11.31
Middle East and North Africa	309	-0.03	0.00	0.26	-1.60	1.11
Sub-Saharan African	509	0.03	0.05	0.29	-2.28	1.11
Other	284	-0.09	0.04	0.58	-7.09	1.03
Panel B. Welfare Effects of GATT/WTO (2001)						
China	1	-2.02	-2.02	.	-2.02	-2.02
OECD	23	-0.10	-0.02	0.33	-1.51	0.20
East Europe and Cent. Asia	11	-0.10	0.02	0.31	-0.75	0.38
East and South Asia	19	-0.44	-0.34	0.65	-2.01	0.76
Latin America and Caribbean	32	-0.02	0.03	0.37	-1.16	0.54
Middle East and North Africa	21	0.01	0.05	0.20	-0.53	0.36
Sub-Saharan African	36	0.05	0.09	0.22	-0.49	0.35
Other	15	-0.04	0.05	0.25	-0.64	0.20
Panel C. Welfare Effects of GATT/WTO (2015)						
China	1	-0.47	-0.47	.	-0.47	-0.47
OECD	23	-0.17	-0.06	0.35	-1.66	0.06
East Europe and Cent. Asia	11	-0.01	-0.07	0.15	-0.20	0.28
East and South Asia	21	-0.48	-0.28	0.63	-2.37	0.40
Latin America and Caribbean	27	-0.13	-0.02	0.37	-1.07	0.73
Middle East and North Africa	20	-0.03	0.02	0.24	-1.02	0.15
Sub-Saharan African	27	0.06	0.05	0.22	-0.73	0.59
Other	15	0.07	0.07	0.39	-1.08	0.71

Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects (based on real income) are simulated for the counterfactual if China had not joined the GATT/WTO in 2001, relative to the status quo.

Table 1.36 Welfare effects by development stages (if China had not joined the GATT/WTO in 2001)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (2001-2015)						
Developing	1589	-0.14	-0.01	0.56	-7.09	1.31
Developed	789	-0.17	-0.04	0.84	-14.98	11.31
Panel B. Welfare Effects of GATT/WTO (2001)						
Developing	115	-0.08	0.03	0.41	-2.02	0.76
Developed	43	-0.09	0.00	0.38	-1.51	0.48
Panel C. Welfare Effects of GATT/WTO (2015)						
Developing	89	-0.09	0.00	0.43	-2.37	0.73
Developed	56	-0.14	-0.04	0.35	-1.66	0.59

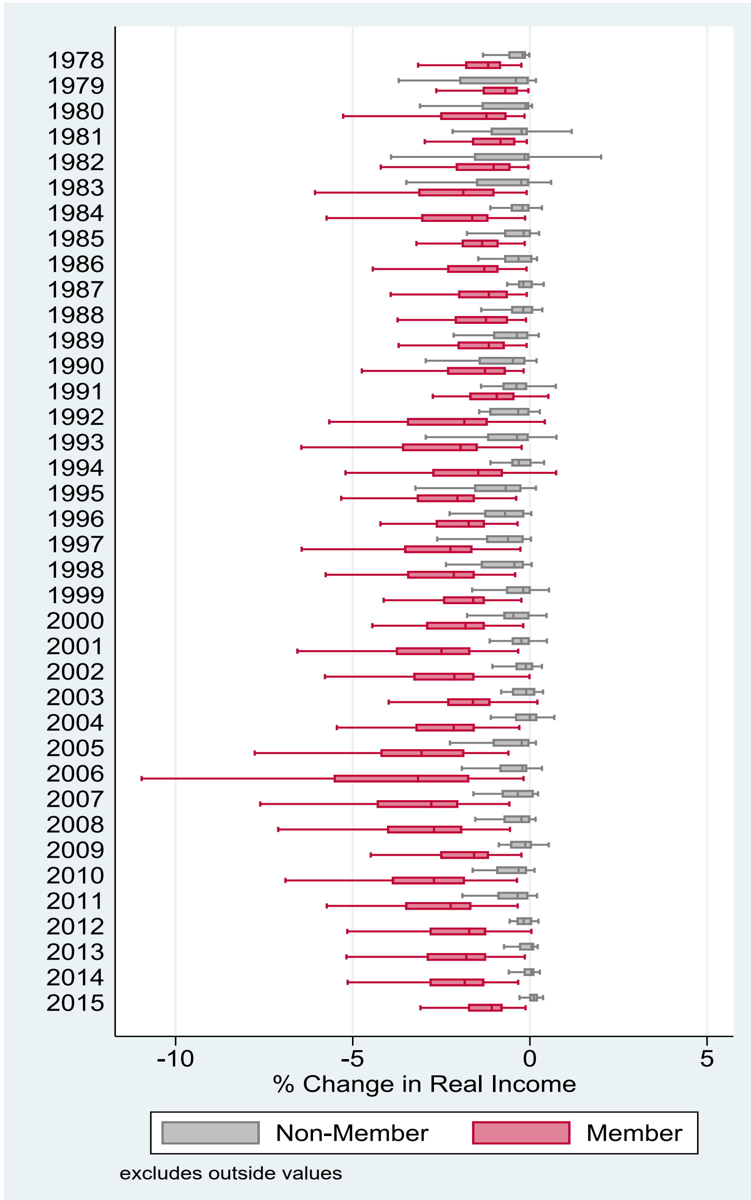
Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects (based on real income) are simulated for the counterfactual if China had not joined the GATT/WTO in 2001, relative to the status quo.

Table 1.37 Welfare effects by income levels (if China had not joined the GATT/WTO in 2001)

	No. of obs.	Mean	Median	Std.	Min	Max
Panel A. Welfare Effects of GATT/WTO (2001-2015)						
High Income	729	-0.18	-0.04	0.52	-5.07	3.12
Middle Income	1195	-0.14	-0.01	0.78	-14.98	11.31
Low Income	454	-0.13	0.02	0.56	-3.45	0.96
Panel B. Welfare Effects of GATT/WTO (2001)						
High Income	40	-0.12	-0.02	0.38	-1.51	0.41
Middle Income	73	-0.04	0.05	0.37	-2.02	0.54
Low Income	45	-0.12	0.01	0.47	-2.01	0.76
Panel C. Welfare Effects of GATT/WTO (2015)						
High Income	55	-0.16	-0.04	0.34	-1.66	0.23
Middle Income	71	-0.13	-0.02	0.47	-2.37	0.73
Low Income	19	0.10	0.04	0.19	-0.15	0.59

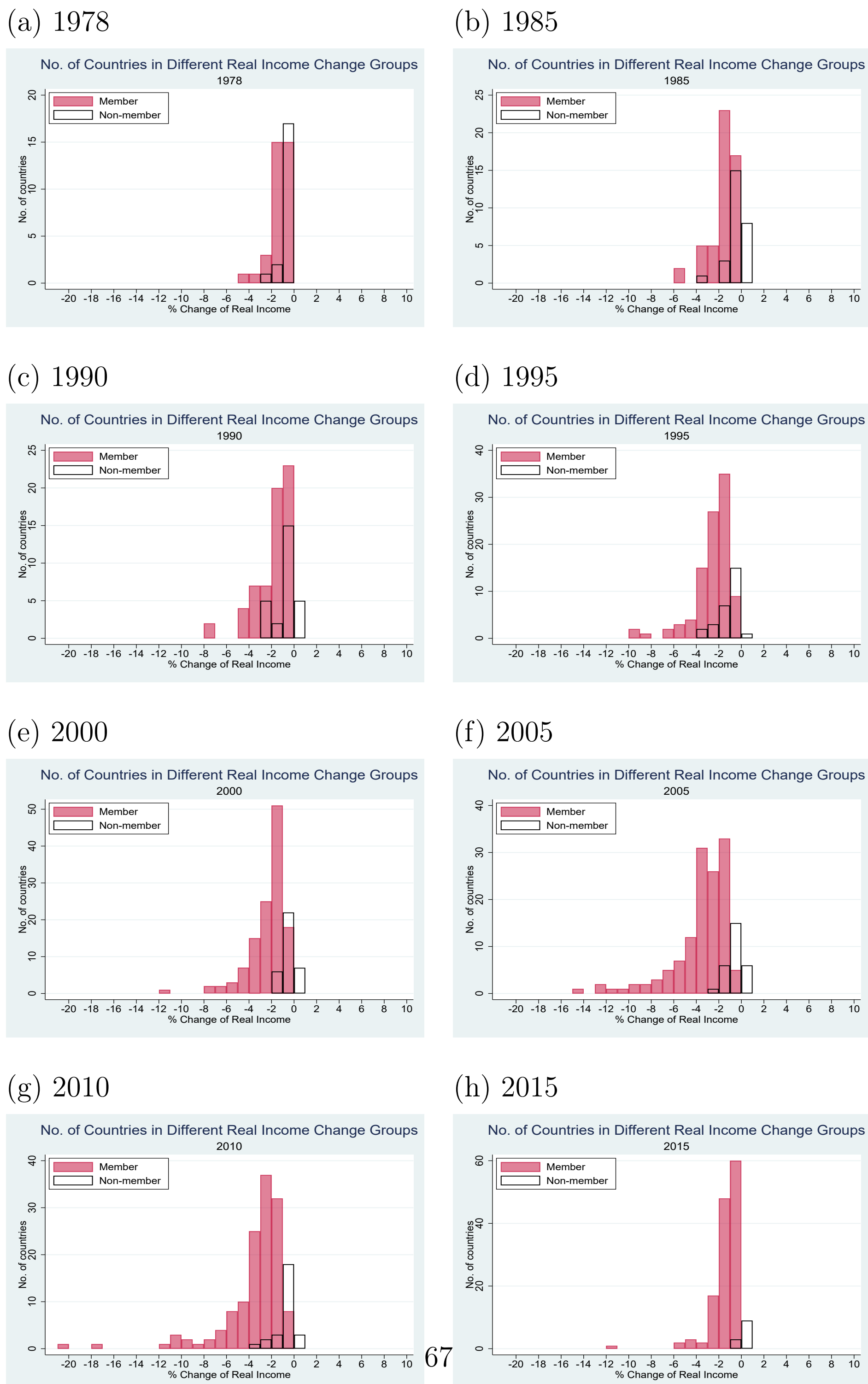
Note: Based on the estimates of GATT/WTO effects in Table 1.6, the welfare effects (based on real income) are simulated for the counterfactual if China had not joined the GATT/WTO in 2001, relative to the status quo.

Figure 1.1 Welfare effects of GATT/WTO (shutting down GATT/WTO)



Note: This figure presents the range of the GATT/WTO welfare effects in each year from 1978 to 2015. The box indicates the 25th percentile (the lower hinge of the box), the median, and the 75th percentile (the upper hinge of the box) of the variable of interest. Outliers are omitted.

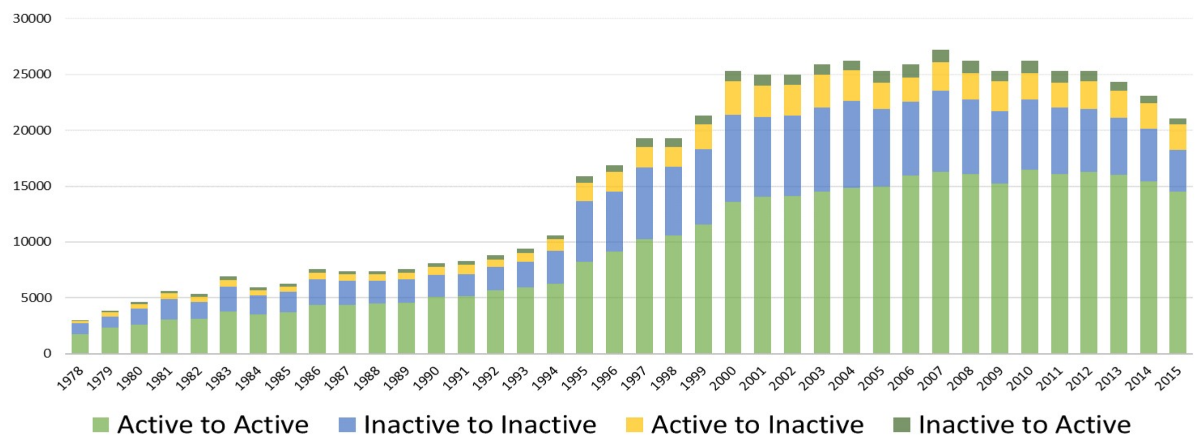
Figure 1.2 Welfare effects of GATT/WTO (shutting down GATT/WTO)



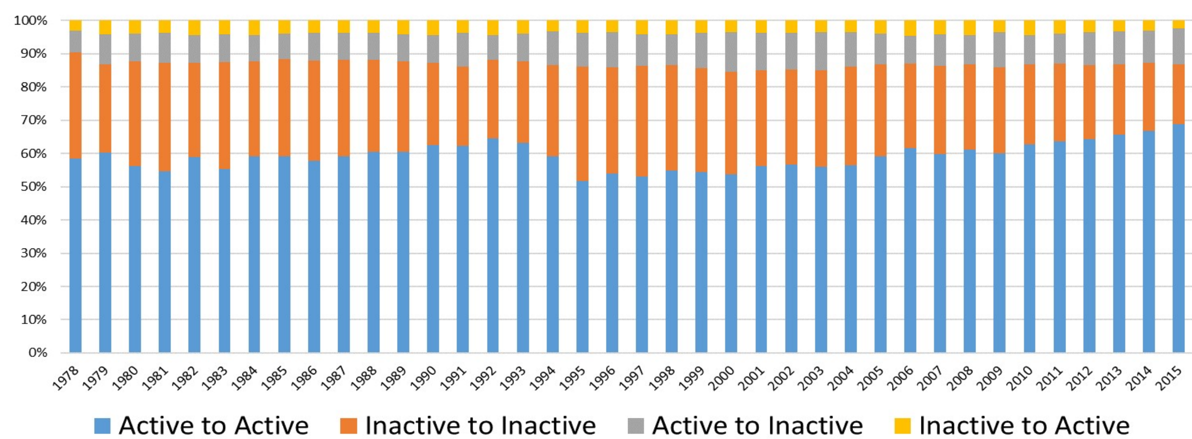
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO in the counterfactual had GATT/WTO not existed, relative to the status quo. The y-axis indicates the number of countries, and the x-axis the % change in welfare (real income). Outliers are omitted.

Figure 1.3 Trade status change due to GATT/WTO effects (shutting down GATT/WTO)

Panel A. Trade status change: frequencies



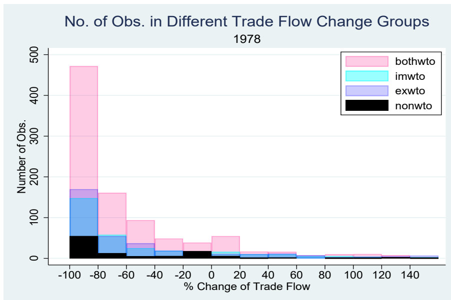
Panel B. Trade status change: fractions



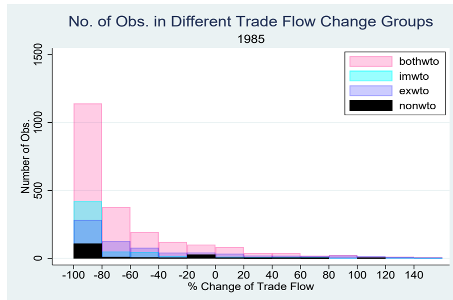
Note: Based on the trade flow change simulated in the counterfactual analysis, trade status (active or inactive) change is calculated and presented by the frequencies and fractions of different groups in each year.

Figure 1.4 Effects of GATT/WTO on trade flow (shutting down GAT-T/WTO)

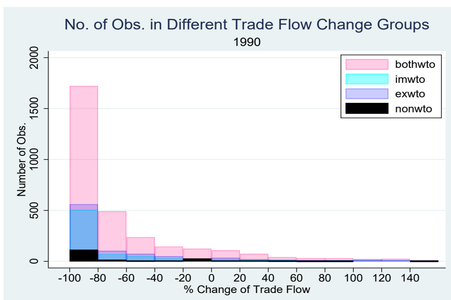
(a) 1978



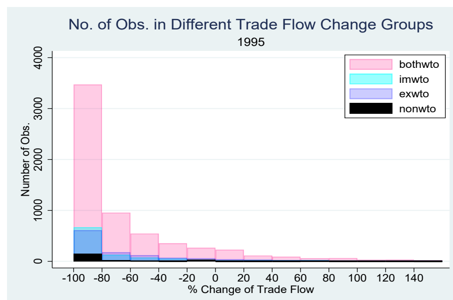
(b) 1985



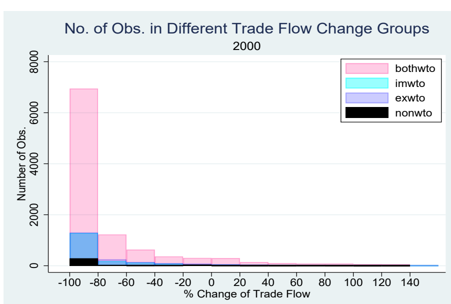
(c) 1990



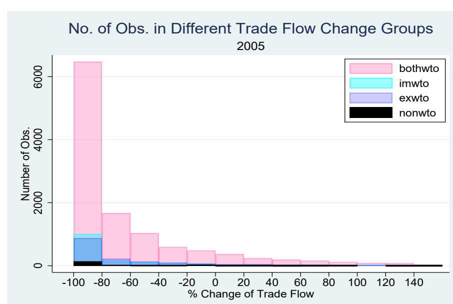
(d) 1995



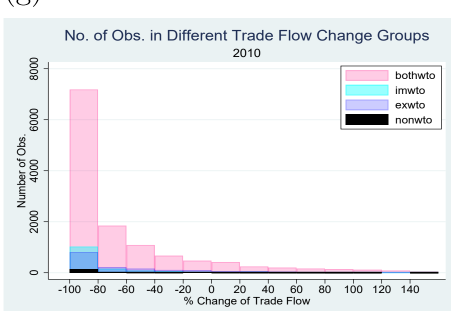
(e) 2000



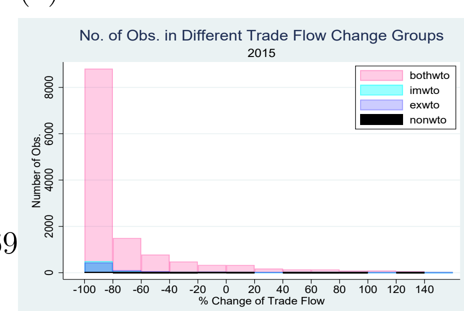
(f) 2005



(g) 2010



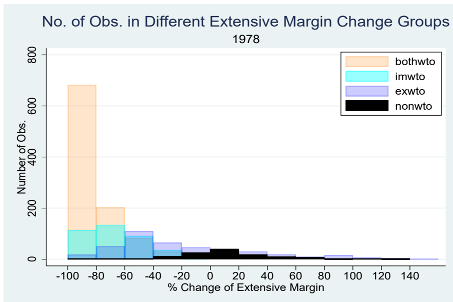
(h) 2015



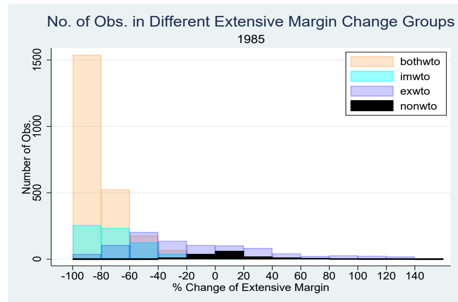
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on trade flows. The y-axis indicates the number of observations, and the x-axis the % change in trade flow. Outliers are omitted.

Figure 1.5 Effects of GATT/WTO on extensive margin N_{ijt} (shutting down GATT/WTO)

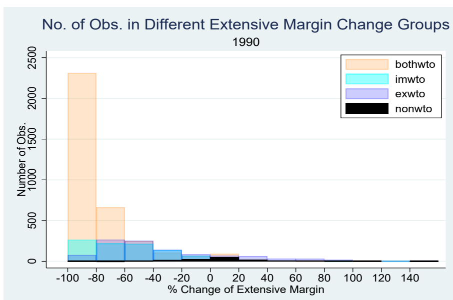
(a) 1978



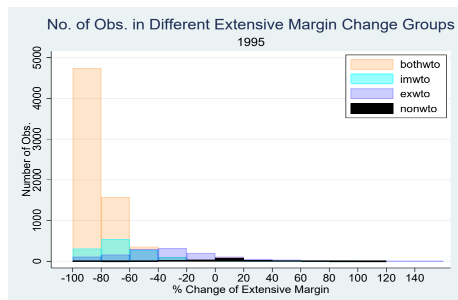
(b) 1985



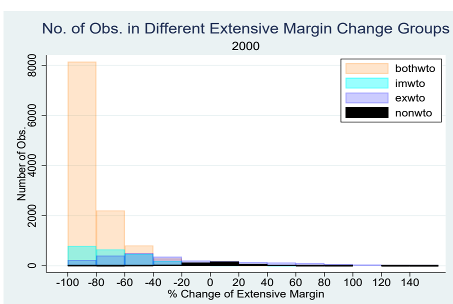
(c) 1990



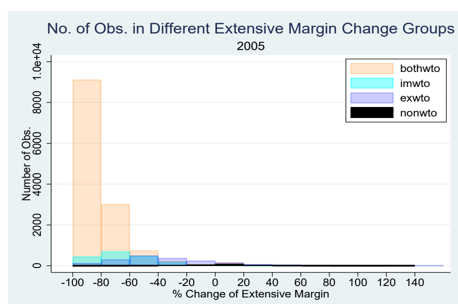
(d) 1995



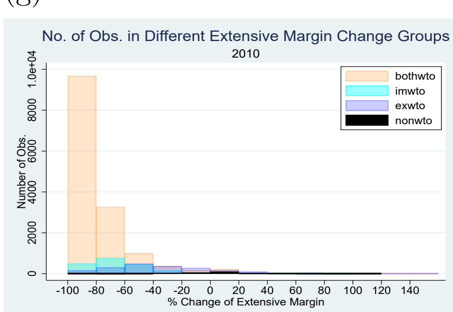
(e) 2000



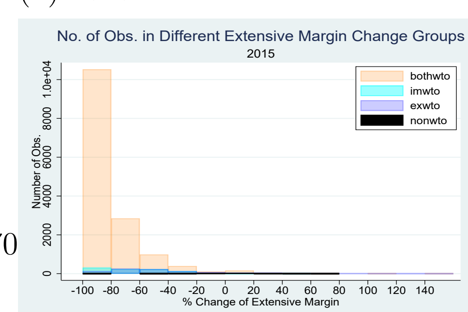
(f) 2005



(g) 2010



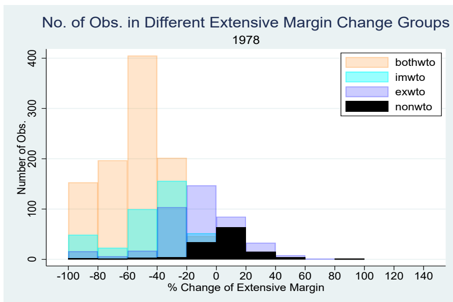
(h) 2015



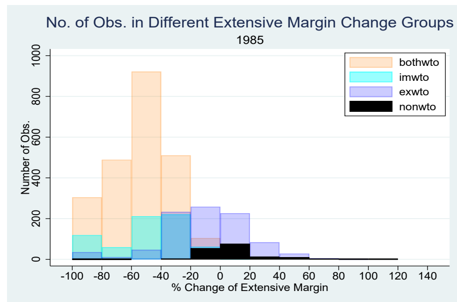
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the extensive margin N_{ijt}. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.6 Effects of GATT/WTO on extensive margin Ω_{ijt} (shutting down GATT/WTO)

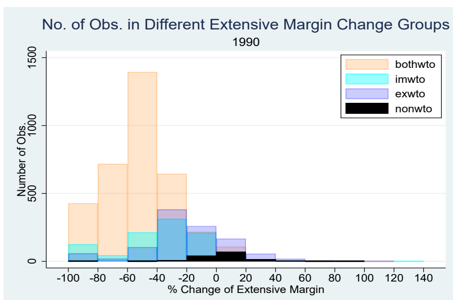
(a) 1978



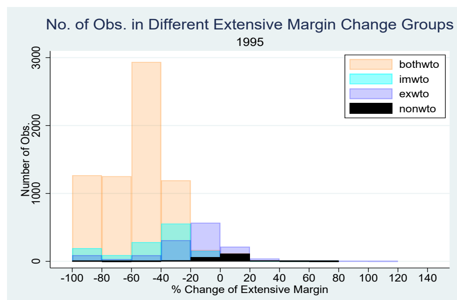
(b) 1985



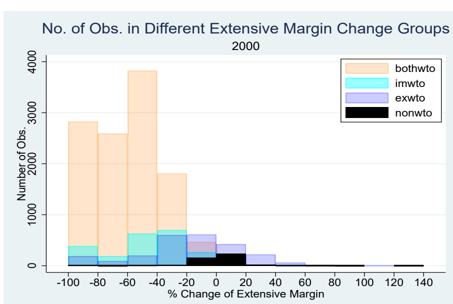
(c) 1990



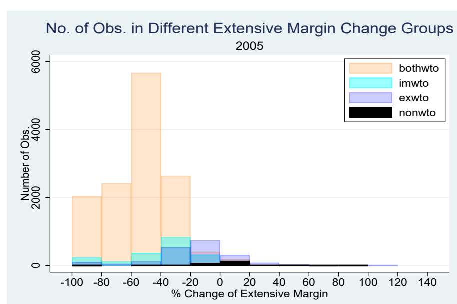
(d) 1995



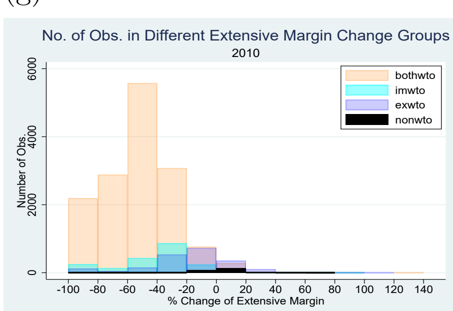
(e) 2000



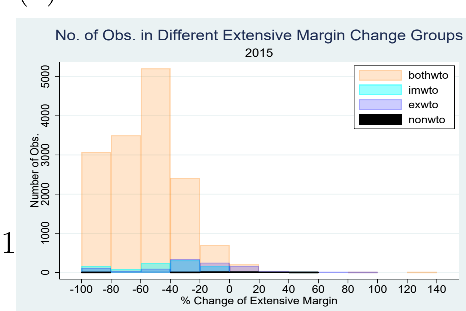
(f) 2005



(g) 2010



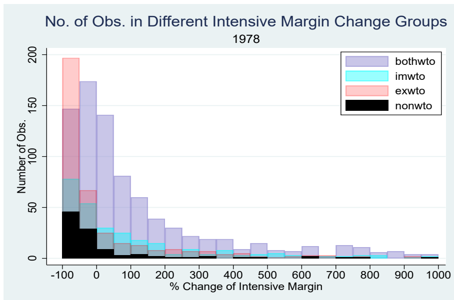
(h) 2015



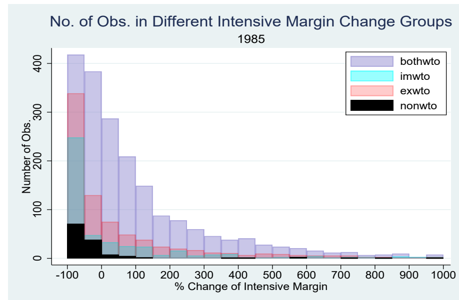
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the extensive margin Ω_{ijt}. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.7 Effects of GATT/WTO on intensive margin X_{ijt}/N_{ijt} (shutting down GATT/WTO)

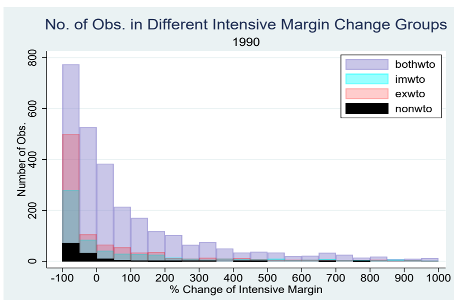
(a) 1978



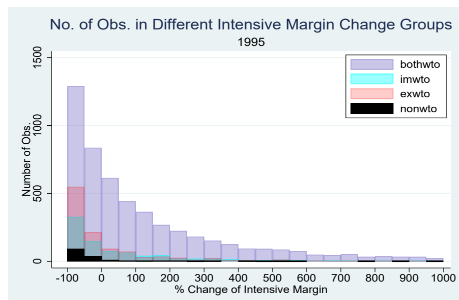
(b) 1985



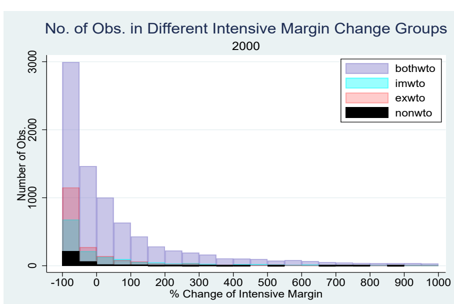
(c) 1990



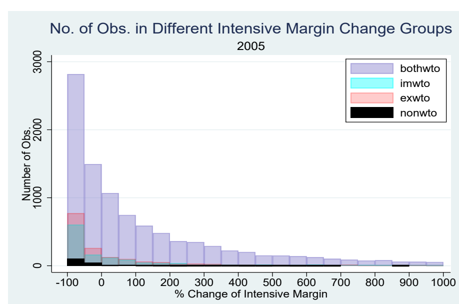
(d) 1995



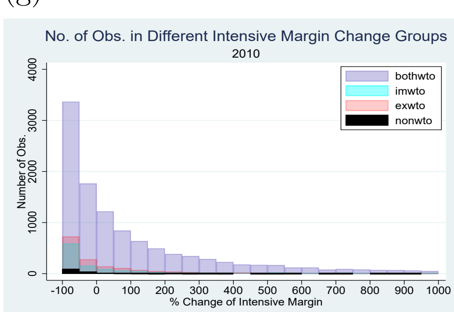
(e) 2000



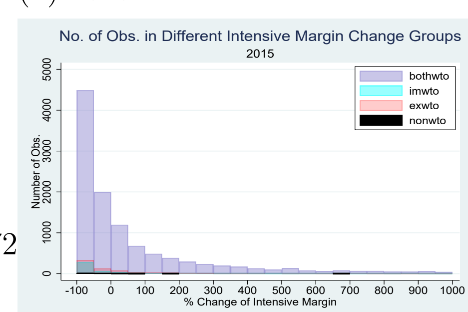
(f) 2005



(g) 2010



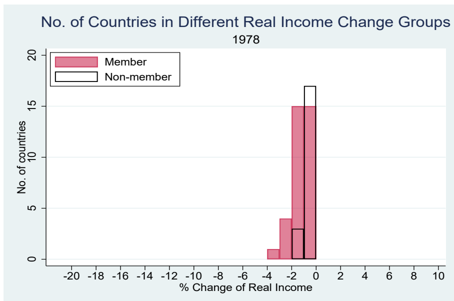
(h) 2015



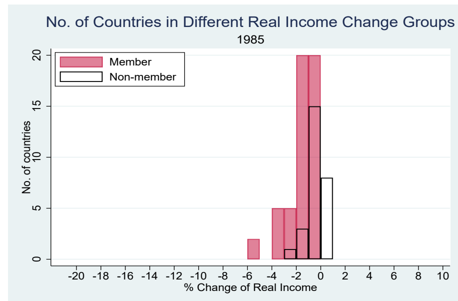
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the intensive margin X_{ijt}/N_{ijt}. The y-axis indicates the number of observations, and the x-axis the % change in intensive margin. Outliers are omitted.

Figure 1.8 Welfare effects of GATT/WTO (via variable trade cost)

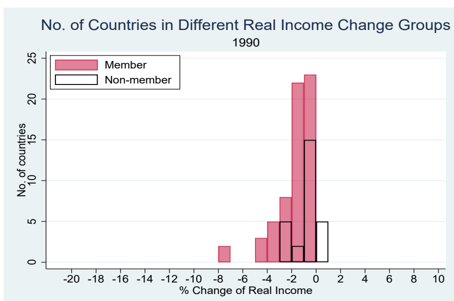
(a) 1978



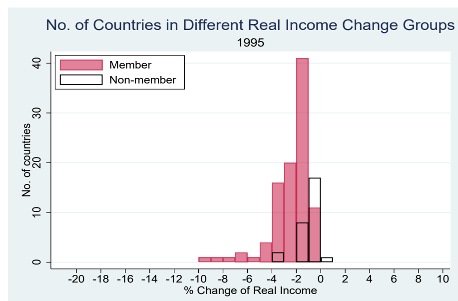
(b) 1985



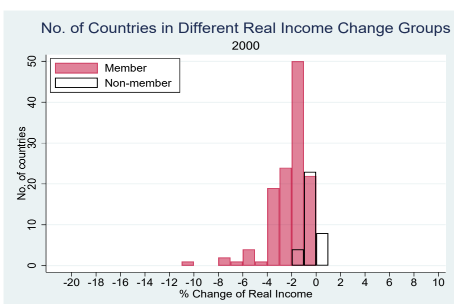
(c) 1990



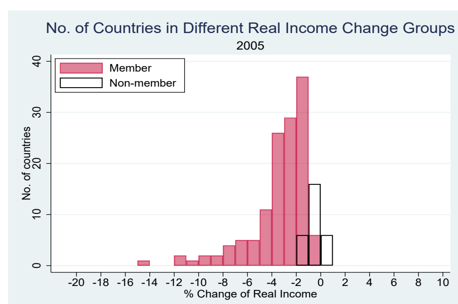
(d) 1995



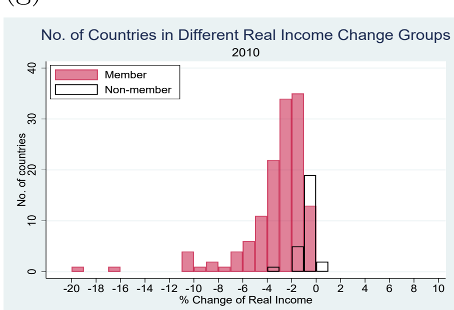
(e) 2000



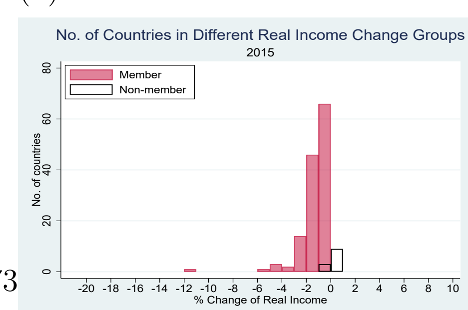
(f) 2005



(g) 2010



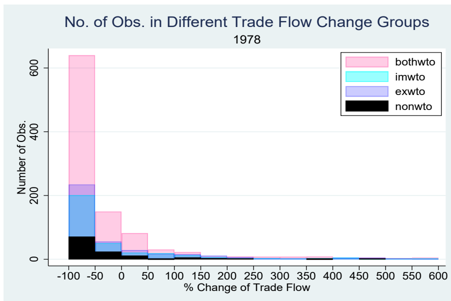
(h) 2015



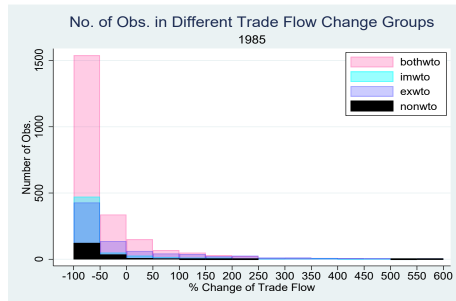
Note: Based on estimates in Table 1.6, this set of analyses evaluates the welfare effects of GATT/WTO for the counterfactual of shutting down the GATT/WTO effects on variable trade costs, relative to the status quo. The y-axis indicates the number of countries, and the x-axis the % change in welfare (real income). Outliers are omitted.

Figure 1.9 Effects of GATT/WTO on trade flow (via variable trade cost)

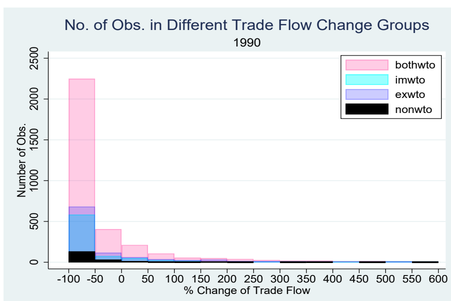
(a) 1978



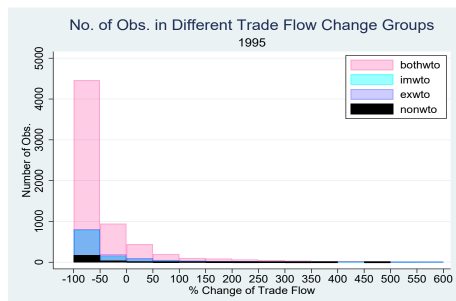
(b) 1985



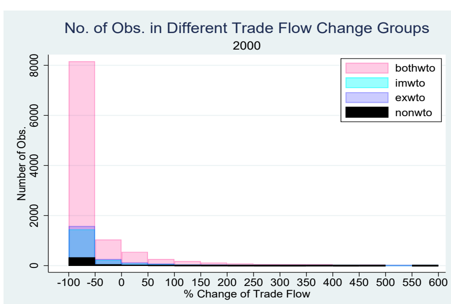
(c) 1990



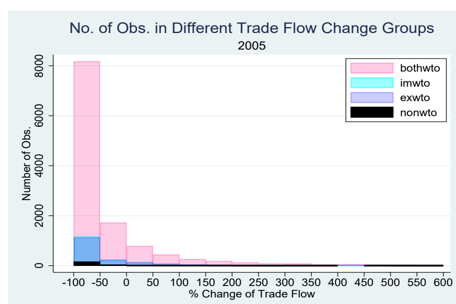
(d) 1995



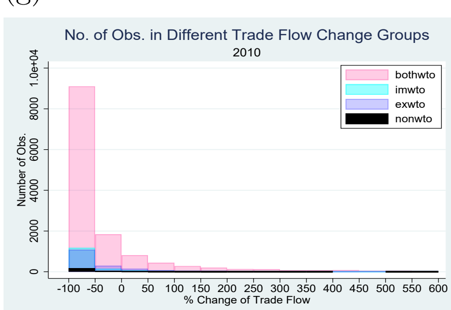
(e) 2000



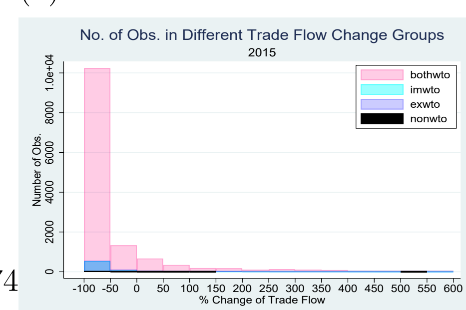
(f) 2005



(g) 2010



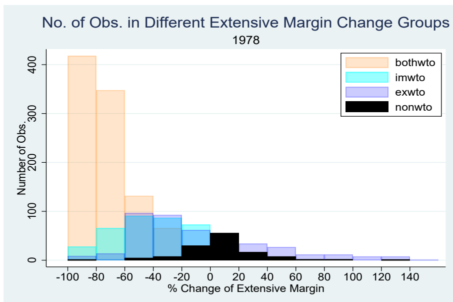
(h) 2015



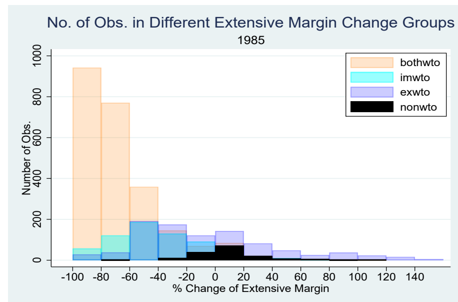
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on trade flows via the variable trade cost. The y-axis indicates the number of observations, and the x-axis the % change in trade flow. Outliers are omitted.

Figure 1.10 Effects of GATT/WTO on extensive margin N_{ijt} (via variable trade cost)

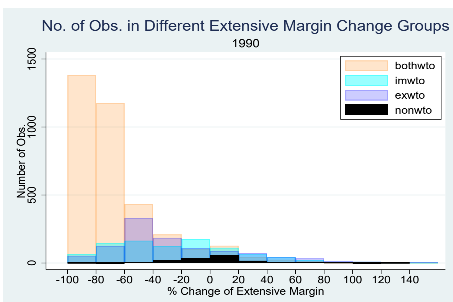
(a) 1978



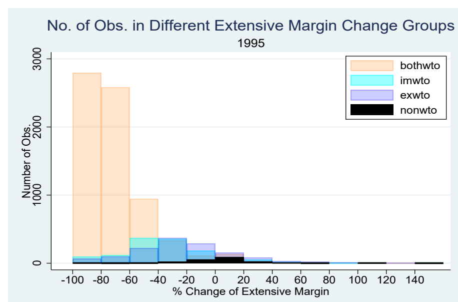
(b) 1985



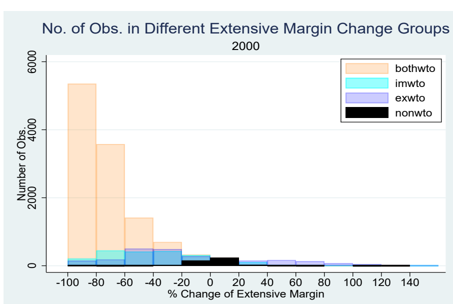
(c) 1990



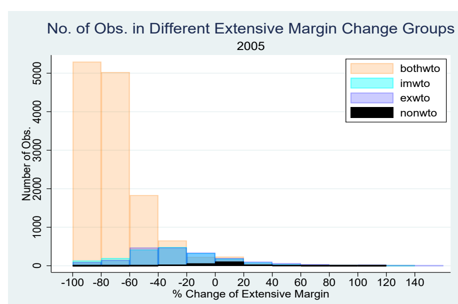
(d) 1995



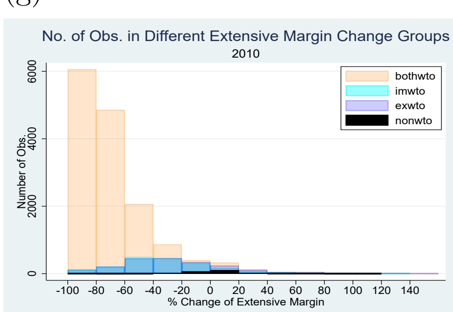
(e) 2000



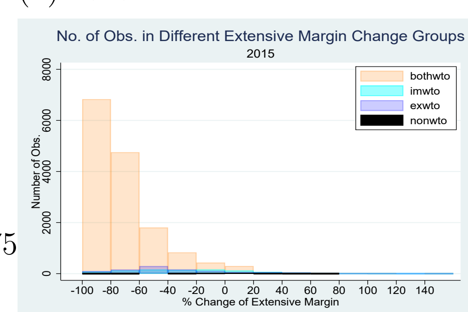
(f) 2005



(g) 2010



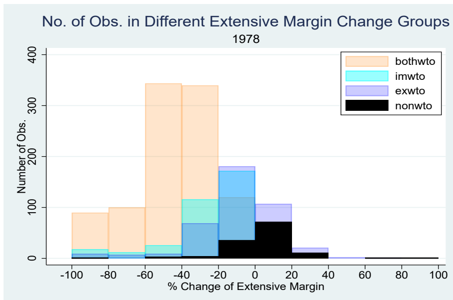
(h) 2015



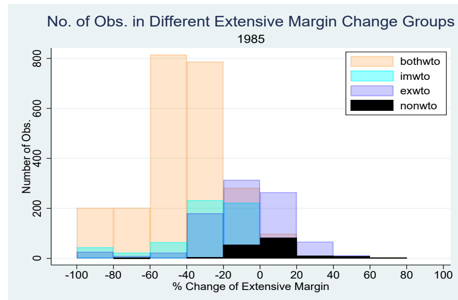
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the extensive margin N_{ijt} via the variable trade cost. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.11 Effects of GATT/WTO on extensive margin Ω_{ijt} (via variable trade cost)

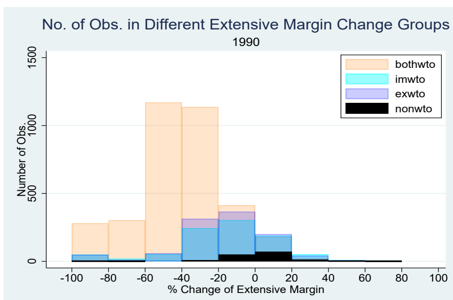
(a) 1978



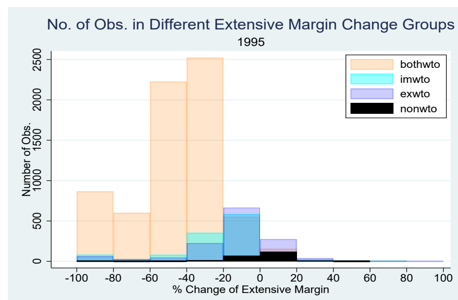
(b) 1985



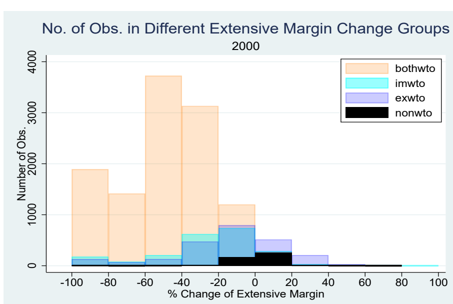
(c) 1990



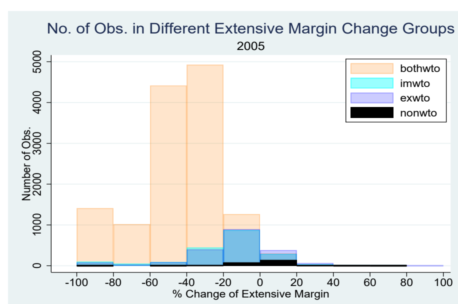
(d) 1995



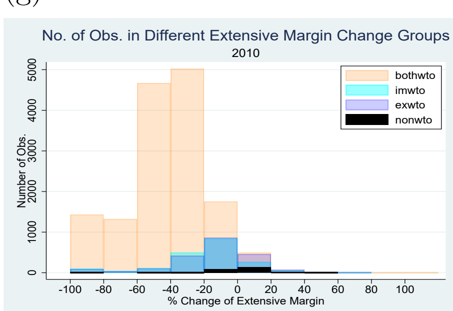
(e) 2000



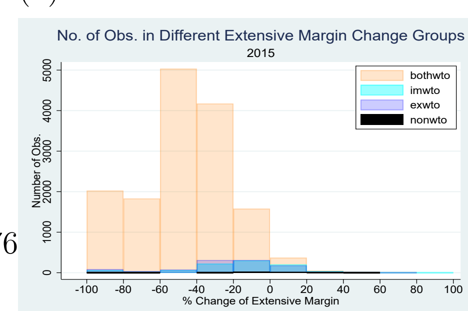
(f) 2005



(g) 2010



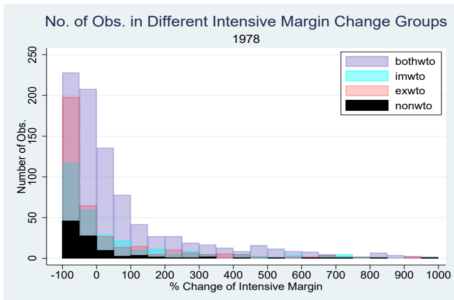
(h) 2015



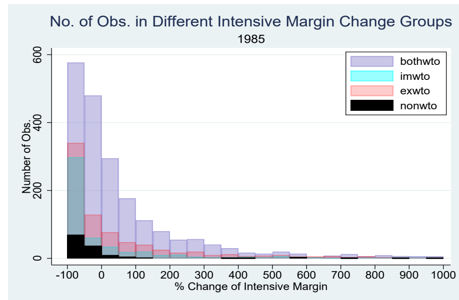
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the extensive margin Ω_{ijt} via the variable trade cost. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.12 Effects of GATT/WTO on intensive margin X_{ijt}/N_{ijt} (via variable trade cost)

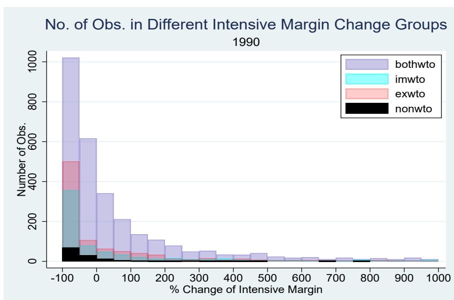
(a) 1978



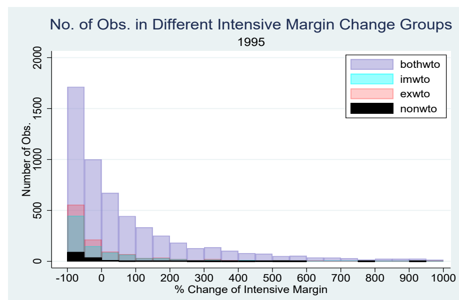
(b) 1985



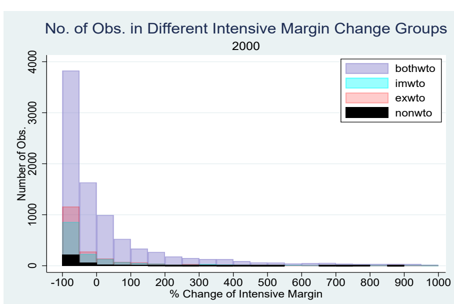
(c) 1990



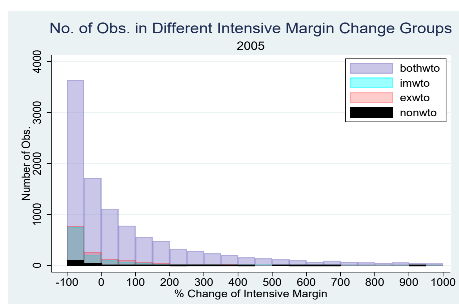
(d) 1995



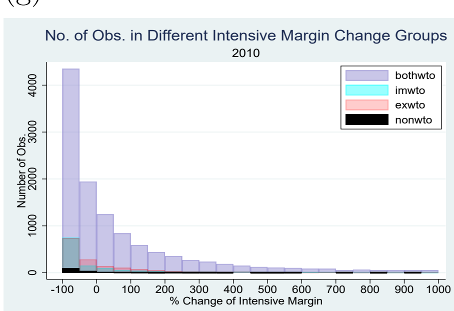
(e) 2000



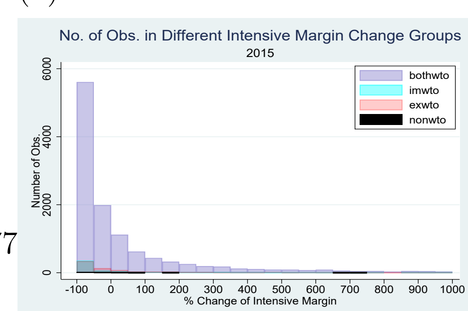
(f) 2005



(g) 2010



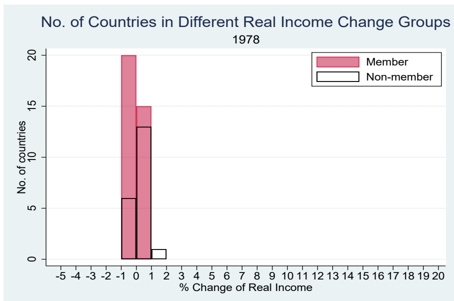
(h) 2015



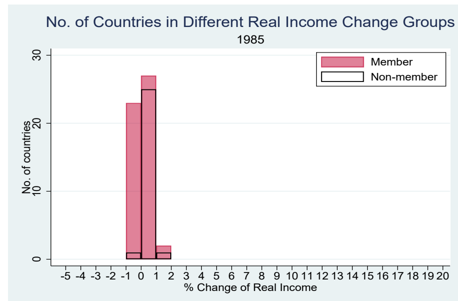
Note: Based on estimates in Table 1.6, this set of analyses evaluates the effects of GATT/WTO on the intensive margin X_{ijt}/N_{ijt} via the variable trade cost. The y-axis indicates the number of observations, and the x-axis the % change in intensive margin. Outliers are omitted.

Figure 1.13 Welfare effects of GATT/WTO (via fixed trade cost)

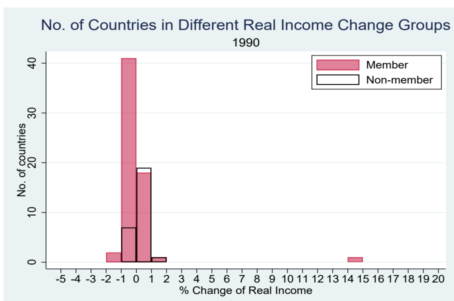
(a) 1978



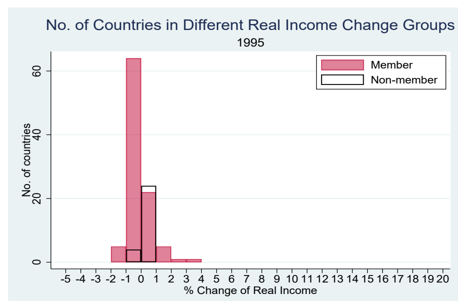
(b) 1985



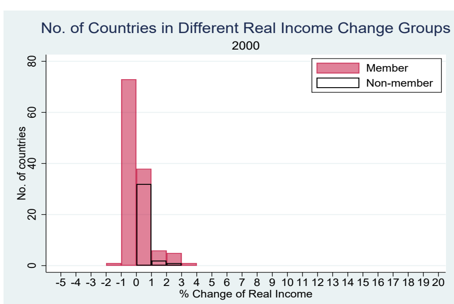
(c) 1990



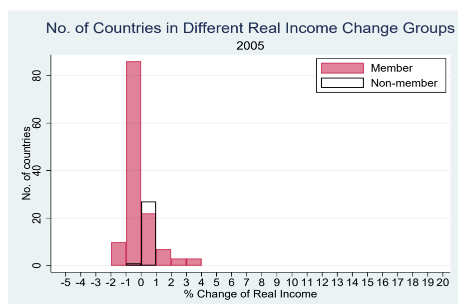
(d) 1995



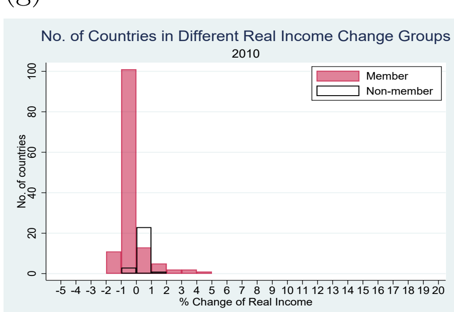
(e) 2000



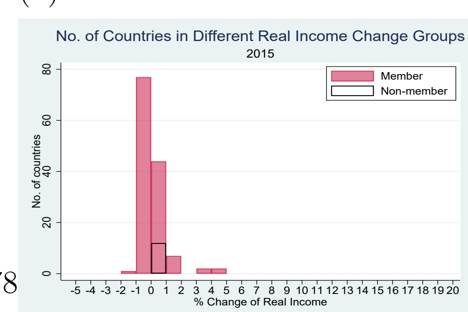
(f) 2005



(g) 2010



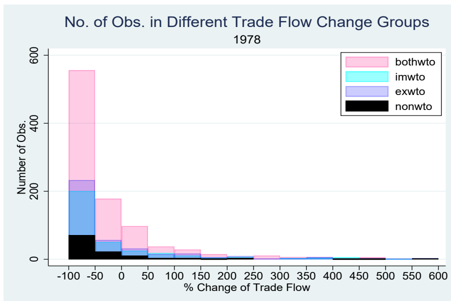
(h) 2015



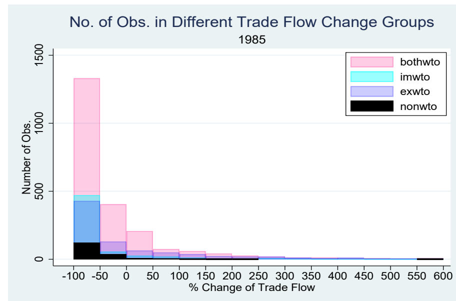
Note: Based on estimates in Table 1.6, this set of analyses evaluates the welfare effects of GATT/WTO for the counterfactual of shutting down the GATT/WTO effects on fixed trade cost. The y-axis indicates the number of countries, and the x-axis the % change in welfare (real income). Outliers are omitted.

Figure 1.14 Effects of GATT/WTO on trade flow (via fixed trade cost)

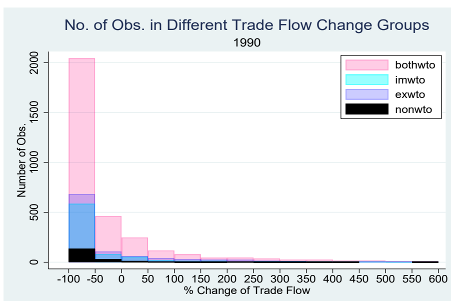
(a) 1978



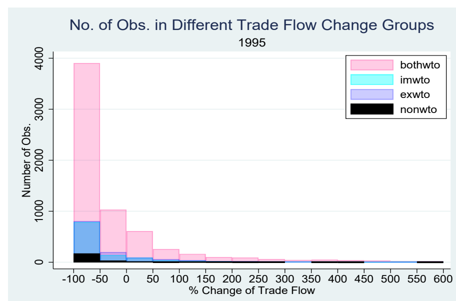
(b) 1985



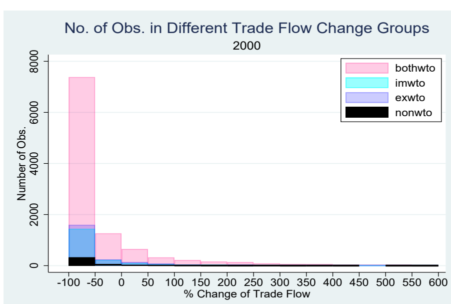
(c) 1990



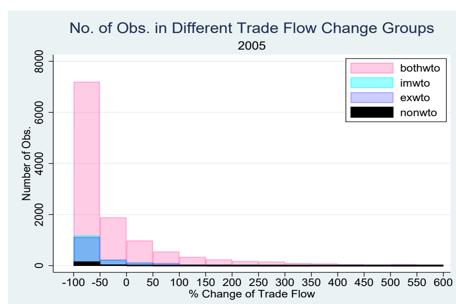
(d) 1995



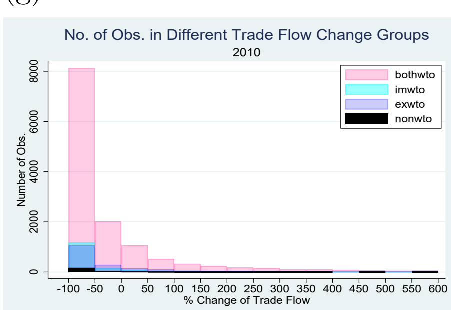
(e) 2000



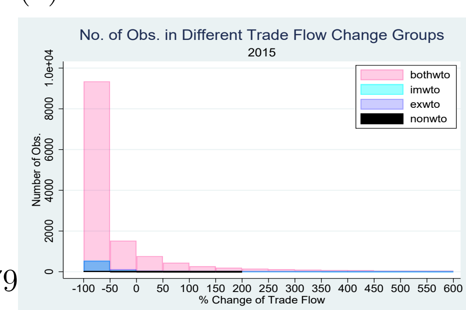
(f) 2005



(g) 2010



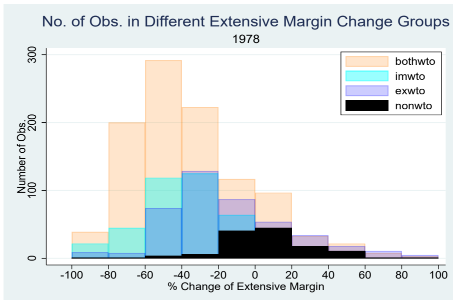
(h) 2015



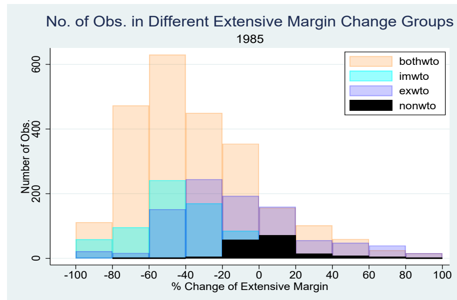
Note: Based on estimates in Table 1.6, this set of analyses evaluates the GATT/WTO effects on trade flows via the fixed trade cost. The y-axis indicates the number of observations, and the x-axis the % change in trade flow. Outliers are omitted.

Figure 1.15 Effects of GATT/WTO on extensive margin N_{ijt} (via fixed trade cost)

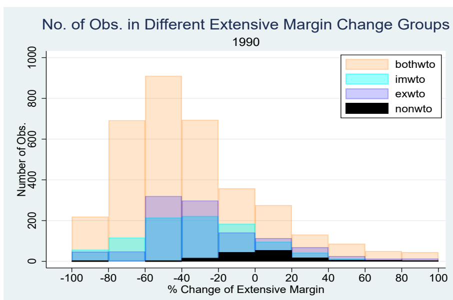
(a) 1978



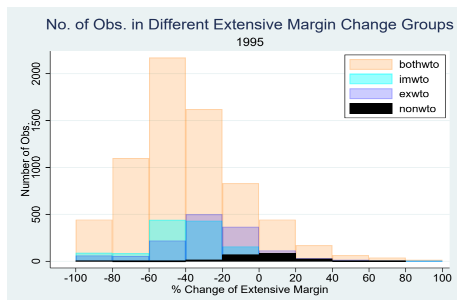
(b) 1985



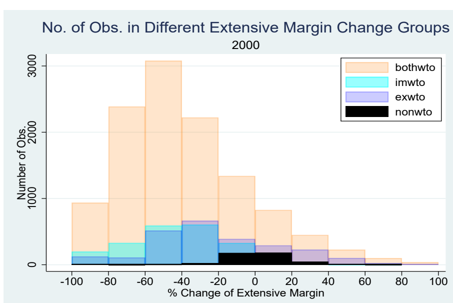
(c) 1990



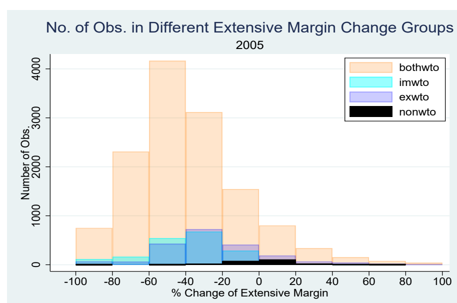
(d) 1995



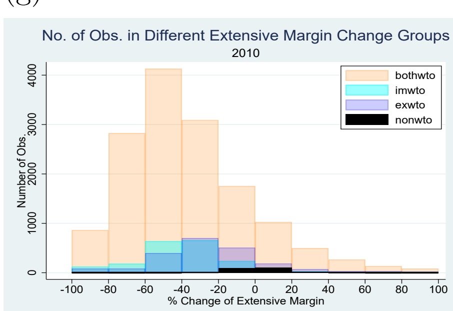
(e) 2000



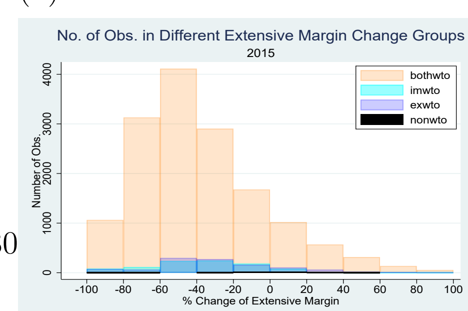
(f) 2005



(g) 2010



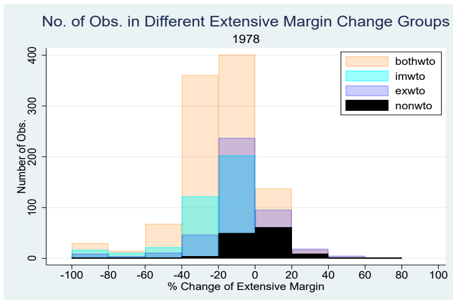
(h) 2015



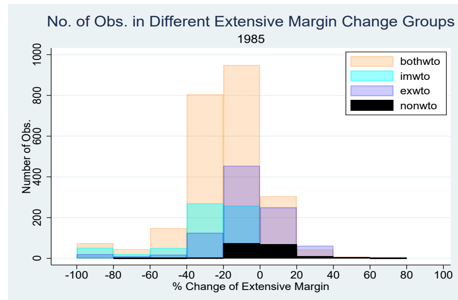
Note: Based on estimates in Table 1.6, this set of analyses evaluates the GATT/WTO effects on the extensive margin N_{ijt} via the fixed trade cost. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.16 Effects of GATT/WTO on extensive margin Ω_{ijt} (via fixed trade cost)

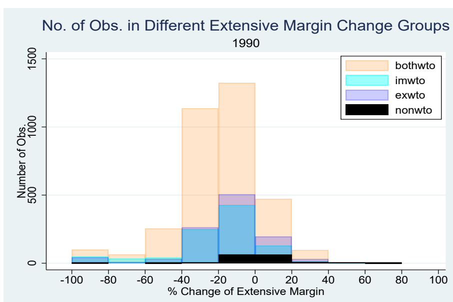
(a) 1978



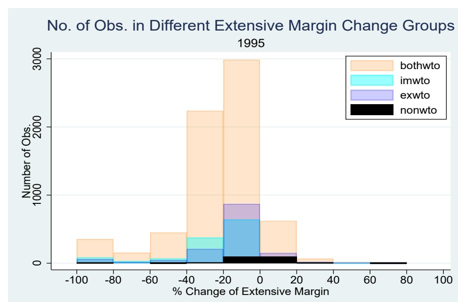
(b) 1985



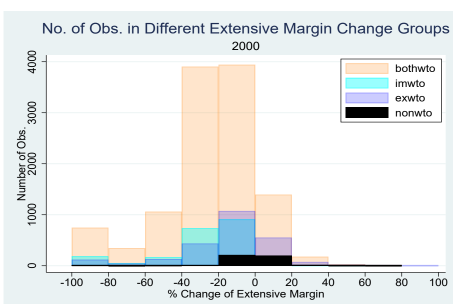
(c) 1990



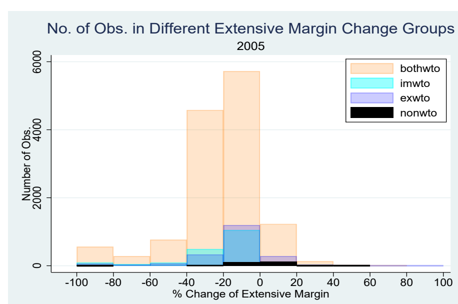
(d) 1995



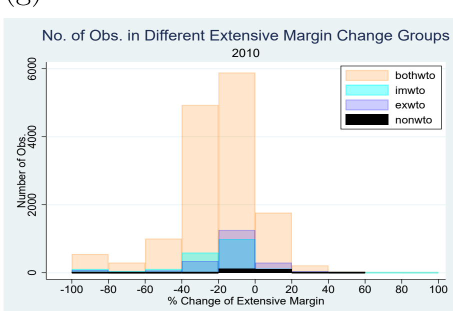
(e) 2000



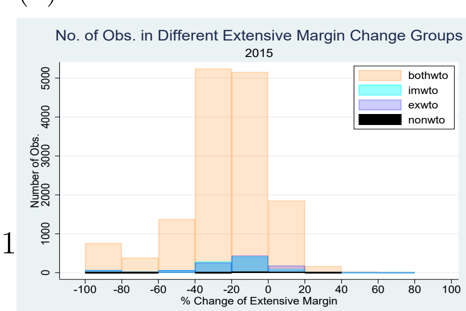
(f) 2005



(g) 2010



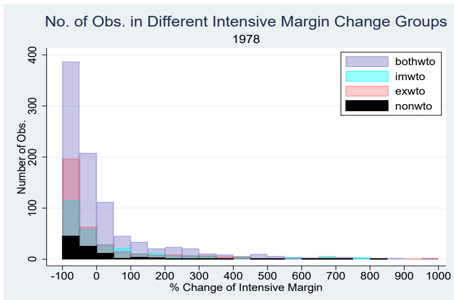
(h) 2015



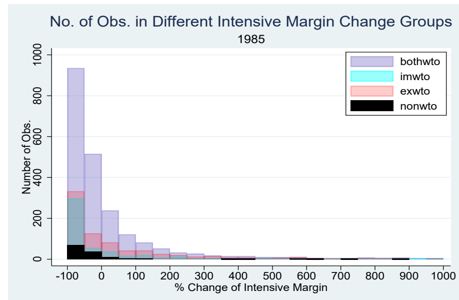
Note: Based on estimates in Table 1.6, this set of analyses evaluates the GATT/WTO effects on the extensive margin Ω_{ijt} via the fixed trade cost. The y-axis indicates the number of observations, and the x-axis the % change in extensive margin. Outliers are omitted.

Figure 1.17 Effects of GATT/WTO on intensive margin X_{ijt}/N_{ijt} (via fixed trade cost)

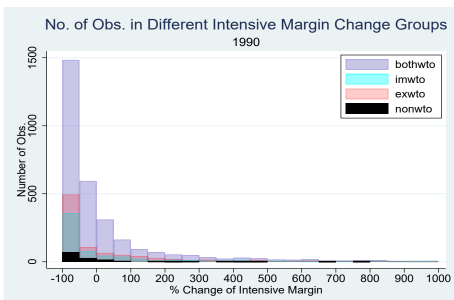
(a) 1978



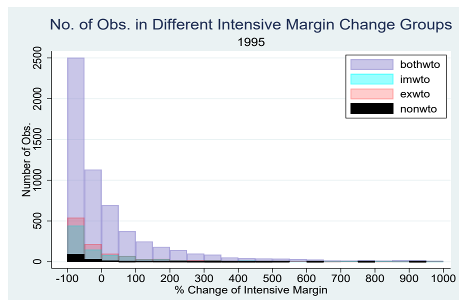
(b) 1985



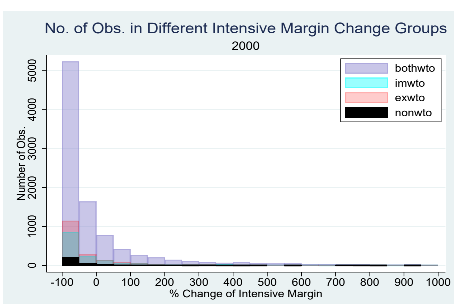
(c) 1990



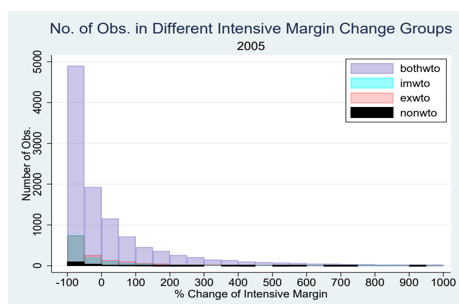
(d) 1995



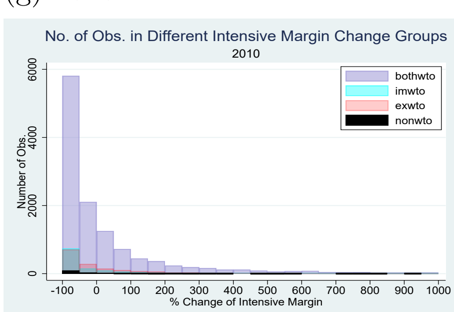
(e) 2000



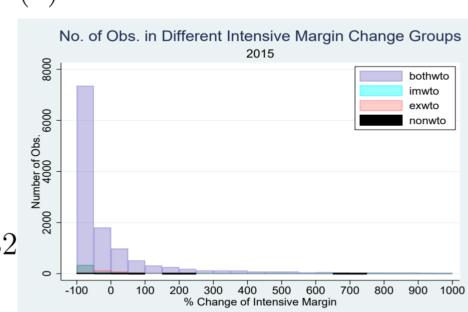
(f) 2005



(g) 2010



(h) 2015

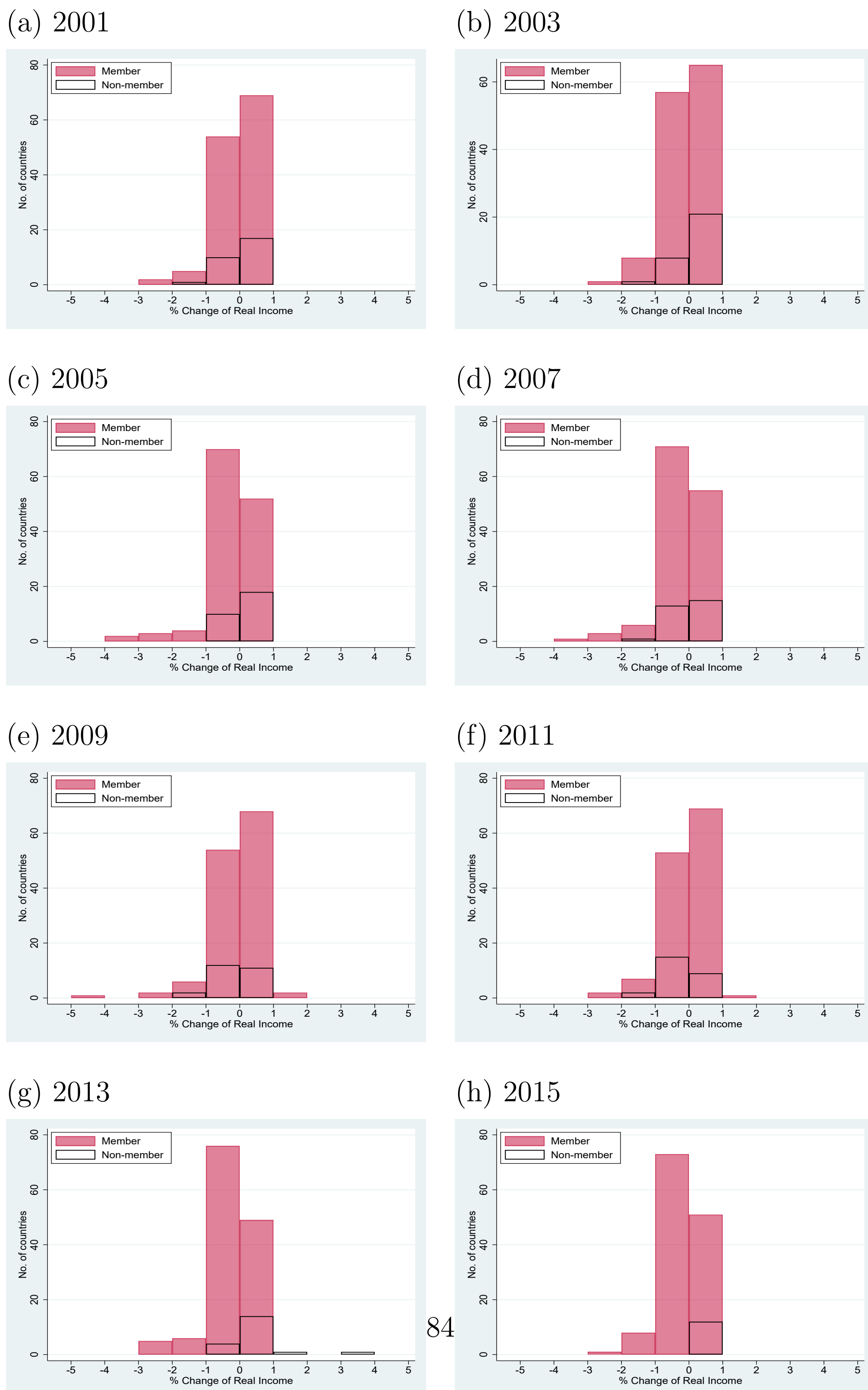


Note: Based on estimates in Table 1.6, this set of analyses evaluates the GATT/WTO effects on the intensive margin X_{ijt}/N_{ijt} via the fixed trade cost. The y-axis indicates the number of observations, and the x-axis the % change in intensive margin. Outliers are omitted.

Figure 1.18 Welfare effects of China's membership in GATT/WTO (if China had not joined the GATT/WTO in 2001)

Note: This figure presents the range of welfare effects if China had not joined the GATT/WTO in 2001. The box indicates the 25th percentile (the lower hinge of the box), the median, and the 75th percentile (the upper hinge of the box) of the variable of interest. Outliers are omitted.

Figure 1.19 Welfare effects of China's membership in GATT/WTO (if China had not joined the GATT/WTO in 2001)



Note: Based on estimates in Table 1.6, this set of analyses evaluates the welfare effects for the counterfactual if China had not joined the GATT/WTO, relative to the status quo. The y-axis indicates the number of countries, and the x-axis the % change in welfare (real income). Outliers are omitted.

Chapter Two

Information Asymmetry and Dynamic Sourcing: Evidence from Chinese Firms

Author: Renjing Chen

2.1 Introduction

Information asymmetry affects firms' external relationships with intermediates and supplying markets (Greenwald and Stiglitz, 1990), as it makes it hard for firms to distinguish reliable suppliers from unreliable ones in the market.[1] Therefore, one of the serious consequences of information asymmetry is that importers may forge relationships with unreliable suppliers and receive products that fail to satisfy their

[1]According to the estimation in Monarch and Schmidt-Eisenlohr (2016), the share of reliable suppliers that always exert high effort on production is no more than 44 percent.

requirements, thus leading to wastage (Sternquist, 1994).

In the field of international trade, information asymmetry has been acknowledged as an important source of trade frictions (Banerjee and Duflo, 2000; Jensen, 2007; Aker, 2010; Chaney, 2014; Allen, 2014; Startz, 2016). To overcome the problem of information asymmetry, firms often incur large costs to acquire information on foreign markets (Allen, 2014). Importers tend to be more familiar with the countries they have imported from before. They know more about the product specifications, social norms and ways of communication in these familiar countries. Therefore, one should expect that importing from a more familiar country is likely a good way to reduce the risks associated with information asymmetry. However, to date, there has been little research on the differences on sourcing cost across countries within the context of information asymmetry and familiarity level.

In this paper, I investigate the benefits of importing from familiar sourcing countries measured by the probability improvement of receiving satisfactory products. Using the detailed import record of China Custom Data from 2007 to 2014, I find that 67.8 percent of importing observations were with the familiar countries from which the firms had imported in the same sector in the previous year. This sourcing preference for familiar countries is robust to different definitions of familiar countries when applying alternative time restrictions or sector specifications. These results imply that importers prefer to import from familiar countries which they already have a importing relationship.

Motivated by firms' sourcing preference for familiar countries, I develop a model to quantify the benefits of such preference. This model incorporates both satisfaction uncertainty brought about by information asymmetry and the associated communication cost as in Furusawa et al. (2017). Due to the presence of information asymmetry, some products offered by suppliers might be unsatisfactory and useless for the importers. I introduce satisfaction uncertainty into the sourcing model, which increases the effective unit cost of intermediates and thus increases the cost of production. In order to mitigate this risk, importers pay the communication cost to negotiate with exporters in order to guarantee that what they receive meets their requirements. This communication cost is assumed to be related to the importing experience with the sourcing country in the same sector. In addition, the model assumes that the probability of receiving satisfactory products differs across countries, depending on their level of familiarity. These satisfaction uncertainty differences may lead to varied increases in effective unit costs of intermediates and influence firms' importing shares related to different sourcing countries.[2]

One of the key results derived from this model is that firms' importing share from a specific country in one sector is related to the satisfaction uncertainty and communication cost. Using this feature and detailed data from China Custom Data, I empirically examine the results by estimating the parameters measuring the benefits of importing from familiar countries. I show that the maximal satisfaction probability improvement of importing from familiar countries reaches 89.0 percent when controlling for firms' productivity, if importing experience is measured by accu-

[2]In reality, importers' sourcing behavior incorporates complicated decision making process and is driven by many factors. However, regarding the importance of information asymmetry and firms' obvious preference of sourcing from familiar countries, this article mainly aims at evaluating the benefits of such preference, instead of identifying the main driver of such preference.

mulated importing volume. The results show that importing from familiar countries effectively increases the satisfaction probability. The results are robust to changes in the measurement of importing experience. According to the propositions derived from the model, these results also imply that importing from familiar countries reduces the effective unit cost of intermediates.

This paper contributes to the literature on outsourcing by taking into account information asymmetry and communication cost. In the extant literature, research has been conducted on the impact of offshoring (Hijzen et al., 2010; Rodríguez-Clare, 2010) and firms' choice between integration and outsourcing. For example, Antras and Helpman (2004) studied the relationship between sector heterogeneity and final producers' choice of outsourcing and integration. Antras et al. (2017) built a sourcing model in a multi-country world to study firms' intensive and extensive decisions on sourcing countries and sectors. Bernard et al. (2019) generated a production network in the domestic economy, focusing on the relationship between firm performance and regional search and trade costs. My paper contributes to the existing literature by considering satisfaction uncertainty brought about by information asymmetry and the communication cost that importers have to pay in order to guarantee that they receive satisfactory products. These assumptions help to describe importers' concerns and sourcing decisions when facing information asymmetry. The increase in effective unit cost caused by satisfaction uncertainty also helps to explain the increasing trade cost brought about by information asymmetry.

By quantifying the benefits of importers' preference for importing from familiar countries, my work also contributes to a small but growing body of literature tackling information asymmetry in the field of international trade. For example, Zhao (2018) built a dynamic model to estimate the magnitude of information asymmetry in the exporting market. Startz (2016) emphasized the importance of face-to-face communication when dealing with the problem of search and contracting frictions caused by information asymmetry. Furusawa et al. (2017) also considered the quality uncertainty caused by information asymmetry and the communication cost. My paper is distinct from theirs in assuming different satisfaction uncertainties when firms import from familiar and unfamiliar countries. In addition, I further assume that the communication cost is related to firms' importing experience with the sourcing country. These assumptions enable me to estimate the parameter that measures the benefits of importing from familiar countries.

This paper is not the first paper to study the benefits of importing from familiar partners; however, I am not aware of existing works that consider both the satisfaction uncertainty brought about by information asymmetry and firms' communication efforts to cope with this problem. The most relevant papers in this area are Macchiavello and Morjaria (2015) and Monarch and Schmidt-Eisenlohr (2016). Macchiavello and Morjaria (2015) quantified the value of the importer–exporter relationship in the Kenyan rose market. Monarch and Schmidt-Eisenlohr (2016) highlighted the benefits of trading with old suppliers by calculating the country-specific expected value of relationships with both new and old suppliers. While they accounted for the satisfaction uncertainty caused by the reliability levels of the exporters, they did not consider the firms' communication efforts to cope with these problems. In this paper, I describe a channel (communication effort) whereby importers can mitigate the risks caused by information asymmetry. In addition, instead of focusing on a specific sector, this model can generate estimates on a more general level.

The rest of the paper proceeds as follow: Section 2.2 introduces the data source and uses the China Customs Data to illustrate importing firms' preference of sourcing countries. Section 2.3 presents the sourcing model. Section 2.4 provides the estimation method, discusses the results and and presents some extension analyses. Section 2.5 concludes.

2.2 Data and Importers' Choice of Sourcing Countries

Before constructing the model to describe firms' outsourcing behavior, I introduce the data source and analyze firms' preference of sourcing countries in this section. Chinese firms' import data are from China Customs Data from 2007 to 2014. This dataset records every transaction related to Chinese firms' importing and exporting behavior at Harmonized System 8 Digit Level (HS8).[3] It contains information on trade volume, quantity, trade type and so on.[4] Since this paper focuses on the problem of information asymmetry in terms of the probability of satisfaction in meeting production requirements, I only keep the importing observations used for

[3]Hereafter, I will use HS8, HS6, HS4, and HS2 to stand for Harmonized System 8, 6, 4, and 2 Digit Level, respectively.

[4]It also includes firms' basic information such as name, ID, location (province and city), address, postcode, contact number, firm type, etc.

production.[5] The remaining sample contains 261,402 firms that imported goods from 203 countries from 2007 to 2014, accounting for 18.47 percent of the total import volume. It is also worth noting that each observation in the estimation section has been aggregated to HS4 level in order to match the estimation requirements.[6]

It is important to consider time and sector specifications when defining familiar and unfamiliar countries. If a firm has imported from a certain country in the same HS4 sector, HS2 sector or any sector in the previous T year(s), where $T \in \{1, 2, 3, \ldots, 7\}$,[7] this country can be considered a familiar country for the firm; otherwise, it is considered an unfamiliar one. It is also important to clarify that although I use part of the raw data to conduct the estimation, I use the entire raw data to identify the familiar and unfamiliar countries, regardless of their importing purpose (trade type). This is because importing from a country can help a firm gain a better understanding of the goods produced by that country.

Table 2.1 provides the statistics on import volumes and the number of sourcing countries from which a firm imports the same HS4 products per year. In defining the familiar countries as exporting to this firm in the same HS4 sector in the previous year, Table 1 shows that the import volume from familiar countries and the number of familiar sourcing countries are on average larger than those with respect to unfamiliar countries.

[5] I also drop those observations without sector information or exporting country's name.

[6] The data that support the findings of this study are available from the corresponding author upon reasonable request.

[7] Since the data span eight years from 2007 to 2014, the maximal time restriction of the definition would be "during the last seven years".

In order to check importers' preference of sourcing countries, I keep those firms that sourced in the same sector for at least two years from 2007 to 2014 and remove those sectors that have only one sourcing country. Figure 2.1 shows the fractions of observations with familiar countries over the total observations when applying different definitions of familiar countries. Given each value of T, there are three histograms indicating the fraction when the familiar countries are defined as exporting to this firm in the same HS4 sector (black), in the same HS2 sector (grey) and in any sector (grainy) in the previous T years. In all cases, the fractions of observations with familiar countries are larger than 50 percent. Given the value of T, this fraction decreases if we use a finer specification of sectors. This change implies that firms always prefer to import from their familiar countries. Combining this finding with the importance of the information asymmetry problem, I analyze whether the firms' preference of sourcing country will bring them any benefit, and if so, to what extent.

2.3 Theory

Drawing on the idea that firms prefer to import from familiar countries, I develop a partial equilibrium model based on Furusawa et al. (2017). The model describes firms' sourcing behavior to measure the benefits of importing from familiar countries. This model features the satisfaction uncertainty brought about by information asymmetry and firms' communication effort to receive satisfactory goods. This satisfaction uncertainty and communication effort differ when importing from familiar and unfamiliar countries.

2.3.1 Firm's Production Stages

This model describes a partial equilibrium focusing on the production side. The production of final goods requires intermediates from K sectors. The total set of sectors is κ. There are two production stages for the final goods producer.

In the first stage, firms purchase intermediates from domestic or foreign suppliers. Each intermediate k is composed of differentiated varieties s and s is assumed to be a continuum on $(0,1)$. Firms in country j produce every variety in every sector k. The quantity of intermediate k that firm i composes follows the constant elasticity of substitution (CES) production function:

$$x_{ik} = \left[\int_o^1 \tilde{x}_{ik}(s)^{\frac{\varepsilon_k - 1}{\varepsilon_k}} ds\right]^{\frac{\varepsilon_k}{\varepsilon_k - 1}},$$

where $\tilde{x}_{ik}(s)$ is the quantity of variety s in sector k the firm uses to compose intermediate k and ε_k is the elasticity of substitution across different varieties in sector k.

In the second stage, firms take advantage of the intermediates to produce final goods. The production function is given by:

$$y_i = H(\varphi_i, x_{i1}, \cdots, x_{iK}), \tag{2.1}$$

where y_i is the final production, φ_i is firm i's core productivity, $x_{i1}, \cdots, x_{iK}$ are the quantities of intermediates.

2.3.2 Different Sourcing Countries

I assume that each variety can be sourced from domestic or foreign countries. Ω is the set of all the countries in the world. Let j denote the sourcing country (both domestic and foreign). When $j = d$, it denotes the domestic country, whereas when $j \in \{1, 2, 3, \ldots, J\}$, it denotes a foreign country. I also assume that there are N_{jk} firms producing intermediate k in country j. N_{jk} is exogenous. Suppliers draw their productivity z from the Frechet distribution $F_{jk}(z) = e^{-T_{jk}z^{-\theta_k}}$, where $T_{jk} > 0$ represents the likelihood of high productivity in sector k and country j, while $\theta_k > 1$ represents the sector-specific level of variation. Regardless of all kinds of trade costs, the price of intermediate k produced by a firm with productivity z in country j is $\frac{w_j c_k}{z}$, where w_j is the country-specific cost and c_k is the sector-specific cost.

In addition, I further assume that there are two kinds of foreign countries: familiar sourcing countries and unfamiliar sourcing countries. The former refers to those countries that have exported to this importer in the same sector in the previous few years. The latter refers to those countries that have not exported to this importer in the same sector in the previous few years. This is one of the key assumptions of this paper. I discuss how the trade costs will differ between familiar and unfamiliar countries in Section 2.3.3. The trade costs of different sourcing countries will affect importers' sourcing decisions.

2.3.3 Trade Costs

In this subsection, I introduce three trade costs induced by sourcing behavior: iceberg trade cost, searching cost and communication cost. The iceberg trade cost between importing firm i and foreign supplier from country j is $\tau_{ij} > 1$. There is no iceberg trade cost for domestic sourcing, i.e. $\tau_{id} = 1$.

In addition to the iceberg trade cost, firms also need to pay fixed searching costs.

To conduct a search for suppliers producing intermediate k in foreign countries, importers need to pay a fixed searching cost f_k for basic information on the suppliers (e.g. number of firms and prices they offer) in each country it would like to search in. f_k is assumed to be exogenous and indifferent across countries for sector k.

The communication cost is an additional trade cost. I focus on this particular cost in the model. After choosing the suppliers in sector k and determining the price and quantity of the purchase, importers still face the risk of receiving unsatisfactory products. Because of information asymmetry, importers may encounter moral hazard and adverse selection, and then receive low-quality goods (Startz, 2016; Zhao, 2018; Bai et al., 2019). The ability to ensure reliable delivery is also a very important requirement in international trade (Egan and Mody, 1992). If the purchase cannot be successfully and completely delivered to the importers, importers will also suffer a loss. Considering the uncertainty of product quality and the supplier's capacity for proper delivery, I introduce satisfaction uncertainty into the sourcing model.

Satisfactory products refer to high-quality good that are successfully delivered to the importers. The satisfaction uncertainty brought about by information asymmetry is captured in the probability of receiving satisfactory products.[8] Therefore, importers need to make communication efforts to archive this probability. Such efforts are reflected in the communication cost in the model. Let q denote the probability that intermediates offered by a supplier are satisfactory for the importers, and $q \in (0, 1)$. Meanwhile, with probability $1 - q$, the intermediates are unsatis-

[8]The uncertainty mentioned in this paper is not equivalent to the description of market characteristics. Instead, the satisfaction uncertainty refers to the unpredictable quality or satisfaction level of goods, which is similar to the quality uncertainty discussed in Akerlof (1970).

factory and useless for the importers. I also assume $q = 1$ for domestic sourcing, which means that importers have full information on domestic suppliers. There is no communication cost in such a case.

It is also worth noting the communication cost is a variable trade cost instead of a fixed cost, since it is increasing in the amount of trading (Liu et al., 2017). Additionally, the communication cost is assumed to be related to both the level of this probability and firms' importing history with the sourcing country. Because achieving a higher probability of satisfactory goods requires greater communication effort and more importing experience with this country in the same sector will help to reduce such effort. I discuss the functional form of the communication cost in Section 2.3.5 and Section 1.3 in detail.

2.3.4 Firm's Decision Sequence

Before proceeding to solve for the optimal communication intensity and importing share from different sourcing countries, I summarize importer i's decision sequence to offer an overview of when and how firms optimally choose their sourcing countries and importing share from those countries. Taking the importers' decision sequence, optimal sourcing strategy $\{R_k\}_{k\in\kappa}$ can be solved by backwards induction.

1. Intermediate suppliers draw their productivity according to the distribution $F(z)$ in every variety in every sector.

2. In every sector k, importer i selects a set of countries it searches and pays the fixed searching cost f_k for each country. The set of all sourcing countries for

purchasing intermediate k is R_k. Because of the searching cost, firms will not search every country in the world. Therefore, R_k is a subset of Ω.

3. For each variety s in sector k, importer chooses the cheapest suppliers among all the sourcing countries. Importers choose the set of sourcing countries in each sector to maximize their profits from producing one unit of final goods:

$$\max_{\{R_k\}_{k\in\kappa}} py_i - \sum_{k\in\kappa} c^*_{ik}x^*_{ik} - \sum_{k\in\kappa}\sum_{j\in R_k} f_k,$$

   where final production $y_i = 1$, x^*_{ik} is the quantity of intermediate k derived from Equation (2.1) when producing one unit of final goods and c^*_{ik} is the unit cost of intermediate k — a CES form composition of prices from all the sourcing countries in sector k. The optimal sets of sourcing countries $\{R_k\}_{k\in\kappa}$ are also called the optimal sourcing strategy. It is important to note that, of the sourcing countries in R_k, R_f denotes the set of familiar countries, R_{uf} denotes the set of unfamiliar countries and d denotes the domestic country. Their relationship with R_k is $R_f \cup R_{uf} \cup d = R_k$.

4. Given the set of sourcing countries for intermediate k, firms can solve the intermediate's unit cost minimization problem and calculate its minimal unit cost c^*_{ik} of intermediate k. Importers then solve for the optimal communication intensity for each intermediate in each sourcing country and get the updated effective unit cost of intermediate k from j, which is $\tilde{p}_{ijk}$. Therefore, each importer can derive the import share from each sourcing country when purchasing intermediate k. This is the main focus of this paper, closely related

to the estimation of benefits of importing from familiar countries. Details are provided in Section 2.3.5 and Section 2.3.6.[9]

2.3.5 Optimal Communication Intensity

Firms in the same country share the same language, social norms, communication habits and even similar product specifications. Therefore, there is a higher probability of receiving satisfactory products from a familiar country while exerting the same communication effort. In other words, to achieve the same probability of satisfaction, firms will exert less communication effort when importing from familiar countries than when importing from unfamiliar countries.

Based on this expectation and firms' preference for importing from familiar countries, I further assume that the probability of receiving satisfactory products becomes q^{α} when the supplier is from a familiar country. α is assumed to be positive to ensure the probability is still within the interval $(0, 1)$. Proposition 1 discusses how α determines the difference between importing from familiar and importing from unfamiliar countries. I estimate the value of α in Section 1.3 in order to see whether there is higher probability when importing from familiar countries.

Proposition 1. *If $\alpha \in (0, 1)$, then the satisfaction probability will be higher when importing from familiar countries than when importing from unfamiliar countries*

[9] Details of the derivation for optimal sourcing strategy are available upon request. By including the demand side and making the assumption of constant markup, a general equilibrium production network can be generated. There is no closed form solution for optimal strategy, but there are conditions on whether to add an extra sourcing country by comparing the profit changes.

($q^\alpha > q$). If $\alpha \in [1, +\infty)$, then the satisfaction probability when importing from familiar countries will be lower than or the same as when importing from unfamiliar countries ($q^\alpha \leq q$).

Proof. Given that $q \in (0, 1)$ and $\alpha > 0$, assume $b(\alpha) = q^\alpha - q$. It is equivalent to prove that $b > 0$ when $\alpha \in (0, 1)$ and $b \leq 0$ when $\alpha \geq 1$.

Since $\partial y / \partial \alpha = q^\alpha \ln q < 0$, $b(\alpha)$ is decreasing in α and $b(1) = 0$, then $b(\alpha) > b(1) = 0$ when $\alpha \in (0, 1)$, and $b(\alpha) \leq b(1) = 0$ when $\alpha \in [1, +\infty)$.

□

Communication intensity with the firms in country j and sector k is defined as corresponding to the satisfaction probability q_{ijk} and q^α_{ijk}. In this part, I solve for the optimal communication intensity that minimizes the unit cost (including the iceberg trade cost and communication cost) of intermediate k. The optimal communication intensity will differ when trading with firms in familiar and unfamiliar countries.

First, we need to solve the unit cost minimization problem. I assume that price p of intermediate k imported from country j to importer i follows the distribution $G_{ijk}(p) = e^{-T_{jk}(w_j c_k \tau_{ij})^{-\theta_k} p^{\theta_k}}$. μ_{ijk} is the measure of varieties in sector k importer i sourced from country j. According to the law of large numbers, $q_{ijk}\mu_{ijk}$ of the intermediates sourced from unfamiliar countries and $q^\alpha_{ijk}\mu_{ijk}$ of the intermediates sourced from familiar countries can be used for first-stage production. Conditional on R_k, the unit cost minimization problem is given by:

$$\min_{x_{ijk}} \sum_{j \in R_k} \mu_{ijk} \int_0^\infty p x_{ijk}(p) dG_{ijk}(p)$$

$$\text{s.t.} \left[\mu_{idk}\int_0^\infty x_{idk}(p)^{\frac{\varepsilon_k-1}{\varepsilon_k}}dG_{idk}(p)+\sum_{j\in R_{uf}} q_{ijk}\mu_{ijk}\int_0^\infty x_{ijk}(p)^{\frac{\varepsilon_k-1}{\varepsilon_k}}dG_{ijk}(p)+\sum_{j\in R_f} q_{ijk}^{\alpha}\mu_{ijk}\int_0^\infty x_{ijk}(p)^{\frac{\varepsilon_k-1}{\varepsilon_k}}dG_{ijk}(p)\right]^{\frac{\varepsilon_k}{\varepsilon_k-1}} \geq 1,$$

where the three terms in the brackets refer to the intermediates that can be used for first-stage production sourced from the domestic country, unfamiliar countries and familiar countries, respectively.

Solving the unit cost minimization problem (see the proof in Appendix B.1.1), we get firm i's optimal unit cost of intermediate k:

$$c_{ik}^* = \left[\mu_{idk}\int_0^\infty p^{1-\varepsilon_k}dG_{idk}(p)+\sum_{j\in R_{uf}}\mu_{ijk}\int_0^\infty\left(q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}p\right)^{1-\varepsilon_k}dG_{ijk}(p)+\sum_{j\in R_f}\mu_{ijk}\int_0^\infty\left(q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}}p\right)^{1-\varepsilon_k}dG_{ijk}(p)\right]^{\frac{1}{1-\varepsilon_k}} \tag{2.2}$$

According to Equation (2.2), $q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}p$ and $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}}p$ can be considered the updated unit cost of intermediate k sourced from unfamiliar countries and familiar countries, respectively.

Without considering information asymmetry, the price of intermediate k is simply p. However, the satisfaction uncertainty induced by information asymmetry assigns the multiplier $q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$ or $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}}$ to p. Lemma 1 describes how satisfaction uncertainty affects the effective unit cost. Proposition 2 discusses how this effect differs when trading with familiar and unfamiliar countries.

Lemma 1. *The satisfaction uncertainty induced by information asymmetry will increase the effective unit cost of products* ($q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}p > p$ *and* $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}}p > p$).

Proof. It is equivalent to prove that $q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} > 1$ and $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} > 1$.

Since $\alpha > 0$ and $\varepsilon > 1$, $\frac{\alpha\varepsilon_k}{1-\varepsilon_k} < 0$ and $\frac{\alpha\varepsilon_k}{1-\varepsilon_k} < 0$ are satisfied. Given that $q \in (0,1)$, $q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} > 1$ and $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} > 1$ are satisfied.

□

Proposition 2. *If $\alpha \in (0,1)$, the effective unit cost will be lower when importing from familiar countries than when importing from unfamiliar countries ($q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} < q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$). If $\alpha \in [1,+\infty)$, the effective unit cost when importing from familiar countries will be higher than or the same as when importing from unfamiliar countries ($q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} \geq q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$).*

Proof. Since $q \in (0,1)$, q^h is a decreasing function of h. When $\alpha \in (0,1)$, $\frac{\varepsilon_k}{1-\varepsilon_k} < \frac{\alpha\varepsilon_k}{1-\varepsilon_k} < 0$ is satisfied. Hence, $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} < q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$. When $\alpha \in [1,+\infty)$, $\frac{\varepsilon_k}{1-\varepsilon_k} \geq \frac{\alpha\varepsilon_k}{1-\varepsilon_k}$, and so $q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} \geq q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$.

□

Having constructed the updated effective unit cost of the intermediates, I will derive the optimal communication intensity with exporters from country j in sector k. But first, we need to update the expression of p by including the iceberg trade cost and communication cost. The communication cost is assumed to be related to both the communication intensity and the firm's importing history with this sourcing country. The expression of p_{ijk} is given by:

$$p_{ijk} = \frac{w_j c_k \tau_{ij}}{z} e^{q_{ijk}/m_{ijk}}, \tag{2.3}$$

where m_{ijk} is the firm's importing experience with this country in sector k, and $m_{ijk} \neq 0$.[10]

In Equation (2.3), I include term $e^{q_{ijk}/m_{ijk}}$ to represent the communication cost importer i pays to realize optimal communication intensity.This value increases in

[10]Without the iceberg trade cost and communication cost, the price of domestic intermediate k is given by $p_{idk} = \frac{w_d c_k}{z}$

q_{ijk}, since higher communication intensity requires more effort. At the same time, it decreases in firms' importing history with this country in the same sector. As the firm has more experience importing from the firms from this country in this sector, it will have better knowledge of the products offered by the country and therefore have a lower communication cost with all other factors equal. I discuss the functional form of m_{ijk} in detail in Section 1.3.

Combine with the updated expression of p_{ijk} described above, the effective unit cost of intermediate k firm i imports from foreign supplier j is given by:

$$\tilde{p}_{ijk} = \tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} p_{ijk} = \tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} \frac{w_j c_k \tau_{ij}}{z} e^{q_{ijk}/m_{ijk}}, \tag{2.4}$$

where

$$\tilde{q}_{ijk} \equiv \begin{cases} q_{ijk} & \text{, if } \; j \in R_{uf} \\ q_{ijk}^{\alpha} & \text{, if } \; j \in R_f \end{cases} \tag{2.5}$$

According to Equation (2.4), the updated expression of the effective unit cost of intermediate k consists of three parts: unit cost increase multiplier due to the satisfaction uncertainty $\tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}}$, iceberg trade cost inclusive origin country price $\frac{w_j c_k \tau_{ij}}{z}$ and the communication cost $e^{q_{ijk}/m_{ijk}}$.

The communication cost and satisfaction uncertainty inclusive unit cost minimization problem is given by:

$$\min_{q_{ijk}} \tilde{p}_{ijk} = \tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} p_{ijk} = \tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} \frac{w_j c_k \tau_{ij}}{z} e^{q_{ijk}/m_{ijk}}$$

Once we have solved for the unit cost minimization problem above for familiar and unfamiliar countries separately, we get the expressions for optimal communication intensity:

$$q_{ijk} = \begin{cases} \frac{\varepsilon_k m_{ijk}}{\varepsilon_k - 1} & , \text{if } \ j \in R_{uf} \\ \frac{\alpha \varepsilon_k m_{ijk}}{\varepsilon_k - 1} & , \text{if } \ j \in R_f \end{cases} \tag{2.6}$$

Substituting Equation (2.6) back into the total cost expression, we get the expressions for the effective unit cost of intermediate k firm i sourced from supplier j:

$$\tilde{p}_{ijk} = \tilde{q}_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} p_{ijk} = \begin{cases} \left(\frac{\varepsilon_k m_{ijk}}{\varepsilon_k - 1}\right)^{\frac{\varepsilon_k}{1-\varepsilon_k}} \frac{w_j c_k \tau_j}{z} e^{\frac{\varepsilon_k}{\varepsilon_k - 1}} & , \text{if } \ j \in R_{uf} \\ \left(\frac{\alpha \varepsilon_k m_{ijk}}{\varepsilon_k - 1}\right)^{\frac{\alpha \varepsilon_k}{1-\varepsilon_k}} \frac{w_j c_k \tau_j}{z} e^{\frac{\alpha \varepsilon_k}{\varepsilon_k - 1}} & , \text{if } \ j \in R_f \end{cases} \tag{2.7}$$

2.3.6 Importing Shares

After getting the updated effective unit price in Equation (2.7), similar to Eaton and Kortum (2002b), conditional on the sourcing strategy R_k, the share of intermediate k sourced from country j is given by the ratio of corresponding sourcing potential over the sourcing capacity:

$$\frac{V_{ijk}}{V_{ik}} = \frac{\Phi_{ijk}}{\Phi_{ik}}, \tag{2.8}$$

where V_{ijk} is the trade volume of intermediate k imported from country j and V_{ik} is the total trade volume of intermediate k imported by firm i. Sourcing capacity Φ_{ik} is given by:

$$\Phi_{ik} = \Phi_{idk} + \sum_{j \in R_{uf}} \Phi_{ijk} + \sum_{j \in R_f} \Phi_{ijk},$$

and sourcing potential Φ_{ijk} is given by:

$$\Phi_{ijk} = \begin{cases} N_{dk} T_{dk} (w_d c_k)^{-\theta_k} & , \text{if } \ j = d \\ N_{jk} T_{jk} (w_j c_k \tau_j)^{-\theta_k} \left(\frac{\varepsilon_k m_{ijk}}{\varepsilon_k - 1}\right)^{\frac{\theta_k \varepsilon_k}{\varepsilon_k - 1}} e^{\frac{\theta_k \varepsilon_k}{1-\varepsilon_k}} & , \text{if } \ j \in R_{uf} \\ N_{jk} T_{jk} (w_j c_k \tau_j)^{-\theta_k} \left(\frac{\alpha \varepsilon_k m_{ijk}}{\varepsilon_k - 1}\right)^{\frac{\alpha \theta_k \varepsilon_k}{\varepsilon_k - 1}} e^{\frac{\alpha \theta_k \varepsilon_k}{1-\varepsilon_k}} & , \text{if } \ j \in R_f \end{cases} \tag{2.9}$$

2.4 Estimation

This paper focuses on the benefits of importing from familiar countries. Using the model described above, I determine to check whether the probability of receiving satisfactory products will be higher when importing from familiar countries, i.e. whether $\alpha \in (0, 1)$ is satisfied. In this section, I take advantage of the expression of sourcing potentials to identify α.

2.4.1 Method

Let j denote the unfamiliar country for firm i, while j' denotes the familiar country. According to Equations (2.8) and (2.9), we can get the ratio of importing trade flow from firm i's familiar and unfamiliar countries in sector k. After taking the logarithm of the ratio (see the proof in Appendix B.1.2), we get:

$$\begin{aligned} \log \frac{V_{ij'k}}{V_{ijk}} =& \log \left[N_{j'k} T_{j'k} (w_{j'} c_k \tau_{j'})^{-\theta_k} \right] - \log \left[N_{jk} T_{jk} (w_j c_k \tau_j)^{-\theta_k} \right] \\ &+ \log \left[\alpha^{\frac{\alpha \theta_k \varepsilon_k}{\varepsilon - 1}} \left(\frac{e \varepsilon_k}{\varepsilon_k - 1} \right)^{\frac{(\alpha - 1)\theta_k \varepsilon_k}{1 - \varepsilon_k}} \right] \\ &+ \frac{\alpha \theta_k \varepsilon_k}{\varepsilon_k - 1} \log m_{ij'k} - \frac{\theta_k \varepsilon_k}{\varepsilon_k - 1} \log m_{ijk}, \end{aligned} \tag{2.10}$$

where the first term on the right hand side is familiar country–industry–time-specific, the second term is unfamiliar country–industry–time-specific, and the third term can be considered a constant term. It is important to note that τ_{ij} and $\tau_{ij'}$ measure the traditional iceberg trade cost between country pairs, and importing firm i is always located in China. Therefore, τ_{ij} and $\tau_{ij'}$ become τ_j and τ_j' in Equation (2.10).

Recall that the communication cost $e^{q_{ijk}/m_{ijk}}$ is a decreasing function of m_{ijk}, and m_{ijk} measures firm i's importing experience with country j in sector k. The measurement of importing experience with the sourcing country must be related to the importing history between firm i and country j and significantly reflects the difference between familiar and unfamiliar countries. Therefore, I assume that m_{ijk} is an increasing function of accumulated import volume from country j to firm i in sector k before the current period. This assumption implies that the more a firm previously imported from a country in a sector, the better knowledge it will have of the country's products and the less effort it will have to make to achieve the optimal communication intensity. Now, I introduce the time dimension t, and m_{ijkt} is given by:

$$\begin{cases} m_{ijkt} = e^{aiv_{ijk,t-1}} \\ m_{ij'kt} = e^{aiv_{ij'k,t-1}} \end{cases} \tag{2.11}$$

where $aiv_{ijk,t-1}$ is the accumulated import volume from j to i by the time $t-1$ (including $t-1$). It is worth noting that the exponential form in Equation (2.11) is essential. This is because when the unfamiliar country is defined as not exporting to this firm in this sector during a certain period, it is highly possible that the accumulated exporting trade volume to this firm in this sector will be very small or even zero. Or if we assume that $m_{ijkt} = aiv_{ijk,t-1}$, zero value will be omitted after taking the logarithm. If we assume that $m_{ijkt} = aiv_{ijk,t-1} + A$, and A is a positive constant, the difference between $aiv_{ijk,t-1}$ and $aiv_{ij'k,t-1}$ will be reduced when taking the logarithm, and that will affect the estimates of α as well.

The first term and the second term on the right hand side of Equation (2.10) can be represented by familiar country–industry–time fixed effect $FE_{j'kt}$ and unfamiliar–

industry–time fixed effect FE_{jkt} and the third term can be represented by a constant term. The country–industry-time fixed effects also capture the market characteristics of origin countries in each sector at specific time, thus controlling for all the other effects from the supplying market except for familiarity. Combine with the expression of m_{ijkt}, the regression can be expressed as:

$$\log \frac{V_{ij'kt}}{V_{ijkt}} = FE_{j'kt} + FE_{jkt} + \beta_1 aiv_{ij'k,t-1} - \beta_2 aiv_{ijk,t-1} + \epsilon_{ijkt}, \tag{2.12}$$

where:

$$\beta_1 = \frac{\alpha\theta_k\varepsilon_k}{\varepsilon_k - 1}, \tag{2.13}$$

$$\beta_2 = \frac{\theta_k\varepsilon_k}{\varepsilon_k - 1}, \tag{2.14}$$

I use Equation (2.12) as the regression equation to estimate β_1 and β_2. Then, the ratio of estimates of β_1 and β_2 gives the estimate of α, which is the main focus of the estimation. According to Proposition 1 and Proposition 2, whether $\alpha \in (0, 1)$ indicates whether the satisfaction probability will be higher and whether the effective unit price for intermediate k will be lower when importing from familiar countries than when importing from unfamiliar countries. Thus, the value of α reflects the benefits of importing from familiar countries.

2.4.2 Results

Considering the sample size, I restrict T to be 1 in the main estimation and regress the logarithm of import volume ratio between familiar and unfamiliar countries on the accumulated import volume from familiar and unfamiliar sourcing countries for the same firm in the same sector. I control for familiar country–sector–time fixed effects and unfamiliar country–sector–time fixed effects in each regression.

Table 2.2 shows the estimation results along with the value of α when $T = 1$. Familiar countries are defined as exporting to this firm in the same HS4 sector (Columns (1) to (4)), in the same HS2 sector (Column (5)) or in any sector (Column (6)) in the previous year. To control for importer's productivity, I also include firm fixed effects, firm–time fixed effects and firm–sector–time fixed effects in Columns (2), (3) and (4), respectively. In Columns (5) and (6), firm–sector–time fixed effects have also been controlled.

The results show that the value of α is always positive, ranging from 0 to 1 in each column. From Proposition 1, $\alpha \in (0, 1)$ implies that the probability of receiving satisfactory intermediates is higher when importing from familiar countries than when importing from unfamiliar ones. This implication is consistent with the expectation that firms have a higher probability of receiving satisfactory products when importing the product from a familiar country. In addition, according to Proposition 2, these results also indicate that importing from familiar countries will help to reduce the effective unit cost of the intermediate goods. As a robustness check, I also present the complete set of results using all kinds of firm-related fixed effects under the definition of "in the same HS2 sector" and "in any sector" respectively in Table A.1. All the results are robust to modifying the sector restriction of familiar countries or controlling for importer's productivity.

I use Figure **??** to explain the estimation results and show the magnitude of benefits of importing from familiar countries. Figure **??** plots the satisfaction probability improvement between importing from familiar countries and importing from unfamiliar ones ($q^\alpha - q$) against q when $q \in (0, 1)$. Each panel corresponds to the estimates of α in Table 2.2 with the same serial number. The values indicate that importing from familiar countries always leads to higher satisfaction probability, since the improvements are always positive in all panels ($q^\alpha - q > 0$). Figure **??** also shows the potential magnitude of the probability improvement when $q \in (0, 1)$. Taking Panel (4) as an example, using the estimates of $\alpha = 0.0244$ from Column (4) in Table 2.2, the satisfaction probability is always larger when importing from familiar countries than when importing from unfamiliar ones.[11] The probability improvement $q^\alpha - q$ reached its peak value of 89.0 percent when $q = 2.3$ percent. In the rest of the panels, the peak values are 58.3 percent, 75.4 percent, 78.1 percent, 90.9 percent and 51.7 percent. Thus, this figure provides a more visual depiction of the satisfaction probability improvement of importing from familiar countries. It also shows the magnitude of this improvement according to the value of q.

2.4.3 Extensions

In this section, I present and explain the estimation results of two extensions, using alternative ways to measure importing experience with sourcing countries. The measurement of importing experience should be quantitatively related to the importing history and reflect the difference between importing from familiar and unfamiliar countries.

[11] I take Panel (4) as the example because the regression in Column (4) of Table 2.2 includes the most restrictive firm-related fixed effects.

First, I assign a yearly discount rate of 80 percent to the previous import volume and then calculate the accumulated import volume again.[12] The intuition is that the information from previous importing experience will become less helpful over time. For example, trading experience from two years ago will be less useful than experience from only one year ago. I name the updated accumulated import volume as discounted accumulated import volume $disaiv_{ijk,t-1}$.

Second, for each importer in each year, I take the average of the import volume with this sourcing country within each HS4 sector, and then calculate the accumulated average import volume again. I name this updated accumulated import volume as accumulated average import volume $aaiv_{ijk,t-1}$.

The main results by using these two measurements are shown in Table 2.3 and Table 2.4, respectively. The definitions of familiar and unfamiliar countries take the same pattern as in the main estimation in Table 2.2. As a robustness check, I also present the complete sets of results using all kinds of firm-related fixed effects under the definition of "in the same HS2 sector" and "in any sector" respectively in Table A.2 and Table A.3. In all results, the estimates of α range from 0 to 1. According to Proposition 1 and Proposition 2, these results indicate that importing from familiar countries can help to increase the probability of satisfaction and decrease the effective unit cost of intermediates, even when using an alternative measurement of importing experience.

I also plot the satisfaction probability improvement $q^{\alpha} - q$ against q in Figure 2.3

[12] Therefore, for the period $t-1$, the trade volume has been discounted by 0.8 and for the period $t-2$, the trade volume has been discounted by 0.8^2, and so on.

and Figure 2.4 to explain the probability improvements from Table 2.3 and Table 2.4, respectively. In Figure 2.3, I also take Panel (4) as an example; when $\alpha = 0.0221$, the satisfaction probability improvement of importing from familiar countries reaches its peak value 89.7 percent when $q = 2.1$ percent. The remaining peak values of probability improvement are 58.3 percent, 78.0 percent, 78.5 percent, 93.3 percent and 47.1 percent. In Panel (4) of Figure 2.3, when $\alpha = 0.0264$, the satisfaction probability improvement of importing from familiar countries reaches its peak value of 88.2 percent when $q = 2.5$ percent. The remaining peak values of probability improvement are 55.0 percent, 69.4 percent, 74.2 percent, 82.1 percent and 18.9 percent. Figure 2.3 and Figure 2.4 illustrate the satisfaction probability improvement of importing from familiar countries. They also show the magnitude of this improvement according to the value of q.

Additionally, in the estimation part, I assume that importing experience m_{ijkt} takes an exponential form because of the limitation of available sample size. The functional form of m_{ijkt} is required to capture the obvious difference between familiar and unfamiliar countries in terms of import experience. If the sample size is abundant enough and yields a large enough difference between import experience with familiar countries and unfamiliar countries, the exponential form will no longer be essential. Following Zhao (2018), we also assume that firms do not share information on foreign market with each other, since they will not gain much from information sharing. Thus, communication cost is irrelevant to other firms' importing experience and we do not consider multiple equilibrium in this project.

2.5 Conclusion

In this paper, I study importers' choice of sourcing countries and estimate the benefits of importing from familiar countries. Those benefits are measured by the satisfaction probability improvement and the fall in effective unit cost.

Inspired by firms' preference for importing from familiar countries, I develop a model describing firms' sourcing behavior in a multi-country world, incorporating both satisfaction uncertainty and communication cost. Such satisfaction uncertainty is assumed to be different when importing from familiar and importing unfamiliar countries.

Using the model, I estimate the benefit of importing from familiar countries and find that importing from familiar countries improves the probability of receiving satisfactory products. The main estimation results show that there is a maximal probability improvement range from 51.7 percent to 90.9 percent. The results also indicate that, facing the problem of information asymmetry, the effective unit cost decreases when firms import from familiar countries. All of the robustness checks are consistent with the main results.

Table 2.1 Firm–sector–year-level Statistics on the Import Volume (million USD) and Number of Sourcing Countries

	Mean	Min	Max
Import Volume	0.42	0.000001	11100
Import Volume from Familiar Countries	0.68	0.000001	11100
Import Volume from Unfamiliar Countries	0.12	0.000001	1420
Number of Sourcing Countries	1.13	1	17
Number of Familiar Sourcing Countries	0.62	0	17
Number of Unfamiliar Sourcing Countries	0.52	0	14

Notes:

This table reports statistics on the import volume and number of countries from which a firm imports the same HS4 products per year. Familiar countries are defined as exporting to this firm in the same HS4 sector in the previous year.

Table 2.2 Probability Improvement with Familiar Countries $m_{ijkt} = e^{aiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$					
	HS4				HS2	Any Sector
	(1)	(2)	(3)	(4)	(5)	(6)
$aiv_{ij'k,t-1}$	0.133***	0.108***	0.102***	0.0859***	0.110**	0.103**
	(0.0238)	(0.0199)	(0.0227)	(0.0306)	(0.0463)	(0.0404)
$aiv_{ijk,t-1}$	-0.802**	-1.722***	-1.646**	-3.520***	-5.875***	-0.481***
	(0.375)	(0.654)	(0.789)	(1.037)	(1.528)	(0.105)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	N
FE_{it}	N	N	Y	N	N	N
FE_{ikt}	N	N	N	Y	Y	Y
Constant	1.307***	1.324***	1.331***	1.371***	1.178***	1.053***
	(0.00690)	(0.00702)	(0.00726)	(0.00747)	(0.00936)	(0.0110)
Obs	188,914	174,972	153,160	99,102	65,231	42,345
R^2	0.256	0.383	0.512	0.752	0.725	0.672
Value of α	0.1658	0.0627	0.0619	0.0244	0.0187	0.2141

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS4 sector in the previous year. In Column (5), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. In Column (6), familiar countries are defined as exporting to this firm in any sector in the previous year.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 2.3 Probability Improvement with Familiar Countries $m_{ijkt} = e^{disaiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$					
	HS4				HS2	Any Sector
	(1)	(2)	(3)	(4)	(5)	(6)
$disaiv_{ij'k,t-1}$	0.220***	0.177***	0.168***	0.137***	0.164***	0.158***
	(0.0341)	(0.0317)	(0.0366)	(0.0466)	(0.0622)	(0.0571)
$disaiv_{ijk,t-1}$	-1.325**	-2.852***	-2.794**	-6.210***	-12.80***	-0.629***
	(0.637)	(1.099)	(1.415)	(1.915)	(3.252)	(0.107)
Constant	1.306***	1.322***	1.330***	1.370***	1.181***	1.051***
	(0.00690)	(0.00705)	(0.00730)	(0.00759)	(0.00962)	(0.0110)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	N
FE_{it}	N	N	Y	N	N	N
FE_{ikt}	N	N	N	Y	Y	Y
obs	188,914	174,972	153,160	99,102	65,231	42,345
R^2	0.256	0.383	0.512	0.752	0.726	0.672
Value of α	0.1660	0.0621	0.0601	0.0221	0.0128	0.2512

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS4 sector in the previous year. In Column (5), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. In Column (6), familiar countries are defined as exporting to this firm in any sector in the previous year.

$disaiv_{ij'k,t-1}$ ($disaiv_{ijk,t-1}$) denotes the discounted accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively. The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table 2.4 Probability Improvement with Familiar Countries $m_{ijkt} = e^{aaiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$					
	HS4				HS2	Any Sector
	(1)	(2)	(3)	(4)	(5)	(6)
$aaiv_{ij'k,t-1}$	0.330***	0.297***	0.292***	0.296*	0.574***	0.587***
	(0.0848)	(0.0726)	(0.0762)	(0.169)	(0.118)	(0.122)
$aaiv_{ijk,t-1}$	-1.748**	-2.936**	-3.724***	-11.21***	-12.32***	-0.988***
	(0.702)	(1.142)	(1.433)	(3.856)	(3.713)	(0.274)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	N
FE_{it}	N	N	Y	N	N	N
FE_{ikt}	N	N	N	Y	Y	Y
Constant	1.309***	1.324***	1.332***	1.375***	1.176***	1.045***
	(0.00693)	(0.00704)	(0.00726)	(0.00842)	(0.00944)	(0.0110)
Obs	188,914	174,972	153,160	99,102	65,231	42,345
R^2	0.255	0.383	0.512	0.752	0.725	0.672
Value of α	0.1888	0.1012	0.0784	0.0264	0.0466	0.5941

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS4 sector in the previous year. In Column (5), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. In Column (6), familiar countries are defined as exporting to this firm in any sector in the previous year.

$aaiv_{ij'k,t-1}$ ($aaiv_{ijk,t-1}$) denotes the accumulated average import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively. The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.1 Probability Improvement with Familiar Countries $m_{ijkt} = e^{aiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$							
	HS2				Any Sector			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$aiv_{ij'k,t-1}$	0.0866***	0.0802***	0.0780***	0.110**	0.0709***	0.0610***	0.0825***	0.103**
	(0.0256)	(0.0180)	(0.0164)	(0.0463)	(0.0180)	(0.0108)	(0.0176)	(0.0404)
$aiv_{ijk,t-1}$	-0.913**	-2.284***	-2.928***	-5.875***	-0.274*	-0.591***	-0.475***	-0.481***
	(0.460)	(0.776)	(1.035)	(1.528)	(0.142)	(0.125)	(0.0984)	(0.105)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	Y	N	N
FE_{it}	N	N	Y	N	N	N	Y	N
FE_{ikt}	N	N	N	Y	N	N	N	Y
Constant	1.100***	1.119***	1.129***	1.178***	0.968***	0.994***	1.008***	1.053***
	(0.00810)	(0.00830)	(0.00864)	(0.00936)	(0.0102)	(0.0104)	(0.0108)	(0.0110)
Obs	135,169	120,677	100,543	65,231	83,317	69,165	55,958	42,345
R^2	0.152	0.341	0.498	0.725	0.035	0.345	0.498	0.672
Value of α	0.0949	0.0351	0.0266	0.0187	0.2587	0.1032	0.1737	0.2141

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. From Columns (5) to (8), familiar countries are defined as exporting to this firm in any sector in the previous year.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.2 Probability Improvement with Familiar Countries $m_{ijkt} = e^{disaiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$							
	HS2				Any Sector			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$disaiv_{ij'k,t-1}$	0.149***	0.134***	0.126***	0.164***	0.125***	0.107***	0.132***	0.158***
	(0.0359)	(0.0254)	(0.0242)	(0.0622)	(0.0265)	(0.0165)	(0.0270)	(0.0571)
$disaiv_{ijk,t-1}$	-1.421*	-4.087***	-5.985***	-12.80***	-0.392**	-0.783***	-0.628***	-0.629***
	(0.761)	(1.420)	(2.050)	(3.252)	(0.182)	(0.150)	(0.0991)	(0.107)
Constant	1.099***	1.118***	1.129***	1.181***	0.967***	0.993***	1.006***	1.051***
	(0.0081)	(0.00832)	(0.00869)	(0.00962)	(0.0102)	(0.0104)	(0.0108)	(0.0110)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	Y	N	N
FE_{it}	N	N	Y	N	N	N	Y	N
FE_{ikt}	N	N	N	Y	N	N	N	Y
obs	135,169	120,677	100,543	65,231	83,317	69,165	55,958	42,345
R^2	0.152	0.341	0.498	0.726	0.036	0.345	0.498	0.672
Value of α	0.1049	0.0328	0.0211	0.0128	0.3189	0.1367	0.2102	0.2512

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. From Columns (5) to (8), familiar countries are defined as exporting to this firm in any sector in the previous year. $disaiv_{ij'k,t-1}$ ($disaiv_{ijk,t-1}$) denotes the discounted accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.3 Probability Improvement with Familiar Countries $m_{ijkt} = e^{aaiv_{ijk,t-1}}$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$							
	HS2				Any Sector			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$aaiv_{ij'k,t-1}$	0.175***	0.176***	0.177***	0.574***	0.138***	0.135***	0.220***	0.587***
	(0.0643)	(0.0506)	(0.0462)	(0.118)	(0.0397)	(0.0297)	(0.064)	(0.122)
$aaiv_{ijk,t-1}$	-2.360***	-4.321***	-4.681**	-12.32***	-0.664*	-1.369***	-0.986***	-0.988***
	(0.772)	(1.588)	(2.101)	(3.713)	(0.359)	(0.345)	(0.305)	(0.274)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	Y	N	N
FE_{it}	N	N	Y	N	N	N	Y	N
FE_{ikt}	N	N	N	Y	N	N	N	Y
Constant	1.102***	1.120***	1.130***	1.176***	0.970***	0.995***	1.008***	1.045***
	(0.00808)	(0.00831)	(0.00866)	(0.00944)	(0.0101)	(0.0104)	(0.0109)	(0.0110)
Obs	135,169	120,677	100,543	65,231	83,317	69,165	55,958	42,345
R^2	0.151	0.34	0.498	0.725	0.035	0.345	0.497	0.672
Value of α	0.0742	0.0407	0.0378	0.0466	0.2078	0.0986	0.2231	0.5941

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous year. From Columns (5) to (8), familiar countries are defined as exporting to this firm in any sector in the previous year. $aaiv_{ij'k,t-1}$ ($aaiv_{ijk,t-1}$) denotes the accumulated average import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.4 Probability Improvement with Familiar Countries $T = 2$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$			
	HS4			
	(1)	(2)	(3)	(4)
$aiv_{ij'k,t-1}$	0.167***	0.132***	0.130***	0.102**
	(0.0383)	(0.0398)	(0.0503)	(0.0518)
$aiv_{ijk,t-1}$	-0.785	-1.905	-1.893	-2.666
	(0.492)	(1.590)	(2.245)	(5.166)
$FE_{jk't}$	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y
FE_i	N	Y	N	N
FE_{it}	N	N	Y	N
FE_{ikt}	N	N	N	Y
Constant	1.253***	1.271***	1.276***	1.320***
	(0.00770)	(0.00791)	(0.00826)	(0.00865)
Obs	151,918	138,422	120,510	78,177
R^2	0.268	0.411	0.537	0.757
Value of α	0.2127	0.0693	0.0687	0.0383

Notes:

Familiar countries are defined as exporting to this firm in the same HS4 sector in the previous two years.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar(unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.5 Probability Improvement with Familiar Countries $T = 2$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$							
	HS2				Any Sector			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$aiv_{ij'k,t-1}$	0.0999***	0.0999***	0.0939***	0.109*	0.0789***	0.0667***	0.0702***	0.0908*
	(0.0332)	(0.0243)	(0.0255)	(0.0638)	(0.0200)	(0.0140)	(0.0186)	(0.0511)
$aiv_{ijk,t-1}$	-0.589	-2.940	-6.388**	-6.890*	-0.226	-0.664***	-5.338	-8.646*
	(0.532)	(1.892)	(2.604)	(4.029)	(0.216)	(0.221)	(3.716)	(4.934)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	Y	N	N
FE_{it}	N	N	Y	N	N	N	Y	N
FE_{ikt}	N	N	N	Y	N	N	N	Y
Constant	1.082***	1.100***	1.111***	1.150***	0.948***	0.970***	0.978***	1.020***
	(0.00914)	(0.00940)	(0.00972)	(0.0105)	(0.0115)	(0.0118)	(0.0122)	(0.0126)
Obs	104,837	91,139	75,760	50,208	63,716	50,766	42,344	32,726
R^2	0.164	0.381	0.528	0.729	0.040	0.391	0.517	0.676
Value of α	0.1696	0.0340	0.0147	0.0158	0.3491	0.1005	0.0132	0.0105

Notes:

From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous two years. From Columns (5) to (8), familiar countries are defined as exporting to this firm in any sector in the previous two years.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.6 Probability Improvement with Familiar Countries $T = 3$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$			
	HS4			
	(1)	(2)	(3)	(4)
$aiv_{ij'k,t-1}$	0.152***	0.120***	0.117**	0.100*
	(0.0380)	(0.0407)	(0.0497)	(0.0549)
$aiv_{ijk,t-1}$	-5.103**	-0.997	1.344	-49.81
	(2.015)	(2.845)	(4.206)	(40.94)
$FE_{jk't}$	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y
FE_i	N	Y	N	N
FE_{it}	N	N	Y	N
FE_{ikt}	N	N	N	Y
Constant	1.245***	1.262***	1.268***	1.321***
	(0.00861)	(0.00886)	(0.00918)	(0.0108)
Obs	120,034	107,655	94,239	61,445
R^2	0.275	0.434	0.552	0.759
Value of α	0.0298	0.1204	0.0871	0.0020

Notes:

Familiar countries are defined as exporting to this firm in the same HS4 sector in the previous two years.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm-year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Table A.7 Probability Improvement with Familiar Countries $T = 3$

	Dependent Variable: $log(X_{ij'kt}/X_{ijkt})$							
	HS2				Any Sector			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$aiv_{ij'k,t-1}$	0.0825***	0.0907***	0.0809***	0.0977	0.0910***	0.0719***	0.0787**	0.0740*
	(0.0294)	(0.0254)	(0.0257)	(0.0647)	(0.0197)	(0.0222)	(0.0332)	(0.0417)
$aiv_{ijk,t-1}$	-4.810**	-8.205**	-5.468**	-8.963*	-3.747*	-4.558	-0.177	-18.09
	(2.423)	(3.232)	(2.598)	(5.034)	(1.958)	(4.278)	(4.712)	(48.64)
$FE_{jk't}$	Y	Y	Y	Y	Y	Y	Y	Y
FE_{jkt}	Y	Y	Y	Y	Y	Y	Y	Y
FE_i	N	Y	N	N	N	Y	N	N
FE_{it}	N	N	Y	N	N	N	Y	N
FE_{ikt}	N	N	N	Y	N	N	N	Y
Constant	1.081***	1.097***	1.103***	1.147***	0.954***	0.974***	0.977***	1.023***
	(0.0102)	(0.0106)	(0.0109)	(0.0115)	(0.0130)	(0.0134)	(0.0136)	(0.0143)
Obs	81,721	69,232	58,183	39,209	49,367	38,021	32,741	25,440
R^2	0.173	0.411	0.542	0.735	0.043	0.420	0.523	0.681
Value of α	0.0172	0.0111	0.0148	0.0109	0.0243	0.0158	0.4446	0.0041

Notes:

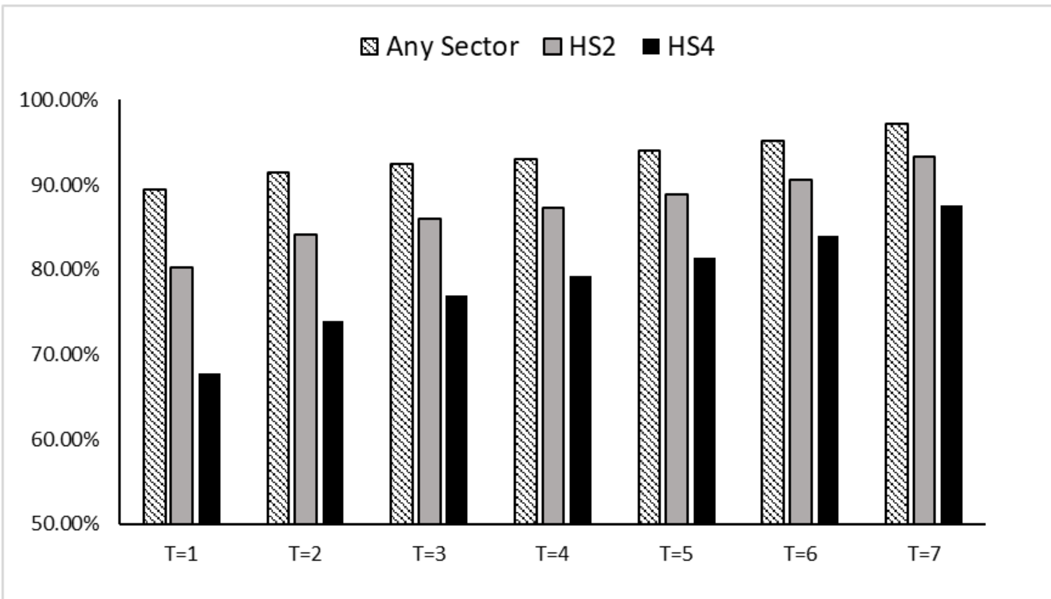
From Columns (1) to (4), familiar countries are defined as exporting to this firm in the same HS2 sector in the previous two years. From Columns (5) to (8), familiar countries are defined as exporting to this firm in any sector in the previous two years.

$aiv_{ij'k,t-1}$ ($aiv_{ijk,t-1}$) denotes the accumulated import volume with familiar (unfamiliar) countries in this HS4 sector. $FE_{j'kt}$ denotes the familiar country–sector–year fixed effect and FE_{jkt} denotes the unfamiliar country–sector–year fixed effect. FE_i, FE_{it} and FE_{ikt} denote the firm fixed effect, firm–year fixed effect and firm–sector–year fixed effect, respectively.

The robust standard errors are reported in parenthesis.

The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

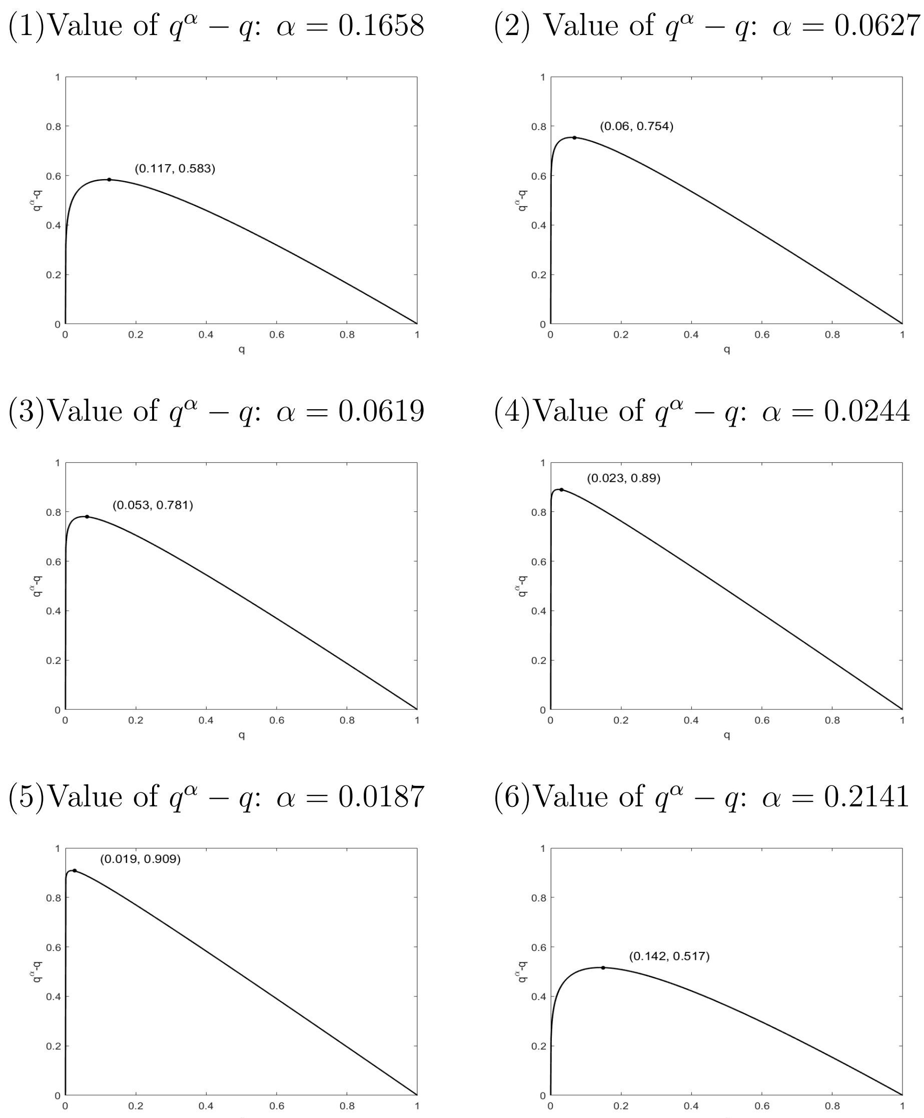
Figure 2.1 Fractions of Observations with Familiar Countries



Notes:

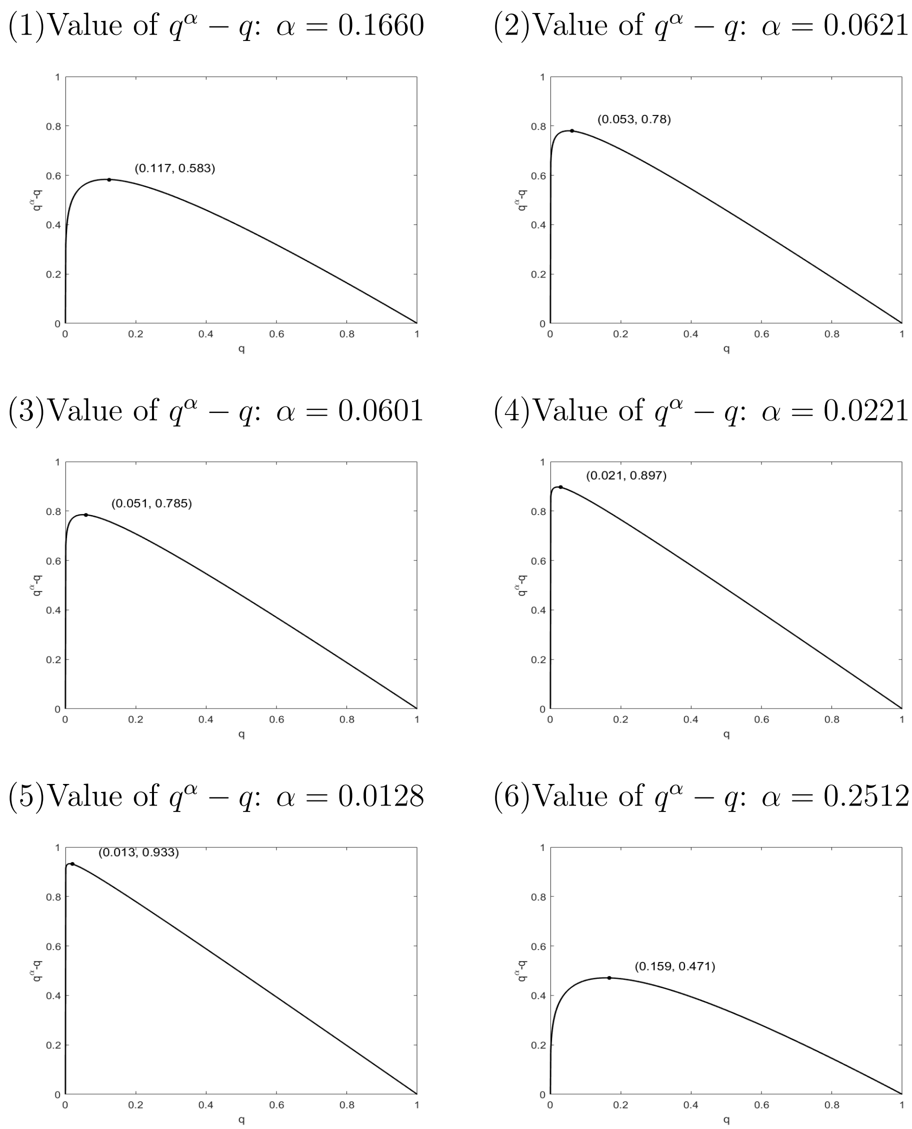
This figure shows the fractions of observations with familiar countries over the entire observations. Familiar countries are defined as exporting to this firm in the same HS4 sector (black), in the same HS2 sector (grey) or in any sector (grainy) in the previous T years, where $T \in \{1, 2, 3, \ldots, 7\}$. Importers only imported once in the same sector from 2007 to 2014 are excluded. Sectors that only have one sourcing country are also excluded.

Figure 2.2 Benefits of Importing from Familiar Countries $m_{ijkt} = e^{aiv_{ijk,t-1}}$



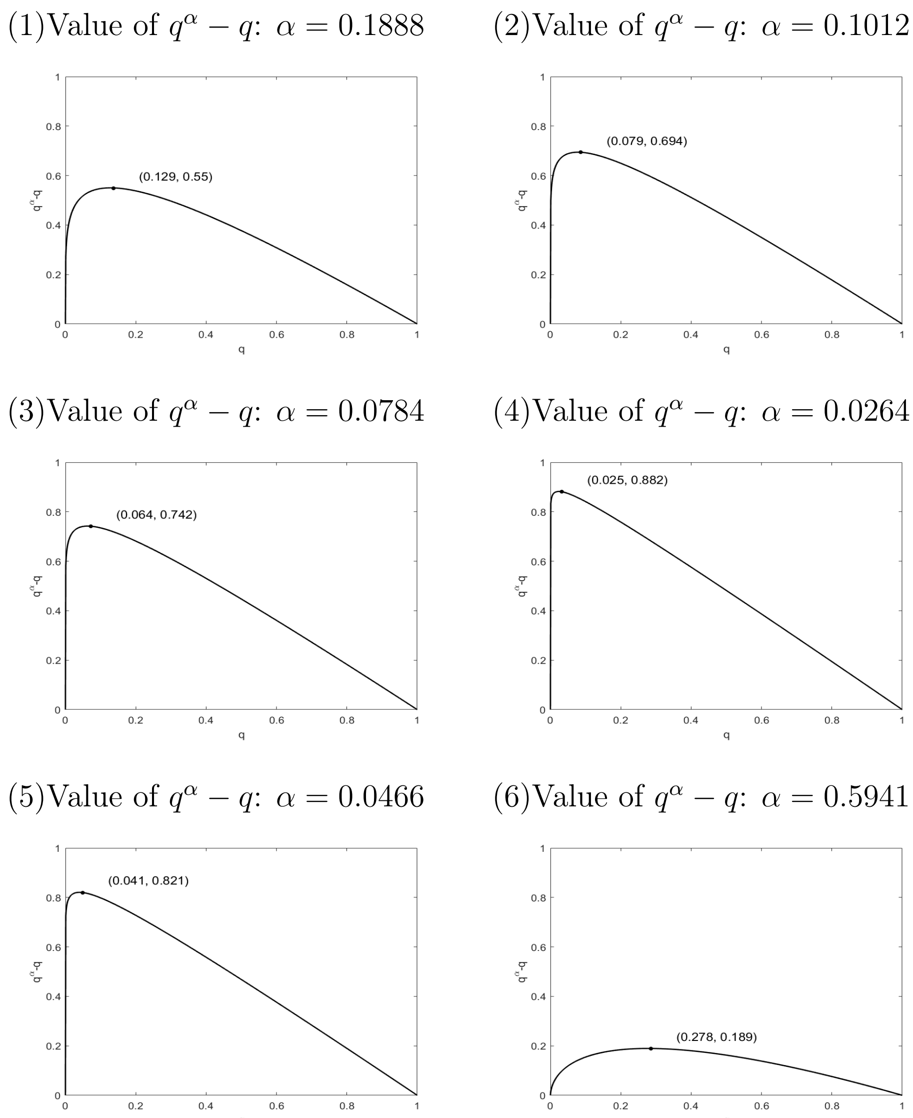
Note: This figure shows the benefits of importing from familiar countries. It plots $q^{\alpha} - q$ against q when $q \in (0, 1)$. Each panel corresponds to the estimate of α in Table 2.2 with the same serial number. In each panel, I mark the maximal value of $q^{\alpha} - q$ and its corresponding q in the parentheses.

Figure 2.3 Benefits of Importing from Familiar Countries $m_{ijkt} = e^{disaiv_{ijk,t-1}}$



Note: This figure shows the benefits of importing from familiar countries. It plots $q^\alpha - q$ against q when $q \in (0, 1)$. Each panel corresponds to the estimate of α in Table 2.3 with the same serial number. In each panel, I mark the maximal value of $q^\alpha - q$ and its corresponding q in the parentheses.

Figure 2.4 Benefits of Importing from Familiar Countries $m_{ijkt} = e^{aaiv_{ijk,t-1}}$



Note: This figure shows the benefits of importing from familiar countries. It plots $q^{\alpha} - q$ against q when $q \in (0, 1)$. Each panel corresponds to the estimate of α in Table 2.4 with the same serial number. In each panel, I mark the maximal value of $q^{\alpha} - q$ and its corresponding q in the parentheses.

Chapter Three

Diligence Redeems Stupidity: Substitution between Managerial Effort and Financial Development

Authors: Renjing Chen, Yuting Chen, Wei Jin

3.1 Introduction

There is increasing literature on how credit constraints affect firms' production and export activities (Antras et al., 2009; Chan and Manova, 2015; Foley and Manova, 2015; Manova, 2013b; Manova et al., 2015). Generally, lower financial development, which may manifest in a lack of loans, costly financial contracting, and weak investor protection, raises the cutoff for both domestic production and export. Disadvantaged access to finance has a larger influence on trade in more financially vulnerable sectors (Manova et al., 2015). The mechanism driving this effect is that weaker financial contracting and investor protection impose higher risks for investors (creditors), who in turn demand high payback from debtors (entrepreneurs). Inadequate loans drive up financing costs for entrepreneurs. The credit constraint problem is more severe for trade since exporting is generally more costly than selling domestically. As a result, countries with better financial institutions have a comparative advantage in sectors that are more sensitive to finance[1].

A natural question, then, is the following: do the comparative advantage differences in trade due to differences in financial institutions imply that financially underdeveloped countries can never compete with financially developed countries? The answer is no. Managerial effort can, to some extent, make up for the disadvantage related to financial institutions. Take as an example the IT industry, which relies heavily on external finance. We can find many successful Chinese IT companies (such as Alibaba, Meituan, and Tencent) that compete alongside famous American IT giants (such as Amazon, Facebook, and Google, to name a few). It is generally recognized that China's financial development does not match that of the US. Perhaps the secret of success for China is to "work harder". In fact, we can find some evidence from the media on these IT companies' different ways of running their business. Jack Ma, the chairman of Alibaba Group, once publicly advocated the work scheme of "996": from 9 am to 9 pm 6 days a week. Perhaps "996" sounds extreme to the public. However, as an anecdotal example, one friend of the authors working

[1] This theoretical mechanism is well-studied; for examples, please refer to Acemoglu et al. (2007) on contracting institutions with endogenous comparative advantage differences and Costinot (2009) on the complementarity between better institutions and more human capital as sources of comparative advantage across countries.

at another Chinese IT giant called Meituan reveals that in his department working from 9 am to 12 pm 5 days a week is already routine. In contrast, it is often reported that large US IT companies such as Facebook and Google provide a very flexible and cozy working environment.

To harmonize the observations on managerial effort and theories of financial development, we present a heterogeneous firm model à la Melitz (2003) where firms suffer from both the agency problem internally and financial constraints externally. In our theoretical model, credit frictions and the agency problem are substitutes. Firms with the highest initial productivity can overcome credit friction problems with operating profits that are higher than the financing cost. In this case, managers invariably exert first-best effort, and these firms export. However, although financial constraints on firms with moderate productivity are binding, they still might export, since managers have an incentive to exert second-best (higher than first-best) effort. The second-best effort level is contingent upon external credit constraints, since operating profits can only cover the financing cost. Firms with the lowest productivity exit the export market since the payoffs to managers are lower than the value of their outside option. Chen (2019) argues that the partnership firm is a perfect example of the type of firm that he considers. In the real world, most firms are organized in the form described as agency firms in that paper. Inevitably, credit constraints are pervasive for almost all firms (Manova, 2013b). Therefore, firms with these two problems are more relevant to reality than firms with only one of the two problems. We show that conditional on the same raw productivity draw, managers of potential exporting firms around the export cutoff in financially underdeveloped countries exert more effort than their counterparts in financially developed countries, so as to induce their owners to export. This finding has very positive policy implications, as firms in financially underdeveloped countries can compete with their peers in financially developed countries by exerting more managerial effort. We find clear empirical evidence for this theoretical prediction using the World Management Survey data for more than 7,000 firms in 20 countries during 2002-2012.

Our work connects to several branches of the literature. First is the literature on financial frictions and international trade. Manova (2013b) incorporates financial frictions into a heterogeneous-firm model à la Melitz (2003) and applies it to a large panel of the bilateral trade for 27 industries during 1985-1995. She identifies and quantifies three mechanisms through which credit constraints affect trade: selection into production, selection into export, and exporters' foreign sales. She shows that financially developed economies have a comparative advantage in financially vulnerable sectors because better financial institutions are associated with more destination markets (Chan and Manova, 2015), more export product varieties, and larger aggregate trade volumes. Foley and Manova (2015) provide an excellent survey on how corporate finance affects international trade patterns and multinational activities. They highlight that easier access to financial capital can help firms to overcome the fixed and variable costs of trade. Additionally, Bilir et al. (2019); Chan and Manova (2015); Hur et al. (2006); Kroszner et al. (2007); Manova et al. (2015); Manova and Yu (2016); Chor and Manova (2012) also discuss the relationship between financial friction and trade behavior. However, they do not include the agency problem into the framework.

Second, we contribute to the literature that studies the relationship between agency problems and international trade.Grossman (2004) includes the labor's effort as endogenous in the model. Chen (2019) constructs a model à la Melitz (2003) that captures the agency problem inside the firm to explain why some agency firms show improved productivity after trade liberalization. The mechanism is that managers in small surviving nonexporting firms have incentives to exert more effort to induce their owners to produce after trade liberalization. Empirical results show that managerial incentives have a nonmonotonic impact on aggregate productivity gains after trade liberalization. Chen (2011); Chen and Steinwender (2019) also show that the agency problem may affect firm's productivity, therefore affecting their trade behavior. Our paper contributes to this strand of literature by combing both agency problem and financial friction.

Finally, our study is closely related to the literature on management practices and trade. According to Bloom et al. (2012) and Bloom and Van Reenen (2010), management practices vary across countries, organizations, industries, ownership types, and firms. Stronger product market competition, higher worker skills, and less regulated labor market are associated with better management practices. Bloom et al. (2019) find a substantial dispersion of management practices across plants from a two-wave survey of "structured" management practices of 35,000 American manufacturing plants in 2010 and 2015. In fact, management practices account for more than 20 percent of the variation in productivity, on par with R&D, ICT, or human capital. They identify two drivers of management practices changes: the business environment and learning spillovers. Our paper here shows that the agency problem due to information asymmetry provides another possible explanation for the dispersion of management practices. Bloom et al. (2020b) find using data for China, the US, and India that firms with better management are more likely to export, sell more products to more destinations, and earn higher revenues and profits from export. They further propose a heterogeneous-firm model where effective management improves performance by raising production efficiency and quality capacity. In addition, Bloom et al. (2013); Bloom and Van Reenen (2007); Bloom et al. (2020a) also find that the management level will have an impact on firm's performance. Our results are consistent with the findings of Bender et al. (2018). Using German data, they point out close relationships among productivity, management practices, and employee ability. We find that better-managed firms have higher productivity and recruit and retain workers with higher average human capital. Comparing with the existing literature, our paper include the management performance into the trade model with the financial friction and agency problem.

The current paper is organized as follows. Section 3.2 proposes the theoretical framework of this paper. Section 3.3 explains the econometric specification for the empirical study and describes the data. Section 3.4 presents the results from the empirical study and discusses robustness checks. Finally, Section 3.5 concludes.

3.2 Model

3.2.1 Setup

We incorporate credit constraints, the agency problem and firm heterogeneity into a static equilibrium framework à la Melitz (2003). Manova (2013b) regards firm as a black box; i.e., the manager and owner are not distinguished. We adopt the setting of Chen (2019) and introduce the agency problem into Manova's model. In the current model, firms suffer from the agency problems internally and credit constraints externally.

There are four types of agents in the economy: investors (bankers), owners (entrepreneurs), workers, and managers. Managers and workers are ex ante identical labor providers who make their occupational choices endogenously. The endowments of agents are I, O, M, and L. The endowment amounts of I, O, and $(M+L)$ are fixed throughout firms' operating process. We also assume that the measures of bankers and entrepreneurs are large enough for the free-entry condition to hold. Managers and workers are inputs to production, and workers receive a uniform wage from employment. Labor providers are homogeneous, and some of them are matched with entrepreneurs after the latter enter the industry.

Differentiated varieties are produced by a continuum of firms in each of J countries and S sectors. The utility of a representative consumer in country i is a Cobb-Douglas aggregate:

$$U_i = \prod_s C_{is}^{\mu_s} \tag{3.1}$$

where μ_s is the share of sector s in total consumption with $\sum_s \mu_s = 1$ and C_{is} is the sector-specific constant elasticity of substitution (CES) consumption bundle:

$$C_{is} = \left[\int_{\omega\in\Omega_{is}} q_{is}(\omega)^{\frac{\sigma_s-1}{\sigma_s}} d\omega\right]^{\frac{\sigma_s}{\sigma_s-1}} \tag{3.2}$$

where Ω_{is} is the set of available varieties in country i and sector s, $q_{is}(\omega)$ is the consumption of variety ω in sector s, and σ_s is the elasticity of substitution within sector s.

From the utility function above, we can obtain the demand for a variety ω given its price $p_{is}(\omega)$ as:

$$q_{is}(\omega) = \left(\frac{p_{is}(\omega)}{P_{is}}\right)^{-\sigma_s} \frac{\mu_s Y_i}{P_{is}} \tag{3.3}$$

where Y_i is the total expenditure and P_{is} is the ideal price index defined as:

$$P_{is} \equiv \left[\int_{\omega\in\Omega_{is}} p_{is}(\omega)^{1-\sigma_s} d\omega\right]^{\frac{1}{1-\sigma_s}}. \tag{3.4}$$

3.2.2 Rule of the Game

We modify the timing of the game in Chen (2019). The rule that the investor, owner, worker and manager obey is described as follows.

First, an entrepreneur in sector s and country j pays a sunk entry cost $w_j f_{ej}$, where w_j is the wage level in country j. Then, the entrepreneur is randomly matched with a manager. After the match, a firm is set up, and the manager and the entrepreneur discuss an implementable idea with initial quality ρ, which is a randomly realized draw from a cumulative distribution function $G(\rho)$.

Second, the manager makes her occupational choice. She can quit the firm and become a worker, in which case the entrepreneur receives zero profit afterwards. Alternatively, the manager can choose to work for the entrepreneur and exert effort

ψ to develop the implementable idea that leads to a blueprint for a product (i.e., variety ω).

Third, if the manager chooses to work for the entrepreneur, the entrepreneur needs to decide whether to pay a fixed production cost $w_j f_{jj}$ to start production or a fixed cost $w_j f_{ji}$ to export to country i. An iceberg trade cost is incurred so that $\tau_{ji} > 1$ units of a variety need to be shipped out of country j for one unit to arrive at country i. We assume that the entrepreneur observes the overall quality of the implementable idea, which equals $\rho\psi$, when deciding whether to start production and export. The overall quality of the implementable idea determines the labor productivity of the firm in the subsequent production phase.

At this stage, the problem of financial frictions emerges. The entrepreneur needs to decide the optimal financial contract with the investor. The details will be discussed in the next section. The entrepreneur is willing to produce if and only if the operating profit can cover the fixed costs of production or export along with the repayment to the investor (lender).

Fourth, if production starts, the manager decides the price and quantity in each market given external credit F chosen by the entrepreneur. At this point, firms compete with each other in each market, and revenue is received. At this stage, the financial contract with the investor is also enforced. Finally, the operating profit is realized. The labor productivity of the firm is $\rho\psi(\rho)$. The manager exerts effort level $\psi(\rho)$ to obtain the payoff, which is a fraction α of the firm's operating profit minus the disutility of exerting that effort. The manager's effort depends on the initial firm productivity ρ and is not a continuous function of it. The details of this point will be discussed in the following sections. The manager chooses an optimal effort level accordingly and becomes a worker if her payoff is lower than the outside option w_j. In the latter case, the entrepreneur does not produce and exits the market. **Finally**, the entrepreneur and the manager bargain over the operating profit. They play a generalized Nash bargaining game, with ends with them receiving α and $(1-\alpha)$ fractions of the operating profit, respectively.

3.2.3 Credit-constrained Firms' Problem

We incorporate the effect of credit constraints on export and production behavior following Manova (2013b). We make the assumption that entrepreneurs need to finance their fixed costs of export or production[2].

Financial contracting is modeled following Manova (2013b). Entrepreneurs face credit constraints in financing their production and export activities. A fraction $d_s \in (0,1)$ of the fixed costs has to be covered by outside capital for firms in sector s. Entrepreneurs must pledge collateral to borrow in country j. A fraction of $t_s \in (0,1)$ of the sunk entry cost is assumed to be used as collateral. d_s and t_s vary across sectors that are exogenous from the individual firm's perspective. Countries have different levels of financial contractibility. An entrepreneur honors the contract with probability $\lambda_j \in (0,1)$ and defaults with probability $(1-\lambda_j)$. In the

[2]We can also model the credit constraints such that entrepreneurs have to finance both fixed and variable costs. Our results would remain qualitatively the same but would be quantitatively reinforced since more firms would consequently be credit constrained. Please refer to Manova (2013b) for detailed discussions.

default case, the creditor seizes the collateral $t_s w_j f_{ej}$. In the beginning of each period, every entrepreneur offers a contract to a potential investor that specifies the borrowing amount, the repayment F, and the collateral in case of default. Then, the entrepreneur starts her operation and receives profits. Finally, the creditor receives repayment or the collateral.

The entrepreneur's problem is represented as:

$$\begin{aligned} \max_{p,q,F} \quad & (1-\alpha)\left[p_{jis}(\rho,\psi)q_{jis}(\rho,\psi) - \tfrac{\tau_{ji}w_j}{\rho\psi(\rho)}q_{jis}(\rho,\psi)\right] \\ & -(1-d_s)w_j f_{ji} - \lambda_j F(\rho,\psi) - (1-\lambda_j)t_s w_j f_{ej}, \end{aligned} \tag{3.5}$$

subject to

(3.5.1) $q_{jis}(\rho,\psi) = \left(\frac{p_{jis}(\rho,\psi)}{P_{is}}\right)^{-\sigma_s}\frac{\mu_s Y_i}{P_{is}}$,

(3.5.2) $A_{js}(\rho,\psi) \equiv (1-\alpha)\left[p_{jis}(\rho,\psi)q_{jis}(\rho,\psi) - \frac{\tau_{ji}w_j}{\rho\psi(\rho)}q_{jis}(\rho,\psi)\right] - (1-d_s)w_j f_{ji} \geq F(\rho,\psi)$,

(3.5.3) $B_{jis}(\rho,\psi) \equiv -d_s w_j f_{ji} + \lambda_j F(\rho,\psi) + (1-\lambda_j)t_s w_j f_{ej} \geq 0$.

Condition (3.5.2) states the constraint that the operating profit that the owner receives must cover repayment in the enforcement case. Condition (3.5.3) states the constraint that the investor's expected payoff is nonnegative. As in Manova (2013b), investors break even in expectation, and entrepreneurs adjust the payment $F(\rho,\psi)$ so that $B_{jis}(\rho,\psi) = 0$. Naturally, we have the following relation:

$$t_s w_j f_{ej} \leq d_s w_j f_{ji} \leq F(\rho,\psi). \tag{3.6}$$

The operating profit $\tilde{\pi}_{jis}$, if the entrepreneur chooses to operate, is:

$$\tilde{\pi}_{jis} \equiv \frac{1}{\sigma_s}R_{jis}(\rho,\psi) = \frac{1}{\sigma_s}\left(\frac{\sigma_s\tau_{ji}w_j}{(\sigma_s-1)P_{is}\rho\psi(\rho)}\right)^{1-\sigma_s}\mu_s Y_i = \beta(\phi_{jis})\phi\eta_{jis}, \tag{3.7}$$

where $\phi \equiv \rho^{\sigma_s-1}$, $\beta \equiv \psi^{\sigma_s-1}$, and $\eta_{jis} \equiv \frac{1}{\sigma_s}\left(\frac{\sigma_s\tau_{ji}w_j}{(\sigma_s-1)P_{is}}\right)^{1-\sigma_s}\mu_s Y_i$.

3.2.4 Agency Problem

The manager's problem is represented as follows:

$$\max_{\psi} \quad \alpha\tilde{\pi}_{jis}(\rho,\psi) - \psi^{\theta_0},$$
$$s.t. \quad \alpha\tilde{\pi}_{jis}(\rho,\psi) - \psi^{\theta_0} \geq w_j,$$

where ψ^{θ_0} is the disutility of managerial effort and $\tilde{\pi}_{jis}$ is the firm's aforementioned operating profit. Following Chen (2019), we assume the cost of effort $\theta_0 > \sigma_s - 1$. Here, the outside option for the manager is to be a worker with wage payment w_j. Using the transformation above and defining $\theta \equiv \frac{\theta_0}{\sigma_s - 1}$, the manager's problem can be rewritten as:

$$\max_{\beta} \quad \alpha\beta(\phi_{jis})\phi_{jis}\eta_{jis} - \beta(\phi_{jis})^{\theta}, \tag{3.8}$$

$$s.t. \quad \alpha\beta(\phi_{jis})\phi_{jis}\eta_{jis} - \beta(\phi_{jis})^{\theta} \geq w_j. \tag{3.9}$$

If the manager's participation constraint is not binding, the solution to the optimization problem is:

$$\beta_s(\phi_{jis}) = \left(\frac{\alpha\phi_{jis}\eta_{jis}}{\theta}\right)^{\frac{1}{\theta-1}} \tag{3.10}$$

which we call the "second-best" effort.

3.2.5 Selection into Export

It is worth noting here that when the initial quality ϕ_{jis} is too small, the profit the entrepreneur obtains from the manager's second-best effort is not enough to cover repayment; i.e., Condition (3.5.2) cannot be satisfied. Therefore, there exists a cutoff

ϕ'_{jis} below which the entrepreneur does not export to market i given the manager's second-best effort. Formally, the entrepreneur's export decision equation (or liquidity constraint condition) under this case is given by:

$$(1-\alpha)\phi'_{jis}\beta_s(\phi'_{jis})\eta_{jis} = (1-d_s)w_j f_{ji} + F(\rho,\psi),$$

which gives the cutoff level together with the manager's second-best effort in (3.10):

$$\phi'_{jis} = \left(\frac{D_{jis}}{1-\alpha}\right)^{\frac{\theta-1}{\theta}} \left(\frac{\theta}{\alpha}\right)^{\frac{1}{\theta}} \frac{1}{\eta}, \tag{3.11}$$

where, from the assumption that the investor breaks even, we define:

$$D_{jis} \equiv (1-d_s+d_s/\lambda_j)w_j f_{ji} - t_s w_j f_{ej}(1-\lambda_j)/\lambda_j. \tag{3.12}$$

Note that now the manager's effort working for the firm with initial quality ϕ'_{jis} is:

$$\beta(\phi'_{jis}) = \beta_s(\phi'_{jis}) = \left(\frac{D_{jis}}{1-\alpha}\frac{\alpha}{\theta}\right)^{\frac{1}{\theta}}. \tag{3.13}$$

3.2.6 Manager's Effort

Chen (2019) argues that for the manager working with a firm with initial quality lower than ϕ'_{jis} but not too low, she can exert higher effort to induce the entrepreneur to enter market i and still receive a payoff higher than the value of the outside option. Her optimal effort level in this case should be:

$$\beta(\phi_{jis}) = \frac{\phi'_{jis}\beta(\phi'_{jis})}{\phi_{jis}} = \frac{D_{jis}}{1-\alpha}\frac{1}{\eta}\frac{1}{\phi_{jis}} \tag{3.14}$$

which decreases with the firm's initial quality.

However, if the initial quality is too low, exerting effort $\frac{\phi'_{jis}\beta(\phi'_{jis})}{\phi_{jis}}$ gives the manager a payoff lower than the value of her outside option. In this case, the manager does not have an incentive to induce the entrepreneur to enter market i. Formally, the manager's participation constraint condition and the entrepreneur's export decision under such a case are shown as:

$$\alpha\beta(\phi^*_{jis})\phi^*_{jis}\eta_{jis} - \beta(\phi^*_{jis})^\theta = w_j, \tag{3.15}$$

$$(1-\alpha)\beta(\phi^*_{jis})\phi^*_{jis}\eta_{jis} = (1-d_s)w_j f_{ji} + F(\rho, \psi), \tag{3.16}$$

where we can obtain the lower cutoff of quality:

$$\phi^*_{jis} = \frac{D_{jis}}{1-\alpha}\frac{1}{\eta}\left(\frac{\alpha D_{jis}}{1-\alpha} - w_j\right)^{-\frac{1}{\theta}} = \frac{(\alpha D_{jis})^{\frac{1}{\theta}}}{[\theta(\alpha D_{jis} - (1-\alpha)w_j)]^{\frac{1}{\theta}}}\phi'_{jis}. \tag{3.17}$$

Furthermore, an uninteresting case arises if the manager chooses to be a worker in one firm with ϕ'_{jis}. Thus, we make the assumption that at the cutoff ϕ', the manager's payoff is higher than the value of the outside option: $\alpha\beta_s(\phi'_{jis})\phi'_{jis}\eta_{jis} - \beta_s(\phi'_{jis})^\theta > w_j$, which also implies:

$$\phi^*_{jis} < \phi'_{jis}. \tag{3.18}$$

The assumption below guarantees that relation.

Assumption 1.

$$\alpha D_{jis} < \theta[\alpha D_{jis} - (1-\alpha)w_j].$$

Note that when $\phi_{jis} = \phi^*_{jis}$, from (3.15) and (3.16), managerial effort is given by:

$$\beta(\phi^*_{jis}) = \left(\frac{\alpha D_{jis}}{1-\alpha} - w_j\right)^{\frac{1}{\theta}} \tag{3.19}$$

which is higher than $\beta_s(\phi'_{jis})$.

3.2.7 Comparative Statics

Building on the model above, we make some testable predictions on the relationship of financial development and managerial effort as well as the initial quality of ideas. We divide firms into two large categories in terms of their initial quality: more productive, unconstrained firms ($\phi_{jis} > \phi'_{jis}$) and less productive, constrained firms ($\phi^*_{jis} \leq \phi_{jis} \leq \phi'_{jis}$). Then, we examine how the relationship between financial development and managerial effort changes with respect to the initial quality of ideas.

Proposition 3. *(Manager's Effort Level) When $\phi_{jis} > \phi'_{jis}$, all else constant, financial development or sector vulnerability does not affect the manager's second-best effort* $\left(\frac{\partial \beta_s}{\partial d_s} = 0, \frac{\partial \beta_s}{\partial t_s} = 0, \frac{\partial \beta_s}{\partial \lambda_j} = 0\right)$. *When $\phi_{jis} \in [\phi^*_{jis}, \phi'_{jis}]$, all else constant, managers tend to exert more effort in more financially vulnerable sectors, while exerting less effort in more financially developed countries* $\left(\frac{\partial \beta(\phi_{jis})}{\partial d_s} > 0, \frac{\partial \beta(\phi_{jis})}{\partial t_s} < 0, \frac{\partial \beta(\phi_{jis})}{\partial \lambda_j} < 0\right)$. *Financial development lowers the effort level relatively more in more financially vulnerable sectors* $\left(\frac{\partial^2 \beta(\phi_{jis})}{\partial \lambda_j \partial d_s} < 0, \frac{\partial^2 \beta(\phi_{jis})}{\partial \lambda_j \partial t_s} > 0\right)$.

Proof: When $\phi_{jis} > \phi'_{jis}$, the manager's second-best effort is $\beta_s(\phi_{jis}) = \left(\frac{\alpha \phi_{jis} \eta_{jis}}{\theta}\right)^{\frac{1}{\theta-1}}$, which is irrelevant to (λ_j, t_s, d_s). When $\phi_{jis} \in [\phi^*_{jis}, \phi'_{jis}]$, the manager's effort is $\beta(\phi_{jis}) = \frac{D_{jis}}{1-\alpha} \frac{1}{\eta} \frac{1}{\phi_{jis}}$. Holding $(\alpha, \eta, \phi_{jis})$ constant, $\left(\frac{\partial \beta(\phi_{jis})}{\partial \lambda_j}, \frac{\partial \beta(\phi_{jis})}{\partial t_s}, \frac{\partial \beta(\phi_{jis})}{\partial d_s}\right)$ has the same sign as $\left(\frac{\partial D_{jis}}{\partial \lambda_j}, \frac{\partial D_{jis}}{\partial t_s}, \frac{\partial D_{jis}}{\partial d_s}\right)$. According to the definition of D_{jis} in (3.12) and the relation $t_s w_j f_{ej} \leq d_s w_j f_{ji}$ in (3.6), we can derive $\frac{\partial D_{jis}}{\partial d_s} = \left(\frac{1}{\lambda_j} - 1\right) w_j f_{ji} > 0$, $\frac{\partial D_{jis}}{\partial t_s} =$

$\frac{\lambda_j - 1}{\lambda_j} w_j f_{ej} < 0$, and $\frac{\partial D_{jis}}{\partial \lambda_j} = \frac{1}{\lambda_j^2}(t_s w_j f_{ej} - d_s w_j f_{ji}) < 0$. Hence, $\left(\frac{\partial \beta(\phi_{jis})}{\partial d_s} > 0, \frac{\partial \beta(\phi_{jis})}{\partial t_s} < 0, \frac{\partial \beta(\phi_{jis})}{\partial \lambda_j} < 0\right)$, and $\frac{\partial^2 \beta(\phi_{jis})}{\partial \lambda_j \partial d_s} < 0$, $\frac{\partial^2 \beta(\phi_{jis})}{\partial \lambda_j \partial t_s} > 0$. QED.

Unconstrained firms are more productive, so they are unlikely to suffer from financial frictions. Meanwhile, production or export can generate large operating profits that are positively correlated with the initial quality of ideas. We know that the manager can receive a fraction of the operating profit in the Nash bargaining game with the owner. As a result, the manager exerts her second-best effort, which is increasing with the initial quality and has nothing to do with financial development.

In contrast, for constrained firms, the manager exerts more than second-best effort. This is because the manager's second-best effort discourages the owner from exporting or producing. However, being a worker is worse than being a manager. Thus, by exerting more effort, the manager tries to motivate the owner to export or produce. For firms in less financially developed countries or more financially vulnerable sectors, the firm's liquidity constraint is more likely to be binding than for firms in more financially developed countries or less financially vulnerable sectors. As a result, managers in these firms have to work harder to compensate for the disadvantage in financial institutions. Thus, we can conclude that to some extent, the optimal effort and the country's financial development are substitutes for firms on the margin of survival. This effect is stronger in more financially vulnerable sectors.

We can further make predictions on how financial development affects the lower quality cutoff ϕ^*_{jis}, below which firms do not produce or export. Corollary 1 summarizes the results, which are consistent with those of Manova (2013b).

Corollary 1. *(Lower Cutoff) The quality cutoff ϕ^*_{jis} is higher in more financially vul-*

nerable sectors and lower in more financially developed countries $\left(\frac{\partial \phi^*_{jis}}{\partial d_s} > 0, \frac{\partial \phi^*_{jis}}{\partial t_s} < 0, \frac{\partial \phi^*_{jis}}{\partial \lambda_j} < 0\right)$. *Financial development lowers this cutoff relatively more in more financially vulnerable sectors* $\left(\frac{\partial^2 \phi^*_{jis}}{\partial d_s \partial \lambda_j} < 0, \frac{\partial^2 \phi^*_{jis}}{\partial t_s \partial \lambda_j} > 0\right)$.

Proof: The lower cutoff is $\phi^*_{jis} = \frac{D_{jis}}{1-\alpha}\frac{1}{\eta}\left(\frac{\alpha D_{jis}}{1-\alpha} - w_j\right)^{-\frac{1}{\theta}} = \frac{(\alpha D_{jis})^{\frac{1}{\theta}}}{[\theta(\alpha D_{jis}-(1-\alpha)w_j)]^{\frac{1}{\theta}}}\phi'_{jis}$. Then, $\frac{\partial \phi^*_{jis}}{\partial D_{jis}} = \left(\frac{1}{1-\alpha}\right)^{1-\frac{1}{\theta}} \frac{1}{\eta}\left[\alpha D_{jis} - (1-\alpha)w_j\right]^{-\frac{1}{\theta}-1}\left[\alpha D_{jis} - (1-\alpha)w_j - \alpha D_{jis}/\theta\right]$. By Assumption 1, $[\alpha D_{jis} - (1-\alpha)w_j - \alpha D_{jis}/\theta]$ is positive. Thus, $\frac{\partial \phi^*_{jis}}{\partial D_{jis}} > 0$. Therefore, $\frac{\partial \phi^*_{jis}}{\partial d_s} = \frac{\partial \phi^*_{jis}}{\partial D_{jis}}\frac{\partial D_{jis}}{\partial d_s} > 0$, $\frac{\partial \phi^*_{jis}}{\partial t_s} = \frac{\partial \phi^*_{jis}}{\partial D_{jis}}\frac{\partial D_{jis}}{\partial t_s} < 0$, $\frac{\partial \phi^*_{jis}}{\partial \lambda_j} = \frac{\partial \phi^*_{jis}}{\partial D_{jis}}\frac{\partial D_{jis}}{\partial \lambda_j} < 0$. Furthermore, $\frac{\partial^2 \phi^*_{jis}}{\partial d_s \partial \lambda_j} < 0$, $\frac{\partial^2 \phi^*_{jis}}{\partial t_s \partial \lambda_j} > 0$. QED.

We can also predict how the higher quality cutoff ϕ'_{jis}, below which managers do not exert second-best effort, responds to financial development. Corollary 2 demonstrates the results.

Corollary 2. *(Higher Cutoff) All else constant, the quality cutoff* ϕ'_{jis} *is higher in more financially vulnerable sectors and lower in more financially developed countries* $\left(\frac{\partial \phi'_{jis}}{\partial d_s} > 0, \frac{\partial \phi'_{jis}}{\partial t_s} < 0, \frac{\partial \phi'_{jis}}{\partial \lambda_j} < 0\right)$. *Financial development lowers this cutoff relatively more in more financially vulnerable sectors* $\left(\frac{\partial^2 \phi'_{jis}}{\partial d_s \partial \lambda_j} < 0, \frac{\partial^2 \phi'_{jis}}{\partial t_s \partial \lambda_j} > 0\right)$.

Proof: The export or production cutoff is $\phi'_{jis} = \left(\frac{D_{jis}}{1-\alpha}\right)^{\frac{\theta-1}{\theta}}\left(\frac{\theta}{\alpha}\right)^{\frac{1}{\theta}}\frac{1}{\eta}$; then, $\left(\frac{\partial \phi'_{jis}}{\partial d_s}, \frac{\partial \phi'_{jis}}{\partial t_s}, \frac{\partial \phi'_{jis}}{\partial \lambda_j}\right)$ has the same sign as $\left(\frac{\partial D_{jis}}{\partial d_s}, \frac{\partial D_{jis}}{\partial t_s}, \frac{\partial D_{jis}}{\partial \lambda_j}\right)$. Similar to the proof of Proposition 3, we have $\left(\frac{\partial \phi'_{jis}}{\partial d_s} > 0, \frac{\partial \phi'_{jis}}{\partial t_s} < 0, \frac{\partial \phi'_{jis}}{\partial \lambda_j} < 0\right)$ and $\left(\frac{\partial^2 \phi'_{jis}}{\partial d_s \partial \lambda_j} < 0, \frac{\partial^2 \phi'_{jis}}{\partial t_s \partial \lambda_j} > 0\right)$. QED.

Corollaries 1 and 2 clearly show that even with the agency problem taken into account, weak financial development is still an obstacle that hinders firms from producing or exporting. The underlying mechanism is well explained by Manova (2013b). Unlike financial institutions, which are taken as given and outside the control of firms, the agency problem à la Chen (2019) is an obstacle within firms that impedes a firm's production and export activities. Proposition 3 states that these two obstacles—financial frictions and agency problems—can substitute each other for less productive firms; we will empirically test this hypothesis later in the paper.

3.3 Empirical Analysis

3.3.1 Empirical Specification

To provide evidence for the theories above, we run a reduced-form regression of management scores on various credit constraint variables, their interactions, firm-level control variables and several fixed effects. The empirical specification takes the following form:

$$\begin{aligned}\log(Management\ Score_{fsit}) =& \alpha_0 + \alpha_1 FinDev_{it} + \alpha_2 FinDev_{it} \times FinVul_s + B \cdot X_{fist} \\ &+ \psi_t + \psi_s + \psi_i + \psi_{mne} + \psi_{own} + \epsilon_{fsit},\end{aligned} \tag{3.20}$$

where $Management\ Score_{fsit}$ denotes the management score of firm f in sector s in year t in country i, $FinDev_{it}$ denotes the financial development level of country i in year t, $FinVul_s$ denotes the financial vulnerability of sector s, and $FinDev_{it} \times FinVul_s$ is their interaction term. X_{fist} is the vector of firm-level characteristics, including the proxy for firm productivity level. ψ_t, ψ_s, ψ_i, ψ_{mne}, and ψ_{own} are year, sector, country, multinational entrepreneur type, and ownership type fixed effects, respectively. ϵ_{fsit} is the idiosyncratic error.

The reason why we include year, sector, country, multinational entrepreneur type, and ownership type fixed effects is that previous studies have shown that managerial practice varies substantially across countries, organizations, industries, ownership, and firms (Bloom and Van Reenen, 2007, 2010; Bloom et al., 2012). For example, multinationals are generally better managed than nonmultinationals, among which exporters are better managed than pure domestic nonexporters. Family-owned firms that appoint a family member (especially the eldest son) as CEO and government-owned firms tend to be very badly managed. We use firm size (number of employees) to proxy for the initial quality of ideas, following Chen (2019). This is also consistent with the setting of heterogeneous firms, in which larger firms might be less credit constrained and hence sell more in financially dependent industries (Manova et al., 2015).

We expect the coefficient estimates $\alpha_1 < 0$ and $\alpha_2 > 0$ for small firms (less productive, constrained firms) but nonsignificant α_1 and α_2 for large firms (more productive, unconstrained firms), according to the predictions of Proposition 3.

3.3.2 Data

Table A.1 provides the summary statistics for the variables that we use in the baseline regressions and robustness check. The data source in this paper consists of three parts: (1) firm-level data from the World Management Survey (WMS), (2) financial development data from the World Development Indicators provided by the World Bank, and (3) financial vulnerability data from Kroszner et al. (2007).

The firm-level data are from the WMS[3]. This data set is intended to measure the quality of management practices in establishments in various countries. We applied for the special access data set instead of the public version. This version contains 10,051 observations across 20 countries[4] for 2002-2012. The advantage of the data set is that it provides measures of managerial effort through 18 management practice questions. There are 18 questions and corresponding scores (from point 1 to point 5, with higher scores representing better management practice) measuring the management practice dimension of each firm (please see Bloom et al. (2012) and Bloom et al. (2016) for details). We use the logarithm of the management score (average score of all 18 questions) as the dependent variable in the empirical part. Another advantage of the data set is that it provides additional firm-level characteristics such as the Rigidity of Employment Index[5], numbers of managers with a college degree, numbers of competitors, export status[6], multinational enterprise type[7], ownership type[8], and firm size (number of employees). This last indicator

[3] https://worldmanagementsurvey.org/.

[4]These countries are Argentina, Australia, Brazil, Canada, Chile, China, France, Germany, Greece, India, Italy, Japan, Mexico, New Zealand, Poland, Portugal, Republic of Ireland, Sweden, United Kingdom and United States.

[5]This index is constructed by the World Bank and reflects the difficulties that firms face in hiring workers, firing workers, and changing workers' hours and pay (Bloom et al., 2012). The value of this index ranges from 0 to 100.

[6]Export status refers to whether it exports or not.

[7]There are three enterprise types: foreign multinational enterprise, domestic enterprise, and nonenterprise. We also construct the dummy "MNE or Not" as a robustness check.

[8]There are 13 ownership types: banks/holdings/financial institutions, dispersed shareholders, employees/coop, family firm, foundation/research institute, founder firm, government, joint venture,

serves as the proxy for initial productivity. In sum, we collect both the management score and firm-level characteristic variables from the WMS data.

Following Manova (2013b), we consider the share of private credit by deposit money banks and other financial institutions to GDP (%) as the proxy of the financial development level of each country in each year. This variable comes from the World Bank's World Development Indicators[9].

We collect industry-level external financial dependence and tangibility data as the proxy of financial vulnerability (Braun, 2005; Kroszner et al., 2007; Manova, 2013b; Rajan and Zingales, 1998). Kroszner et al. (2007) report data on the external financial dependence and tangibility of International Standard Industrial Classification (ISIC) industries in the United States during the 1980s and 1990s. External financial dependence is the fraction of capital expenditure that is not financed with cash flow from operations. Tangibility is the median level of the ratio of fixed assets to total assets. In addition to convenience, another reason why we use US data is that the USA has an advanced financial system, which ensures that the measures reflect a firm's optimal choices over external financing and asset structure. Additionally, external financial dependence and tangibility are significantly negatively correlated

managers, pension/trust/private fund, private equity/venture capital, private individuals and other. We also construct another dummy "Owned by Managers or Not" to control for the agency problem. The agency problem is less likely to occur when a firm is directly owned by its managers. Therefore, when the ownership type is managers or private individuals, the dummy "Owned by Managers or Not" takes the value of 1.

[9] https://databank.worldbank.org/reports.aspx?source=2&series=FD.AST.PRVT.GD.ZS&country=.

at the level of -0.0607 (i.e., an industry can have high asset tangibility while relying heavily on external financial resources).

In addition, since the WMS data set uses the 1987 US Standard Industrial Classification (SIC, 2-digit) nomenclature to define different industries, Kroszner et al. (2007) use the International Standard Industrial Classification (ISIC Rev. 2, 3-digit and 4-digit) nomenclature. We take advantage of the Industry Concordances from Jon Haveman[10] to connect those two types of codes and merge them together. Finally, we end with a data set that contains approximately 9,724 observations covering 7,409 unique firms from 2002 to 2012.

3.4 Empirical Results

3.4.1 Baseline Results

In this section, we directly test the predictions of Proposition 3 using (3.20). Since the relationship between managerial effort and financial development varies with the initial quality of ideas, we first split the data into two groups by using the (log) firm size equal to 7.5 as the cutoff: observations with (log) firm size larger than 7.5 are considered more productive, unconstrained firms, whereas those below 7.5 are considered less productive, constrained ones. According to the theoretical prediction, the estimated coefficients are expected to be significant for the sample with firm size below 7.5 and nonsignificant for the sample with firm size above 7.5.

[10] https://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeConcordances.html.

Table A.2 shows the baseline results when the (log) firm size is smaller than the cutoff of 7.5. In general, the point estimates are in line with the theoretical predictions in Proposition 3. In Column (1) of Table A.2, the coefficient of $FinDev_{it}$ is negative and statistically significant, indicating that managers tend to exert more effort in less financially developed countries than in more financially developed countries. The magnitude of the coefficient is economically meaningful: a mild one-percentage-point increase in a country's private credit on average reduces managerial effort by 0.141 percent, with other conditions held constant. At the same time, the coefficient of the interaction term of financial development and financial vulnerability $FinDev_{it} \times FinVul_s$ is positive and statistically significant, showing that financial development lowers managerial effort relatively more in more financially vulnerable sectors. These two estimates are robust when we change the combination of fixed effects of ownership types and MNE types from Column (2) to Column (4)[11].

Table A.3 shows the baseline results when the (log) firm size is larger than the cutoff of 7.5. We find that financial development or financial vulnerability has no significant effect on managerial effort. The null effect is robust if we choose different sets of fixed effects for ownership types and MNE types.

The results in Table A.2 and Table A.3 confirm our predictions in Proposition 3. For firms that have a lower productivity level and that may not be able to export or produce due to financial constraints, managers have an incentive to exert more effort

[11] We do not include external financial dependence in the regression because it is significantly correlated with financial tangibility and we have a limited sample size. We do not include firm-level fixed effects since among the 9,724 observations, there are 7,409 unique firms, making the data set more like cross-sectional rather than panel data.

to improve overall productivity and make it profitable for firms to export or produce; thus, managers can receive a better payoff. This result echoes the old Chinese saying "Diligence redeems Stupidity". In our case, more managerial effort helps compensate for the disadvantage of financial frictions, improve total productivity, and increase expected profit. Thus, for less productive firms, managerial effort and financial development are substitutes.

3.4.2 Robustness Check

To assess the robustness of the baseline results, we conduct several sets of robustness checks by using alternative cutoffs; alternative measurements of financial development, financial vulnerability, and management scores; and alternative econometric methods.

First, we change the (log) firm size cutoff to 7 or 8 and repeat the estimation. Table A.4 and Table A.5 show the results when the cutoff is 7, while Table A.6 and Table A.7 provide the results when the cutoff is 8.

Second, we provide the results when changing the measurements of financial development and financial vulnerability and the dependent variables. After taking the logarithm of financial development in the baseline regressions, Table A.8 and Table A.9 show the results using "FinDev2", which is defined as the logarithm of credit to GDP to measure financial development. Table A.10 and Table A.11 show the results when financial vulnerability is measured by whether the tangibility level is above 60% instead of 50% as in the baseline results. Table **??** shows the results when financial vulnerability is measured by whether the tangibility level is above

40%. Additionally, we use the original management score as the dependent variable in Table A.12 and Table A.13.

Third, it is noticeable that econometric techniques may matter here. The average management score dependent variable ranges from 1 to 5 due to the design of the questionnaire. Therefore, the dependent variable may be both left and right censored. Therefore, we use tobit estimation to conduct robustness checks. Table A.14 and Table A.15 show the tobit estimation results using the same variables as in the baseline regressions.

All the robustness results demonstrate that the predictions of Proposition 3 continue to hold. Specifically, the coefficient of $FinDev_{it}$ is still negative and statistically significant, whereas the coefficient of $FinDev_{it} \times FinVul_s$ is still positive and statistically significant for smaller firms. Their statistical significance and economic magnitude are very close to those in the baseline case. We still cannot find any significant effect of financial development on managerial effort for larger firms.

3.5 Conclusion

This paper presents a heterogeneous firm model that captures the coexistence of financial constraints outside a firm and the agency problem inside a firm. The main prediction in the model is that when firms enter the export market or produce domestically, managerial effort is higher in financially underdeveloped countries since managers are incentivized to exert more effort to improve the productivity, so as to induce their owners to produce or export. This substitution effect between managerial effort and financial development is even stronger in more financially vulnerable sectors. However, the substitution effect does not apply to firms with sufficiently high initial productivity since they are not subject to financial constraints.

Using WMS firm-level data, we provide evidence to support the model predictions on the relationship between managerial effort and financial constraints. We find that only managerial effort in smaller firms is affected by financial constraints. Managerial effort in the largest firms is invariant to credit frictions at the industry and country levels. The policy implication of our findings is quite intuitive: financially underdeveloped countries can compete with financially developed countries through the exertion of more managerial effort.

Nevertheless, much remains to be done. For example, we regard national institutions as exogenous in our model. One related question is how these institutions endogenously respond to trade liberalization. Moreover, it may be worthwhile to look at the welfare effects of shocks to financial development in a general-equilibrium counterfactual analysis. However, these issues seem beyond the scope of this paper. We thus leave them to future research.

Table A.1 Summary Statistics

Variable	**Explanation**	**Obs**	**Mean**	**Std Dev**	**Min**	**Max**
Management Score	Average score across all 18 managerial survey questions	9,724	2.9550	0.6851	1	4.9444
log(Management Score)	Logarithm of management score	9,724	1.0541	0.2496	0	1.5983
FinDev	Credit to GDP: Private credit by deposit money banks and other financial institutions to GDP (%)	9,724	109.2634	52.4601	11.45	195.58
FinDev2	Logarithm of credit to GDP	9,724	4.5291	0.6471	2.4380	5.2760
FinVul	Tangibility: Whether is above the 50% level	9,334	0.3764	0.4845	0	1
FinVul2	Tangibility: Whether it is above the 60% level	9,724	0.3613	0.4804	0	1
FinVul3	Tangibility: Whether it is above the 40% level	9,724	0.5068	0.5000	0	1
Rigidity Index	Rigidity of employment index	9,618	23.4683	18.2399	0	52
log(PPP GDP)	Logarithm of PPP-based GDP	9,704	7.5573	1.2373	4.7471	9.5904
log(Degree)	Logarithm of percentage of managers with a college degree	8,273	3.8698	0.8751	0	4.6052
log(Competitor)	Logarithm of number of competitors	8,652	1.8305	0.6052	0.0000	2.3026
log(Firm Size)	Logarithm of firm size (number of employees)	9,724	5.8687	1.1134	0	11.5129
Export or Not	Whether firm exports	9,724	0.3167	0.4652	0	1
Ownership Type	Ownership type	9,724	6.0638	4.2083	1	14
Owned by Managers or Not	Whether firm is owned by the managers	9,724	0.1546	0.3615	0	1
MNE Type	Multinational enterprise type	9,724	0.7214	0.8433	0	2
MNE or not	Whether firm is a multinational enterprise	9,724	0.7726	0.4192	0	1

Table A.2 Baseline Result

	Sample: (log) firm size smaller than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.141***	-0.134**	-0.140***	-0.125**
	(0.0515)	(0.0519)	(0.0532)	(0.0547)
FinDev×FinVul	0.0206**	0.0207**	0.0207**	0.0210**
	(0.0103)	(0.0103)	(0.0104)	(0.0105)
log (Rigidity Index)	1.082***	1.036***	1.096***	1.016***
	(0.291)	(0.294)	(0.297)	(0.305)
log (PPP GDP)	0.517	2.688	-0.541	3.443
	(6.127)	(6.314)	(5.958)	(6.243)
log (Degree)	3.038***	3.203***	3.288***	3.793***
	(0.320)	(0.322)	(0.326)	(0.333)
Export or Not	5.155***	5.228***	5.745***	6.128***
	(0.841)	(0.842)	(0.840)	(0.853)
log (Competitor)	2.190***	2.128***	1.858***	1.470***
	(0.527)	(0.536)	(0.536)	(0.561)
log (Firm Size)	6.139***	6.391***	6.488***	7.247***
	(0.355)	(0.355)	(0.356)	(0.362)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	6,979	6,979	6,981	6,981
R^2	0.304	0.295	0.285	0.255

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.3 Baseline Result

	Sample: (log) firm size larger than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.0300	-0.0214	-0.0329	-0.0237
	(0.162)	(0.165)	(0.166)	(0.170)
FinDev×FinVul	0.0111	0.00229	0.00787	-0.00234
	(0.0314)	(0.0316)	(0.0318)	(0.0322)
log (Rigidity Index)	0.372	0.405	0.282	0.327
	(0.912)	(0.908)	(0.929)	(0.930)
log (PPP GDP)	26.06	28.57*	25.95	28.67*
	(16.67)	(16.31)	(16.78)	(16.24)
log (Degree)	3.586***	3.776***	3.808***	4.084***
	(0.729)	(0.750)	(0.718)	(0.743)
Export or Not	-0.604	-0.443	-0.883	-0.570
	(2.160)	(2.306)	(2.172)	(2.337)
log (Competitor)	-0.498	-0.373	-0.446	-0.365
	(1.193)	(1.192)	(1.222)	(1.237)
log (Firm Size)	1.730	2.230	1.568	2.094
	(1.406)	(1.440)	(1.355)	(1.406)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	742	742	742	742
R^2	0.273	0.253	0.259	0.236

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.4 Robustness Check: Alternative Cutoff 7

	Sample: (log) firm size smaller than the cutoff (7)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.137**	-0.129**	-0.140**	-0.126**
	(0.0533)	(0.0533)	(0.0548)	(0.0559)
FinDev×FinVul	0.0188*	0.0190*	0.0190*	0.0196*
	(0.0107)	(0.0107)	(0.0108)	(0.0110)
log (Rigidity Index)	1.071***	1.029***	1.080***	1.012***
	(0.301)	(0.303)	(0.305)	(0.312)
log (PPP GDP)	-2.078	0.0139	-3.453	0.311
	(6.275)	(6.452)	(6.106)	(6.403)
log (Degree)	3.143***	3.309***	3.399***	3.911***
	(0.333)	(0.336)	(0.339)	(0.349)
Export or Not	4.708***	4.780***	5.353***	5.761***
	(0.853)	(0.853)	(0.863)	(0.881)
log (Competitor)	2.197***	2.112***	1.887***	1.461**
	(0.540)	(0.548)	(0.550)	(0.575)
log (Firm Size)	6.769***	7.003***	7.126***	7.858***
	(0.421)	(0.423)	(0.424)	(0.431)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	6,475	6,475	6,477	6,477
R^2	0.304	0.294	0.285	0.253

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 7. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.5 Robustness Check: Alternative Cutoff 7

	Sample: (log) firm size larger than the cutoff (7)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.0286	-0.0175	-0.0130	0.00448
	(0.149)	(0.149)	(0.151)	(0.152)
FinDev×FinVul	0.0222	0.0193	0.0198	0.0149
	(0.0238)	(0.0242)	(0.0244)	(0.0250)
log (Rigidity Index)	0.228	0.272	0.169	0.190
	(0.776)	(0.773)	(0.789)	(0.788)
log (PPP GDP)	25.40*	26.76*	25.86*	28.39**
	(14.42)	(14.33)	(14.51)	(14.34)
log (Degree)	3.083***	3.136***	3.305***	3.467***
	(0.628)	(0.632)	(0.615)	(0.623)
Export or Not	2.089	2.203	1.960	2.146
	(1.958)	(1.997)	(1.976)	(2.038)
log (Competitor)	-0.0185	0.125	-0.133	-0.0654
	(1.002)	(0.998)	(1.016)	(1.017)
log (Firm Size)	1.758	1.920*	1.784*	1.942*
	(1.087)	(1.076)	(1.079)	(1.068)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	1,245	1,246	1,245	1,246
R^2	0.259	0.249	0.246	0.230

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.6 Robustness Check: Alternative Cutoff 8

	Sample: (log) firm size smaller than the cutoff (8)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.131**	-0.125**	-0.131**	-0.116**
	(0.0510)	(0.0512)	(0.0528)	(0.0542)
FinDev×FinVul	0.0202**	0.0199*	0.0198*	0.0193*
	(0.0103)	(0.0103)	(0.0104)	(0.0105)
log (Rigidity Index)	1.026***	0.981***	1.034***	0.949***
	(0.288)	(0.290)	(0.296)	(0.303)
log (PPP GDP)	3.143	5.142	1.922	5.504
	(6.411)	(6.569)	(6.225)	(6.423)
log (Degree)	3.083***	3.247***	3.321***	3.804***
	(0.308)	(0.311)	(0.312)	(0.321)
Export or Not	4.974***	5.073***	5.521***	5.921***
	(0.817)	(0.819)	(0.813)	(0.826)
log (Competitor)	2.172***	2.107***	1.872***	1.504***
	(0.526)	(0.534)	(0.535)	(0.558)
log (Firm Size)	5.436***	5.683***	5.774***	6.497***
	(0.314)	(0.315)	(0.315)	(0.319)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	7,331	7,331	7,333	7,333
R^2	0.303	0.294	0.285	0.256

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 8. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.7 Robustness Check: Alternative Cutoff 8

	Sample: (log) firm size larger than the cutoff (8)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.237	-0.250	-0.250	-0.262
	(0.264)	(0.250)	(0.269)	(0.256)
FinDev×FinVul	0.0587	0.0548	0.0621	0.0564
	(0.0393)	(0.0406)	(0.0402)	(0.0419)
log (Rigidity Index)	1.367	1.387	1.249	1.333
	(1.608)	(1.485)	(1.648)	(1.523)
log (PPP GDP)	25.00	25.83	26.33	28.32
	(18.91)	(18.36)	(20.00)	(19.53)
log (Degree)	3.755***	4.125***	4.218***	4.661***
	(1.099)	(1.118)	(1.107)	(1.111)
Export or Not	1.430	1.100	1.294	1.184
	(3.052)	(3.131)	(3.163)	(3.197)
log (Competitor)	-2.914*	-3.316*	-2.646	-3.078
	(1.715)	(1.727)	(1.850)	(1.865)
log (Firm Size)	0.288	1.186	-0.876	0.170
	(2.166)	(2.140)	(2.024)	(2.058)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	387	389	387	389
R^2	0.323	0.298	0.295	0.267

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 8. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.8 Robustness Check: Alternative Financial Development

	Sample: (log) firm size smaller than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev2	-11.68**	-11.09**	-11.28**	-9.997*
	(4.994)	(4.967)	(5.197)	(5.268)
FinDev2×FinVul	1.485*	1.515*	1.551*	1.669**
	(0.813)	(0.811)	(0.816)	(0.819)
log (Rigidity Index)	0.849***	0.815***	0.859***	0.805***
	(0.241)	(0.242)	(0.245)	(0.249)
log (PPP GDP)	4.625	6.575	3.452	6.944
	(6.507)	(6.738)	(6.310)	(6.664)
log (Degree)	3.065***	3.228***	3.314***	3.814***
	(0.320)	(0.322)	(0.326)	(0.333)
Export or Not	5.002***	5.083***	5.588***	5.986***
	(0.844)	(0.846)	(0.846)	(0.860)
log (Competitor)	2.192***	2.131***	1.859***	1.471***
	(0.528)	(0.538)	(0.538)	(0.563)
log (Firm Size)	6.139***	6.390***	6.488***	7.246***
	(0.354)	(0.355)	(0.356)	(0.361)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	6,979	6,979	6,981	6,981
R^2	0.304	0.294	0.285	0.255

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.9 Robustness Check: Alternative Financial Development

	Sample: (log) firm size larger than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev2	-4.939	-6.502	-4.284	-5.685
	(20.23)	(20.42)	(20.77)	(21.29)
FinDev2×FinVul	2.126	1.418	2.066	1.228
	(2.912)	(2.952)	(3.030)	(3.103)
log (Rigidity Index)	0.375	0.484	0.253	0.372
	(0.819)	(0.809)	(0.836)	(0.831)
log (PPP GDP)	27.33	30.19*	27.08	30.13*
	(17.30)	(17.03)	(17.39)	(16.96)
log (Degree)	3.587***	3.771***	3.809***	4.082***
	(0.722)	(0.743)	(0.712)	(0.737)
Export or Not	-0.658	-0.431	-0.957	-0.577
	(2.146)	(2.296)	(2.157)	(2.326)
log (Competitor)	-0.474	-0.340	-0.420	-0.330
	(1.193)	(1.191)	(1.222)	(1.237)
log (Firm Size)	1.716	2.216	1.549	2.075
	(1.405)	(1.441)	(1.353)	(1.404)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	742	742	742	742
R^2	0.273	0.254	0.260	0.236

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.10 Robustness Check: Alternative Financial Vulnerability

	Sample: (log) firm size smaller than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.128**	-0.122**	-0.124**	-0.109**
	(0.0499)	(0.0502)	(0.0516)	(0.0529)
FinDev×FinVul2	0.0223**	0.0218**	0.0228**	0.0222**
	(0.0102)	(0.0102)	(0.0103)	(0.0104)
log (Rigidity Index)	1.073***	1.024***	1.076***	0.984***
	(0.281)	(0.283)	(0.286)	(0.293)
log (PPP GDP)	0.661	2.757	-0.305	3.583
	(6.090)	(6.277)	(5.931)	(6.217)
log (Degree)	3.018***	3.195***	3.256***	3.774***
	(0.316)	(0.318)	(0.322)	(0.329)
Export or Not	5.302***	5.357***	5.880***	6.228***
	(0.833)	(0.833)	(0.832)	(0.843)
log (Competitor)	2.280***	2.219***	1.957***	1.582***
	(0.519)	(0.528)	(0.530)	(0.554)
log (Firm Size)	6.124***	6.381***	6.474***	7.241***
	(0.345)	(0.346)	(0.347)	(0.351)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	7,241	7,241	7,243	7,243
R^2	0.306	0.297	0.287	0.256

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.11 Robustness Check: Alternative Financial Vulnerability

	Sample: (log) firm size larger than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.0538	-0.0481	-0.0599	-0.0532
	(0.160)	(0.163)	(0.164)	(0.167)
FinDev×FinVul2	0.00736	-0.000283	0.00335	-0.00565
	(0.0313)	(0.0315)	(0.0317)	(0.0320)
log (Rigidity Index)	0.463	0.485	0.427	0.466
	(0.874)	(0.869)	(0.891)	(0.891)
log (PPP GDP)	23.41	25.86	23.25	26.07
	(16.71)	(16.34)	(16.83)	(16.28)
log (Degree)	3.528***	3.706***	3.764***	4.024***
	(0.728)	(0.747)	(0.717)	(0.741)
Export or Not	-0.472	-0.350	-0.744	-0.468
	(2.124)	(2.265)	(2.133)	(2.290)
log (Competitor)	-0.447	-0.332	-0.397	-0.332
	(1.167)	(1.163)	(1.196)	(1.206)
log (Firm Size)	1.872	2.322*	1.815	2.313*
	(1.343)	(1.371)	(1.311)	(1.353)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	770	770	770	770
R^2	0.281	0.265	0.266	0.246

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.12 Robustness Check: Alternative Management S-core

	Sample: (log) firm size smaller than the cutoff (7.5)			
	$Management\ Score_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.385***	-0.366***	-0.383***	-0.340**
	(0.136)	(0.137)	(0.140)	(0.146)
FinDev×FinVul	0.0488*	0.0487*	0.0488*	0.0495*
	(0.0272)	(0.0273)	(0.0275)	(0.0280)
log (Rigidity Index)	2.971***	2.837***	3.010***	2.780***
	(0.800)	(0.807)	(0.815)	(0.838)
log (PPP GDP)	-12.65	-6.639	-15.66	-4.497
	(15.87)	(16.39)	(15.44)	(16.26)
log (Degree)	8.319***	8.804***	9.031***	10.48***
	(0.874)	(0.881)	(0.890)	(0.910)
Export or Not	12.73***	12.91***	14.41***	15.46***
	(2.248)	(2.260)	(2.247)	(2.298)
log (Competitor)	5.598***	5.406***	4.652***	3.535**
	(1.382)	(1.409)	(1.412)	(1.489)
log (Firm Size)	16.31***	17.02***	17.30***	19.46***
	(0.906)	(0.902)	(0.918)	(0.926)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	6,979	6,979	6,981	6,981
R^2	0.309	0.299	0.288	0.255

Notes: This table reports the results when the logarithm of firm size is s-maller than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.13 Robustness Check: Alternative Management S-core

	Sample: (log) firm size larger than the cutoff (7.5)			
	$Management\ Score_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.0955	-0.0879	-0.105	-0.0950
	(0.489)	(0.494)	(0.501)	(0.509)
FinDev×FinVul	0.0364	0.0106	0.0258	-0.00386
	(0.0940)	(0.0946)	(0.0953)	(0.0965)
log (Rigidity Index)	1.090	1.218	0.800	0.975
	(2.769)	(2.750)	(2.827)	(2.822)
log (PPP GDP)	69.69	77.69*	69.34	78.01*
	(45.88)	(44.69)	(46.33)	(44.62)
log (Degree)	11.42***	11.96***	12.14***	12.92***
	(2.194)	(2.223)	(2.165)	(2.208)
Export or Not	-0.113	0.334	-1.011	-0.0630
	(6.600)	(6.976)	(6.611)	(7.032)
log (Competitor)	-1.573	-1.191	-1.405	-1.167
	(3.607)	(3.600)	(3.699)	(3.742)
log (Firm Size)	5.220	6.726	4.697	6.299
	(4.425)	(4.523)	(4.264)	(4.412)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	742	742	742	742
R^2	0.269	0.252	0.254	0.234

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.14 Robustness Check: Tobit

	Sample: (log) firm size smaller than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.141***	-0.134***	-0.140***	-0.125**
	(0.0513)	(0.0517)	(0.0529)	(0.0546)
FinDev×FinVul	0.0206**	0.0207**	0.0207**	0.0210**
	(0.0102)	(0.0103)	(0.0103)	(0.0105)
log (Rigidity Index)	1.083***	1.037***	1.097***	1.017***
	(0.290)	(0.293)	(0.295)	(0.304)
log (PPP GDP)	0.584	2.756	-0.472	3.515
	(6.104)	(6.296)	(5.936)	(6.225)
log (Degree)	3.036***	3.201***	3.286***	3.791***
	(0.319)	(0.321)	(0.325)	(0.332)
Export or Not	5.155***	5.228***	5.744***	6.127***
	(0.837)	(0.839)	(0.837)	(0.850)
log (Competitor)	2.197***	2.135***	1.865***	1.477***
	(0.525)	(0.535)	(0.535)	(0.560)
log (Firm Size)	6.145***	6.397***	6.494***	7.254***
	(0.354)	(0.355)	(0.356)	(0.361)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	6,979	6,979	6,981	6,981

Notes: This table reports the results when the logarithm of firm size is smaller than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Table A.15 Robustness Check: Tobit

	Sample: (log) firm size larger than the cutoff (7.5)			
	$\log(Management\ Score)_{fsit} \times 100$			
	(1)	(2)	(3)	(4)
FinDev	-0.0300	-0.0214	-0.0329	-0.0237
	(0.155)	(0.160)	(0.159)	(0.164)
FinDev×FinVul	0.0111	0.00229	0.00787	-0.00234
	(0.0301)	(0.0305)	(0.0305)	(0.0311)
log (Rigidity Index)	0.372	0.405	0.282	0.327
	(0.873)	(0.876)	(0.891)	(0.898)
log (PPP GDP)	26.06	28.57*	25.95	28.67*
	(15.97)	(15.74)	(16.08)	(15.68)
log (Degree)	3.586***	3.776***	3.808***	4.084***
	(0.698)	(0.723)	(0.689)	(0.718)
Export or Not	-0.604	-0.443	-0.883	-0.570
	(2.069)	(2.225)	(2.082)	(2.257)
log (Competitor)	-0.498	-0.373	-0.446	-0.365
	(1.143)	(1.150)	(1.171)	(1.194)
log (Firm Size)	1.730	2.230	1.568	2.094
	(1.346)	(1.390)	(1.299)	(1.357)
Sector FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
MNE Type FE	Y	Y		
Ownership Type FE	Y		Y	
MNE or Not			Y	Y
Owned by Managers or Not		Y		Y
Observations	743	743	743	743

Notes: This table reports the results when the logarithm of firm size is larger than the cutoff of 7.5. In addition to sector, year, and country fixed effects, there are two groups of MNE-related fixed effects and ownership-related fixed effects. The results from Columns (1) to (4) show the results using different combinations of these fixed effects. Robust standard errors (clustered at the year-country-sector level) are reported in parentheses. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

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APPENDIX

Appendix A

Appendix for Chapter1

A.1 Data Appendix

The country-level data used in this paper comprise three main components: trade flow, GDP, and trade-cost proxy variables. These data are compiled for the period from 1978 to 2015. In addition, we use global firm-level data for the period 2008-2018 to estimate firm productivity distribution parameters.

A.1.1 Bilateral Trade Flow

Bilateral merchandise trade flows are retrieved from the UN Comtrade at the SITC (Revision 2) 5-digit level. We measure N_{ijt} by the number of SITC 5-digit categories exported by country i to j in year t. The trade flow X_{ijt} is measured by the sum of the CIF import value of all SITC 5-digit categories exported by country i to j in year t.

A.1.2 GDP, Value-added Share, and Gross Output

We use the GDP data from the CEPII's Gravity dataset,[12] and supplement the missing entries with the GDP data from the World Bank's World Development Indicators (WDI).[3] We construct the gross output Y_i data by taking the ratio of GDP and the value-added share α_{it} in gross output: $Y_{it} = GDP_{it}/\alpha_{it}$.

The data on value-added share α_{it} are compiled from several sources. The first option is "STAN STructural ANalysis Database,"[4] which covers 37 countries for the 1970-2017 period. We take the ratio of "*Value added, current prices*" over "*Production (gross output), current prices*" for "*Industry: Total.*"[5] The second option is the WIOD Socio-Economic Accounts,[6] which has three releases: a November 2016 release (with data for 2000-2014), a July 2014 release (with data for 1995-2011), and a February 2012 release (with data for 1995-2009). We use figures from the latest available release. The third option is the Input-Output Tables (IOTs) from the OECD Input-Output database.[7] There are four editions of IOTs reported: a 2018 edition (ISIC Rev.4), a 2015 edition (ISIC Rev.3), a 2002 edition (ISIC Rev.3), and a 1995 edition (ISIC Rev.2). Again, we use figures from the latest available edition. As an example, given the 2018 edition IOTs, we calculate the value-added share by aggregating the "*Value added at basic prices*" and "*Output at basic prices*" across

1 http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=8.
2 http://sites.google.com/site/hiegravity/data-sources.
3 http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.
4 https://www.oecd.org/industry/ind/stanstructuralanalysisdatabase.htm.
5 https://stats.oecd.org/Index.aspx?DataSetCode=STANI4_2016.
6 http://www.wiod.org/database/seas16.
7 https://www.oecd.org/sti/ind/input-outputtables.htm.

all sectors. Despite all these alternatives, some countries have no data for some years. In those cases, we fill in the missing entries as follows: (1) $\alpha_{it} = \alpha_{i,T_i^e}$ for all $t > T_i^e$, where T_i^e is the latest year with data on the value-added share for country i; (2) $\alpha_{it} = \alpha_{i,T_i^s}$ for all $t < T_i^s$, where T_i^s is the earliest year with data on the value-added share for country i; (3) $\alpha_{it} = (\alpha_{i,t_i^1} + \alpha_{i,t_i^2})/2$ for $t_i^1 < t < t_i^2$, where t_i^1 and t_i^2 are the two years nearest to t and with available data. For countries without any information, we use the value-added shares of the Rest of the World (ROW), available in the 2015 edition IOTs.

We use the population data from the CEPII's Gravity dataset and supplement the missing entries with the population data from the WDI and the International Monetary Fund's International Financial Statistics (IFS).[8] The data on GDP per capita are also obtained from the CEPII's Gravity dataset. When it is missing in CEPII, we calculate the variable by the ratio of GDP and population as compiled above.

A.1.3 Expenditure

Based on bilateral trade flow, we construct the trade deficit of a country by $\bar{D}_{jt} = \sum_i X_{ijt} - \sum_i X_{jit}$. However, due to data measurement errors, the world trade deficit $\bar{D}_{wt}$ does not always sum to zero. We allocate the discrepancy $\bar{D}_{wt}$ to each country in proportion to its output share of the world, i.e., $D_{jt} = \bar{D}_{jt} - \frac{Y_{jt}}{Y_{wt}}\bar{D}_{wt}$. The gross expenditure of a country is then constructed as $E_{jt} = Y_{jt} + D_{jt}$.

[8] http://data.imf.org/?sk=4C514D48-B6BA-49ED-8AB9-52B0C1A0179B.

A.1.4 Proxies for the Asymmetric Bilateral Trade Cost

The trade cost variables are taken from CEPII's Gravity dataset and GeoDist dataset, except otherwise noted below.[9] The original dataset includes 225 countries. We drop French Southern and Antarctic Lands because it does not have a permanent population.

The GATT/WTO membership indicator variables $bothwto_{ijt}$ and $imwto_{ijt}$ are constructed from the CEPII variables *gatt_ o* and *gatt_ d* (which equals one if the exporting country is a GATT/WTO member and if the importing country is a GATT/WTO member).[10]

The other variables used include: population-weighted bilateral distance ($wdist_{ij}$); two common language indicators: the first indicator equals one if a language is spoken by at least 9% of the population in both countries ($comlang2_{ij}$), and the second indicator equals one if a language is the official or primary language in both countries ($comlang_{ij}$); a common border indicator, which equals one if two countries are contiguous ($contig_{ij}$); a common colonizer indicator, which equals one if two countries have had a common colonizer after year 1945 ($comcol_{ij}$); the same country indicator, which equals one if two countries were or are the same state or the same administrative entity for a long period of time (25–50 years in the twentieth century, 75 years in the nineteenth century, or 100 years before the nineteenth century; $smctry_{ij}$); a

[9] http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=6.

[10] We also make some corrections for GATT/WTO membership in CEPII's dataset with the information from WTO's website whenever we find strong evidence. For example, Madagascar has been a member of the GATT since 1963 and a member of the WTO since 1995, as indicated on the WTO website, whereas it is listed as a nonmember for all years in CEPII's gravity dataset.

regional trade agreement indicator, which equals one if a regional trade agreement is in force between two countries (rta_{ijt}); a common currency indicator, which equals one if two countries use a common currency ($comcur_{ijt}$); an indicator for whether exporter i has ever been a colonizer of importer j (heg_o_{ij}); and an indicator for whether importer j has ever been a colonizer of exporter i (heg_d_{ij}).

Because the identities of colonizers versus colonies never switched in the period of our study, we constructed the indicator for whether exporter i is currently a colonizer of importer j based on the CEPII variable $curcol_{ijt}$ (whether i is currently a colony of j or vice versa) and heg_o_{ij}: $curheg\_o_{ijt} = 1$ if $curcol_{ijt} = 1$ and $heg\_o_{ij} = 1$. The indicator for whether importer j is currently a colonizer of exporter i is constructed in a similar way: $curheg\_d_{ijt} = 1$ if $curcol_{ijt} = 1$ and $heg\_d_{ij} = 1$.

We supplement the legal origin data from CEPII with the information from La Porta et al. (1999), La Porta, de Silanes and Shleifer (2008), and CIA's *World Factbook* website,[11] to construct the common legal origin indicator ($comleg_{ij}$), which equals one if two countries share a common legal origin. The information on the number of landlocked or island countries in a pair ($land_{ij}$, $island_{ij}$) is obtained from Andrew Rose,[12] supplemented with information from CIA's *World Factbook* website. The data on the common currency indicator ($comcur_{ijt}$) are from de Sousa,[13] and supplemented with CEPII's Gravity dataset.

The data on the regional trade agreement indicator (rta_{ijt}) are from the Database on Economic Integration Agreements (April 2017) constructed by Scott Baier and

[11] http://www.cia.gov/library/publications/the-world-factbook.

[12] http://faculty.haas.berkeley.edu/arose/RecRes.htm.

[13] http://jdesousa.univ.free.fr/data.htm.

Jeffrey Bergstrand.[14] We supplement the missing rta_{ijt} data with the information from the WTO Regional Trade Agreements Database.[15]

The data on whether importer j offers GSP preferential treatment to exporter i (GSP_{ijt}) are from the Database on Economic Integration Agreements (April 2017) constructed by Scott Baier and Jeffrey Bergstrand.[16] To supplement the missing GSP_{ijt} entries, we first use the information from WTO's Database on Preferential Trade Agreements.[17] If the information on GSP_{ijt} is still missing, we compile the data manually from the "Generalized System of Preferences: List of Beneficiary Countries" reported by the UNCTAD.[18] The UNCTAD updates the information on the GSP schemes from time to time, but not annually. The information on the GSP schemes is only available for 2001, 2005, 2006, 2008, 2009, 2011, and 2015.

A.1.5 Classification of Developed and Developing Countries

Rose (2004) and Subramanian and Wei (2007) classify the traditional industrialized countries as developed countries,[19] which is our benchmark. However, this classification is time invariant and thus does not reflect the rise of newly industrialized countries. Hence, we also consider classifying a country as developed based on the income threshold of US $6,000 per capita (in 1987 prices) used by the World Bank

[14] https://www3.nd.edu/~jbergstr/. Ornelas and Ritel (2018) provide a detailed introduction to this database.

[15] https://rtais.wto.org/UI/PublicMaintainRTAHome.aspx.

[16] https://www3.nd.edu/~jbergstr/.

[17] http://ptadb.wto.org/.

[18] http://unctad.org/en/Pages/DITC/GSP/GSP-List-of-Beneficiary-Countries.aspx.

[19] See Appendix Table 2 in Subramanian and Wei (2003).

for high-income countries.[20] These thresholds have been updated annually by the World Bank since 1987, using the IMF's SDR (Special Drawing Rights) deflator to adjust for inflation. We extrapolate the thresholds for the 1978-1986 period using the same SDR deflator.[21] The World Bank threshold is in terms of GNI per capita, but the GNI data in earlier years are not readily available for a large number of countries. Thus, we classify countries as developed or developing based on their GDP per capita instead.

Together, a county is classified as developed if its GDP per capita exceeds the threshold constructed above or if it belongs to the set of traditional industrialized countries listed in Subramanian and Wei (2003). Otherwise, it is classified as a developing country.

A.1.6 Classification of High-Income, Middle-Income, and Low-Income Countries

Countries are classified as high-income, upper-middle-income, lower-middle-income and low-income by the World Bank.[22] This information is available from 1987 onwards. We group the upper-middle-income and lower-middle-income countries together as middle-income countries and use the classification in 1987 for the early years (1978–1986) of the study.

[20] http://datahelpdesk.worldbank.org/knowledgebase/articles/378833-how-are-the-income-group-thresholds-determined.

[21] http://datahelpdesk.worldbank.org/knowledgebase/articles/378829-what-is-the-sdr-deflator.

[22] https://datahelpdesk.worldbank.org/knowledgebase/articles/378833-how-are-the-income-group-thresholds-determined.

A.1.7 Pseudo World

We trim the data as follows to arrive at a sample we call the pseudo world for the analysis. For obvious reasons, we drop countries that do not have GDP data. We also drop countries that do not import or export to any other countries in each year. Given the set of remaining countries, we constructed trade deficits and expenditures as discussed above and dropped countries if the constructed expenditure was negative. We also drop countries whose implied internal trade is negative: $X_{ii} \equiv Y_i - \sum_{j \neq i} X_{ij} < 0$. These are typically small territories whose data are prone to measurement errors. We iterate the process of constructing trade deficits and expenditures after each round of adjustment in the set of countries until the constructed expenditure and internal trade of all countries are positive. We call the resulting set of countries the pseudo world and calculate the supply and expenditure shares of each country relative to the pseudo world.

The number of countries in the raw data and in the pseudo world are reported in Table 1.1. The number of countries included in the pseudo world increased from 55 in 1978 to 145 in 2015. The set of countries in the pseudo world are the same as in the raw data, except for 2001, 2002 and 2011. In Table 1.2, we also decompose the pseudo world import flows by GATT/WTO members versus nonmembers. As shown, GATT/WTO members are proportionally larger importers. Even in the early decades, when the membership size was small, approximately 88.55% of the world import flows were covered under the GATT/WTO treaties, with another 4.95% imported by members from nonmembers. With the membership size continuing to grow, the import flows among members increased to 94.40% by 2006 and 98.70% by

2015, while those by members from nonmembers fell to 2.51% in 2006 and 0.39% in 2015.

A.1.8 ORBIS Data

We download from ORBIS the firm-level variables on operating revenues, total assets, number of employees, material costs, cost of goods sold, cost of employees, NACE sector name, and BvD sector name for the 2008–2018 period.[23] If the data on material costs are missing, we replace the missing values with the difference between the cost of goods sold and the cost of employees. Data were downloaded in US dollars and deflated into 2008 PPP dollars as documented next.

A.1.9 Deflator for Firm-level Variables

Let $E_{c,t}$ indicate the exchange rate of country c in year t (in terms of local currency/USD), and let $deflator_{c,t} \equiv P_{c,t}/P_{c,2008}$ denote country c's local deflator relative to year 2008. The current values of firm-level revenues and other input expenditures (in USD) are converted to 2008 PPP dollars by $deflator\_2008\_ppp_{c,t} \equiv deflator_{c,t}/(E_{c,t}/E_{c,2008})$. The local GDP deflators $\frac{P_{c,t}}{P_{c,2008}}$ are retrieved from the World Bank Development Indicators.[24] The exchange rate deflator $\frac{E_{c,t}}{E_{c,2008}}$ is obtained from the Penn World Table version 9.1[25] and supplemented by World Bank Development Indicators.

[23] http:https://www.bvdinfo.com/en-gb/our-products/data/international/orbis.

[24] https://databank.worldbank.org/reports.aspx?source=world-development-indicators.

[25] https://www.rug.nl/ggdc/productivity/pwt/.

A.2 Estimation of Shape Parameter k

Fix a bilateral trading relationship. Let $R(a) \equiv Aa^{1-\sigma}$ denote the sales of a firm in the foreign market given a productivity level $1/a$. Given a truncated Pareto distribution of a, it can be verified that R also follows a truncated Pareto distribution with a shape parameter $\theta = k/(\sigma - 1)$ and a support $[R_L, R_H]$. The corresponding c.d.f. is

$$M(R) = \frac{R_L^{-\theta} - R^{-\theta}}{R_L^{-\theta} - R_H^{-\theta}}. \tag{A.1}$$

We rank firm sales to tabulate the empirical c.d.f. on the left-hand side, i.e., $\frac{n}{N}$, where $n = 0, 1, \ldots, N$ is the rank of the firm in terms of sales, with smaller numbers indicating lower sales, and N is the rank of the firm with the largest sales. We use a non-linear least squares estimator to obtain the estimate for θ and in turn k (by assuming a parameter value of $\sigma = 5$).

Alternatively, we also use the Quantile-Quantile estimator (QQ estimator) in the spirit of Head, Mayer and Thoenig (2014) to minimize the distance between the empirical quantiles Q_n^E and the theoretical quantiles Q_n^P of the sales to estimate the shape parameter θ. The empirical quantiles are $Q_n^E = R$, while the theoretical quantiles Q_n^P are given by the inverse function of the empirical c.d.f. of R:

$$Q_n^P = \left[R_L^{-\theta} - \widehat{M}_n \times (R_L^{-\theta} - R_H^{-\theta})\right]^{-\frac{1}{\theta}}, \tag{A.2}$$

where $\widehat{M}_n = \frac{n}{N}$ is the empirical c.d.f. of R. Using the nonlinear least squares estimator that minimizes the distance between Q_n^E and Q_n^P, we obtain the estimates of θ.

We apply the methodology above using the ORBIS firm-level sales data of 15 European countries for the period 2008–2015. The choice of the set of countries is based on the data quality, as explained in the next section. The sample for each country-year is trimmed at the 10th percentile and 90th percentile of firm productivity estimates (as explained in the next section). Given the sample for each country-year, we use the top 5% of the sales observations (still of truncated Pareto with the same shape parameter θ) and its corresponding R_L and R_H to calculate the empirical c.d.f. and to obtain the estimates of θ (and k given $\sigma = 5$) for each country-year. We choose these upper tail observations because we have only the total sales of a firm but not its sales to each market. Since not all firms export to all markets, using the top firms increases the likelihood that their sales reflect those to a similar set of markets. We also repeat the same estimation procedure but pool observations across countries in each year and obtain estimates of k for each year during the period 2008–2015. The average value of the year-level estimates of k is 4.4255. To satisfy the requirement $k > \sigma - 1$, if a country-year estimate of k is smaller than 4.1, we replace the estimate with the country's average estimate across years. If the country-level average is still smaller than 4.1, we replace the estimate with 4.4255. This value is also applied to all countries other than the 15 European countries. The resulting estimates of k we use in the robustness check are reported in Table 1.9.

A.3 Calibration of a'_{ijt}, a_{ijt}, a_{H_i}, and a_{L_i}

The (inverse) productivity cutoff a_{ijt} can be inferred by Equation (1.19), given the definition of the latent variable Z_{ijt} and the estimates of $Z_{ijt} = \exp(s_\eta z^*_{ijt})$. Similarly, we can obtain a'_{ijt} given the counterfactual value for Z'_{ijt}.

We estimate the support of the (inverse) productivity distribution parameters a_{L_i} and a_{H_i} using the ORBIS firm-level data. In view that the quality of the firm-level data is the best for European countries in the ORBIS dataset (Kalemli-Ozcan et al., 2015), we estimate the firm productivity based on the firm-level data for 15 European countries: Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Sweden. The production functions are estimated by sector (defined at the NACE sector level) using the method of Wooldridge (2009).

Given the productivity estimates of all firms across all sectors, we define $TFP_{it}^{90\%}$ as the 90th percentile firm productivity level of all firms in each country and year. We regress this variable $TFP_{it}^{90\%}$ on GDP per capita and extrapolate/predict this variable for the other countries in our sample based on the relationship identified between $TFP_{it}^{90\%}$ and the GDP per capita of the European countries. We then take the average across years to measure the upper bound of the productivity support of a country $(1/a_{L_i})$. The lower bound of the productivity support of a country $(1/a_{H_i})$ is constructed in the same way but based on the 10th percentile productivity estimates. We use the 90th and 10th percentiles instead of the maximum and minimum productivity estimates literally, to minimize the influence of outliers and measurement errors. The estimates of a_{L_i} and a_{H_i} are reported in Table 1.13.

A.4 N'_{ijt} for the Inactive Trading Relationship

The changes in the mass of varieties exported $\widehat{N}_{ijt}$ can be simulated by using Equation (1.45) when $z^*_{ijt} > 0$. In this appendix, we estimate N_{it} and use it to impute N'_{ijt} for $z^*_{ijt} < 0$.

Given the estimates of a_{L_i}, a_{H_i}, a_{ijt}, and $k = 6$ (when we take $\frac{k}{\sigma-1} = 1.5$ and $\sigma = 5$), we use the nonlinear least square estimator to estimate N_{it} using Equation (1.15). Given $\widehat{N}_{it}$ from the counterfactual analysis, we obtain $N'_{it} = N_{it}\widehat{N}_{it}$. Using the relationship between N'_{ijt} and N'_{it} by Equation (1.15) again and a'_{ijt} calibrated in Section A.3, we can impute the value of N'_{ijt} as a result for $z^*_{ijt} < 0$.

We also use two other methods to estimate N_{it}, given Equation (1.15). The first method is to divide N_{ijt} by $\frac{a^k_{L_i}}{a^k_{H_i}-a^k_{L_i}}\left[\left(\frac{a_{ijt}}{a_{L_i}}\right)^k - 1\right]$ and then to take the average of the results within each it to obtain an estimate of N_{it}. The second method is to take the average of N_{ijt} and that of $\frac{a^k_{L_i}}{a^k_{H_i}-a^k_{L_i}}\left[\left(\frac{a_{ijt}}{a_{L_i}}\right)^k - 1\right]$ within each it and then to take the ratio of the two averages to obtain N_{it}. Using the estimates of N_{it} from these two alternative methods, we can impute N'_{ijt} for $z^*_{ijt} < 0$ in a similar way as discussed in the previous paragraph. The summary statistics of N'_{ijt} for $z^*_{ijt} < 0$ are reported in Table 1.14 for the counterfactual if the GATT/WTO were shut down.

Appendix B

Appendix for Chapter2

B.1 Appendix

B.1.1 Unit Cost Minimization Problem

I derive the expression of the unit cost of intermediate k in this section. I assume that price p follows distribution $G(p)$. Intermediate k's unit cost minimization problem is given by:

$$\min_{x_{ijk}} \sum_{j \in R_k} \mu_{ijk} \int_0^\infty p x_{ijk}(p) dG_{ijk}(p)$$

$$\text{s.t.} \left[\mu_{idk} \int_0^\infty x_{idk}(p)^{\frac{\varepsilon_k - 1}{\varepsilon_k}} dG_{idk}(p) + \sum_{j \in R_{uf}} q_{ijk} \mu_{ijk} \int_0^\infty x_{ijk}(p)^{\frac{\varepsilon_k - 1}{\varepsilon_k}} dG_{ijk}(p) + \sum_{j \in R_f} q_{ijk}^{\alpha} \mu_{ijk} \int_0^\infty x_{ijk}(p)^{\frac{\varepsilon_k - 1}{\varepsilon_k}} dG_{ijk}(p) \right]^{\frac{\varepsilon_k}{\varepsilon_k - 1}} \geq 1$$

After solving the unit cost minimization problem, we get the optimal variety quantities from firms in different countries:

If $j = d$:

$$x_{idk}(p) = p^{-\varepsilon_k} M, \tag{B.1}$$

If $j \in R_{uf}$:

$$x_{ijk}(p) = p^{-\varepsilon_k} q_{ijk}^{\varepsilon_k} M, \tag{B.2}$$

If $j \in R_f$:

$$x_{ijk}(p) = p^{-\varepsilon_k} q_{ijk}^{\alpha\varepsilon_k} M, \tag{B.3}$$

where

$$M = \left[\mu_{idk}\int_0^\infty p^{1-\varepsilon_k} dG_{idk}(p) + \sum_{j\in R_{uf}} \mu_{ijk}\int_0^\infty \left(q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} p\right)^{1-\varepsilon_k} dG_{ijk}(p) + \sum_{j\in R_f} \mu_{ijk}\int_0^\infty \left(q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} p\right)^{1-\varepsilon_k} dG_{ijk}(p)\right]^{\frac{\varepsilon_k}{1-\varepsilon_k}}$$

Plugging Equations (B.1), (B.2) and (B.3) back into the objective function, we get the optimal unit cost of intermediate k:

$$c_{ik}^* = \left[\mu_{idk}\int_0^\infty p^{1-\varepsilon_k} dG_{idk}(p) + \sum_{j\in R_{uf}} \mu_{ijk}\int_0^\infty \left(q_{ijk}^{\frac{\varepsilon_k}{1-\varepsilon_k}} p\right)^{1-\varepsilon_k} dG_{ijk}(p) + \sum_{j\in R_f} \mu_{ijk}\int_0^\infty \left(q_{ijk}^{\frac{\alpha\varepsilon_k}{1-\varepsilon_k}} p\right)^{1-\varepsilon_k} dG_{ijk}(p)\right]^{\frac{1}{1-\varepsilon_k}}$$

B.1.2 Derivation of Equation (2.10)

$$\begin{aligned}
\log\frac{V_{ij'k}}{V_{ijk}} &= \log\left(\frac{V_{ij'k}}{V_{ik}}\Big/\frac{V_{ijk}}{V_{ik}}\right) \\
&= \log\left\{\frac{N_{j'k}T_{j'k}(w_{j'}c_k\tau_{j'})^{-\theta_k}\left(\frac{\alpha\varepsilon_k m_{ij'k}}{\varepsilon_k-1}\right)^{\frac{\alpha\theta_k\varepsilon_k}{\varepsilon_k-1}} e^{\frac{\alpha\theta_k\varepsilon_k}{1-\varepsilon_k}}}{N_{jk}T_{jk}(w_j c_k\tau_j)^{-\theta_k}\left(\frac{\varepsilon_k m_{ijk}}{\varepsilon_k-1}\right)^{\frac{\theta_k\varepsilon_k}{\varepsilon_k-1}} e^{\frac{\theta_k\varepsilon_k}{1-\varepsilon_k}}}\right\} \\
&= \log\left[N_{j'k}T_{j'k}(w_{j'}c_k\tau_{j'})^{-\theta_k}\right] - \log\left[N_{jk}T_{jk}(w_j c_k\tau_j)^{-\theta_k}\right] \\
&\quad + \log\left[\alpha^{\frac{\alpha\theta_k\varepsilon_k}{\varepsilon-1}}\left(\frac{e\varepsilon_k}{\varepsilon_k-1}\right)^{\frac{(\alpha-1)\theta_k\varepsilon_k}{1-\varepsilon_k}}\right] \\
&\quad + \frac{\alpha\theta_k\varepsilon_k}{\varepsilon_k-1}\log m_{ij'k} - \frac{\theta_k\varepsilon_k}{\varepsilon_k-1}\log m_{ijk},
\end{aligned}$$

B.1.3 Robustness Check: Extension of Time Restriction

Given the sample size, I only include the result when $T = 1$ in the main text. I also conduct the estimation by extending T to be 2 or 3. Extension of the time restriction reduces the sample size and causes insignificance of the coefficients of the importing experience with unfamiliar countries. However, the signs of coefficients are still consistent with my expectations and the model, and the value of α is still positive, ranging from 0 to 1.

Table A.4, Table A.5, Table A.6 and Table A.7 show the results of using the accumulated import volume $aiv_{ijk,t-1}$ to measure importing experience when $T = 2$ and $T = 3$. The results are always robust and consistent with the main estimation and extensions. Furthermore, the results act as a robustness check to support the conclusion that importing from familiar countries increases the satisfaction probability and reduces the effective unit cost of intermediates.