Appendices

A Data and Empiricis Appendix

A.1 Data Description

Our main data source, Chinese Customs Trade Statistics (henceforth CCTS) maintained by General Administration of Customs of China (2000-2015), covers the universe of Chinese export and import transactions. We restrict attention to ordinary trade records only and exclude processing trade records from our sample. Furthermore, we keep only manufacturing firms and drop trade intermediaries from our sample (Ahn, Khandelwal, and Wei, 2011). The basic units of our analysis are firm-country-year triplets indicating firm's trade decisions across foreign countries in each year from 2000 to 2015.

In the baseline sample, we limit our attention to firm's import of intermediate goods and export of final goods identified by Broad Economic Categories Revision 4 (BEC4). This is to bring our empirical analysis closer to quantitative framework where firms are assumed to import intermediate inputs and export final products. Our empirical results remain stable to including all types of goods in the sample.

Finally, we focus only on the top 30 export destinations and top 30 import sourcing origins for China in terms of trade value that account for, on average, over 93% of China's annual export value and 96% of annual import value.[33] As our study focuses on firm's trade decisions at the extensive margin, this restriction helps to eliminate firm's ad-hoc trading activity in small countries and also makes both empirical and quantitative analysis computationally feasible.

Appendix A.2 lists detailed data cleaning process for CCTS. Finally, in 2007, the customs sample contains over 68,000 unique Chinese exporters and the mean and median number of export destination per exporter is 5.77 and 2, respectively. On the import side, there are about 82,000 unique importers in 2007. The mean and median number of import sourcing origins per importer is 3.01 and 2, respectively.

In addition, we obtain firms' accounting information, such as total sales revenue and total input purchase from the Annual Survey of Industrial Enterprise (henceforth ASIE)

[33] In 2007, the top 30 export destinations and top 30 import sourcing origins include 36 unique foreign countries.

from National Bureau of Statistics of China (1998-2009). We follow the standard approach in cleaning ASIE, e.g., dropping observations with missing or wrong sales revenue, output, establishment date, and employment.[34] Merging ASIE and CCTS gives us a full picture of Chinese firms' sales and sourcing activity in both domestic and foreign countries. In the merged sample, there are around 300,000 firms in 2007, and the share of exporters and importers is 8.73% and 10.78%, respectively. Lastly, the gravity variables including population weighted geographic distances, indicator for common language are from the CEPII.

A.2 Data Cleaning and Processing

We clean and construct the customs sample from the Chinese Customs Trade Statistics (2000-2015) as follows.

1. First, we restrict attention to records of ordinary trade only, and drop the two categories of processing trade: pure assembly (PA) and import and assembly (IA).

2. Second, products in Chinese customs database are classified using the Harmonized System (HS) code at the 8-digit level across years using different vintages (1996, 2002, 2007 or 2012). We aggregate the sample to firm-country-HS6 (6-digit) level within each year and then convert HS6 codes from different vintages to the 1996 vintage using publicly available correspondence tables from the UN Statistical Division.

3. Both the empirical and the model sections focus on the sourcing of intermediates and the export of final goods. Therefore, for export, we only keep consumption goods at the HS6 level identified by Broad Economic Categories Rev. 4 (BEC4), and for import, we focus on the non-consumption goods imported by Chinese firms.

4. Following the method in Ahn, Khandelwal, and Wei (2011), we identify trade intermediaries based on their company names in the customs sample and exclude such firms from our analysis.

[34] See, for example, Brandt, Van Biesebroeck, and Zhang (2012).

5. Finally, we restrict our attention to a set of major trading partners with China. For each year from 2000 to 2015, we choose the top 30 export destinations in terms of export value and the top 30 import sourcing origins in terms of import value for China. The union of two country sets cover over 93% of the annual export volume and over 96% of the annual import volume during this period. In year 2007, the two country sets overlap a lot and have 36 unique foreign countries.

A.3 Unobserved Processing Trade

One potential concern is that the correlation between firm's export and import decision in a foreign country may reflect the supply chain or offshoring contract which Chinese firms sign with foreign partner. Throughout the paper, we drop the observed processing trade records from the customs sample. Note that reporting transactions as processing trade exempts firms from tariff duty. Therefore, firms have incentive to overreport processing trade, and dropping the observed processing trade records should be sufficient to exclude such mechanical linkages. To further address the issue of unobserved processing trade, we provide additional evidence as follows.

First, developed countries are more likely to sign supply contracts with Chinese firms, and we check whether the results are driven by those countries. Here, we consider G7 as the major foreign partners of processing trade for China, and we repeat the baseline regressions by adding an interaction term between our variable of interest and dummy for G7. Columns (1)-(2) and (5)-(6) of Table A1 present the results and show that our variables of interest remain stable taking into account the primary supply contractors of China. Second, in the customs sample, some firms engage in both ordinary trade and processing trade. As we only exclude processing trade records from those firms, the resulting sample thus contains two types of firms: those who only do ordinary trade and the hybrid ones who do both. We also check whether hybrid firms drive our empirical findings. We repeat the regression by adding an interaction term between our variable of interest and a dummy for processing trader (equal to one if firm has any processing trade records on either export or import side). Columns (3)-(4) and (7)-(8) of Table A1 show that our variables of interest remain largely unchanged. Finally, if the majority of the trade linkages are unobserved processing subcontract, we should expect firms with more trade linkages (such as two-way traders) to have lower markup compared to those with fewer trade linkages (such as pure exporter/importers). For example, Yu (2015) shows that Chinese firms with a larger processing trade share experienced a lower productivity growth after tariff reduction. In the merged sample, we estimate firm-level markup using the De Loecker and Warzynski (2012) method and find that the mean markup of two-way traders and pure exporters is 1.31 and 1.27 respectively, and the difference is statistically significant, suggesting the subcontract issue is not prevalent.

Table A1: Processing Trade and Bilateral Economies of Scope

Dependent Var.:	$\mathbb{I}\{Exp._{fct} > 0\}$				$\mathbb{I}\{Imp._{fct} > 0\}$			
	LPM	Probit	LPM	Probit	LPM	Probit	LPM	Probit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{I}\{Imp._{fct-1} > 0\}$	0.013***	0.265***	0.018***	0.184***	0.055***	1.473***	0.055***	1.474***
	(0.002)	(0.004)	(0.002)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
.× G7 Indicator$_c$	0.010***	0.045***						
	(0.002)	(0.005)						
.× Processing Trader$_{ft}$			-0.002	0.133**				
			(0.002)	(0.007)				
$\mathbb{I}\{Exp._{fct-1} > 0\}$	0.060***	1.276***	0.060***	1.276***	0.005***	0.255***	0.004***	0.222***
	(0.003)	(0.004)	(0.003)	(0.004)	(0.001)	(0.004)	(0.001)	(0.006)
.× G7 Indicator$_c$					0.015***	0.067***		
					(0.003)	(0.005)		
.× Processing Trader$_{ft}$							0.006***	0.082***
							(0.001)	(0.006)
Constant	0.122***	-0.897***	0.122***	-0.890***	0.016	-0.875***	0.016	-0.874***
	(0.018)	(0.041)	(0.018)	(0.041)	(0.010)	(0.040)	(0.010)	(0.040)
Export Extended Gravity	YES	YES	YES	YES	NO	NO	NO	NO
Import Extended Gravity	NO	NO	NO	NO	YES	YES	YES	YES
Gravity Variables	YES	YES	YES	YES	YES	YES	YES	YES
Firm-level Controls	NO	YES	NO	YES	NO	YES	NO	YES
Firm-Year FE	YES	NO	YES	NO	YES	NO	YES	NO
Country-Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm-Country FE	YES	NO	YES	NO	YES	NO	YES	NO
Obs.	11,650,553	13,244,910	11,650,553	13,244,910	10,515,452	11,764,732	10,515,452	11,764,732
Adj. R^2	0.574	-	0.574	-	0.609	-	0.609	-
Pseudo R^2	-	0.468	-	0.469	-	0.546	-	0.546

Note: This table presents additional tests on the unobserved processing trade. G7 indicator denotes whether country c is a G7 country. The processing trader dummy is equal to one if the firm f engages in processing trade on the export or import side in year t. The extended gravity for distance$_{fct-1}$ is constructed following Chaney (2014) while the other variables of extended gravity are constructed after Morales, Sheu, and Zahler (2019). Export extended gravity variables are constructed using only firm's past export decisions while import extended gravity variables are constructed using only firm's past import decisions. Standard gravity variables include distance, indicator for contiguity, common continent, common language, common income group, and RTA between China and foreign country, and foreign GDP per capita. Standard errors are in the parentheses and clustered at firm and country level. The number of asterisks indicates significance at 1%(***), 5%(**) and 10%(*) level.

A.4 Linear Probability Model

We present the estimation results using the linear probability model in Tables A2 and A3. The advantage of using the linear probability model is that we can add firm-year and firm-country fixed effects and use the code *reghdfe* developed by Correia (2015) in Stata to efficiently estimate the model.

Table A2: The Effect of Import Choice on Export Decision: LPM

	Dependent Var.: $\mathbb{I}\{\text{Exp.}_{fct} > 0\}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.117***	0.0722***	0.0722***	0.0169***	0.102***	0.0677***	0.0677***	0.0168***
	(0.0185)	(0.0130)	(0.0128)	(0.00152)	(0.0123)	(0.0108)	(0.0107)	(0.00151)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	0.542***	0.501***	0.501***	0.0600***	0.513***	0.481***	0.481***	0.0597***
	(0.0184)	(0.0136)	(0.0134)	(0.00253)	(0.0135)	(0.0106)	(0.0106)	(0.00280)
Exp. Ext. Distance_{fct-1}					-0.0218**	-0.0260**	-0.0254**	-0.00158
					(0.0102)	(0.0105)	(0.0104)	(0.00194)
Exp. Ext. $\text{Contiguity}_{fct-1}$					0.0382***	0.0386***	0.0389***	0.0189***
					(0.0118)	(0.00932)	(0.00921)	(0.00287)
Exp. Ext. Continent_{fct-1}					-0.00198	-0.00425	-0.00393	-0.00328***
					(0.00738)	(0.00732)	(0.00719)	(0.00115)
Exp. Ext. Com. Lang._{fct-1}					0.0172*	0.0138*	0.0129*	0.00317
					(0.00936)	(0.00707)	(0.00702)	(0.00243)
Exp. Ext. Income Group_{fct-1}					0.00832	-0.0114**	-0.0141**	-0.00681***
					(0.00566)	(0.00495)	(0.00537)	(0.00208)
Constant	0.210*	0.0489***	0.0502***	0.106***	-0.367**	0.280***	0.276***	0.122***
	(0.122)	(0.00363)	(0.00208)	(0.000318)	(0.174)	(0.0954)	(0.0944)	(0.0176)
Gravity Variables	YES	YES	YES	YES	YES	YES	YES	YES
Firm-Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Country FE		YES				YES		
Country-Year FE			YES	YES			YES	YES
Firm-Country FE				YES				YES
Obs.	13,026,937	13,026,937	13,244,910	11,650,553	12,840,780	13,026,937	13,244,910	11,650,553
Adj. R^2	0.459	0.473	0.473	0.574	0.467	0.477	0.477	0.574

Note: This table presents the estimation results from specification (1) using linear probability model (LPM). The dependent variable is firm f's export dummy in country c at year t. Extended gravity for distance_{fct-1} is constructed following Chaney (2014) while the other extended gravity variables are constructed after Morales, Sheu, and Zahler (2019). Standard gravity variables include distance, indicator for contiguity, common continent, common language, common income group and RTA between China and foreign country, and foreign GDP per capita. Standard errors are in the parentheses and clustered at firm and country level. The number of asterisks indicates significance at 1%(***), 5%(**) and 10%(*) level.

Table A3: The Effect of Export Choice on Import Decision: LPM

	Dependent Var.: $\mathbb{I}\left\{\text{Imp.}_{fct} > 0\right\}$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\mathbb{I}\left\{\text{Exp.}_{fct-1} > 0\right\}$	0.0640***	0.0382***	0.0381***	0.00909***	0.0572***	0.0366***	0.0365***	0.00899***
	(0.0130)	(0.00899)	(0.00880)	(0.00123)	(0.0102)	(0.00830)	(0.00816)	(0.00122)
$\mathbb{I}\left\{\text{Imp.}_{fct-1} > 0\right\}$	0.605***	0.560***	0.559***	0.0515***	0.588***	0.547***	0.547***	0.0554***
	(0.0174)	(0.0131)	(0.0129)	(0.00403)	(0.0149)	(0.0115)	(0.0114)	(0.00414)
Imp. Ext. Distance_{fct-1}					-0.00588	-0.00959	-0.00903	0.00561***
					(0.00645)	(0.00623)	(0.00614)	(0.00109)
Imp. Ext. $\text{Contiguity}_{fct-1}$					0.0404***	0.0425***	0.0428***	0.0171***
					(0.00963)	(0.00865)	(0.00863)	(0.00309)
Imp. Ext. Continent_{fct-1}					-0.00141	-0.00386	-0.00358	-0.000345
					(0.00498)	(0.00482)	(0.00473)	(0.00108)
Imp. Ext. Com. Lang._{fct-1}					0.00885	0.0132**	0.0131**	0.00306
					(0.00877)	(0.00657)	(0.00653)	(0.00214)
Imp. Ext. Income Group_{fct-1}					0.00175	-0.0130***	-0.0163***	-0.00493***
					(0.00355)	(0.00361)	(0.00411)	(0.00155)
Constant	0.433***	0.0314***	0.0251***	0.0646***	0.0828	0.120**	0.110*	0.0163
	(0.123)	(0.00318)	(0.00165)	(0.000272)	(0.171)	(0.0577)	(0.0569)	(0.0102)
Gravity Variables	YES	YES	YES	YES	YES	YES	YES	YES
Firm-Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Country FE		YES				YES		
Country-Year FE			YES	YES			YES	YES
Firm-Country FE				YES				YES
Obs.	11,712,877	11,712,877	11,905,433	10,515,452	11,543,364	11,712,877	11,905,433	10,515,452
Adj. R^2	0.484	0.498	0.499	0.608	0.488	0.501	0.502	0.609

Note: This table presents the estimation results from specification (1) using linear probability model (LPM). The dependent variable is firm f's import dummy in country c at year t. Extended gravity for distance_{fct-1} is constructed following Chaney (2014) while the other extended gravity variables are constructed after Morales, Sheu, and Zahler (2019). Standard gravity variables include distance, indicator for contiguity, common continent, common language, common income group and RTA between China and foreign country, and foreign GDP per capita. Standard errors are in the parentheses and clustered at firm and country level. The number of asterisks indicates significance at 1%(***), 5%(**) and 10%(*) level.

A.5 Empirical Tests for Stagnant firms

Table A4 presents additional results for alternative definitions of stagnant firms as discussed in Section 2.3.2.

A.6 Complementarity in Exit Decisions

We test the effect of export exit on import exit from the same country and its opposite case through the following specification.

$$\begin{aligned}
\Pr\Big(\text{Exp. (Imp.) Exit}_{fct}|\text{Observables}\Big) &= \Phi\Big(\beta_1\text{Imp. (Exp.) Exit}_{fct-1} \\
&+ \delta\text{Standard Gravity}_{\text{CHN},ct} \\
&+ \gamma_1\text{Extended Gravity: Distance}_{fct-1} + \gamma_2\text{Remoteness}_{ct-1} \\
&+ \gamma_3\text{Other Extended Gravity}_{fct-1} \\
&+ \omega\text{Controls}_{ft-1}\Big)\,, \qquad \text{(A.1)}
\end{aligned}$$

where the dummy Exp. (Imp.) Exit_{fct} equals to one if firm f exported to (imported from) country c at year $t-1$ but stops doing so at year t, and zero otherwise. The parameter of interest β_1 indicates whether ceasing importing from (exporting to) a country would affect the firm's decision of stopping export (import) within the same place. The results are shown in Table A5 where we also limit attention to diminishing firms as in Section 2.3.2, suggesting that exiting importing (exporting) is associated with subsequent exit from exporting (importing).

A.7 Potential Sources of Bilateral Economies of Scope

In this section, we show several tests that focus on the potential sources of bilateral complementarity. In Table A6, to further investigate the role played by geographic distance and language, we conduct exercises similar to those in column (4) of Table 3 and Table 4, and include an interaction term between the gravity variables (e.g., distance and indicator common language) and firm's past trade decision. Table A7 shows that the estimated

Table A4: Bilateral Economies of Scope for Stagnant Firms: Probit

	Dependent Var.: $\mathbb{I}\{\text{Exp.}_{fct} > 0\}$			Dependent Var.: $\mathbb{I}\{\text{Imp.}_{fct} > 0\}$		
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Stagnant Importers					
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.467***	0.260***	0.261***	1.786***	1.457***	1.452***
	(0.00390)	(0.00419)	(0.00420)	(0.00431)	(0.00466)	(0.00467)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.504***	1.295***	1.292***	0.498***	0.309***	0.311***
	(0.00443)	(0.00478)	(0.00479)	(0.00396)	(0.00420)	(0.00422)
Obs.	4,889,200	4,959,287	5,034,549	5,761,066	5,843,244	5,744,302
Pseudo R^2	0.455	0.482	0.484	0.526	0.562	0.560
	Panel B: Stagnant Productivity: Value-Added per Worker					
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.506***	0.301***	0.303***	1.891***	1.542***	1.542***
	(0.00820)	(0.00880)	(0.00883)	(0.00915)	(0.00973)	(0.00976)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.538***	1.329***	1.331***	0.542***	0.333***	0.338***
	(0.00739)	(0.00788)	(0.00789)	(0.00811)	(0.00837)	(0.00838)
Obs.	1,329,307	1,352,695	1,370,458	1,215,220	1,236,601	1,121,312
Pseudo R^2	0.446	0.475	0.477	0.515	0.558	0.547
	Panel C: Stagnant Productivity: Ackerberg-Caves-Fraze					
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.497***	0.288***	0.289***	1.891***	1.542***	1.543***
	(0.00933)	(0.00994)	(0.00999)	(0.0101)	(0.0107)	(0.0107)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.546***	1.339***	1.341***	0.517***	0.310***	0.316***
	(0.00841)	(0.00898)	(0.00900)	(0.00938)	(0.00967)	(0.00970)
Obs.	1,015,566	1,033,431	1,045,585	924,980	894,957	815,763
Pseudo R^2	0.450	0.478	0.480	0.511	0.548	0.538
	Panel D: Stagnant Productivity: Olley-Pakes					
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.465***	0.253***	0.257***	1.910***	1.539***	1.542***
	(0.0141)	(0.0149)	(0.0150)	(0.0138)	(0.0147)	(0.0147)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.552***	1.344***	1.348***	0.492***	0.281***	0.286***
	(0.0121)	(0.0130)	(0.0130)	(0.0137)	(0.0142)	(0.0143)
Obs.	395,057	402,003	408,535	376,706	356,837	320,502
Pseudo R^2	0.447	0.475	0.478	0.515	0.551	0.538
	Panel E: Stagnant Productivity: Levinsohn-Petrin					
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.493***	0.283***	0.286***	1.905***	1.550***	1.551***
	(0.00997)	(0.0105)	(0.0106)	(0.0107)	(0.0115)	(0.0115)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.534***	1.324***	1.327***	0.520***	0.313***	0.320***
	(0.00885)	(0.00939)	(0.00940)	(0.00993)	(0.0103)	(0.0103)
Obs.	804,962	819,115	833,424	748,808	709,313	655,345
Pseudo R^2	0.450	0.478	0.481	0.514	0.548	0.539

Note: This table presents the estimation results from specification (1) using Probit model. The stagnant importers are defined as those who experience a growth rate of firm-level import less than or equal to 0 percentage from $t-1$ to t. The stagnant productivity refers to firms who experience a growth rate (by different firm-level TFP measures) of less than or equal to 0 percentage from $t-1$ to t.

Table A5: Bilateral Economies of Scope in Exit Decisions: Probit

Dependent Var.:	Exp. Exit_{fct}			Imp. Exit_{fct}		
	(1)	(2)	(3)	(4)	(5)	(6)
Imp. Exit_{fct-1}	0.123***	0.0409***	0.0405***			
	(0.00600)	(0.00608)	(0.00609)			
Exp. Exit_{fct-1}				0.149***	0.0800***	0.0787***
				(0.00577)	(0.00604)	(0.00604)
Exp. Ext. Distance_{fct-1}	-0.462***	-0.481***	-0.482***			
	(0.00314)	(0.00329)	(0.00330)			
Exp. Ext. $\text{Contiguity}_{fct-1}$	-0.0134***	-0.00108	-0.00364			
	(0.00323)	(0.00433)	(0.00434)			
Exp. Ext. Com. Lang._{fct-1}	0.130***	0.135***	0.135***			
	(0.00278)	(0.00385)	(0.00386)			
Imp. Ext. Distance_{fct-1}				-0.476***	-0.460***	-0.462***
				(0.00287)	(0.00312)	(0.00313)
Imp. Ext. $\text{Contiguity}_{fct-1}$				-0.0973***	-0.222***	-0.224***
				(0.00370)	(0.00518)	(0.00520)
Imp. Ext. Com. Lang._{fct-1}				0.102***	0.0259***	0.0269***
				(0.00340)	(0.00499)	(0.00499)
Constant	-6.135***	2.589***	2.562***	-7.650***	2.310***	2.149***
	(0.0490)	(0.0301)	(0.0539)	(0.0601)	(0.0301)	(0.0619)
Year FE	YES	YES	YES	YES	YES	YES
Country FE		YES			YES	
Country-Year FE			YES			YES
Obs.	5,574,832	5,634,634	5,684,571	4,180,331	4,213,643	4,218,766
Pseudo R^2	0.0768	0.107	0.111	0.115	0.180	0.183

Note: This table examines the effect of a firm's past exit decision in a foreign country on its current exit decision of export in the same place, and the opposite case.

coefficient on the distance variable is significantly negative, suggesting that greater distances pose higher entry barriers for firms through exports and imports. Meanwhile, the significant positive coefficient on the interaction term in columns (1) and (3) suggests that the complementarity increases with distance. Similarly, columns (2) and (4) show that the bilateral economies of scope becomes weaker if a foreign country shares a common language with China, consistent with the finding in Table A6.

A.8 Additional Tests

In Table A8, we include an additional interaction term between a firm's export dummy and its import dummy within the same country in the last year, and repeat the regressions

Table A6: Conditional Export and Import Ratios with Gravity Variables

Dependent Var.:	Conditional Export Ratio		Conditional Import Ratio	
	(1)	(2)	(3)	(4)
Com. Lang.$_c$	-0.0719	-3.801***	-0.405	-2.957**
	(0.727)	(1.115)	(0.698)	(1.086)
Distance$_c$		-0.569		0.487
		(0.867)		(0.819)
Contiguity$_c$		-2.550		-1.825
		(1.702)		(1.451)
Continent$_c$		2.153*		1.833
		(1.200)		(1.132)
Income Group$_{ct}$		-1.732		-0.869
		(1.549)		(1.501)
GDP per capita$_{ct}$		-0.0146		0.126
		(0.615)		(0.629)
RTA$_{ct}$		1.669		1.526
		(1.205)		(1.251)
Constant	8.955***	9.692***	9.047***	7.212**
	(0.411)	(3.311)	(0.370)	(3.162)
Obs.	34	34	34	34
Adj. R^2	0.000	0.341	0.002	0.149

Note: This table presents the estimates from OLS regression of conditional ratios on gravity variables. We exclude Kazakhstan and Kyrgyzstan from our sample as they contain extreme values for conditional ratios.

as in Table 3 and 4. The key empirical findings are barely affected: exporting to a foreign country associates with a higher likelihood for the firm importing from the same place, and vice versa.

Table A7: The Potential Sources of Bilateral Economies of Scope

Dependent Var.:	$\mathbb{I}\{\text{Exp.}_{fct} > 0\}$		$\mathbb{I}\{\text{Imp.}_{fct} > 0\}$	
	(1)	(2)	(3)	(4)
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.0730***	0.501***	1.812***	1.811***
	(0.0253)	(0.00288)	(0.00369)	(0.00369)
.× Distance$_{ct}$	0.0484***			
	(0.00295)			
.× Com. Lang.$_{ct}$		-0.232***		
		(0.00935)		
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.487***	1.487***	0.326***	0.505***
	(0.00324)	(0.00324)	(0.0268)	(0.00297)
.× Distance$_{ct}$			0.0187***	
			(0.00307)	
.× Com. Lang.$_{ct}$				-0.276***
				(0.00894)
Exp. Ext. Distance$_{fct-1}$	-0.177***	-0.177***		
	(0.00202)	(0.00201)		
Exp. Ext. Contiguity$_{fct-1}$	0.216***	0.217***		
	(0.00207)	(0.00207)		
Exp. Ext. Continent$_{fct-1}$	0.194***	0.194***		
	(0.00327)	(0.00326)		
Exp. Ext. Com. Lang.$_{fct-1}$	0.190***	0.191***		
	(0.00195)	(0.00195)		
Exp. Ext. Income Group$_{fct-1}$	0.404***	0.403***		
	(0.00324)	(0.00324)		
Imp. Ext. Distance$_{fct-1}$			-0.177***	-0.177***
			(0.00202)	(0.00201)
Imp. Ext. Contiguity$_{fct-1}$			0.279***	0.280***
			(0.00284)	(0.00284)
Imp. Ext. Continent$_{fct-1}$			0.127***	0.127***
			(0.00350)	(0.00349)
Imp. Ext. Com. Lang.$_{fct-1}$			0.120***	0.121***
			(0.00251)	(0.00251)
Imp. Ext. Income Group$_{fct-1}$			0.253***	0.253***
			(0.00335)	(0.00335)
Distance$_{ct}$	-0.252***	-0.239***	-0.552***	-0.546***
	(0.00226)	(0.00217)	(0.00216)	(0.00282)
Contiguity$_{c}$	0.0576***	0.0650***	-0.0328***	-0.0308***
	(0.00275)	(0.00273)	(0.00273)	(0.00353)
Continent$_{c}$	-0.315***	-0.312***	-0.499***	-0.498***
	(0.00268)	(0.00268)	(0.00374)	(0.00374)
Com. Lang.$_{ct}$	-0.0340***	0.00545	0.0106***	0.0670***
	(0.00335)	(0.00356)	(0.00396)	(0.00428)
Income Group$_{ct}$	-0.0702***	-0.0692***	-0.0696***	-0.0696***
	(0.00173)	(0.00173)	(0.00216)	(0.00216)
GDP per capita$_{ct}$	0.00223***	0.00227***	0.00263***	0.00263***
	(4.30e-05)	(4.30e-05)	(4.55e-05)	(4.56e-05)
RTA$_{ct}$	-0.0865***	-0.0856***	0.0948***	0.0972***
	(0.00260)	(0.00260)	(0.00286)	(0.00287)
Year FE	YES	YES	YES	YES
Observations	12,840,780	12,840,780	11,543,307	11,543,307
Pseudo R^2	0.438	0.439	0.504	0.504

Note: This table presents the estimation results from specification (1) using Probit model.

Table A8: Empirical Tests of Bilateral Economies of Scope: Robustness

Dependent Var.:	$\mathbb{I}\{\text{Exp.}_{fct} > 0\}$			$\mathbb{I}\{\text{Imp.}_{fct} > 0\}$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	0.506***	0.270***	0.270***	1.860***	1.512***	1.507***
	(0.00385)	(0.00403)	(0.00405)	(0.00394)	(0.00417)	(0.00417)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$	1.493***	1.275***	1.272***	0.552***	0.331***	0.332***
	(0.00330)	(0.00357)	(0.00358)	(0.00357)	(0.00378)	(0.00379)
$\mathbb{I}\{\text{Exp.}_{fct-1} > 0\} \times \mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$	-0.0419***	0.0361***	0.0370***	-0.177***	-0.124***	-0.123***
	(0.00589)	(0.00605)	(0.00605)	(0.00584)	(0.00613)	(0.00615)
Exp. Ext. Distance$_{fct-1}$	-0.177***	-0.219***	-0.219***			
	(0.00203)	(0.00221)	(0.00222)			
Exp. Ext. Contiguity$_{fct-1}$	0.216***	0.207***	0.207***			
	(0.00207)	(0.00270)	(0.00271)			
Exp. Ext. Continent$_{fct-1}$	0.195***	0.208***	0.210***			
	(0.00326)	(0.00371)	(0.00371)			
Exp. Ext. Com. Lang.$_{fct-1}$	0.190***	0.268***	0.268***			
	(0.00195)	(0.00280)	(0.00281)			
Exp. Ext. Income Group$_{fct-1}$	0.402***	0.311***	0.313***			
	(0.00325)	(0.00386)	(0.00398)			
Imp. Ext. Distance$_{fct-1}$				-0.0991***	-0.187***	-0.187***
				(0.00195)	(0.00218)	(0.00220)
Imp. Ext. Contiguity$_{fct-1}$				0.274***	0.192***	0.191***
				(0.00284)	(0.00354)	(0.00354)
Imp. Ext. Continent$_{fct-1}$				0.131***	0.0633***	0.0632***
				(0.00348)	(0.00424)	(0.00426)
Imp. Ext. Com. Lang.$_{fct-1}$				0.119***	0.176***	0.174***
				(0.00251)	(0.00355)	(0.00355)
Imp. Ext. Income Group$_{fct-1}$				0.247***	0.142***	0.136***
				(0.00334)	(0.00424)	(0.00443)
Year FE	YES	YES	YES	YES	YES	YES
Country FE		YES			YES	
Country-Year FE			YES			YES
Obs.	12,840,780	13,026,937	13,244,910	11,543,307	11,712,820	11,764,732
Pseudo R^2	0.438	0.466	0.468	0.504	0.545	0.546

Note: This table presents the estimation results from specification (1) using Probit model.

A.9 Construction of Extended Gravity Variables

This section constructs the extended gravity variables (recall that in the third and forth line of baseline specification (1), we include firm-country-specific gravity variables constructed from the firm's previous export or import network, which are often referred to as "extended gravity" after Morales, Sheu, and Zahler (2019)). We focus on the construction of export-side extended gravity variables based on firm's past export network, and the import-side ones are constructed in a similar way.

Following Chaney (2014), we first include the extended gravity variable of distance, $\text{Exp. Ext. Distance}_{fct-1}$ which measures the average geographic distance between country c and firm f's past export destinations. This is defined as

$$\text{Exp. Ext. Distance}_{fct-1} \equiv \frac{\sum_{c' \in \Omega} \mathbb{I}\left\{\text{Exp.}_{fc't-1} > 0\right\} \times \ln\left(\text{Distance}_{cc't-1}\right)}{\sum_{c' \in \Omega} \mathbb{I}\left\{\text{Exp.}_{fc't-1} > 0\right\}},$$

where $\text{Exp.}_{fc't-1}$ denotes firm f's export value to country c' in year $t-1$, Ω is the set of countries in our sample and $\ln\left(\text{Distance}_{cc't-1}\right)$ is log (population weighted) distance between country c and country c' that firm f exported to in year $t-1$. The indicator function $\mathbb{I}\left\{\text{Exp.}_{fc't-1} > 0\right\}$ equals to one if firm f exported to country c' at year $t-1$ and zero otherwise. As in Chaney (2014), we add another control for geographic remoteness of country c which is defined as

$$\text{Remoteness}_{ct-1} \equiv \frac{\sum_{c' \neq \text{CHN}} \ln\left(\text{Distance}_{cc't-1}\right)}{N_{c' \neq \text{CHN}}},$$

where CHN refers to China and $N_{c' \neq \text{CHN}}$ is the number of foreign countries in our sample. Remoteness_{ct-1} measures the average distance from country c to the countries other than China. This variable can be absorbed by the country-year fixed effects.

Following Morales, Sheu, and Zahler (2019), we include other extended gravity variables measuring geographic, cultural, and economic similarity between country c and a firm's past export network. These extended gravity variables are all dummy variables constructed from whether the firm exported to any country that is adjacent to country c ($\text{Exp. Ext. Contiguity}_{fct-1}$), locates in the same continent as country c ($\text{Exp. Ext. Continent}_{fct-1}$), shares common official language with country c (Exp. Ext. Com. Lang.$_{fct-1}$) or fall into same income group as country c (Exp. Ext. Income Group$_{fct-1}$). For example, the extended gravity variable for contiguity, Exp. Ext. Contiguity$_{fct-1}$, equals to one if firm f exported to any country in year $t-1$ that is adjacent to country c and zero otherwise. The extended gravity variable for common language, Exp. Ext. Language$_{fct-1}$, equals to one if firm f exported to any country in year $t-1$ that shares a common official language with country c and zero otherwise.

A.10 Construction of Instrument Variables for System GMM

In this section, we show the construction of instrument variables used in the system GMM estimation. We follow Feng, Li, and Swenson (2016) and use two instrument variables: i) firm-country-specific import and export tariff exposure, and ii) firm-country-specific dummy for processing importer and processing exporters. When we study the firm's export probability, the instrument variables used are firm-country-specific import tariff exposure and firm-country-specific dummy for processing importer. In the case when we study firm's import probability, the instrument variables used are firm-country-specific export tariff exposure and firm-country-specific dummy for processing exporter.

First, the firm-country-specific import tariff exposure is defined for some baseline year as follows.

$$\text{Import Tariff}_{fjt} = \sum_{h=1}^{H^M_{fj,t_b}} \left(\frac{\text{Imp.}_{fjh,t_b}}{\sum_{h=1}^{H^M_{fj,t_b}} \text{Imp.}_{fjh,t_b}} \text{Applied MFN Import Tariff}_{jht} \right),$$

where H^M_{fc,t_b} denotes the set of products firm f imports from foreign origin j in the base year t_b, Imp.$_{fjh,t_b}$ is the associated import value and Import Tariff$_{jht}$ is applied MFN tariffs on product h from origin j imposed by Chinese government. Similarly, firm-country-specific export tariff exposure is defined as

$$\text{Export Tariff}_{fkt} = \sum_{h=1}^{H^X_{fk,t_b}} \left(\frac{\text{Exp.}_{fkh,t_b}}{\sum_{h=1}^{H^X_{fk,t_b}} \text{Exp.}_{fkh,t_b}} \text{Applied MFN Export Tariff}_{kht} \right),$$

where H^X_{fc,t_b} denotes the set of products firm f exports towards foreign market k in the base year t_b, $\text{Exp.}_{fjh,t_b}$ is the associated import value and $\text{Export Tariff}_{jht}$ is applied MFN tariffs on product h from China imposed by foreign market k. Both tariffs are from the WTO Tariff Database. We choose $t_b = 2001$ as the base year.

Second, the firm-country-specific dummy for processing importer is defined as

$$\text{Processing Importer}_{fct-1} = \mathbb{I}\left\{\text{Value of processing import}_{fct-1} > 0\right\}.$$

The firm-country-specific dummy for processing exporter is defined in a symmetric way:

$$\text{Processing Exporter}_{fct-1} = \mathbb{I}\left\{\text{Value of processing export}_{fct-1} > 0\right\}.$$

The rationale for the two instrument variables is as follows. First, import tariff (export tariff) only directly affects the firm's import decision (export decision). If bilateral economies of scope is present, then a change in either export or import tariff would affect a firm's trade decision on the other side as well. Second, as in Feng, Li, and Swenson (2016), the firm's processing import would arguably encourage only its ordinary import but do not directly affect its ordinary export. Through our channel, a firm that engages in processing trade on import side in a foreign country is more likely to not only do ordinary import from the same country but also do ordinary export towards the same country. The same assumption applies to the dummy for processing exporter.

In the baseline estimation of system GMM, we take the firm's past trade decisions and all extended gravity variables as GMM-style instrument with maximum lag of 5, and consider standard gravity variables and the aforementioned IVs as IV-style instrument. Our key result of bilateral economies of scope remains stable to alternative specifications.

B Model Appendix

B.1 Solving the Free Entry Conditions

In this section, we show that J free entry conditions (17) deliver J unique aggregate demands across countries. Our strategy is to prove that taking as given the foreign demands $\{B_k\}_{k\neq i}$, the left-hand side of equation (17) is continuously non-decreasing in B_i. Then its valuation at constant $w_i f_{ei}$ gives us a unique equilibrium B_i. As a result, solving the system of J free entry conditions gives J unique B_i's.

The first step is to show the derivative of the left-hand side of equation (17) respect to B_i is positive. Note that we assume there is no iceberg trade cost or fixed cost of serving the domestic market, i.e., $\tau_{ii}^X = 1$ and f_{ii}^X=0, and the fixed cost for selling to any foreign market is sufficiently large even with import activity. Then all active firms including the least productive one in country i at least serve the domestic market. Combined with the condition that the least productive firm earns zero profit, the derivative of left-hand side of equation (17) with respect to B_i is

$$\int_{\tilde{\varphi}_i}^{\infty} \frac{\partial \begin{bmatrix} \varphi^{\sigma-1}\left(\gamma \Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} \Theta_i^X(\varphi) - w_i \sum_{k\in \mathsf{X}(\varphi)} f_{ki}^X - w_i \sum_{j \in \mathsf{M}(\varphi)} f_{ij}^M \\ +w_i \sum_{h\in \mathsf{X}(\varphi)\cap \mathsf{M}(\varphi)} \left(\alpha_0 f_{hi}^X + \alpha_1 f_{ih}^M\right) \end{bmatrix}}{\partial B_i} dG_i(\varphi) > 0. \tag{B.1}$$

Note that the derivative is positive, since raising B_i increases the profit of all firms. Conditional on the export and import strategies of the firms, a higher domestic demand B_i directly increases the total variable profit of all the firms through the increases in sales potential $\Theta_i^X(\varphi)$. Then for any increase in sales potential, firms' endogenous shift in trade strategies should bring additional gains in profit compared to the case when the trade strategies do not change. When $B_i \to 0$, the firm cannot export to or source from any country and earn zero profit, and when $B_i \to \infty$, all the firms include all the countries in both the export and import profiles and earn infinite profit.

Next, we show the continuity of equation (B.1) by parts (i.e., variable profit and fixed costs) and conclude our proof. First, the variable profit is continuously differentiable in B_i. Its derivative with respect to B_i is

$$\int_{\tilde{\varphi}_i}^{\infty} \frac{\partial \left[\varphi^{\sigma-1}\left(\gamma\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}}\Theta_i^X(\varphi)\right]}{\partial B_i} dG_i(\varphi) =$$

$$\int_{\tilde{\varphi}_i}^{\infty} \frac{\partial \left[\varphi^{\sigma-1}\left(\gamma\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} B_i + \varphi^{\sigma-1}\left(\gamma\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}}\left[\sum_{k\neq i}\left(\tau_{ki}^X\right)^{1-\sigma} B_k\right]\right]}{\partial B_i} dG_i(\varphi).$$

A change in B_i might affect firm profit discontinuously as it changes firms' export and import strategy. Following Antràs, Fort, and Tintelnot (2017), it can be shown that both $\Theta_i^M(\varphi)$ and $\Theta_i^X(\varphi)$ are non-decreasing in φ as the firm's profit maximization problem (16) features increasing difference in $\left(\mathbb{I}_{ki}^X, \varphi\right)$ and in $\left(\mathbb{I}_{ij}^M, \varphi\right)$ for any k, j. We provide formal proof for this property in Appendix B.2. As a result, there is a strict hierarchy in a firm's export and import decisions: for any $\varphi_1 \leq \varphi_2$, we have $\mathsf{M}(\varphi_1) \subseteq \mathsf{M}(\varphi_2)$ and $\mathsf{X}(\varphi_1) \subseteq \mathsf{X}(\varphi_2)$. Therefore, we must also have $\Theta_i^M(\varphi_1) \leq \Theta_i^M(\varphi_2)$ and $\Theta_i^X(\varphi_1) \leq \Theta_i^X(\varphi_2)$. We can further show that both $\Theta_i^M(\varphi)$ and $\Theta_i^X(\varphi)$ are also non-decreasing in domestic demand B_i. In other words, the variable profit $\varphi^{\sigma-1}\left(\gamma\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}}\Theta_i^X(\varphi)$ is a non-decreasing step function in φ and shows a jump at different levels of $\varphi^{\sigma-1}B_i$. We focus on the exhaustive case where there are $2J-1$ jumps in the profit function. Then the firm's variable profit can be written as

$$\varphi^{\sigma-1}\left(\gamma\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}}\Theta_i^X(\varphi) = \begin{cases} \theta_1\varphi^{\sigma-1}B_i + \theta_1\varphi^{\sigma-1}B_i\left[\omega_1 - B_i\right] & \text{if } \varphi < b_1/B_i^{1/(\sigma-1)} \\ \theta_2\varphi^{\sigma-1}B_i + \theta_2\varphi^{\sigma-1}B_i\left[\omega_2 - B_i\right] & \text{if } b_1/B_i^{1/(\sigma-1)} \leqslant \varphi < b_2/B_i^{1/(\sigma-1)} \\ \ldots & \\ \theta_{2J}\varphi^{\sigma-1}B_i + \theta_{2J}\varphi^{\sigma-1}B_i\left[\omega_{2J} - B_i\right] & \text{if } b_{2J-1}/B_i^{1/(\sigma-1)} \leqslant \varphi \end{cases},$$

where θ_x denotes the firm's sourcing capacity at interval x and ω_x denotes firm's sales capacity at interval x for $x = 1, 2, ..., 2J$. Intuitively, as we move from less productive firms to more productive ones, previous analysis suggests that a firm discontinuously adds countries to its export or import profile. Hence, we can define the expected profit prior to entry as the sum of $2J$ continuous functions. In each of them, firms with heterogeneous productivities have the same trade profiles. Then it is clear that the sum of the continuous functions that are differentiable with respect to B_i is also continuous in B_i.

Second, the total fixed cost paid by the firm is continuously differentiable in B_i. Note that its derivative with respect to B_i is

$$\int_{\tilde{\varphi}_i}^{\infty} \frac{\partial \left[w_i \sum_{k \in \mathsf{X}(\varphi)} f_{ki}^X - w_i \sum_{j \in \mathsf{M}(\varphi)} f_{ij}^M + w_i \sum_{h \in \mathsf{X}(\varphi) \cap \mathsf{M}(\varphi)} \left(\alpha_0 f_{hi}^X + \alpha_1 f_{ih}^M \right) \right]}{\partial B_i} dG_i(\varphi). \tag{B.2}$$

An increase in B_i cannot reduce the total fixed costs incurred by the firm as higher domestic profit induce the firm to export to or import from a new country, which comes with an additional fixed cost. Using the same logic as before, this derivative can be expressed as the sum of $2J$ functions continuous in B_i, showing jumps at various levels. Within each interval, the total fixed costs is differentiable in B_i, Therefore, the derivative at the total fixed costs across all firms is a continuous function on B_i. This concludes the proof that the domestic free entry condition delivers a unique B_i given the foreign aggregate demands $\{B_j\}_{j \neq i}$.

B.2 Proof of Proposition 1

The following steps show the increasing difference property of the firm's profit maximization problem (16) in $\left(\mathbb{I}_{ki}^X, \mathbb{I}_{ji}^X\right)$, $\left(\mathbb{I}_{ki}^X, \mathbb{I}_{ij}^M\right)$, and $\left(\mathbb{I}_{ik}^M, \mathbb{I}_{ij}^M\right)$ respectively, under the parameter constraint. In our context, the increasing difference property corresponds to the single crossing differences in choices (SCD-C) from below introduced by Arkolakis, Eckert, and Shi (2022), which is a prerequisite to apply the "sandwitch" algorithm in Jia (2008).

Step 1. We show the profit function in (16) features increasing difference in $\left(\mathbb{I}_{ki}^X, \mathbb{I}_{ji}^X\right)$. Ceteris paribus, the marginal benefit of exporting to a market k is an increasing function of the firm's decision to export to another market j. That is,

$$\pi_i\left(\mathbb{I}_{ki}^X = 1, \mathbb{I}_{ji}^X = 1\right) - \pi_i\left(\mathbb{I}_{ki}^X = 0, \mathbb{I}_{ji}^X = 1\right) \geqslant \pi_i\left(\mathbb{I}_{ki}^X = 1, \mathbb{I}_{ji}^X = 0\right) - \pi_i\left(\mathbb{I}_{ki}^X = 0, \mathbb{I}_{ji}^X = 0\right).$$

Plugging in the formulas for profits gives

$$\begin{aligned}
&\varphi^{\sigma-1}\left(\gamma\sum_{j=1}^{J}\mathbb{I}_{ij}^{M}T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{j'\neq j,j'\neq k}\mathbb{I}_{j'i}^{X}\left(\tau_{j'i}^{X}\right)^{1-\sigma}B_{j'}+\mathbb{I}_{ji}^{X}\left(\tau_{ji}^{X}\right)^{1-\sigma}B_j+\mathbb{I}_{ki}^{X}\left(\tau_{ki}^{X}\right)^{1-\sigma}B_k\right)\\
&-w_i\left(1-\alpha_0\mathbb{I}_{ik}^{M}\right)f_{ki}^{X}\left(\omega\right)+w_i\alpha_1\mathbb{I}_{ik}^{M}f_{ik}^{M}\left(\omega\right)\\
&-w_i\left(1-\alpha_0\mathbb{I}_{ij}^{M}\right)f_{ji}^{X}\left(\omega\right)+w_i\alpha_1\mathbb{I}_{ij}^{M}f_{ij}^{M}\left(\omega\right)\\
&-\left[\begin{array}{c}\varphi^{\sigma-1}\left(\gamma\sum_{j=1}^{J}\mathbb{I}_{ij}^{M}T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{j'\neq j,j'\neq k}\mathbb{I}_{j'i}^{X}\left(\tau_{j'i}^{X}\right)^{1-\sigma}B_{j'}+\mathbb{I}_{ji}^{X}\left(\tau_{ji}^{X}\right)^{1-\sigma}B_j\right)\\ -w_i\left(1-\alpha_0\mathbb{I}_{ij}^{M}\right)f_{ji}^{X}\left(\omega\right)+w_i\alpha_1\mathbb{I}_{ij}^{M}f_{ij}^{M}\left(\omega\right)\end{array}\right]\\
\geq&\varphi^{\sigma-1}\left(\gamma\sum_{j=1}^{J}\mathbb{I}_{ij}^{M}T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{j'\neq j,j'\neq k}\mathbb{I}_{j'i}^{X}\left(\tau_{j'i}^{X}\right)^{1-\sigma}B_{j'}+\mathbb{I}_{ki}^{X}\left(\tau_{ki}^{X}\right)^{1-\sigma}B_k\right)\\
&-w_i\left(1-\alpha_0\mathbb{I}_{ik}^{M}\right)f_{ki}^{X}\left(\omega\right)+w_i\alpha_1\mathbb{I}_{ik}^{M}f_{ik}^{M}\left(\omega\right)\\
&-\left[\varphi^{\sigma-1}\left(\gamma\sum_{j=1}^{J}\mathbb{I}_{ij}^{M}T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{j'\neq j,j'\neq k}\mathbb{I}_{j'i}^{X}\left(\tau_{j'i}^{X}\right)^{1-\sigma}B_{j'}\right)\right].
\end{aligned}$$

By canceling common terms on both sides, it can be shown that the equality holds. Also note that the above proof allows fixed costs of import and export to vary across firms and markets, which is captured by the $f_{ik}^{M}\left(\omega\right)$ and $f_{ji}^{X}\left(\omega\right)$ terms.

Step 2. We show if $0<\alpha_0,\alpha_1<1$, the profit function also exhibits increasing difference in $\left(\mathbb{I}_{ki}^{X},\mathbb{I}_{ij}^{M}\right)$ for any j and k. That is,

$$\pi_i\left(\mathbb{I}_{ki}^{X}=1,\mathbb{I}_{ij}^{M}=1\right)-\pi_i\left(\mathbb{I}_{ki}^{X}=0,\mathbb{I}_{ij}^{M}=1\right)\geqslant\pi_i\left(\mathbb{I}_{ki}^{X}=1,\mathbb{I}_{ij}^{M}=0\right)-\pi_i\left(\mathbb{I}_{ki}^{X}=0,\mathbb{I}_{ij}^{M}=0\right),$$

other things equal. It is equivalent to showing that

$$
\begin{aligned}
&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}+T_{j}\left(\tau_{ij}w_{j}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k'\neq k}\mathbb{I}_{k'i}^{X}\left(\tau_{k'i}\right)^{1-\sigma}B_{k'}+\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right)\\
&-w_{i}\left(1-\alpha_{0}\mathbb{I}_{ik}^{M}\right)f_{ki}^{X}\left(\omega\right)+w_{i}\alpha_{1}\mathbb{I}_{ik}^{M}f_{ik}^{M}\left(\omega\right)\\
&-w_{i}\left(1-\alpha_{1}\mathbb{I}_{ji}^{X}\right)f_{ij}^{M}\left(\omega\right)+w_{i}\alpha_{0}\mathbb{I}_{ji}^{X}f_{ji}^{X}\left(\omega\right)-\mathbb{I}\{k=j\}w_{i}\left(\alpha_{0}f_{ki}^{X}\left(\omega\right)+\alpha_{1}f_{ij}^{M}\left(\omega\right)\right)\\
&-\left[\begin{array}{c}\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}+T_{j}\left(\tau_{ij}w_{j}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k'\neq k}\mathbb{I}_{k'i}^{X}\left(\tau_{k'i}\right)^{1-\sigma}B_{k'}\right)\\ -w_{i}\left(1-\alpha_{1}\mathbb{I}_{ji}^{X}\right)f_{ij}^{M}\left(\omega\right)+w_{i}\alpha_{0}\mathbb{I}_{ji}^{X}f_{ji}^{X}\left(\omega\right)-\mathbb{I}\{k=j\}w_{i}\left(\alpha_{0}f_{ki}^{X}\left(\omega\right)\right)\end{array}\right]\\
\geqslant&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k'\neq k}\mathbb{I}_{k'i}^{X}\left(\tau_{k'i}\right)^{1-\sigma}B_{k'}+\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right)\\
&-w_{i}\left(1-\alpha_{0}\mathbb{I}_{ik}^{M}\right)f_{ki}^{X}\left(\omega\right)+w_{i}\alpha_{1}\mathbb{I}_{ik}^{M}f_{ik}^{M}\left(\omega\right)-\mathbb{I}\{k=j\}w_{i}\left(\alpha_{1}f_{ij}^{M}\left(\omega\right)\right)\\
&-\left[\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k'\neq k}\mathbb{I}_{k'i}^{X}\left(\tau_{k'i}\right)^{1-\sigma}B_{k'}\right)\right].
\end{aligned}
$$

Rearranging the inequality, we have, for $k\neq j$,

$$
\begin{aligned}
&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}+T_{j}\left(\tau_{ij}w_{j}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right)\\
\geqslant&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right).
\end{aligned}
$$

The above formula holds since $\sigma-1>0$, which ensures complementarity among the firm's export and import decisions if export destination and import origin are not the same country. If $k=j$, we have

$$
\begin{aligned}
&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}+T_{j}\left(\tau_{ij}w_{j}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right)+\left(\alpha_{0}f_{ki}^{X}\left(\omega\right)+\alpha_{1}f_{ij}^{M}\left(\omega\right)\right)\\
\geqslant&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j}\mathbb{I}_{ij'}^{M}T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\left(\tau_{ki}\right)^{1-\sigma}B_{k}\right).
\end{aligned}
$$

Therefore, if $0<\alpha_0,\alpha_1<1$, the inequality holds. The existence of α_0,α_1 affects only the complementarity between the export and import decision for the same country.

Step 3. Finally, we show that the profit function also exhibits an increasing difference in $\left(\mathbb{I}_{ij}^M, \mathbb{I}_{ik}^M\right)$ for any j and k. That is,

$$\pi_i\left(\mathbb{I}_{ik}^M = 1, \mathbb{I}_{ij}^M = 1\right) - \pi_i\left(\mathbb{I}_{ik}^M = 0, \mathbb{I}_{ij}^M = 1\right) \geqslant \pi_i\left(\mathbb{I}_{ik}^M = 1, \mathbb{I}_{ij}^M = 0\right) - \pi_i\left(\mathbb{I}_{ik}^M = 0, \mathbb{I}_{ij}^M = 0\right),$$

other things equal. It is equivalent to showing that

$$\begin{aligned}
&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j, j'\neq k} \mathbb{I}_{ij'}^M T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta} + T_j\left(\tau_{ij}w_j\right)^{-\theta} + T_k\left(\tau_{ik}w_k\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k=1}^{J} \mathbb{I}_{k'i}^X\left(\tau_{k'i}\right)^{1-\sigma} B_{k'}\right)\\
&- w_i\left(1-\alpha_0\mathbb{I}_{ik}^M\right) f_{ki}^X(\omega) + w_i\alpha_1\mathbb{I}_{ik}^M f_{ik}^M(\omega)\\
&- w_i\left(1-\alpha_1\mathbb{I}_{ji}^X\right) f_{ij}^M(\omega) + w_i\alpha_0\mathbb{I}_{ji}^X f_{ji}^X(\omega)\\
&- \left[\begin{array}{c}\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j, j'\neq k}\mathbb{I}_{ij'}^M T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta} + T_j\left(\tau_{ij}w_j\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k=1}^{J}\mathbb{I}_{k'i}^X\left(\tau_{k'i}\right)^{1-\sigma}B_{k'}\right)\\ -w_i\left(1-\alpha_1\mathbb{I}_{ji}^X\right) f_{ij}^M(\omega) + w_i\alpha_0\mathbb{I}_{ji}^X f_{ji}^X(\omega)\end{array}\right]\\
\geq&\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j, j'\neq k} \mathbb{I}_{ij'}^M T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta} + T_k\left(\tau_{ik}w_k\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k=1}^{J} \mathbb{I}_{k'i}^X\left(\tau_{k'i}\right)^{1-\sigma} B_{k'}\right)\\
&- w_i\left(1-\alpha_1\mathbb{I}_{ji}^X\right) f_{ij}^M(\omega) + w_i\alpha_0\mathbb{I}_{ji}^X f_{ji}^X(\omega)\\
&- \left[\varphi^{\sigma-1}\left(\gamma\left(\sum_{j'\neq j, j'\neq k} \mathbb{I}_{ij'}^M T_{j'}\left(\tau_{ij'}w_{j'}\right)^{-\theta}\right)\right)^{\frac{\sigma-1}{\theta}}\left(\sum_{k=1}^{J} \mathbb{I}_{k'i}^X\left(\tau_{k'i}\right)^{1-\sigma} B_{k'}\right)\right].
\end{aligned}$$

Similarly, it can be shown that this is indeed the case if $\frac{\sigma-1}{\theta} \geq 1$.

B.3 Derivation of Gravity Equations

In this section, we focus on the derivation of the gravity equation for intermediate goods (25), and the one for final goods (29) can be derived in a similar way. Note that rearranging equation (23) gives

$$M_{ij} = N_i \times (\sigma - 1)\gamma^{\frac{\sigma-1}{\theta}} T_j(w_j)^{-\theta} \times \left(\tau_{ij}^M\right)^{-\theta} \times \Lambda_{ij}^M. \tag{B.3}$$

Define origin j's total production of intermediate goods as

$$Q_j \equiv \sum_k M_{kj} = (\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} T_j(w_j)^{-\theta} \times \sum_k N_k \left(\tau_{kj}^M\right)^{-\theta} \Lambda_{kj}^M. \tag{B.4}$$

Hence, we have

$$(\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} T_j(w_j)^{-\theta} = \frac{Q_j}{\sum_k N_k \left(\tau_{kj}^M\right)^{-\theta} \Lambda_{kj}^M}. \tag{B.5}$$

From the free-entry condition (17) and labor market clearing condition (18), we get the equilibrium number of entrants as

$$N_i = \frac{\eta w_i L_i}{\sigma \left(\int_{\underline{\varphi}_i}^{\infty} \varphi^{\sigma-1} \left(\gamma \Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} \Theta_i^X(\varphi) dG_i(\varphi) \right)}. \tag{B.6}$$

Country i's total expenditure on manufacturing sector is given by

$$E_i = \eta w_i L_i. \tag{B.7}$$

Rearranging the denominator of equation (B.6) gives

$$\begin{aligned}
& \sigma \left(\int_{\underline{\varphi}_i}^{\infty} \varphi^{\sigma-1} \left(\gamma \Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} \Theta_i^X(\varphi) dG_i(\varphi) \right) \\
= & \sum_{k=1}^{J} B_k \left(\int_{\underline{\varphi}_i}^{\infty} \mathbb{I}_{ki}^X(\varphi)\, \sigma \varphi^{\sigma-1} \left(\gamma \Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} \left(\tau_{ki}^X\right)^{1-\sigma} dG_i(\varphi) \right) \\
= & \sum_{k=1}^{J} B_k \times \frac{\sigma^\sigma}{(\sigma-1)^{\sigma-1}} P_{ki}^{1-\sigma} / N_i,
\end{aligned}$$

where the ideal export price index of goods exporting from country i to market k is defined as

$$\begin{aligned}
P_{ki}^{1-\sigma} &= N_i \int_{\underline{\varphi}_i}^{\infty} \mathbb{I}_{ki}^X(\varphi)\, p_{ki}^{1-\sigma}(\varphi)\, dG_i(\varphi) \\
&= N_i \int_{\underline{\varphi}_i}^{\infty} \mathbb{I}_{ki}^X(\varphi) \left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} \varphi^{\sigma-1} \left(\gamma \Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} \left(\tau_{ki}^X\right)^{1-\sigma} dG_i(\varphi).
\end{aligned}$$

Therefore

$$
\begin{aligned}
N_i &= \frac{E_i}{\sum_{k=1}^{J} B_k \times \frac{\sigma^\sigma}{(\sigma-1)^{\sigma-1}} P_{ki}^{1-\sigma}/N_i} \\
&= \frac{E_i}{\frac{\sigma^\sigma}{(\sigma-1)^{\sigma-1}} \sum_k B_k \times \sum_{k=1}^{J} b_k \; P_{ki}^{1-\sigma}/N_i} \\
&\equiv \frac{E_i}{\frac{\sigma^\sigma}{(\sigma-1)^{\sigma-1}} \sum_k B_k \times \bar{P}_i^{1-\sigma}/N_i},
\end{aligned}
\tag{B.8}
$$

where $b_k \equiv \frac{B_k}{\sum_{i=1}^{J} B_i}$ and $\bar{P}_i^{1-\sigma} \equiv \sum_{k=1}^{J} b_k \; P_{ki}^{1-\sigma}$.

Finally, plugging $(\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} T_j (w_j)^{-\theta}$ from equation (B.5) and N_i from equation (B.8) back into equation (B.3) yields the gravity equation (25) of intermediate goods.

C Estimation and Quantitative Appendix

C.1 Model Solution and Estimation

In this section, we describe the estimation details. We first describe the construction of moments, followed by the simulation of firm-level productivity and firm-market-level bilateral fixed-cost shocks. Finally, we show how we use the "sandwich" algorithm to get the sourcing and exporting profiles and perform model estimation.

C.1.1 Moment Construction

We list the construction of moments according to the ordering in Table 9. We use the merged sample across Annual Survey of Industrial Enterprise and Chinese customs sample for the year 2007.

1. share of importers and exporters (among all firms): Following the literature, we calculate the share of exporters as the number of exporters divided by the total number of Chinese firms. The share of importers can be obtained in a similar way. We also calculate the share of Chinese firms exporting to and importing from each foreign country.

2. The share of importers and exporters (among small firms): The share of exporters and the share of importers among firms whose sales income is below the median level can be calculated similarly.

3. The share of firms with median (in data) domestic input purchase: The median level of domestic input purchase is directly observed in the data. By definition, the share of firms with domestic input purchase below this level is 50%.

4. The conditional ratios on both export and import side. We use the same calculation as in Table 2. For each foreign country, we calculate the share of Chinese firms exporting to that country among those who import from the same country and among the others who do not. This leads to two conditional shares of exporters. Then we take simple average across foreign countries and calculate the ratio between these

two cross-country mean-level conditional shares, i.e. ratio between share of exporters among importers and non-importers. The ratio between share of importers among exporters and non-exporters is calculated in a similar manner.

5. The two-way distance relationship: For each destination, we compute the share of two-way traders over the total number of firms that either sell to or source from that market. We then compute the correlation between the log two-way share and log distance to China.

6. The entry pattern: We sort foreign countries by their distance to China, with the closest foreign country being the first in the rank. For a firm's vector of export dummies X, we compute the correlation between $X(1 : \text{end}-1)$ and $X(2 : \text{end})$. We then take average of the correlations among all firms. Symmetrically, we compute the average cross-market correlation for a firm's vector of import dummies M as another target moment. The entry correlation is defined as the average of the export side and the import side.

C.1.2 Additional Discussions on the Identification of α_0, α_1 and ρ

Our model identification involves two components: first, separately identifying ρ (the cost correlation parameter) from α_0, α_1 (the cost reduction parameter); second, given ρ, separately identifying α_0 from α_1.

As fixed cost draws are allowed to be correlated across markets with correlation governed by the parameter ρ, we can use cross-market trade patterns to separately identify ρ from α's, precisely because α's affect mainly within-market trade patterns. Intuitively, a firm's trade (export or import) decisions are more correlated across markets, should the fixed costs draws have stronger cross-market correlation.

Then given a calibrated ρ, we use three sets of moments to identify α_0 from α_1. The first set contains the two conditional ratios as shown in Table 2 that capture the exporter's (importer's) advantage in import (export) participation relative to non-exporters (non-importers). The second set of moment is the correlation between a firm's export profile and its import profile. The third set of moment is the correlation between the share of two-way traders in a foreign country and its geographic distance with China. In what follows, we provide detailed discussions on each one of them.

First, as discussed in the identification section 5.1, the conditional ratios in Table 2 are crucial in identifying αs.

Second, we calculate the correlation between a firm's vector of export dummies X and its vector of import dummies M, and then take average across firms. This correlation directly gauges within-firm export-import correlation within the same market.

Finally, to see how the correlation between distance and the share of two-way traders among local trading firms can aid to identify α's, we express the fixed costs of being a two-way trader in a foreign country c according our model as follows:

$$f_{fij}^{\text{twoway}} = (1-\alpha_0)\, e^{\beta_C^X + \beta_{\text{disp}}^X \varepsilon_{fij}^X} \text{distance}_{ij}^{\beta_d^X} + (1-\alpha_1)\, e^{\beta_C^M + \beta_{\text{disp}}^M \varepsilon_{fij}^M} \text{distance}_{ij}^{\beta_d^M},$$

while the fixed costs faced by a pure exporter and a pure importer are given respectively by

$$\begin{aligned} f_{fij}^{\text{exporter}} &= e^{\beta_C^X + \beta_{\text{disp}}^X \varepsilon_{fij}^X} \text{distance}_{ij}^{\beta_d^X}, \\ f_{fij}^{\text{importer}} &= e^{\beta_C^M + \beta_{\text{disp}}^M \varepsilon_{fij}^M} \text{distance}_{ij}^{\beta_d^M}. \end{aligned}$$

In theory, if $\beta_C^X = \beta_C^M = \beta_C$, $\beta_{\text{disp}}^X = \beta_{\text{disp}}^M = \beta_{\text{disp}}$, and $\beta_d^X = \beta_d^M = \beta_d$, the two cost saving parameters have a symmetric effect in reducing the fixed costs of becoming a two-way trader within the same place. However, in the estimation, the bilateral β coefficients are generally not identical. Thus, we can rely on the differential bilateral β coefficients and variation in geographic distance across markets to separate the role played by α_0 from that of α_1. For example, when $\beta_d^X > \beta_d^M$, an increase in α_0 should lead to more cost reduction than an increase in α_1, generating a higher share of two-way traders. More importantly, its impact is more pronounced for more distant markets, thereby altering the elasticity of local two-way traders share with respect to its distance with China. Therefore, in this case, α_0 governs the correlation between the share of two-way traders and geographic distance.

C.1.3 Simulation of Firm Productivity and the Cost Shocks

We follow the steps below to simulate the firm productivity φ and the cost shocks , ε^M_{fij} and ε^X_{fij}. To simulate firm productivity φ, we draw randomly 200,000 samples from a uniform distribution (from 0 to 1) and use the inverse cumulative density function of the Pareto distribution to get φ. Given each φ, we first simulate a vector of $2{\times}N$ uncorrelated standard normal variables: $Z \sim (0, I)$. Then we transform Z to $Y = \text{chol}\,(\Sigma)\,Z$, where Σ is the variance-covariance matrix that has values 1 along the diagonal and ρ otherwise, and chol denotes the Cholesky decomposition. We then extract the first 1 to N elements of Y as ε^M_{fij} and the remaining $N+1$ to $2N$ elements as ε^X_{fij}.

C.1.4 The "Sandwich" Algorithm

In this section, we list the steps in jointly solving a firm's export and import decisions. The algorithm is based on Proposition 1. The algorithm iterates an indicator vector, which contains all dummy variables that indicate a firm's exporting and sourcing status. Specifically, for firms indexed by φ_i and destination-specific exporting and sourcing cost draw $\varepsilon^s_i, \varepsilon^i_i$, we implement the following search algorithm:

1. We initialize two indication vectors: both of size $1 \times 2N$ (with the first $1 \sim N$ elements representing sourcing status and the remaining $N+1 \sim 2N$ elements representing the exporting status). The first vector $\mathcal{J}_l$ contains only zeros indicating firms neither export nor import; The second vector $\mathcal{J}_h$ contains only ones so that firms import from and export to all destinations.

2. Starting from $\mathcal{J}_l$, we sequentially *add* sourcing and exporting destinations, depending on whether this action brings profit. We repeat this step until no room for improvement and label this final vector as $\mathcal{J}_l'$.

3. Starting from $\mathcal{J}_h$, we sequentially *drop* sourcing and exporting destinations depending on whether this action brings profit. We iterate until no room for improvement and label this final vector as $\mathcal{J}_h'$.

4. If $\mathcal{J}_l = \mathcal{J}_h$, then the optimal decision is obtained, otherwise move to the next step

5. We re-initialize $\mathcal{J} = \mathcal{J}_l' \cap \mathcal{J}_h'$, and scan through all the remaining combinations of exporting and sourcing decisions.

C.1.5 SMM Routine

Let $\Theta = \{\theta_1, \ldots, \theta_m\}$ represent parameters, and let $\mathbf{M} = \{\mathbf{m}_1, \ldots, \mathbf{m}_k\}$ represent moments. We numerically compute the following matrix containing derivatives of moments with respect to changes in parameters,

$$\frac{\Delta \mathbf{M}}{\Delta \Theta} = \begin{pmatrix} \frac{\Delta \mathbf{m}_1}{\Delta \theta_1} & \frac{\partial \mathbf{m}_1}{\partial \theta_m} \\ \cdots & \cdots \\ \cdots & \cdots \\ \frac{\partial \theta_k}{\partial \mathbf{m}_1} & \frac{\partial \mathbf{m}_k}{\partial \theta_m}. \end{pmatrix} \tag{C.1}$$

Then the standard error vector is given by

$$\sqrt{\text{Diag}\left[\left(\frac{\Delta \mathbf{M}}{\Delta \Theta}\right)' \hat{\mathbf{W}}_{k \times k} \left(\frac{\Delta \mathbf{M}}{\Delta \Theta}\right)\right]}, \tag{C.2}$$

where

$$\hat{\mathbf{W}} = \begin{pmatrix} \frac{1}{\hat{\sigma}_1^2} & & & \\ & \ddots & & \\ & & \ddots & \\ & & & \frac{1}{\hat{\sigma}_k^2}. \end{pmatrix} \tag{C.3}$$

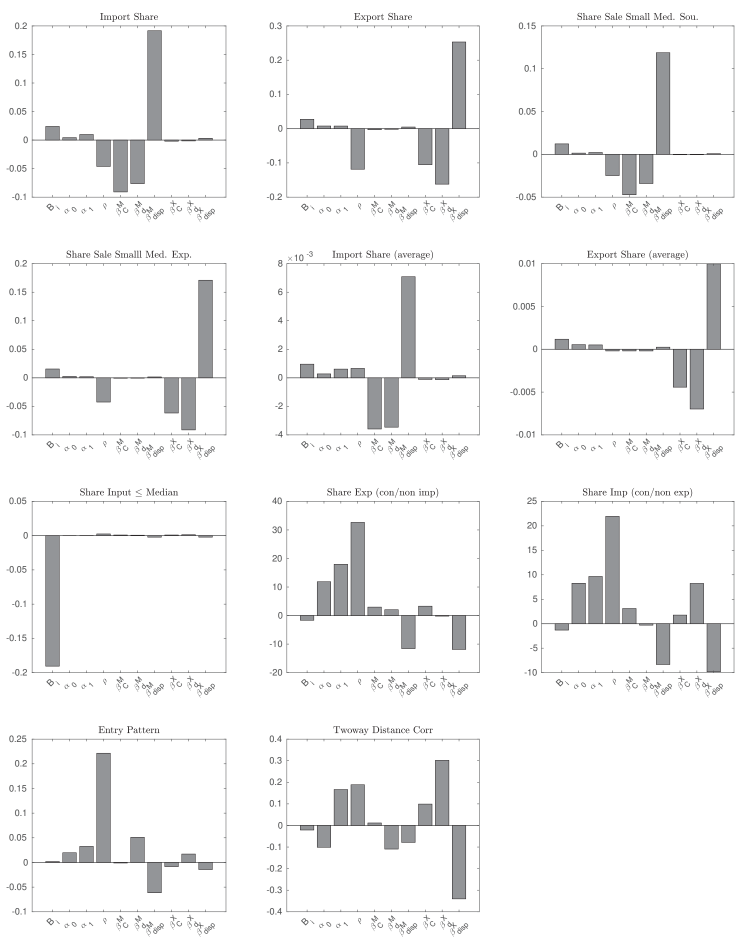
represents the weighting matrix for data. $\hat{\sigma}_k$ is the bootstrapped standard error for data moments.

C.1.6 The Jacobian Matrix

For a more transparent illustration of the model's identification, we chart in Figure A1 the Jacobian matrix associated to the SMM estimation[35]. It shows how parameter changes lead to changes in the targeted moments.

[35]Specifically, we compute the Jacobian matrix following Garcia-Macia, Hsieh, and Klenow (2019) by computing the percentage change in each moment with respect to a 0.1 level increase in each parameter.

Figure A1: Jacobian Matrix



Note: This figure reports the model identification result by showing the Jacobian matrix. The horizontal axis represents the parameters and the vertical axis represents the local derivative of the moment (shown as the title of each panel) with respect to the corresponding parameters.

C.1.7 Monte Carlo Simulation

In addition, we conduct Monte Carlo experiments to show the performance of the model's identification on α_0 and α_1. In doing so, we set all other parameters (such as the fixed costs coefficients) to their baseline level. In each experiment, we assign a value to α_0 and α_1 (i.e., the true value), and then simulate the model to obtain the pseudo-moments.

We then estimate the model using the simulated methods of moments approach to check whether the estimated α_0 and α_1 are close to the true values. We report the results in Table A9.

Table A9: Monte Carlo Analysis

experiment id	α_0(true)	α_0(estim)	α_1(true)	α_1(estim)
1	0.000	0.000	0.000	0.000
2	0.000	0.000	0.200	0.198
3	0.000	0.000	0.400	0.408
4	0.000	0.000	0.600	0.588
5	0.200	0.196	0.000	0.000
6	0.400	0.198	0.000	0.000
7	0.600	0.587	0.000	0.000
8	0.200	0.197	0.200	0.204
9	0.400	0.396	0.400	0.411
10	0.600	0.615	0.600	0.607

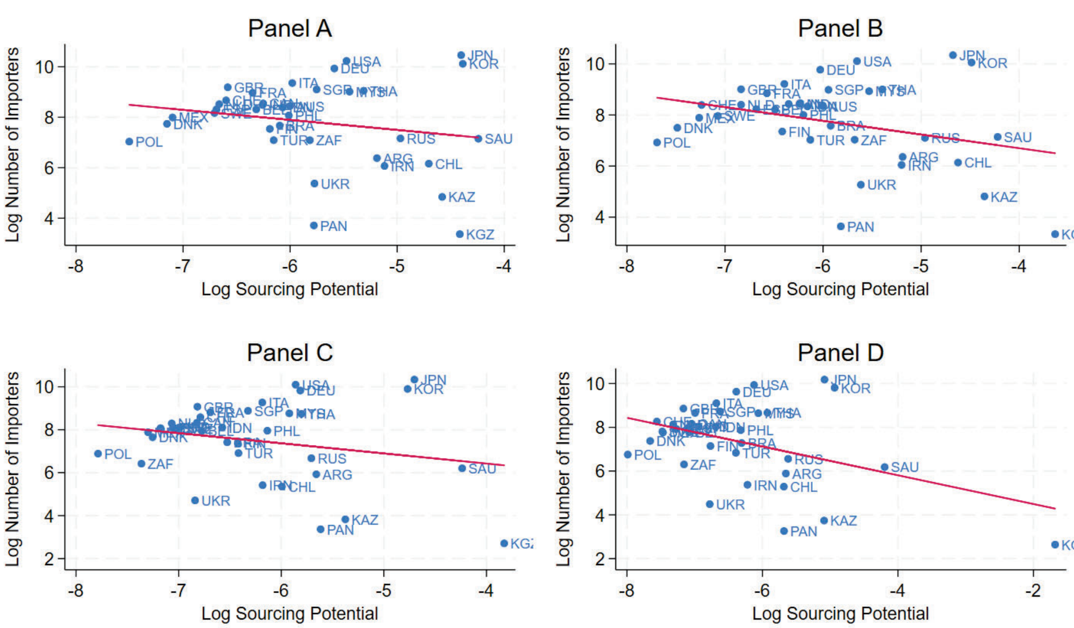
Note: This table shows Monte Carlo analysis. The first column lists the experimentation id, and the remaining four columns show the true αs and the estimated αs.

C.2 Baseline Model

Sourcing Potential Estimates and the Number of Importers Note that in Panel B of Figure 4, there is a negative correlation between the estimated sourcing potentials and the number of Chinese importers. We observe that this relationship appears to be mainly driven by countries such as Kyrgyzstan, Panama, and Kazakhstan, which primarily sell commodity goods. We conduct the following two groups of exercises to further investigate this issue. In the first one, we perform an array of additional exercise to show that the correlation seems to be robust to the choice of imported goods. Specifically, we find that the negative correlation remains if we only consider the intermediate inputs (as in the BEC-4 classification) or (and) the heterogeneous goods (as in the Rauch's classification). Second, we feed the baseline model with the newly estimated sourcing potentials where we only considers the intermediate inputs and the heterogeneous goods, we re-estimate the model and find that the main predictions of the model are barely affected. The details of these exercises are presented below.

Data Patterns We consider three criteria in defining imported non-consumption goods: i) intermediate inputs only (BEC-4), ii) heterogeneous goods (following Rauch's classification), and iii) heterogeneous and intermediate goods (the intersection of i) and ii)). Figure A2 shows the results. Panel A is the baseline result, and Panels B to D show additional results if we focus only on the imported goods defined above. In all panels, the correlation between the estimated sourcing potentials and the number of Chinese importers remains negative, ranging from -0.40 (p-value is 0.246) in Panel A to -0.66 (p-value is 0.010) in Panel D.

Figure A2: Sourcing Potentials and the Number of Importers: Robustness



Note: This figure shows the correlation between country's (log) sourcing potential and the (log) number of Chinese importers for different categories of imported goods.

In addition, Table A10 shows that the estimated sourcing potentials in the baseline case exhibit a high correlation.

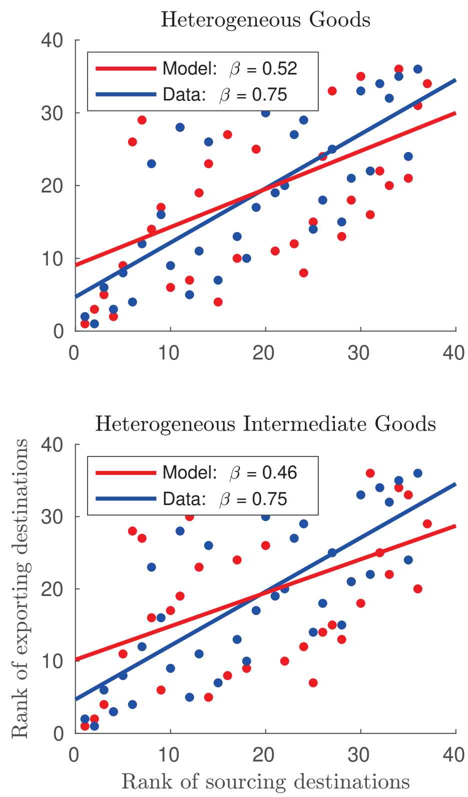
Table A10: Correlation Matrix of Estimated Sourcing Potentials

	Baseline	Alternative 1	Alternative 2	Alternative 3
Baseline	1.000			
Alternative 1	0.976	1.000		
Alternative 2	0.891	0.863	1.000	
Alternative 3	0.850	0.893	0.940	1.000

Note: This figure shows the correlation matrix across several estimated sourcing potentials. Baseline refers to our baseline sourcing potentials, while Alternative 1-3 are alternative estimates.

Model Performance We then re-estimate the model with the reconstructed sourcing potentials. Figure A3 shows the rank-rank correlation under each re-estimation. The first panel revisits the baseline results, the second panel to the forth panel (in horizontal ordering) shows the relationships where the sourcing potentials are constructed using intermediate goods only, heterogeneous goods only, or the intersection of the two groups. We find that the relationship remains robust to the choice of imported goods.

Figure A3: Rank-Rank Correlation (Alternative Sourcing and Exporting Potential)

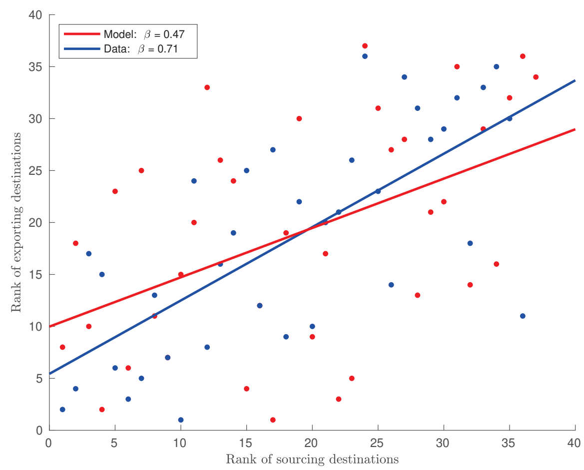


Note: This figure shows the rank-rank correlation under each estimations of sourcing potentials. The first panel shows the baseline result. The second panel shows the correlation when the sourcing potential is constructed using intermediate goods only. The third panel uses only heterogeneous goods, and the last panel uses both intermediate and heterogeneous goods.

C.2.1 Residual Plot of Rank-Rank Relationship

This section shows that the model's performance on the rank-rank correlation is robust when we alternatively conduct a residual plot analysis for the model. Specifically, in Figure A4 and for both the model and the data, we first regress the number of exporters and importers in the gravity variables, including the distance from a foreign country j to China, contiguity, common continent, common language, common income group and RTA between China and the foreign country, and foreign GDP per capita, as in our reduced-form analysis, and get the residuals. We then obtain a country's export rank and import rank using the corresponding residuals, and plot the relationship. The result is presented in Figure A4. We find that the positive rank-rank correlation was slightly weakened after controlling for the gravity variables.

Figure A4: Rank-Rank Correlation: Residual Plot



Note: This figure shows the residual plot of the rank-rank relationship of the baseline model. For both the model and the data, we first regress the number of exporters and importers on the gravity variables. We then obtain a country's export rank and its import rank using the corresponding residuals, and plot the relationship.

C.2.2 Sensitivity Analysis

Sourcing and Sales Potentials To alleviate the concern of outliers in affecting our estimated sourcing and sales potential, we check robustness by using alternative specifications.

Note that our baseline specifications (i.e., equation (30) and (31)) are equivalent to a reduced-form approach that calculates the mean level of foreign input share and sales share normalized by their domestic counterparts: $\frac{\chi^M_{fij}}{\chi^M_{fii}}$ and $\frac{\chi^X_{fij}}{\chi^X_{fii}}$ among firms within each country, as a proxy for a country's sourcing potential and its sales potential, respectively.

Specifically,

$$\hat{\xi}_{ij}^{M} = \underset{f:\chi_{fij}^{M}>0}{\text{mean}} \frac{\chi_{fij}^{M}}{\chi_{fii}^{M}},$$

and

$$\hat{\xi}_{ij}^{X} = \underset{f:\chi_{fij}^{X}>0}{\text{mean}} \frac{\chi_{fij}^{X}}{\chi_{fii}^{X}}.$$

In this section, we provide two alternative approaches to estimate sourcing potentials and sales potentials. In the first one, we use the median level, instead of mean level, of the normalized foreign input share and sales share. That is,

$$\hat{\xi}_{ij}^{M,med} = \underset{f:\chi_{fij}^{M}>0}{\text{median}} \frac{\chi_{fij}^{M}}{\chi_{fii}^{M}},$$

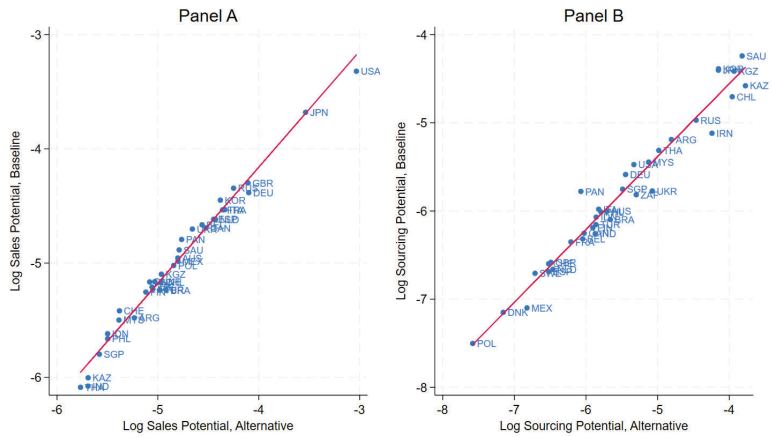
and

$$\hat{\xi}_{ij}^{X,med} = \underset{f:\chi_{fij}^{X}>0}{\text{median}} \frac{\chi_{fij}^{X}}{\chi_{fii}^{X}}.$$

Figure A5 checks the correlation between the baseline and alternative estimates for sourcing and sales potentials. The correlation is 1.01 with p-value 0.000 (Panel A), and that for sourcing potentials is 0.83 with p-value 0.000 (Panel B).

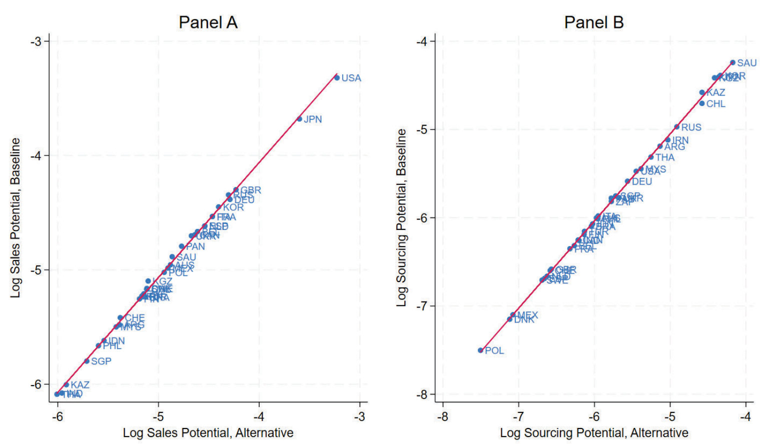
To further address the concern on outliers, we conduct a second exercise where the sourcing and exporting potential estimates are based on the mean level of winsorized $\frac{\xi_{fij}^{X}}{\xi_{fii}^{X}}$ and $\frac{\xi_{fij}^{M}}{\xi_{fii}^{M}}$. In doing so, we trim the observations at the bottom 3% and the top 3% within each foreign country. Figure A6 shows the results, where we find their correlations are high and statistically significant.

Figure A5: Alternative Estimates of Sales Potentials and Sourcing Potentials: Median



Note: This figure shows the correlation between the baseline estimates of sales potentials (Panel A) and sourcing potentials (Panel B) with their counterparts obtained from the median level of observations.

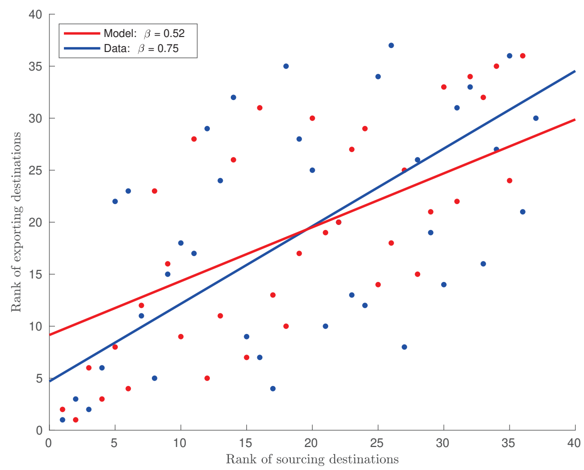
Figure A6: Alternative Estimates of Sales Potentials and Sourcing Potentials: Winsorized Mean



Note: This figure shows the correlation between the baseline estimates of sales potentials (Panel A) and sourcing potentials (Panel B) with their counterparts obtained from the mean level of observations winsorized at the bottom 3% and the top 3%.

Pareto Shape Parameter In this section, we perform a sensitivity analysis on the Pareto shape parameter. We re-estimate the baseline model with the Pareto shape parameter directly backed out from the data of sales income among top 1 firms. Figure A7 shows the rank-rank relationship.

Figure A7: Rank-Rank Correlation: Alternative Pareto Shape



Note: This figure shows the rank-rank relationship of the baseline model when the Pareto shape parameter is estimated from the data of sales income.

Sensitivity to Higher Demand Elasticity Table A11 shows the parameter assignment for a larger value of σ. We re-estimate the model and obtain new parameter values.

Table A11: Parameter Assignment: High Sensitivity to Higher Demand Elasticity

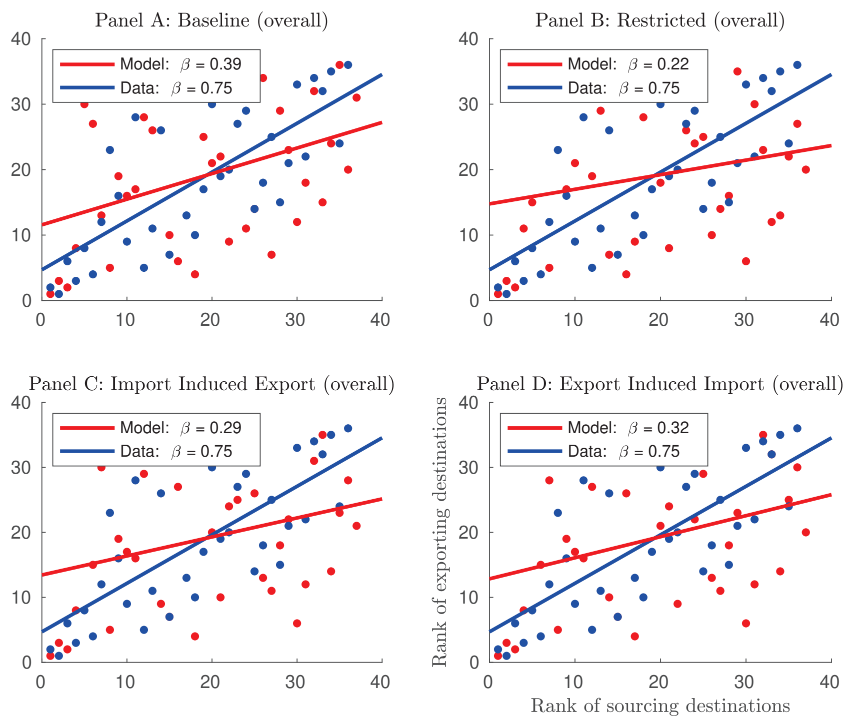
Parameters	Symbols	Baseline	Source
Panel A: Assigned			
Pareto shape.	κ	4.25	Literature
Panel B: Reduced-form regressions			
Demand elasticity	σ	5.76	Estimation
Sourcing elasticity	θ	1.07	Estimation
Panel C: SMM			
Demand scale	$\tilde{B}_i$	2.59 (0.12)	Estimation
Cost reduction (import-induced export)	α_0	0.32 (0.12)	Estimation
Cost reduction (export-induced import)	α_1	0.28 (0.059)	Estimation
Correlation of fixed costs	ρ	0.063 (0.013)	Estimation
Sourcing: constant term	β_C^M	1.55 (0.053)	Estimation
Sourcing: coefficient of distance	β_d^M	2.33 (0.005)	Estimation
Sourcing: standard deviation	β_{disp}^M	1.39 (0.021)	Estimation
Export: constant term	β_C^X	3.09 (0.098)	Estimation
Export: coefficient of distance	β_d^X	1.75 (0.020)	Estimation
Export: standard deviation	β_{disp}^X	2.60 (0.038)	Estimation

Note: This table shows the estimation of model parameters given a higher value of demand elasticity: 5.76 in this case versus 4.23 in the baseline.

C.2.3 Additional Results of the Baseline Model

Rank-Rank for Overall Firms Figure A8 checks the robustness of the rank-rank correlation. In the text, the ranks of sourcing partners and exporting destinations is by the number of importers and exporters, respectively, and is for two-way traders only. In the following figure, we instead use the full sample including pure exporters and pure importers. We observe a similar pattern.

Figure A8: Rank-Rank for Overall Firms



Note: This figure plots the rank-rank result. The ranks of sourcing partners and exporting destinations is by the number of importers and exporters, respectively, using the overall sample.

Correlation of Fixed Cost Draws This section performs a comparative static analysis where we vary the positive correlations between the firm-level fixed cost draws. Table A12 reports the rank-rank correlation for different levels of correlation between the fixed cost draws.

Panel A of the table shows the rank-rank relationship (conditional on all exporters and importers) for all four types of models. We experiment the following correlation levels: $\rho \in \{0.0, 0.2, 0.4, 0.6, 0.8\}$, and all the rest values of the model are taken from our estimation. There are two points to note. First and perhaps not surprisingly, increasing the correlation parameter does make the model to better capture the rank-rank relationship, and this pattern largely holds for all four types of models. For example, for the second type of model (only import-induced export), the rank-rank correlation increases from 0.2 to 0.4

when ρ increase from 0 to 0.40. But for it to deliver data-consistent rank-rank correlations, the correlation of cost draws needs to be very high. Panel B looks at the overall sample, where we find similar patterns.

Table A12: Rank-Rank Correlations for Correlated Fixed-Cost Shock Draws

parameters	baseline	imp to exp	exp to imp	restricted	data
Panel A: num + overall					
$\rho = 0.00$	0.36	0.28	0.32	0.21	0.75
$\rho = 0.20$	0.45	0.31	0.32	0.23	0.75
$\rho = 0.40$	0.53	0.33	0.35	0.22	0.75
$\rho = 0.60$	0.63	0.34	0.36	0.20	0.75
$\rho = 0.80$	0.74	0.39	0.43	0.20	0.75
Panel B: num + twoway					
$\rho = 0.00$	0.51	0.32	0.36	0.21	0.75
$\rho = 0.20$	0.53	0.33	0.33	0.21	0.75
$\rho = 0.40$	0.59	0.34	0.39	0.21	0.75
$\rho = 0.60$	0.66	0.34	0.39	0.19	0.75
$\rho = 0.80$	0.75	0.38	0.44	0.20	0.75

Note: This table shows the rank-rank correlation when firms' fixed cost draws on sourcing and exporting destinations are correlated.

Hierarchy Entry Patterns Table A13 shows the hierarchical entry structure for both exporting and sourcing in model and in data.

C.3 Alternative Models

C.3.1 Same α's

In the baseline model, having two separate parameters allows us to study the impact of unilateral cost reductions in restricted models with either one direction being shut down.

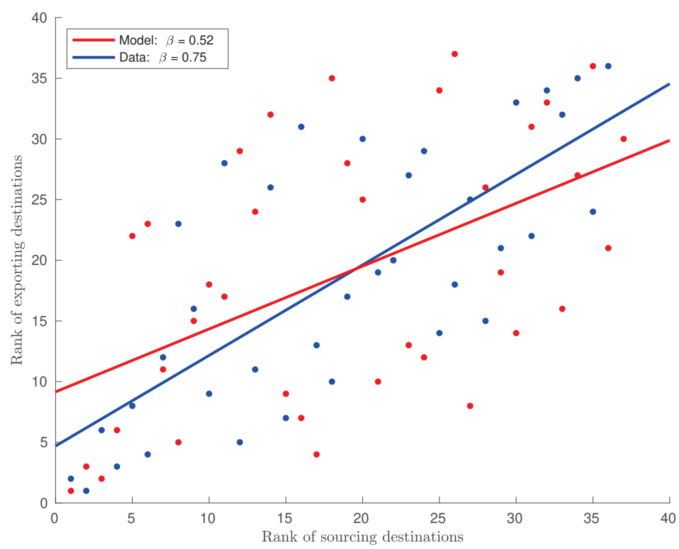
Table A13: Hierarchy Structure in Importing and Exporting

	baseline	imp to exp	exp to imp	restricted	data
Panel A: Sourcing					
1	100	100	100	100	100
1-2	1.95	0.97	0.91	1.27	2.92
1-2-3	0.12	0.06	0.08	0.14	0.57
1-2-3-4	0.016	0.007	0.007	0.027	0.52
1-2-3-4-5	0.002	0.001	0.002	0.007	0.64
Panel B: Exporting					
1	100	100	100	100	100
1-2	0.57	0.52	0.54	0.37	2.27
1-2-3	0.041	0.033	0.037	0.027	0.57
1-2-3-4	0.001	0.002	0.001	0.001	0.52
1-2-3-4-5	0	0	0	0	0.64

Note: This table shows the Chinese firms sourcing and exporting pattern from the top origins and destinations. Panel A shows sourcing, and panel B shows exporting. The string 1 means importing to/exporting from top one country but no other, and the string 1-2 means from/to top one and top two but no other; and so forth. All numbers are normalized by the first row.

Now, we add an exercise where we force the two parameters to be identical. The results are shown in the following figure.

Figure A9: Rank-Rank (Same α's)



Note: This figure shows the rank-rank relationship when we restrict $\alpha_0 = \alpha_1$.

C.3.2 Target Full Moments

Table A14 lists the parameter assignments and estimations when the four types of models are estimated by targeting the same set of moment (identical to the baseline model). In Figure A10, we plot the rank-rank relationship for the four models using the parameters in Table A14.

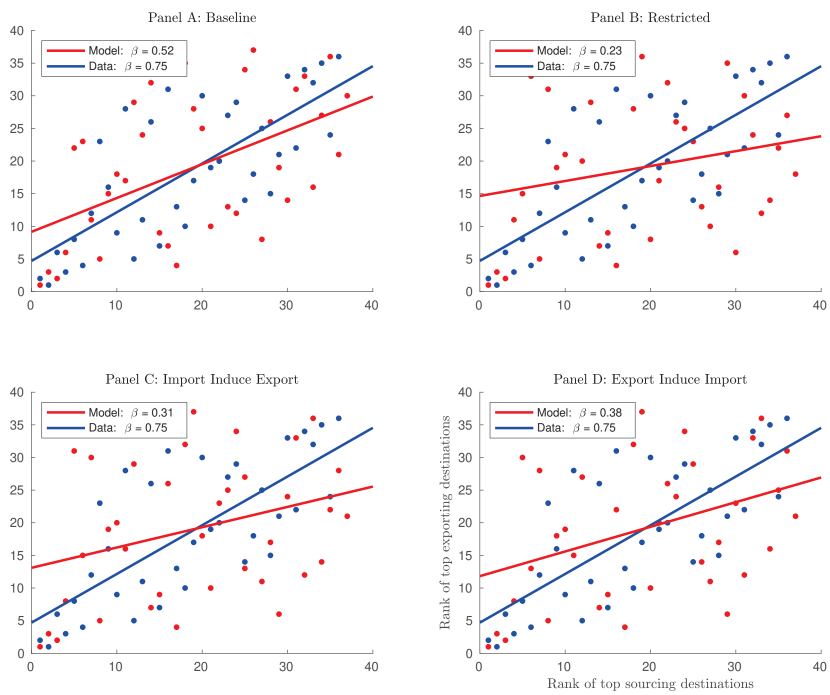
Table A14: Parameter Assignments (Identical Moments)

Parameters/Moments	Baseline	$\alpha_1 = 0$	$\alpha_0 = 0$	Restricted	Source/Data
Panel A: Assigned					
Pareto shape.	4.25	4.25	4.25	4.25	Literature
Panel B: Reduced-form regression					
Demand elasticity	4.23	4.23	4.23	4.23	Estimation
Sourcing elasticity	1.07	1.07	1.07	1.07	Estimation
Panel C: from SMM					
Demand scale	3.81	3.75	3.84	3.72	Estimation
	(0.14)	(0.18)	(0.20)	(0.17)	Estimation
Cost reduction (import-induced export)	0.42	0.31	0.00*	0.00*	Estimation
	(0.034)	(0.020)	(–)	(–)	Estimation
Cost reduction (export-induced import)	0.35	0.00*	0.15	0.00*	Estimation
	(0.024)	(–)	(0.061)	(–)	Estimation
Correlation of fixed costs	0.05	0.04	0.05	0.04	Estimation
	(0.004)	(0.004)	(0.006)	(0.004)	Estimation
Sourcing: constant term	2.72	3.01	3.02	2.31	Estimation
	(0.094)	(0.058)	(0.048)	(0.047)	Estimation
Sourcing: coefficient of distant	1.34	0.85	0.76	0.54	Estimation
	(0.014)	(0.014)	(0.016)	(0.012)	Estimation
Sourcing: standard deviation	2.30	2.51	2.34	1.57	Estimation
	(0.033)	(0.010)	(0.009)	(0.011)	Estimation
Export: constant term	3.39	2.88	2.98	2.95	Estimation
	(0.10)	(0.13)	(0.10)	(0.09)	Estimation
Export: coefficient of distant	0.77	0.72	0.79	0.59	Estimation
	(0.039)	(0.019)	(0.034)	(0.019)	Estimation
Export: standard deviation	2.71	2.63	2.63	2.63	Estimation
	(0.026)	(0.040)	(0.031)	(0.028)	Estimation
Panel D: Targeted moments					
Share of importers	0.11	0.18	0.14	0.06	Data
Share of exporters	0.13	0.17	0.15	0.19	Data
Share of importers (below median sales)	0.043	0.088	0.062	0.010	Data
Share of exporters (below median sales)	0.058	0.084	0.068	0.096	Data
Share of firms with median (in data) domestic input purchase	0.45	0.46	0.44	0.46	Data
Ratio b/w share of exporters among importers and non-importers	11.1	4.29	5.03	6.55	Data
Ratio b/w share of importers among exporters and non-exporters	8.21	4.22	4.67	6.61	Data
Two-way distance correlation	-0.7	-0.7	-0.7	-0.5	Data
Entry order correlation	0.14	0.11	0.11	0.14	Data

Note: This table shows parameterization for the baseline and the three restricted model, where all the models target the same set of moments with the baseline model. The standard errors are in parentheses.

C.3.3 Rank-Rank for Full Moments

Figure A10: Rank-Rank for Two-way Traders (Identical Moments)



Note: This figure plots the rank-rank result. The ranks of sourcing partners and exporting destinations is by the number of overall firms. All four panels share the same axis labels.

C.3.4 Decomposition of Models with Unilateral Economies of Scope

Table A15 shows the decomposition results from the two restricted models of unilateral economies of scope.

Table A15: Extensive Margin of Trade Liberalization (Unilateral Scope)

	Import liberalization	Export liberalization
Panel A: Import induced export		
Number of exporters	.0208	0.979
Number of importers	0.994	6e-3
Panel B: Export induced import		
Number of exporters	.0168	0.983
Number of importers	0.989	.0105

Note: This table decompose the extensive margin of trade into liberalization on sourcing and exporting side. The first column shows the contribution (in percent) of sourcing to exporter and importer entry; The second column is the contribution of export liberalization. The third and forth column are shows the associated numbers for the restricted model.