# Online Appendix for

# Bilateral Economies of Scope

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# 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.[1] 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)

[1] 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.[2] 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.

[2]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 Country-Level Conditional Ratios

Figure A1 plots the conditional export and import ratios across countries. Both ratios range from around 6 to 15. The large conditional ratios are in line with the conceptual framework presented above.

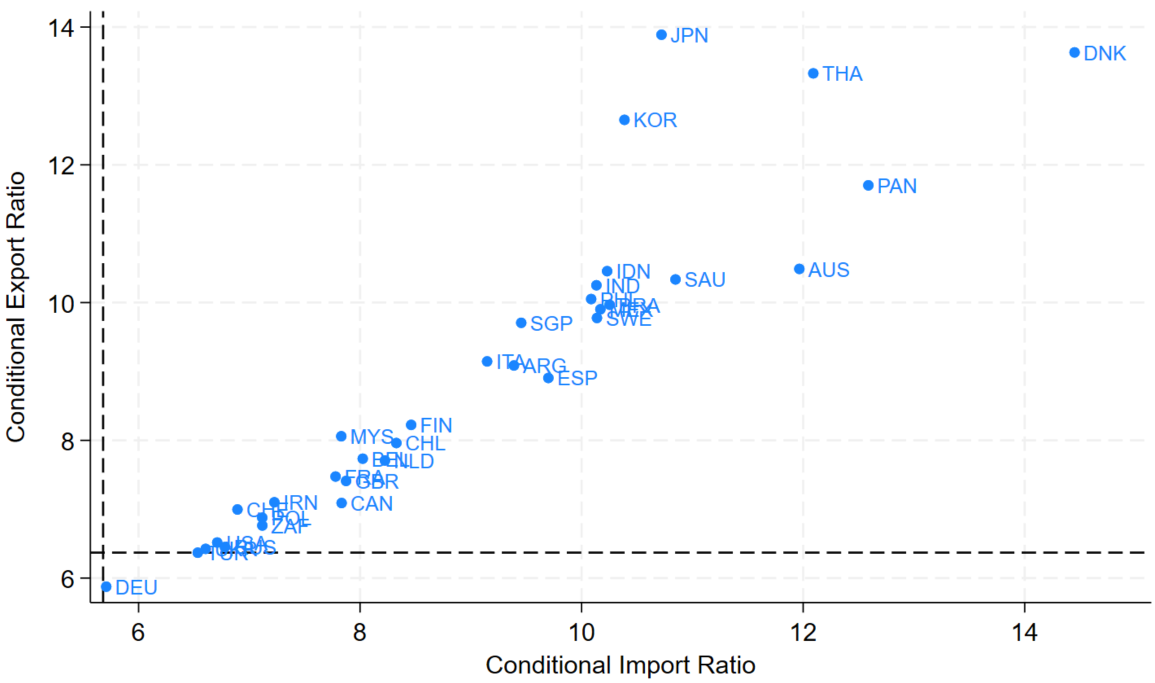


Figure A1: Country-Level Conditional Export and Import Ratios

*Note:* This table shows country-level conditional export and import ratios defined in Table 2. The dashed lines denote the conditional ratios for the global market.

## A.4 Further Discussions

We conclude the section by presenting further tests addressing the issues related to dynamic panel specifications and by showing that our results are robust to taking into account foreign-related firms, stagnant firms, additional extended gravity variables and alternative sample periods.

### A.4.1 Dynamic Panel Regressions

To address the potential problem of endogeneity from the dynamic panel regressions, we follow the solution suggested by Wooldridge (1997, 2010) and employ dynamic Probit model with random effects.[3] The results are shown in column (1) and (2) of Table A1 where the dependent variable is the firm's export dummy and of Table A2 where the dependent variable is the firm's import dummy. Since it is computationally demanding to estimate a dynamic Probit model, we restrict sample size in two different ways and cross-check the results. In column (1) of Table A1 and A2, we estimate the model with sample from 2008 to 2015 which constitutes around 75% observations of the full sample, while in column (2) of Table A1 and A2, we randomly select half of firms and estimate the model with this sub-sample. Our parameters of interest (the first row of column (1) and (2)) remain significant and positive, suggesting that our finding of bilateral economies of scope is robust to accounting for unobserved heterogeneity and serial correlation in firm trade decisions. The estimated coefficients in column (1) and (2) are quite close to each other.

In addition, we employ the standard system GMM model with instrument variables (IVs). Following Feng, Li, and Swenson (2016), we use two IVs. The first one is firm-country-specific exposure to import (export) tariff, and the second one is an indicator for the firm as processing importer (exporter) in a foreign country. Appendix A.11 presents how to construct the IVs and details on the system GMM. The result is given in column (3) of Table A1 and A2.[4] Our qualitative results are robust to using system GMM with

[3] Morales, Sheu, and Zahler (2019) use a mixed Logit model with random effects which is computationally infeasible in our case due to a much larger sample size in our study.

[4] Here we use sample from 2001 to 2007 since after 2007 the variations in both export and import

these two instrument variables.

### A.4.2 Productivity and Financial Constraint Channels

Our empirical finding on the complementarity between firm export and import could also arise for other reasons. For example, when a firm gradually relaxes its financial constraints, or increase its productivity over time, it may find it optimal to trade with a country in one direction first and then trade with the same country in the other direction later. To alleviate this potential issue, we perform sub-sample analysis and focus on firms with stagnant or diminishing trade performance (experience a non-positive growth rate of firm-level export) or declining firm productivity. The results are presented in columns (4) and (8) of Table A1 and A2, where the complementarity is robust. We provide in Appendix A.7 more results.

### A.4.3 Foreign-Related Firms

Several recent papers, notably Wang (2021); Antràs et al. (2022); Fan (2024), show that the linkage of firm ownership across countries (mostly through FDI) is a key determinant of bilateral trade relationships. Firms owned by foreign entities tend to trade more with their headquarters in both directions. To show the robustness of our channel to this potential force, we repeat the reduced-form exercises by adding an interaction term between our variable of interest and the dummy for foreign-related firms.[5] Columns (5) and (9) of Table A1 and A2 show the results.

We find that the significant and positive correlation still remains regardless of the firm's foreign relationship. We also find that foreign-related firms indeed have stronger correlations between exporting to and importing from the same market, which is consistent with the findings in Antràs et al. (2022).

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tariffs is limited. The sample size shrinks a lot as we focus on a balanced panel when constructing the firm-country-specific tariffs.

[5]We identify foreign-related firms as those marked as "Owned by foreign entity"(外商独资企业), "Jointly owned by domestic and foreign entity"(中外合资企业), and "Jointly maintained by domestic and foreign entity"(中外合作企业) in CCTS.

### A.4.4 Multi-Lateral Economies of Scope

In reality, it is possible that exporting to one country encourages firms to import from the country that shares similar geographic or economic characteristics with its export destination. In this subsection, we check if such multi-lateral economies of scope exists and whether it affects our baseline result or not. For this purpose, we repeat the regressions including both export-side and import-side extended gravity variables.[6] Column (6) and (10) of Table A1 and A2 show the results. Several takeaways are worth mentioning. First, incorporating additional extended gravity variables does not alter the sign or change the significance of our key coefficients. Second, there seems to be no multi-lateral economies of scope, as the estimated coefficients on the additional variables (import-side extended gravity variable in Table A1 and export-side extended gravity variable in Table A2) are not significant in general.

### A.4.5 Different Sample Period

Our baseline empirical exercise covers the period from 2000 to 2015. A potential concern here is that the post-WTO period (i.e., 2000-2007) is special, as it is characterized by large declines in trade costs, fast growth in the export and the productivity of Chinese firms. Thus, the firms' trade strategy could be different in this episode compared to normal times. To address this concern, we repeat the same regression in column (7) and (11) of Table A1 and A2 by using data from 2008 to 2015. The results remain stable.

[6]See Appendix A.10 for detailed construction of the extended gravity variables.

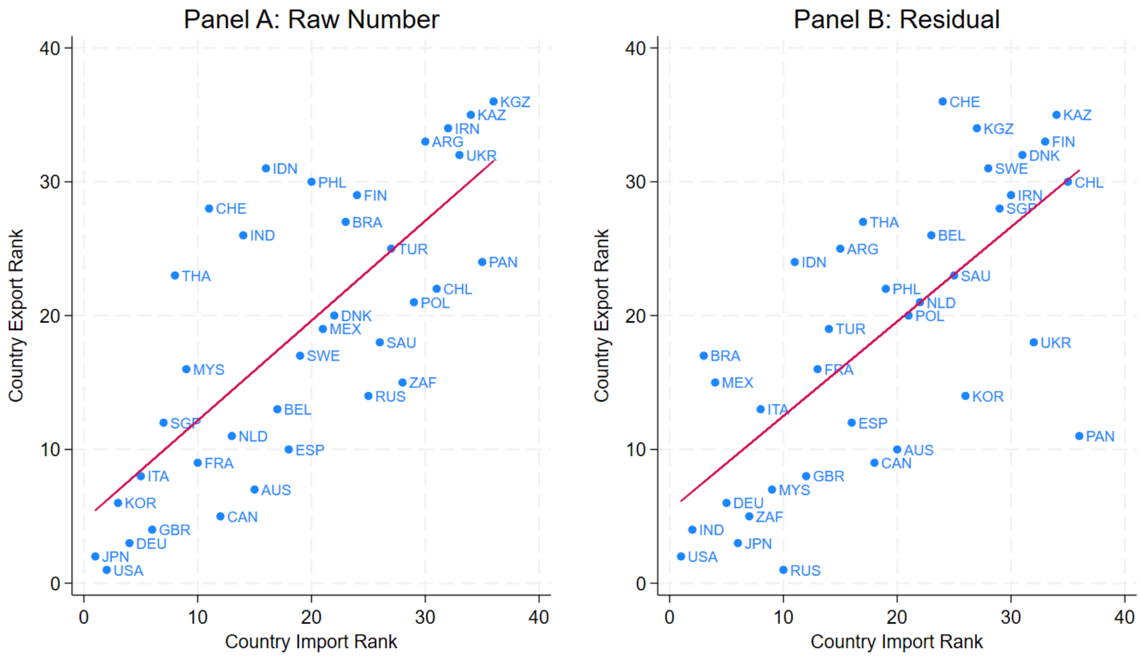



Figure A2: Country Rank Correlation by Number of Firms

*Note:* This exercise uses the merged sample of ASIE and CCTS, which includes top 30 export destinations and top 30 sourcing origins for China in year 2007 (in total 36 foreign countries). In Panel A, a country's export rank and its import rank is based on the raw number of Chinese exporters and importers, while in Panel B, we calculate a country's ranks based on the regression residuals where we regress the raw number of exporters and importers on a set of gravity variables (including distance, indicator for contiguity, common continent, common language, common income group and RTA between China and foreign country, and foreign GDP per capita).

## Table A1: The Effect of Import Choice on Export Decision: Robustness

| | Dependent Var.: $\mathbb{I}\{\text{Exp.}_{fct} > 0\}$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dyn. Probit RE | | System GMM | Probit | | | | LPM | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| $\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$ | 0.733*** | 0.735*** | 0.052*** | 0.278*** | 0.242*** | 0.248*** | 0.293*** | 0.019*** | 0.013*** | 0.017*** | 0.013*** |
| | (0.004) | (0.003) | (0.007) | (0.004) | (0.004) | (0.003) | (0.003) | (0.002) | (0.002) | (0.002) | (0.001) |
| $.\times$ Foreign Ownership Indicator$_{ft-1}$ | | | | | 0.093*** | | | | 0.008*** | | |
| | | | | | (0.002) | | | | (0.00549) | | |
| $\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$ | 1.372*** | 1.459*** | 0.290*** | 1.260*** | 1.276*** | 1.279*** | 1.290*** | 0.095*** | 0.060*** | 0.060*** | 0.008*** |
| | (0.004) | (0.003) | (0.010) | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) | (0.003) | (0.003) | (0.002) |
| Exp. Ext. Distance$_{fct-1}$ | -0.122*** | -0.102*** | -0.066*** | -0.263*** | -0.220*** | -0.208*** | -0.218*** | 0.005* | -0.002 | -0.002 | 0.000 |
| | (0.002) | (0.002) | (0.008) | (0.003) | (0.002) | (0.002) | (0.002) | (0.003) | (0.002) | (0.02) | (0.002) |
| Exp. Ext. Contiguity$_{fct-1}$ | 0.212*** | 0.221*** | 0.017** | 0.194*** | 0.206*** | 0.210*** | 0.213*** | 0.020*** | 0.019*** | 0.019*** | 0.015*** |
| | (0.003) | (0.002) | (0.010) | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.003) | (0.002) |
| Exp. Ext. Continent$_{fct-1}$ | 0.216*** | 0.236*** | -0.059*** | 0.218*** | 0.210*** | 0.214*** | 0.216*** | -0.003 | -0.003*** | -0.003*** | -0.003*** |
| | (0.003) | (0.002) | (0.009) | (0.005) | (0.004) | (0.004) | (0.004) | (0.002) | (0.001) | (0.001) | (0.001) |
| Exp. Ext. Com. Lang.$_{fct-1}$ | 0.269*** | 0.274*** | 0.023** | 0.245*** | 0.267*** | 0.260*** | 0.268*** | 0.004 | 0.003 | 0.003 | 0.002 |
| | (0.002) | (0.002) | (0.011) | (0.004) | (0.003) | (0.003) | (0.003) | (0.003) | (0.002) | (0.002) | (0.002) |
| Exp. Ext. Income Group$_{fct-1}$ | 0.500*** | 0.483*** | 0.015 | 0.345*** | 0.312*** | 0.313*** | 0.321*** | -0.011*** | -0.007*** | -0.007*** | -0.005** |
| | (0.003) | (0.003) | (0.010) | (0.005) | (0.004) | (0.004) | (0.004) | (0.003) | (0.002) | (0.002) | (0.002) |
| Imp. Ext. Distance$_{fct-1}$ | | | | | | -0.052*** | | | | 0.001 | |
| | | | | | | (0.001) | | | | (0.002) | |
| Imp. Ext. Contiguity$_{fct-1}$ | | | | | | -0.044*** | | | | 0.003** | |
| | | | | | | (0.001) | | | | (0.003) | |
| Imp. Ext. Continent$_{fct-1}$ | | | | | | -0.037*** | | | | 0.003*** | |
| | | | | | | (0.001) | | | | (0.003) | |
| Imp. Ext. Com. Lang.$_{fct-1}$ | | | | | | 0.067*** | | | | 0.002* | |
| | | | | | | (0.001) | | | | (0.003) | |
| Imp. Ext. Income Group$_{fct-1}$ | | | | | | 0.000 | | | | -0.002*** | |
| | | | | | | (0.003) | | | | (0.001) | |
| Constant | -1.793*** | -2.015*** | -1.414*** | -1.369*** | -0.899*** | -0.561*** | -0.805*** | 0.049** | 0.122*** | 0.112*** | 0.111*** |
| | (0.018) | (0.014) | (0.124) | (0.067) | (0.041) | (0.044) | (0.033) | (0.025) | (0.018) | (0.021) | (0.013) |
| Gravity Variables | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-level Controls | YES | YES | YES | YES | YES | YES | YES | NO | NO | NO | NO |
| Firm-Year FE | - | - | NO | NO | NO | NO | NO | YES | YES | YES | YES |
| Country-Year FE | - | - | NO | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-Country FE | - | - | NO | NO | NO | NO | NO | YES | YES | YES | YES |
| Obs. | 6,609,062 | 9,752,700 | 78,494 | 6,318,095 | 13,244,910 | 13,087,380 | 10,435,448 | 4,733,039 | 11,650,553 | 11,507,360 | 9,064,524 |
| Adj. $R^2$ | - | - | - | - | - | - | - | 0.553 | 0.574 | 0.575 | 0.585 |
| Pseudo $R^2$ | - | - | - | 0.480 | 0.469 | 0.470 | 0.465 | - | - | - | - |

*Note:* This table presents additional results across different models. Column (1) and (2) present the results from dynamic Probit model with random effects. In column (1), we use the customs sample from 2008 to 2015 while in column (2), we randomly select half of firms from the full sample. Column (3) shows the results from system GMM with instrument variables using the customs sample from 2001 to 2007. Year dummies are included in system GMM. Column (4) to (7) present results from Probit model, and column (8) to (11) list results from linear probability model (LPM). In column (4) and (8), we focus on stagnant and diminishing exporters only. In column (5) and (9), we take into account foreign-related firms. In column (6) and (10), we add more extended gravity variables. In column (7) and (11), we use only the data from 2008 to 2015 to mitigate WTO entry effect. The extended gravity variables with prefix Exp. are constructed using only a firm's past export decisions while the others with prefix Imp. are based on a firm's past import decisions. 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 A2: The Effect of Export Choice on Import Decision: Robustness

| | Dependent Var.: $\mathbb{I}\{\text{Imp.}_{fct} > 0\}$ | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dyn. Probit RE | | System GMM | Probit | | | | LPM | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) |
| $\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$ | 0.645*** | 0.596*** | 0.020*** | 0.270*** | 0.257*** | 0.241*** | 0.286*** | 0.009*** | 0.007*** | 0.009*** | 0.006*** |
| | (0.004) | (0.003) | (0.005) | (0.004) | (0.00375) | (0.003) | (0.003) | (0.001) | (0.001) | (0.001) | (0.001) |
| .× Foreign Ownership Indicator$_{ft-1}$ | | | | | 0.061*** | | | | 0.004*** | | |
| | | | | | (0.004) | | | | (0.000981) | | |
| $\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$ | 1.784*** | 1.955*** | 0.234*** | 1.460*** | 1.473*** | 1.481*** | 1.509*** | 0.076*** | 0.055*** | 0.055*** | 0.001 |
| | (0.006) | (0.004) | (0.009) | (0.005) | (0.004) | (0.004) | (0.004) | (0.005) | (0.004) | (0.004) | (0.003) |
| Imp. Ext. Distance$_{fct-1}$ | -0.174*** | -0.163*** | -0.031*** | -0.197*** | -0.186*** | -0.171*** | -0.185*** | 0.006*** | 0.006*** | 0.006*** | 0.003*** |
| | (0.002) | (0.002) | (0.005) | (0.003) | (0.002) | (0.002) | (0.002) | (0.001) | (0.001) | (0.001) | (0.001) |
| Imp. Ext. Contiguity$_{fct-1}$ | 0.213*** | 0.203*** | 0.032*** | 0.197*** | 0.194*** | 0.199*** | 0.206*** | 0.019*** | 0.017*** | 0.017*** | 0.013*** |
| | (0.004) | (0.003) | (0.008) | (0.005) | (0.004) | (0.004) | (0.004) | (0.004) | (0.003) | (0.003) | (0.002) |
| Imp. Ext. Continent$_{fct-1}$ | 0.103*** | 0.126*** | -0.058*** | 0.052*** | 0.060*** | 0.061*** | 0.070*** | -0.000 | -0.000 | -0.000 | -0.001 |
| | (0.004) | (0.003) | (0.007) | (0.006) | (0.004) | (0.004) | (0.005) | (0.001) | (0.001) | (0.001) | (0.001) |
| Imp. Ext. Com. Lang.$_{fct-1}$ | 0.147*** | 0.129*** | 0.017** | 0.172*** | 0.174*** | 0.167*** | 0.173*** | 0.004* | 0.003 | 0.003 | 0.002 |
| | (0.003) | (0.002) | (0.007) | (0.005) | (0.004) | (0.004) | (0.004) | (0.002) | (0.002) | (0.002) | (0.002) |
| Imp. Ext. Income Group$_{fct-1}$ | 0.346*** | 0.276*** | 0.039*** | 0.146*** | 0.140*** | 0.144*** | 0.136*** | -0.005*** | -0.005*** | -0.005*** | -0.003** |
| | (0.004) | (0.003) | (0.006) | (0.006) | (0.004) | (0.005) | (0.005) | (0.002) | (0.002) | (0.002) | (0.001) |
| Exp. Ext. Distance$_{fct-1}$ | | | | | | -0.057*** | | | | -0.000 | |
| | | | | | | (0.002) | | | | (0.001) | |
| Exp. Ext. Contiguity$_{fct-1}$ | | | | | | -0.038*** | | | | 0.001* | |
| | | | | | | (0.003) | | | | (0.001) | |
| Exp. Ext. Continent$_{fct-1}$ | | | | | | -0.004 | | | | 0.000 | |
| | | | | | | (0.004) | | | | (0.001) | |
| Exp. Ext. Com. Lang.$_{fct-1}$ | | | | | | 0.064*** | | | | -0.001 | |
| | | | | | | (0.003) | | | | (0.006) | |
| Exp. Ext. Income Group$_{fct-1}$ | | | | | | -0.009** | | | | -0.002** | |
| | | | | | | (0.004) | | | | (0.001) | |
| Constant | -1.212*** | -1.288*** | -0.904*** | -0.781*** | -0.873*** | -0.546*** | -0.620*** | 0.014 | 0.016 | 0.020 | 0.041*** |
| | (0.019) | (0.014) | (0.082) | (0.063) | (0.040) | (0.044) | (0.032) | (0.013) | (0.010) | (0.014) | (0.008) |
| Gravity Variables | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-level Controls | YES | YES | YES | YES | YES | YES | YES | NO | NO | NO | NO |
| Firm-Year FE | - | - | NO | NO | NO | NO | NO | YES | YES | YES | YES |
| Country-Year FE | - | - | NO | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-Country FE | - | - | NO | NO | NO | NO | NO | YES | YES | YES | YES |
| Obs. | 5,967,909 | 8,789,230 | 126,044 | 4,523,145 | 11,764,732 | 11,557,192 | 9,383,745 | 3,582,716 | 10,515,452 | 10,357,332 | 8,249,557 |
| Adj. $R^2$ | - | - | - | - | - | - | - | 0.607 | 0.609 | 0.609 | 0.628 |
| Pseudo $R^2$ | - | - | - | 0.550 | 0.546 | 0.546 | 0.547 | - | - | - | - |

*Note:* The explanation of this table follows that of Table A1.

## A.5 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 A3 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 A3 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 A3: Processing Trade and Bilateral Economies of Scope

| Dependent Var.: | $\mathbb{I}\{\text{Exp.}_{fct} > 0\}$ | | | | $\mathbb{I}\{\text{Imp.}_{fct} > 0\}$ | | | |
|---|---|---|---|---|---|---|---|---|
| | LPM | Probit | LPM | Probit | LPM | Probit | LPM | Probit |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\mathbb{I}\{\text{Imp.}_{fct-1} > 0\}$ | 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) | | | | |
| $\mathbb{I}\{\text{Exp.}_{fct-1} > 0\}$ | 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.6 Linear Probability Model

We present the estimation results using the linear probability model in Tables A4 and A5. 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 A4: The Effect of Import Choice on Export Decision: LPM

| | Dependent Var.: $\mathbb{I}\left\{\text{Exp.}_{fct} > 0\right\}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| $\mathbb{I}\left\{\text{Imp.}_{fct-1} > 0\right\}$ | 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) |
| $\mathbb{I}\left\{\text{Exp.}_{fct-1} > 0\right\}$ | 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. 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 A5: 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. 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.7 Empirical Tests for Stagnant firms

Table A6 presents additional results for alternative definitions of stagnant firms as discussed in Section A.4.2.

## A.8 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 A7, to further investigate the role played by geographic distance and language, we conduct exercises similar to those in column (4) of Table 3, and include an interaction term between the gravity variables (e.g., distance and indicator common language) and firm's past trade decision. Table A8 shows that the estimated 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 A7.

## A.9 Additional Tests

In Table A9, 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 as in Table 3. 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 A6: 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 $t$. Column (1) and (4) include only year fixed effect; column (2) and (5) include both year fixed effect and country fixed effect; column (3) and (6) include country-year fixed effect.

Table A7: 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.

Table A8: 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 A9: 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.10 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 $t-1$, $\Omega$ 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. $\text{Remoteness}_{ct-1}$ 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.11 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 Export $\text{Tariff}_{jht}$ 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 (13) 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 (13) 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 (13) 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 (13) with respect to $B_i$ is

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

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 $\varphi$ as the firm's profit maximization problem (12) 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 $\varphi$ 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

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

where $\theta_x$ denotes the firm's sourcing capacity at interval $x$ and $\omega_x$ 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 (12) 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 (12) 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

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

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 $\alpha_0,\alpha_1$ 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 (C.5), and the one for final goods (C.9) can be derived in a similar way. Note that rearranging equation (C.3) gives

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

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 (13) and labor market clearing condition (14), 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

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

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 (C.5) of intermediate goods.

# C Estimation and Quantitative Appendix

## C.1 Final-Goods Producers

In this section, we discuss two issues related to the final-goods producers in the model and in the data. The first one is the interpretation of the fixed costs paid by the final goods producers. Note that the final goods producers pay the fixed costs of both sourcing and exporting. This assumption is plausible considering that Chinese firms typically have low bargaining power in the global market, as either sellers or buyers. In a more general sense, how trade costs are shared between the related parties could be an endogenous outcome of a bargaining process (Eaton et al., 2021). Answering this question in detail would require detailed firm-to-firm transaction-level data, which is not available in China's case. Therefore, our estimated fixed costs should be interpreted as the part borne by Chinese firms.

The second issue relates to the distinction between final-goods producers and input suppliers. The model assumes that a production process involves only two stages, so the notion of final-goods producers and input suppliers is clear. In the data, however, this distinction becomes less clear-cut as firms are typically connected by rich input-output linkages spanning potentially multiple industries. Similar to Antràs, Fort, and Tintelnot (2017), our model inherently lacks the flexibility to provide a framework that allows the exact mapping of the final goods producers in the data to the model. Our quantitative exercise uses the full manufacturing sample to measure or construct statistics related to final goods firms, and we also conduct robustness exercises by dropping firms operating in the more upstream industries.

## C.2 Gravity

We now derive the model-implied gravity equations for both intermediate and final goods, and discuss the implication of our mechanism on bilateral trade flows.

Conditional on a firm's optimal trading strategy $\mathsf{X}^*(\varphi)$ and $\mathsf{M}^*(\varphi)$, its input purchase from origin $j$ is $(\sigma-1)\chi_{ij}(\varphi)$ fraction of firm profit,

$$M_{ij}(\varphi) = (\sigma-1)\varphi^{\sigma-1}\gamma^{\frac{\sigma-1}{\theta}}\left(\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}-1}\Theta_i^X(\varphi)\times T_j(\tau_{ij}^M w_j)^{-\theta}, \tag{C.1}$$

for $j \in \mathsf{M}^*(\varphi)$ and zero otherwise. And its sales revenue in market $k$ is given by

$$X_{ki}(\varphi) = \sigma\varphi^{\sigma-1}\left(\gamma\Theta_i(\varphi)^M\right)^{\frac{\sigma-1}{\theta}}\times\left(\tau_{ki}^X\right)^{1-\sigma}B_k, \tag{C.2}$$

for $k \in \mathsf{X}^*(\varphi)$ and zero otherwise.

Summing equation (C.1) over all firms gives the aggregate import of intermediate goods from any origin $j$ as follows:

$$M_{ij} = N_i\int_{\underline{\varphi}_i}^{\infty} M_{ij}(\varphi)dG_i(\varphi) = (\sigma-1)\gamma^{\frac{\sigma-1}{\theta}}N_iT_j(\tau_{ij}^M w_j)^{-\theta}\Lambda_{ij}^M, \tag{C.3}$$

where

$$\Lambda_{ij}^M \equiv \int_{\underline{\varphi}_i}^{\infty}\mathbb{I}_{ij}^M(\varphi)\varphi^{\sigma-1}\left(\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}-1}\Theta_i^X(\varphi)dG_i(\varphi) \tag{C.4}$$

is increasing in the number of firms in country $i$ importing from origin $j$. By equation (C.3), we may derive the following gravity equation for trade in intermediate goods (see Appendix B.3 for derivations).

$$M_{ij} = \frac{E_i}{\bar{P}_i^{1-\sigma}/N_i}\times\frac{Q_j}{\sum_{h=1}^J\frac{E_h}{\bar{P}_h^{1-\sigma}/N_h}\left(\tau_{hj}^M\right)^{-\theta}\Lambda_{hj}}\times\left(\tau_{ij}^M\right)^{-\theta}\times\Lambda_{ij}^M, \tag{C.5}$$

where

$$\bar{P}_i^{1-\sigma}/N_i \equiv \sum_{k=1}^J b_kP_{ki}^{1-\sigma}/N_i \tag{C.6}$$

is the weighted average of country's mean export price index across all countries and $b_k = \frac{B_k}{\sum_{i=1}^J B_i}$ is the demand share of country $k$ in the world. $P_{ki}^{1-\sigma} = N_i\int_{\underline{\varphi}_i}^{\infty}p_{ki}(\varphi)^{1-\sigma}dG_i(\varphi)$ is the export price index for firms in country $i$ selling to market $k$. $Q_j = \sum_{h=1}^J M_{hj}$ is the total intermediate input produced by origin $j$.

Turning to the bilateral trade of final goods, the aggregate export from country $i$ to market $k$ is

$$X_{ki} = N_i \int_{\underline{\varphi}_i}^{\infty} X_{ki}(\varphi) dG_i(\varphi) = \sigma N_i \gamma^{\frac{\sigma-1}{\theta}} B_k \left(\tau_{ki}^X\right)^{1-\sigma} \Lambda_{ki}^X, \tag{C.7}$$

where

$$\Lambda_{ki}^X \equiv \int_{\underline{\varphi}_i}^{\infty} \mathbb{I}_{ki}^X(\varphi) \varphi^{\sigma-1} \left(\Theta_i^M(\varphi)\right)^{\frac{\sigma-1}{\theta}} dG_i(\varphi) \tag{C.8}$$

is increasing in the number of firms in country $i$ exporting to market $k$. Similarly, we derive the following gravity equation for trade in final goods:

$$X_{ki} = \frac{E_i}{\bar{P}_i^{1-\sigma}/N_i} \times \frac{S_k}{\sum_{h=1}^{J} \frac{E_h}{\bar{P}_h^{1-\sigma}/N_h} \left(\tau_{kh}^X\right)^{1-\sigma} \Lambda_{kh}^X} \times \left(\tau_{ki}^X\right)^{1-\sigma} \times \Lambda_{ki}^X, \tag{C.9}$$

where $S_k = \sum_{h=1}^{J} X_{kh}$ denotes the total absorption of final goods for market $k$.

From equations (C.3) and (C.7), it is clear that the existence of bilateral economies of scope increases aggregate trade flows by facilitating firms' foreign market accession through reduction in bilateral fixed costs.

## C.3 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.3.1 Moment Construction

We list the construction of moments according to the ordering in Table 5. 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.3.2 Additional Discussions on the Identification of $\alpha_0$, $\alpha_1$ and $\rho$

Our model identification involves two components: first, separately identifying $\rho$ (the cost correlation parameter) from $\alpha_0, \alpha_1$ (the cost reduction parameter); second, given $\rho$, separately identifying $\alpha_0$ from $\alpha_1$.

As fixed cost draws are allowed to be correlated across markets with correlation governed by the parameter $\rho$, we can use cross-market trade patterns to separately identify $\rho$ from $\alpha$'s, precisely because $\alpha$'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 $\rho$, we use three sets of moments to identify $\alpha_0$ from $\alpha_1$. 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 $\alpha$s.

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 $\alpha$'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 $\beta$ coefficients are generally not identical. Thus, we can rely on the differential bilateral $\beta$ coefficients and variation in geographic distance across markets to separate the role played by $\alpha_0$ from that of $\alpha_1$. For example, when $\beta_d^X > \beta_d^M$, an increase in $\alpha_0$ should lead to more cost reduction than an increase in $\alpha_1$, 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, $\alpha_0$ governs the correlation between the share of two-way traders and geographic distance.

### C.3.3 Simulation of Firm Productivity and the Cost Shocks

We follow the steps below to simulate the firm productivity $\varphi$ and the cost shocks , $\varepsilon_{fij}^M$ and $\varepsilon_{fij}^X$. To simulate firm productivity $\varphi$, 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 $\varphi$. Given each $\varphi$, 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 $\Sigma$ is the variance-covariance matrix that has values 1 along the diagonal and $\rho$ otherwise, and chol denotes the Cholesky decomposition. We then extract the first 1 to $N$ elements of $Y$ as $\varepsilon^M_{fij}$ and the remaining $N+1$ to $2N$ elements as $\varepsilon^X_{fij}$.

### C.3.4 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 $\varphi_i$ 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.3.5 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,

$$\frac{\Delta \mathbf{M}}{\Delta \Theta} = \begin{pmatrix} \frac{\Delta \mathbf{m}_1}{\Delta \theta_1} & \frac{\partial \mathbf{m}_1}{\partial \theta_m} \\ \cdots & \cdots \\ \cdots & \cdots \\ \frac{\partial \theta_k}{\partial \mathbf{m}_1} & \frac{\partial \mathbf{m}_k}{\partial \theta_m}. \end{pmatrix} \tag{C.10}$$

Then the standard error vector is given by

$$\sqrt{\text{Diag}\left[\left(\frac{\Delta \text{M}}{\Delta \Theta}\right)' \hat{\mathbf{W}}_{k\times k}\left(\frac{\Delta \text{M}}{\Delta \Theta}\right)\right]}, \tag{C.11}$$

where

$$\hat{\mathbf{W}} = \begin{pmatrix} \frac{1}{\hat{\sigma}_1^2} & & & \\ & \ddots & & \\ & & \ddots & \\ & & & \frac{1}{\hat{\sigma}_k^2}. \end{pmatrix} \tag{C.12}$$

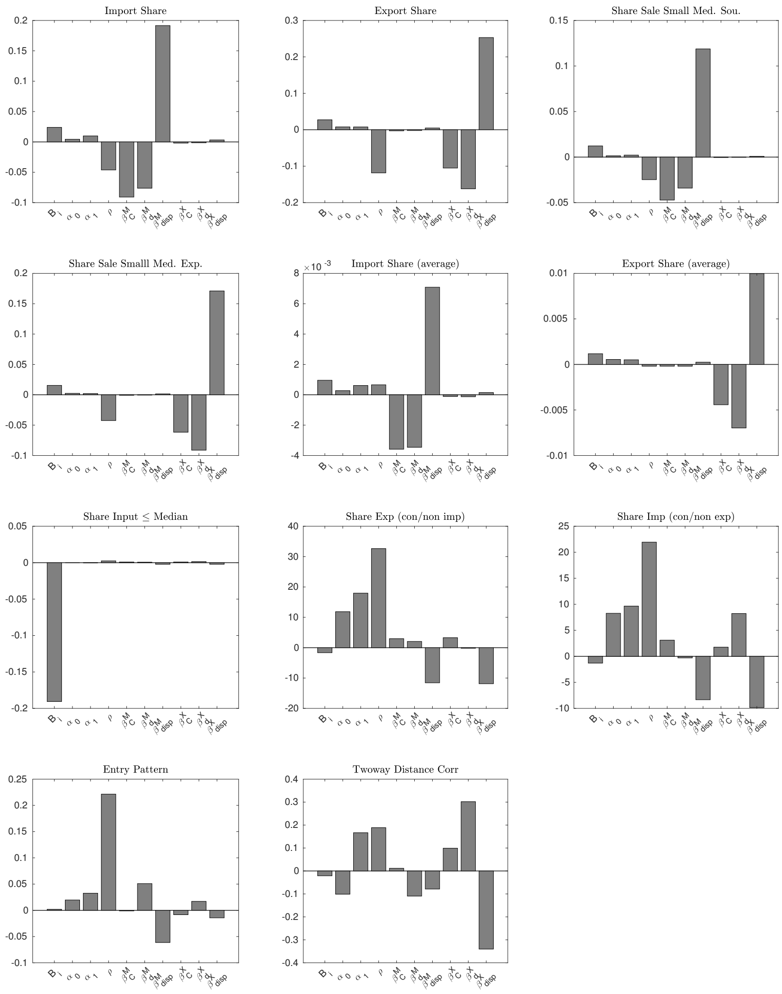
represents the weighting matrix for data. $\hat{\sigma}_k$ is the bootstrapped standard error for data moments.

### C.3.6 The Jacobian Matrix

For a more transparent illustration of the model's identification, we chart in Figure A3 the Jacobian matrix associated to the SMM estimation[7]. It shows how parameter changes lead to changes in the targeted moments.

[7]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 A3: 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.3.7 Monte Carlo Simulation

In addition, we conduct Monte Carlo experiments to show the performance of the model's identification on $\alpha_0$ and $\alpha_1$. 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 $\alpha_0$ and $\alpha_1$ (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 $\alpha_0$ and $\alpha_1$ are close to the true values. We report the results in Table A10.

Table A10: Monte Carlo Analysis

| experiment id | $\alpha_0$(true) | $\alpha_0$(estim) | $\alpha_1$(true) | $\alpha_1$(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 |

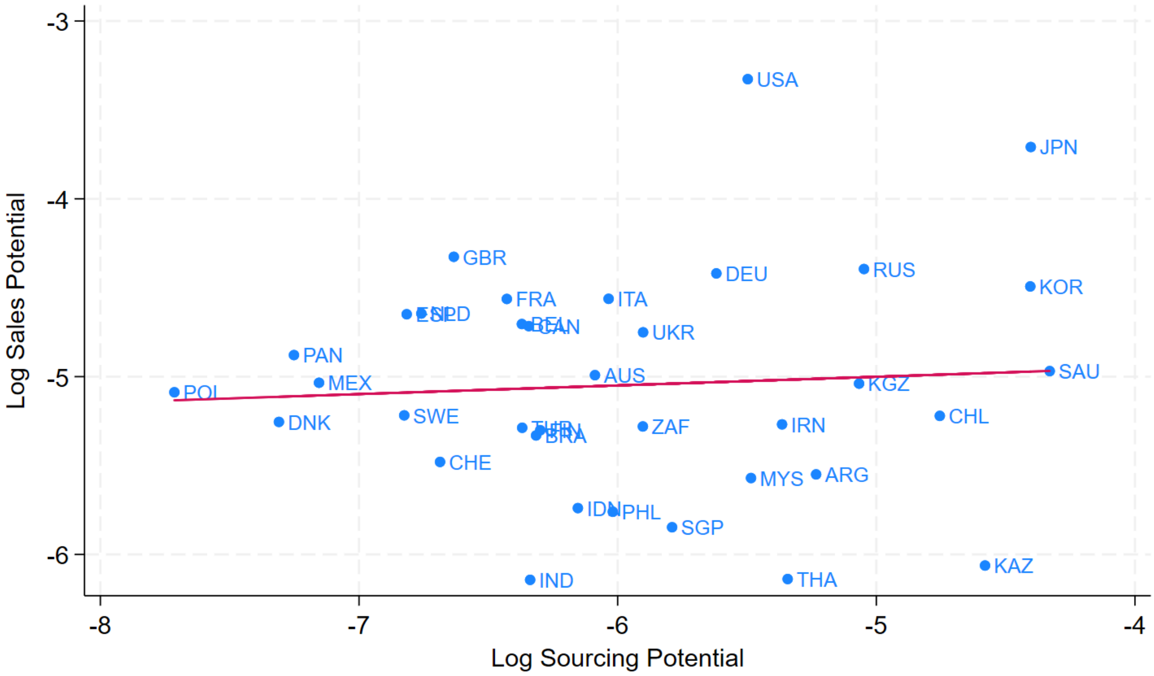
*Note*: This table shows Monte Carlo analysis. The first column lists the experimentation id, and the remaining four columns show the true $\alpha$s and the estimated $\alpha$s.

## C.4 Baseline Model

**Estimated Sourcing and Sales Potentials** Figure A4 scatters the result of the estimated country-level sourcing and sales potential, which shows a very weak positive relationship (with a slope of 0.05 and $p$-value of 0.70). Countries such as the U.S. have the largest sales potential in our sample, whereas the sourcing potential of the U.S. is below Korean and Japan. The weak and insignificant relationship alleviates the concern that our documented stylized facts (e.g., the rank-rank correlation) in the empirical section are instead driven by the correlation between country-level characteristics.

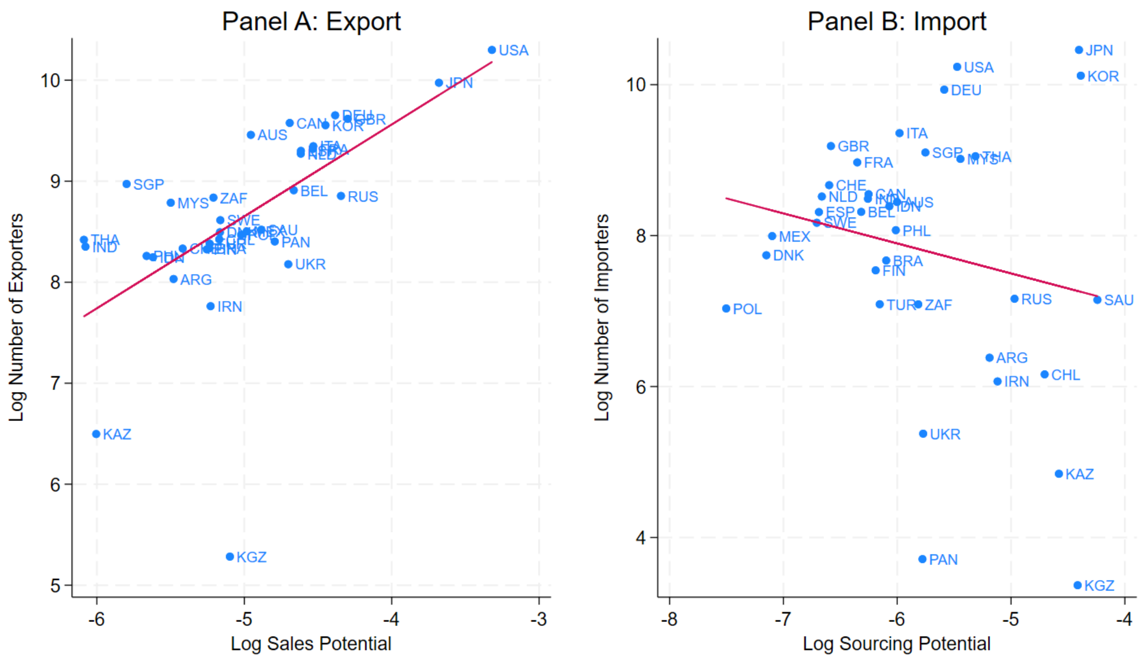
Figure A5 examines the relationship between a country's sales potential (in Panel A) and its sourcing potential (in Panel B) with the number of Chinese exporters and importers, respectively. In Panel A, there is a strong positive correlation between a country's sales potential and the number of Chinese exporters (the slope is 0.91 and the $p$-value of 0.00). However, we do not observe such a positive relationship on the import side (the slope is -0.40 and the $p$-value 0.25 in panel B). From this panel, countries such as Saudi Arabian (SAU) and Ukraine (UKR) are behind the negative relationship. As these countries are commonly perceived as commodity and homogeneous goods suppliers to China (Head, Jing, and Ries, 2017), a potential concern is that the negative correlation might be driven by those goods. We conduct an array of additional checks in Appendix C.4, where we sequentially exclude the trade flows of commodity and homogeneous goods. We find that the negative relationship remains stable. In addition, we re-estimate the baseline model with alternative measures of sourcing potentials and find that the model's quantitative predictions are robust.

Figure A4: Estimated Country-Level Sales Potentials and Sourcing Potentials




*Note:* This figure shows the estimated sales potential and sourcing potential for each foreign country. The slope of the fitted line is 0.05 with a $p$-value of 0.70. The estimation is based on China's top 30 sourcing origins and top 30 export destinations in year 2007 (in total 36 foreign countries). Both sales and sourcing potentials are normalized by China's sales and sourcing potentials respectively.

Figure A5: Sales Potentials, Sourcing Potentials and the Number of Firms

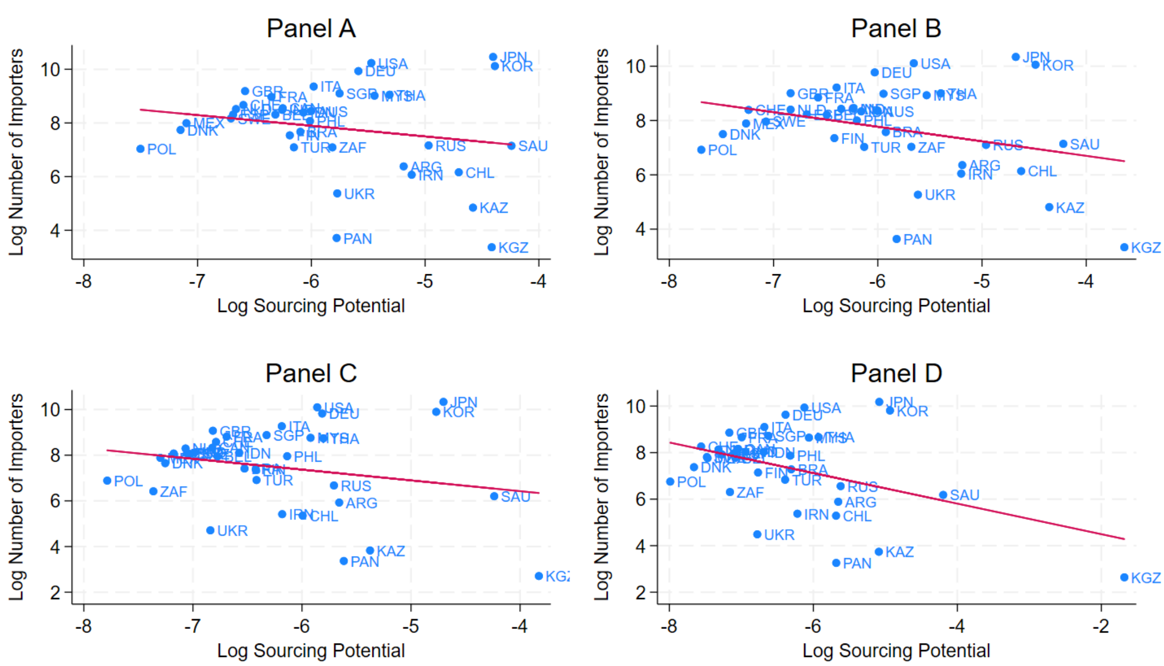



*Note:* This figure shows the correlation between country's (log) sales potential and the (log) number of Chinese exporters (Panel A) and the correlation between country's (log) sourcing potential and the (log) number of Chinese importers (Panel B). In Panel A, the slope of fitted line is 0.91 with $p$-value 0.00. In Panel B, the slope of fitted line is -0.40 with $p$-value 0.25. The estimation is based on China's top 30 sourcing origins and top 30 export destinations in year 2007, amounting to 36 foreign countries. Both sales and sourcing potentials are normalized by China's sales and sourcing potentials respectively.

**Sourcing Potential Estimates and the Number of Importers** Note that in Panel B of Figure A5, 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 A6 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 A6: 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 A11 shows that the estimated sourcing potentials in the baseline case exhibit a high correlation.

Table A11: 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.

**Estimated Sourcing Elasticity** Table A12 provides the estimation results. In columns (1) and (2), we use the estimated sourcing potentials as the dependent variable. The regression results suggest a sourcing elasticity of 1.072 in column (2), where we instrument $\log \tau_{ij}^M w_j$ by population size to deal with the potential correlation of wages across countries and measurement error following Antràs, Fort, and Tintelnot (2017). Our estimated $\theta$ here is slightly lower than that obtained in their paper (1.789). In line with the AFT results, the estimated trade elasticity using firm-level data is smaller than that obtained from using aggregate trade flow[8], indicating a more dispersed productivity distribution among input suppliers.

Alternatively, one may estimate the sourcing elasticity by gravity equation (C.3), and the result is reported in column (3) and (4). We use the observed total import values (in logs) across sourcing origins as dependent variable, and control for $(\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} N_i \Lambda_{ij}^M$ with the total domestic input purchases (in logs) of all Chinese firms importing from origin $j$.[9] We then get an estimated trade elasticity of intermediate goods as 1.273 in column

[8]For instance, Eaton and Kortum (2002) obtain an estimated trade elasticity of 3.60 using data only on wages.

[9]Note that we normalize domestic sourcing potential to be one. The domestic input purchase for

(4) when using same instrument as in column (2). Meanwhile, the estimated coefficient on log domestic input purchase (0.984 in column (3) and 0.985 in column (4)) is close to one, consistent with the theoretical prediction in equation (C.3). We choose 1.072 in column (2) as our baseline value for $\theta$. Note that our estimation suggests $\sigma - 1 > \theta$, indicating that a firm's trade decisions across sourcing origins and export destinations are complementary to each other. Therefore, by Proposition 1, the algorithm in Jia (2008) can be applied in our context.

**Model Performance** We then re-estimate the model with the reconstructed sourcing potentials. Figure A7 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.

firms importing from origin $j$ is

$$N_i \int_{\underline{\varphi_i}}^{\infty} \mathbb{I}_{ij}^M(\varphi)(\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} \varphi^{\sigma-1} \left(\Theta_i(\varphi)\right)^{\frac{\sigma-1}{\theta}-1} \Theta_i^X(\varphi) \times \xi_{ii}^M \, dG_i(\varphi) = (\sigma-1)\gamma^{\frac{\sigma-1}{\theta}} N_i \Lambda_{ij}^M,$$

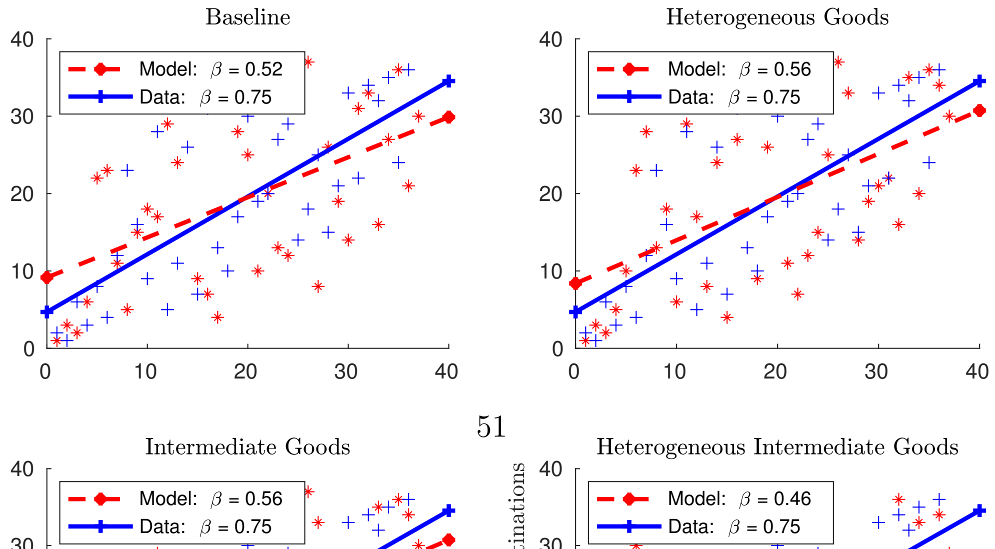
where $\xi_{ii}^M = 1$.

Table A12: Estimating Sourcing Elasticity

| | $\log \xi_j^M$ | | log aggregate import$_j$ | |
|---|---|---|---|---|
| | OLS | IV | OLS | IV |
| | (1) | (2) | (3) | (4) |
| $\log \tau_{ij}^M w_j$ | -1.094** | -1.072** | -1.762*** | -1.273** |
| | (0.416) | (0.508) | (0.557) | (0.639) |
| log distance$_{ij}$ | -0.540* | -0.537** | -0.455 | -0.387 |
| | (0.276) | (0.242) | (0.383) | (0.341) |
| Contiguity$_{ij}$ | -0.987* | -0.981** | -1.009 | -0.895* |
| | (0.560) | (0.490) | (0.660) | (0.530) |
| log GDP per capita$_j$ | 0.408 | 0.384 | 1.169 | 0.631 |
| | (0.642) | (0.690) | (0.779) | (0.903) |
| Income group$_{ij}$ | -1.372*** | -1.367*** | -1.410* | -1.283* |
| | (0.397) | (0.368) | (0.807) | (0.696) |
| RTA$_{ij}$ | -0.109 | -0.110 | -0.0531 | -0.0727 |
| | (0.445) | (0.376) | (0.965) | (0.829) |
| log R&D$_j$ | -0.0499 | -0.0512 | -0.0806 | -0.110 |
| | (0.127) | (0.104) | (0.234) | (0.202) |
| log capital per worker$_j$ | 0.254 | 0.263 | -0.0148 | 0.188 |
| | (0.430) | (0.402) | (0.551) | (0.556) |
| log number of firms$_j$ | 0.121 | 0.121 | 0.304 | 0.303* |
| | (0.177) | (0.150) | (0.199) | (0.168) |
| log domestic input$_j$ | | | 0.984*** | 0.985*** |
| | | | (0.228) | (0.189) |
| Constant | -8.817*** | -8.757*** | -10.18** | -8.848** |
| | (1.730) | (1.817) | (4.746) | (4.210) |
| F-Statistic | - | 15.637 | - | 18.834 |
| Obs. | 36 | 36 | 36 | 36 |
| $R^2$ | 0.526 | 0.526 | 0.860 | 0.856 |

*Note:* This table shows the estimation results for sourcing elasticity. Following Antràs, Fort, and Tintelnot (2017), we use the logarithmic population size as an instrument for $\log\left(\tau_{ij}^M w_j\right)$ in columns (2) and (4). Robust standard errors are in parentheses. The number of asterisks indicates significance at the 1%(***), 5%(**) and 10%(*) levels.

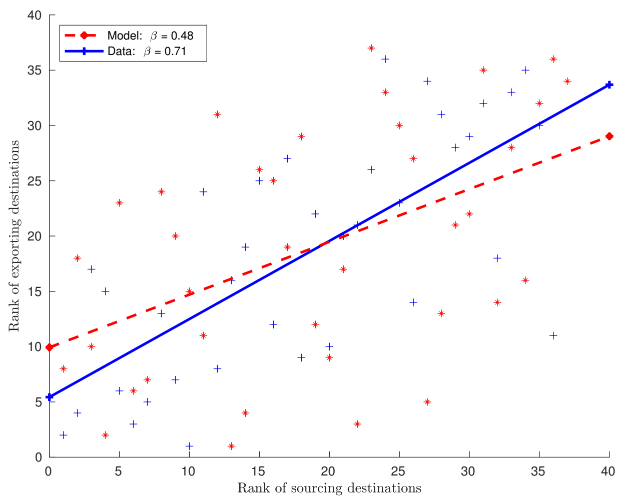
Figure A7: Rank-Rank Correlation (Alternative Sourcing and Exporting Potential)



### C.4.1 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 A8 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 A8. We find that the positive rank-rank correlation was slightly weakened after controlling for the gravity variables.

Figure A8: 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.4.2 Estimation Results for the Residual Models

In Table A13, we report the parameter estimates and fit of both the baseline model and the restricted models. The restricted models, free from the moments associated with bilateral economies of scope, are also able to replicate other moments such as the exporter and importer shares. The performance is anticipated, given that all these models are built on the AFT framework and thus inherit the quantitative properties from it. For example, the conventional export-import complementarity in AFT implies that all the restricted models are important in capturing the relative number and size of two-way traders (14% in model and 11% in data).

### C.4.3 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 (17) and (18)) 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,

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

and

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

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

Table A13: Parameter Assignments and 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) | (0.10) | (0.16) | (0.17) | Estimation |
| Cost reduction (import-induced export) | 0.42 | 0.31 | 0.00* | 0.00* | Estimation |
| | (0.034) | (0.040) | ( – ) | ( – ) | Estimation |
| Cost reduction (export-induced import) | 0.35 | 0.00* | 0.15 | 0.00* | Estimation |
| | (0.024) | ( – ) | (0.029) | ( – ) | Estimation |
| Correlation of fixed costs | 0.050 | 0.040 | 0.050 | 0.040 | Estimation |
| | (0.004) | (0.003) | (0.006) | (0.004) | Estimation |
| Sourcing: constant term | 2.72 | 3.19 | 3.22 | 2.21 | Estimation |
| | (0.094) | (0.059) | (0.077) | (0.047) | Estimation |
| Sourcing: coefficient of distant | 1.34 | 0.85 | 0.76 | 0.54 | Estimation |
| | (0.014) | (0.016) | (0.016) | (0.012) | Estimation |
| Sourcing: standard deviation | 2.30 | 2.51 | 2.34 | 1.67 | Estimation |
| | (0.033) | (0.017) | (0.015) | (0.011) | Estimation |
| Export: constant term | 3.39 | 3.05 | 3.18 | 3.19 | Estimation |
| | (0.095) | (0.080) | 0(.084) | (0.094) | Estimation |
| Export: coefficient of distant | 0.77 | 0.72 | 0.79 | 0.59 | Estimation |
| | (0.039) | (0.025) | (0.037) | (0.019) | Estimation |
| Export: standard deviation | 2.71 | 2.63 | 2.63 | 2.63 | Estimation |
| | (0.026) | (0.034) | (0.043) | (0.028) | Estimation |
| *Panel D: Targeted moments* | | | | | |
| Share of importers | 0.11 | 0.15 | 0.12 | 0.09 | Data |
| Share of exporters | 0.13 | 0.15 | 0.12 | 0.16 | Data |
| Share of importers (below median sales) | 0.043 | 0.072 | 0.049 | 0.021 | Data |
| Share of exporters (below median sales) | 0.058 | 0.070 | 0.055 | 0.074 | 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 | 4.70 | 5.49 | 5.91 | Data |
| Ratio b/w share of importers among exporters and non-exporters | 8.21 | 4.66 | 5.18 | 5.84 | Data |
| Twoway Distance | -0.7 | -0.7 | -0.6 | -0.5 | Data |
| Entry Order Correlation | 0.14 | 0.11 | 0.11 | 0.13 | Data |

*Note:* This table shows parameterization for the baseline and the three restricted model. The second column shows the results for the baseline. The third column lists the calibration for the model where we set $\alpha_1 = 0$. In the estimation, we drop the moment on the conditional export ratio of exporters (i.e., the moment with an asterisk superscript); the fourth column considers a symmetric case where we set $\alpha_0 = 0$. The fifth column sets $\alpha_1 = 0$ and $\alpha_0 = 0$. Standard errors are reported in parentheses.

the normalized foreign input share and sales share. That is,

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

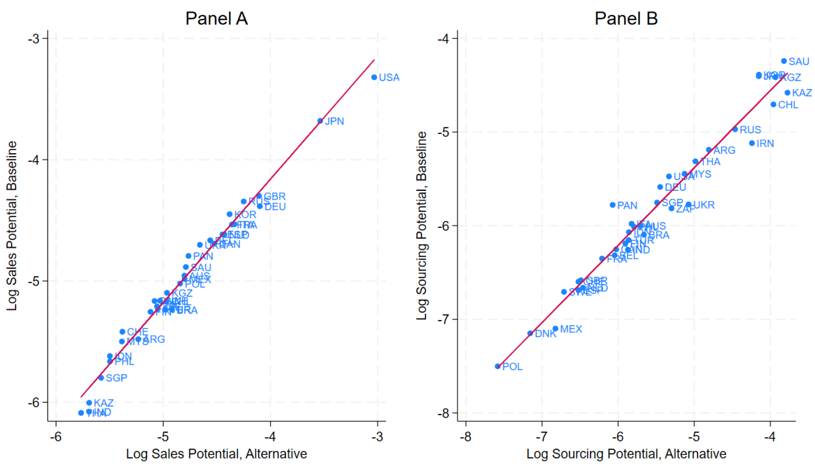
and

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

Figure A9 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).

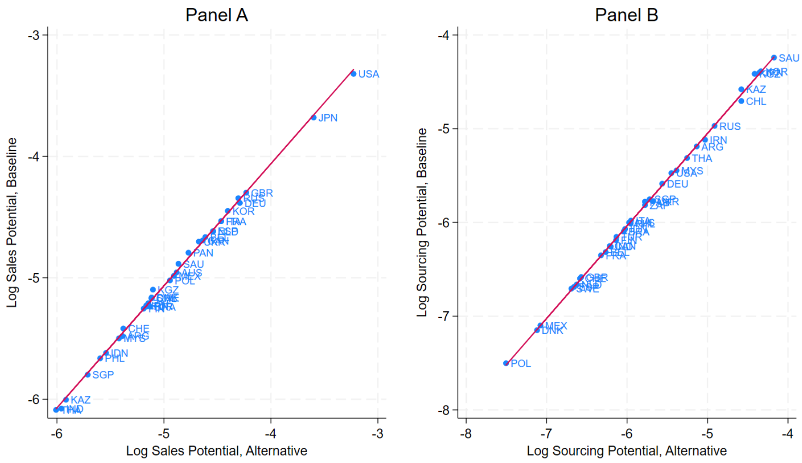
To further address the concern on outliers, we conduct a second exercise where the sourcing and exporting potential estimates are based on the mean level of winsorized $\frac{\xi^X_{fij}}{\xi^X_{fii}}$ and $\frac{\xi^M_{fij}}{\xi^M_{fii}}$. In doing so, we trim the observations at the bottom 3% and the top 3% within each foreign country. Figure A10 shows the results, where we find their correlations are high and statistically significant.

Figure A9: 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.

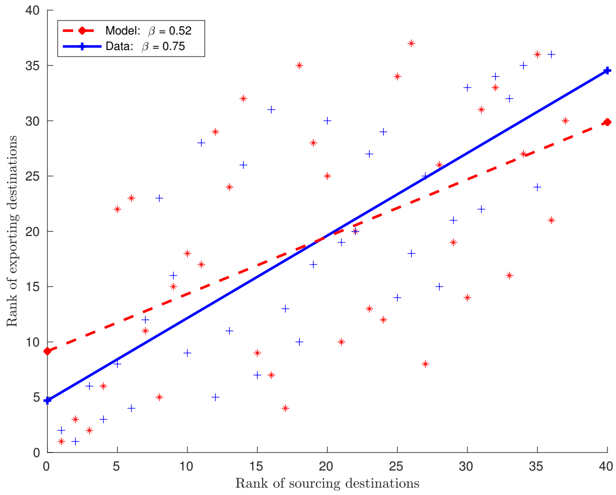
Figure A10: Alternative Estimates of Sales Potentials and Sourcing Potentials: Winsorized Mean




*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 A11 shows the rank-rank relationship.

Figure A11: 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 A14 shows the parameter assignment for a larger value of $\sigma$. We re-estimate the model and obtain new parameter values.

Table A14: Parameter Assignment: High Sensitivity to Higher Demand Elasticity

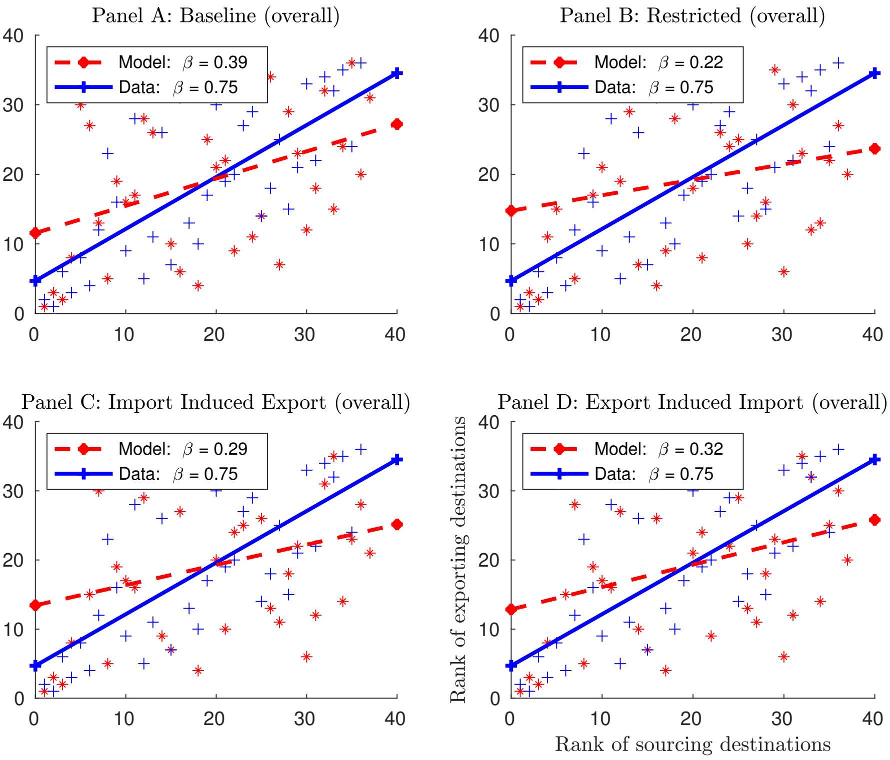
| Parameters | Symbols | Baseline | Source |
|---|---|---|---|
| *Panel A: Assigned* | | | |
| Pareto shape. | $\kappa$ | 4.25 | Literature |
| *Panel B: Reduced-form regressions* | | | |
| Demand elasticity | $\sigma$ | 5.76 | Estimation |
| Sourcing elasticity | $\theta$ | 1.07 | Estimation |
| *Panel C: SMM* | | | |
| Demand scale | $\tilde{B}_i$ | 2.59 (0.12) | Estimation |
| Cost reduction (import-induced export) | $\alpha_0$ | 0.32 (0.12) | Estimation |
| Cost reduction (export-induced import) | $\alpha_1$ | 0.28 (0.059) | Estimation |
| Correlation of fixed costs | $\rho$ | 0.063 (0.013) | Estimation |
| Sourcing: constant term | $\beta_C^M$ | 1.55 (0.053) | Estimation |
| Sourcing: coefficient of distance | $\beta_d^M$ | 2.33 (0.005) | Estimation |
| Sourcing: standard deviation | $\beta_{disp}^M$ | 1.39 (0.021) | Estimation |
| Export: constant term | $\beta_C^X$ | 3.09 (0.098) | Estimation |
| Export: coefficient of distance | $\beta_d^X$ | 1.75 (0.020) | Estimation |
| Export: standard deviation | $\beta_{disp}^X$ | 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.4.4 Additional Results of the Baseline Model

**Rank-Rank for Overall Firms** Figure A12 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 A12: 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 A15 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 $\rho$ 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 A15: 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 A16 shows the hierarchical entry structure for both exporting and sourcing in model and in data.

**The Mechanism of the Counterfactual Results** To further understand the mechanisms behind the decomposition result, we separately shock the baseline and the restricted model by trade costs reductions (in both tariff and fixed costs) for sourcing and exporting to guage their impact on Chinese firms foreign market participation(i.e., the number of sourcing origins and selling destinations). The first row of Figure A13 shows the direct

Table A16: Hierarchy Structure in Importing and Exporting

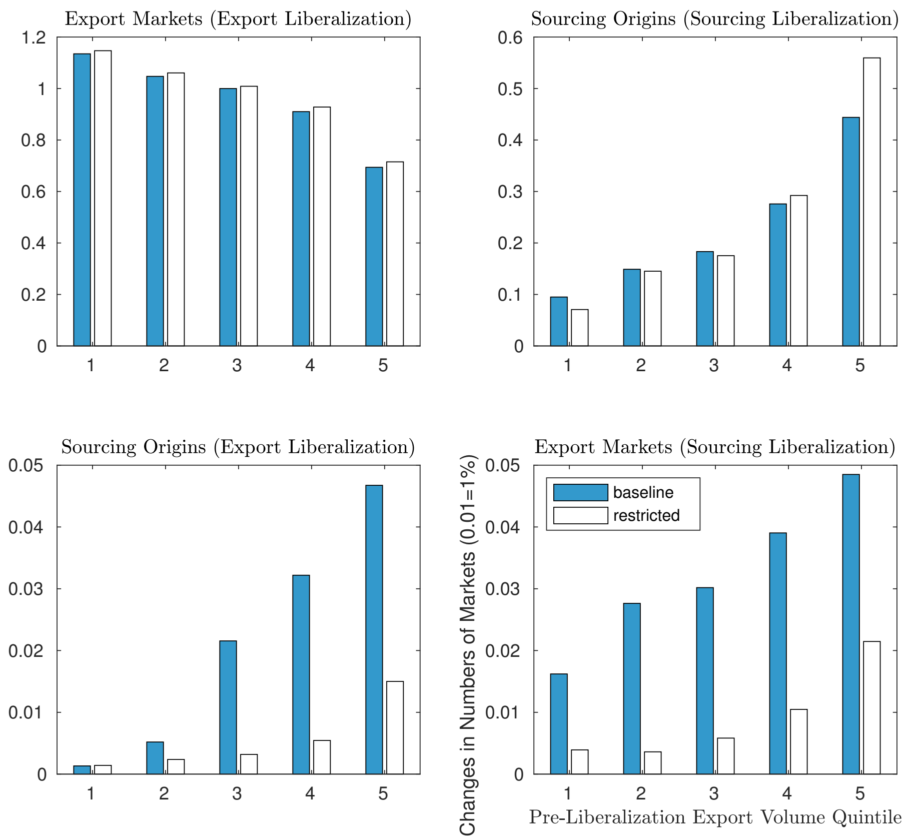
| | baseline | imp to exp | exp to imp | restricted | data |
|---|---|---|---|---|---|
| *Panel A: Sourcing* | | | | | |
| 1 | 100 | 100 | 100 | 100 | 100 |
| 1-2 | 1.95 | 0.97 | 0.91 | 1.27 | 2.92 |
| 1-2-3 | 0.12 | 0.06 | 0.08 | 0.14 | 0.57 |
| 1-2-3-4 | 0.016 | 0.007 | 0.007 | 0.027 | 0.52 |
| 1-2-3-4-5 | 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.

effect of trade liberalization, where we chart the change in the number of sourcing origins after import liberalization and the change in the number of markets after export liberalization. Firms are categorized in 5 classes sorted by their pre-liberalization total sales (with 1 being the lowest and 5 being the highest). The associated response is contrasted for both the baseline and the restricted model. Note that the magnitude of changes in foreign market participation is similar across the two types of models.

As anticipated, firms in both models respond directly to trade costs reductions. The result for the indirect effect, which is shown in the second row of Figure A13, is very different. Taking the export liberalization (the third panel by horizontal order) for example, export liberalization brings on average a 2.5% increase in the number of sourcing destinations, whereas the response of the restricted model is largely muted (around 0.5% on average). Symmetrically, import liberalization also induces around 3% more export destinations for the baseline and less than 1% for the restricted. The observed difference across the two types of model is largely derived from the bilateral cost reduction mechanism, in that trade liberalization from one side incentives market participation from the other side by lowering its fixed cost barriers.

Figure A13: Firm Responses to Trade Liberalization



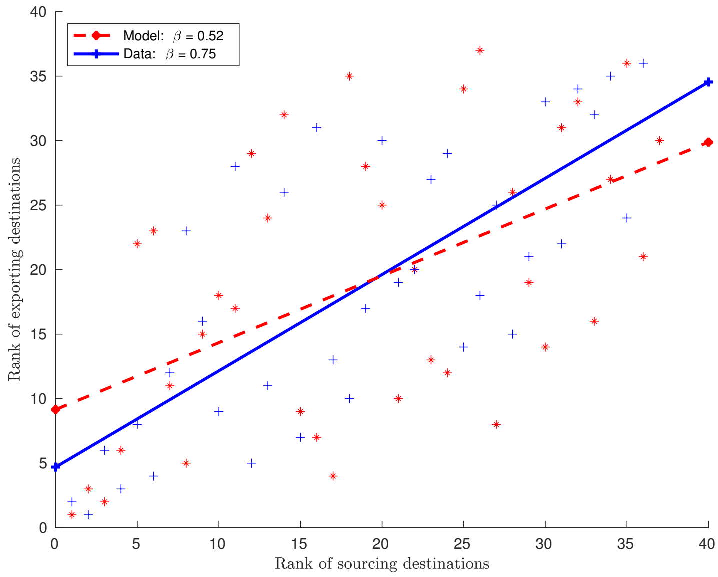

*Note:* This figure plots the responses of firm market accession (number of destinations and origins) for five groups of firms sorted by total revenue (with five being the highest). The blue-colored bars are for the baseline model and the orange-colored bars are for the restricted model where $\alpha_0 = \alpha_1 = 0$. The $y$-axises are in log deviations. All four panels share the same axis labels.

## C.5 Alternative Models

### C.5.1 Same $\alpha$'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. Now, we add an exercise where we force the two parameters to be identical. The results are shown in the following figure.

Figure A14: Rank-Rank (Same $\alpha$'s)




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

### C.5.2 Target Full Moments

Table A17 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 A15, we plot the rank-rank relationship for the four models using the parameters in Table A17.

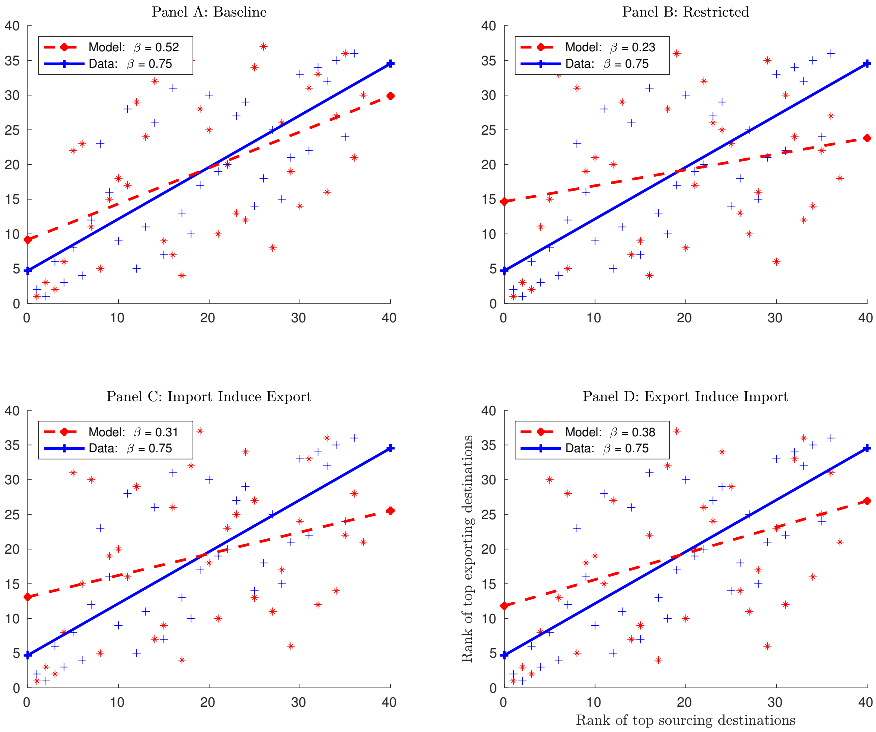
Table A17: Parameter Assignments (Identical Moments)

| 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.5.3 Rank-Rank for Full Moments

Figure A15: 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.5.4 Decomposition of Models with Unilateral Economies of Scope

Table A18 shows the decomposition results from the two restricted models of unilateral economies of scope.

Table A18: 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.

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