Supply chain disruptions and diversification

Central Bank of Chile

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Firms take risk into account and are rethinking their supply chains


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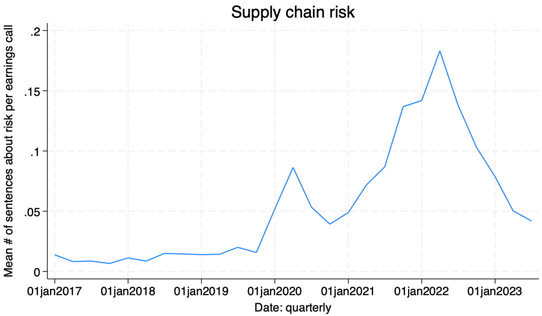
Carmakers quietly cut ties with China in supply chain shake-up

International groups are sourcing parts from other markets as fears rise of breakdown in relations with Beijing

- December 26, 2022. *However, carmakers are also* ***aiming to be more rigorous over their choice of suppliers*** *as they focus on the resilience of the supply chain, as well as costs, to make sure it does not break down. "It is no longer an era where cost is the major driving factor," said Masahiro Moro, senior managing executive officer at Mazda. "Right now, robustness of our supply chain also needs to be considered* ***to ensure the stable procurement of parts."***

Firms are taking supply chain disruption risk into account



Average risk created using Hassan et al. (2023)'s data

- Hassan et al. (2023): Use text-based measures and earning calls to find proportion of the conversation dedicated to the event of interest
  - Risk: Supply chain disruption's overall perceived impact on the variance of the firm's economic outlook
- HHI

Questions

- How does supply chain disruption risk affect firms' sourcing decision?
  - Would firms be sourcing from more foreign countries to diversify against this risk? Or will they be re-shoring instead?
  - Would firms import from cheaper or less risky/riskier countries?
  - How does aggregate and idiosyncratic uncertainty affect firms' sourcing strategy?

Project

- This project:
  - Multi-country sourcing model with supply chain uncertainty and fixed cost of starting a sourcing relationship and of entry. Firms import based on productivity and country-specific variables
  - Trade disruption: exogenous aggregate and idiosyncratic shocks affect cost of importing
  - Firms select which countries to import from taking this into account
  - Counterfactual analysis: effect of changes in uncertainty on extensive and intensive margin

Related Literature

- Sourcing models
  - Antràs and Helpman (2004), Antràs and Helpman (2006), Antràs, Fort, and Tintelnot (2017), Bernard and Moxnes (2018)
    - Study supply chain disruption risk in multi-country model
- Uncertainty in trade
  - Theory of supply chain uncertainty: Grossman et al. (2021), Grossman et al. (2023), Gervais (2021, 2018)
    - Multi-country model allows for sourcing interdependencies and to separate effect of cost and uncertainty, aggregate and idiosyncratic.
    - Structural estimation with micro data and counterfactual analysis
  - Tariff policy uncertainty: Handley et al. (2020), Handley and Limão (2017), Charoenwong et al. (2023)
    - General framework for policy, supply-chain risk, and trade shocks
  - Trade disruption shocks Carreras-Valle (2021), Castro-Vincenzi (2022), Lafrogne-Joussier et al. (2022)
    - Analyze uncertainty and firm's sourcing choice using structural model
  - Empirical literature on propagation through trade networks: Caselli et al. (2020), Boehm et al. (2019), Carvalho et al. (2021)
    - Study of firms' joint sourcing and diversification decision

Outline

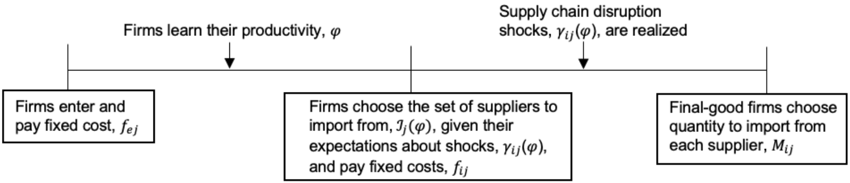
Outline

Model: Setup

- I countries. Origin: i, Destination: j
- Households: Cobb-Douglas with outside sector and consumption as CES bundle over diff varieties, ω, with elast of subst $\sigma > 1$ Preferences
- Final-good producers in country $j \in I$
  - Produce a single, non-tradable, differentiated variety
  - Uses a unit measure of intermediate inputs
  - Monopolistic competition
  - Input varieties ν with CES ρ. Perfect substitution across countries, and imperfect substitution across inputs Technology
- Intermediate good sector back
  - Perfect competition: priced at marginal cost. Iceberg trade cost τ_{ij}
  - Productivity follows Fréchet distribution with T_i state of technology in i and θ variability of prod. draws across inputs Fréchet
- $\mathcal{I}_j(\varphi)$: set of countries final-good firm φ in j can import from

Model: Timeline

- Static model in which firms make decisions in three stages



- With $\gamma_{ij}(\varphi) = \bar{\gamma}_{ij} \times \tilde{\gamma}_{ij}(\varphi)$, and $\bar{\gamma}_{ij} \sim_{\text{iid}} \bar{\Psi}_{ij}(\cdot)$, $\tilde{\gamma}_{ij}(\varphi) \sim_{\text{iid}} \tilde{\Psi}_{ij}^{\varphi}(\cdot)$, independently
- Facts/motivation

Model: Firm Behavior Conditional on Sourcing Strategy, $\mathcal{I}_j(\varphi)$

- Competitive equilibrium: Backward induction
- Share of intermediate input purchases for realized shocks:

$$\mathcal{X}_{ij}(\varphi, \boldsymbol{\gamma}) = \frac{T_i(\tau_{ij}\gamma_{ij}(\varphi)w_i)^{-\theta}}{\Theta_j(\varphi, \boldsymbol{\gamma}(\varphi))} \text{ if } i \in \mathcal{I}_j$$

⇒ $T_i(\tau_{ij}\gamma_{ij}(\varphi)w_i)^{-\theta}$: *sourcing potential* of country i from the point of view of firm φ in country j

⇒ $\Theta_j(\varphi, \boldsymbol{\gamma}(\varphi)) \equiv \sum_{k\in\mathcal{I}_j(\varphi)} T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta}$: *sourcing capability* of firm φ in country j

⇒ *Ex-post* Eaton and Kortum, within the firm

Model: Choice of Set of Countries to Import from, $\mathcal{I}_j(\varphi)$

- Choice of $\mathcal{I}$ using ex-ante profits, with $\mathcal{I}_j(\varphi) = \{i : \mathbb{1}_{ij} = 1\}$:

$$\max_{\mathbb{1}_{ij} \in \{0,1\}_{i=1}^{I}} \mathbb{E}(\pi_j(\varphi, \gamma)) = \mathbb{E}\left(\varphi^{\sigma-1}\left(\eta \sum_{i=1}^{I} \mathbb{1}_{ij} T_i \left(\tau_{ij}\bar{\gamma}_{ij}\tilde{\gamma}_{ij}(\varphi) w_i\right)^{-\theta}\right)^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})\right) - w_j \sum_{i=1}^{I} \mathbb{1}_{ij} f_{ij}$$

- With market demand in j defined as

$$B_j(\bar{\gamma}) \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} E_j P_j(\bar{\gamma})^{\sigma-1}$$

$\Rightarrow$ Effect through price index Price index

Model: Choice of set of Countries to Import from, $\mathcal{I}_j(\varphi)$

- Proposition: Proposition 1 Proof

  a) Higher productivity firms will increase their expected profits by sourcing from more *or* "better" countries

  $$\mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_H, \gamma(\varphi_H)))^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})) > \mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_L, \gamma(\varphi_L)))^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

  b) If $\sigma - 1 > \theta$, import countries are ***complements*** in the sourcing decisions

  $\Rightarrow$ More productive firms source from more countries

  $\Rightarrow$ Pecking order: more productive firms source from more countries. Same choice of countries if fixed costs are the same

- Proposition 2 Algorithm Closing model

Outline

Decomposition: What determines profits

- The firms maximizes expected profit for their sourcing decision

$$\mathbb{E}\big[\pi(\varphi,\gamma)\big] = \varphi^{\sigma-1}\Bigg(\underbrace{\Theta_H(\varphi,\mathbb{E}[\gamma])^{\frac{\sigma-1}{\theta}}}_{\text{Sourcing capability for expected shock}} + \underbrace{\mathbb{E}\Big[\Theta_H(\varphi,\gamma)^{\frac{\sigma-1}{\theta}} - \Theta_H(\varphi,\mathbb{E}[\gamma])^{\frac{\sigma-1}{\theta}}\Big]}_{\text{Risk effect on capability}}\Bigg) \times \underbrace{\mathbb{E}(B_H(\gamma))}_{\text{Expected market demand}} + \varphi^{\sigma-1} \underbrace{Cov(\Theta_H(\varphi,\gamma)^{\frac{\sigma-1}{\theta}}, B_H(\gamma))}_{\text{Covariance btw sourcing capability \& market demand}} - \underbrace{w_j \sum_{i\in\mathcal{I}(\varphi)} f_{ij}}_{\text{Fixed cost of sourcing}}$$

Profit Decomposition - 3 Countries

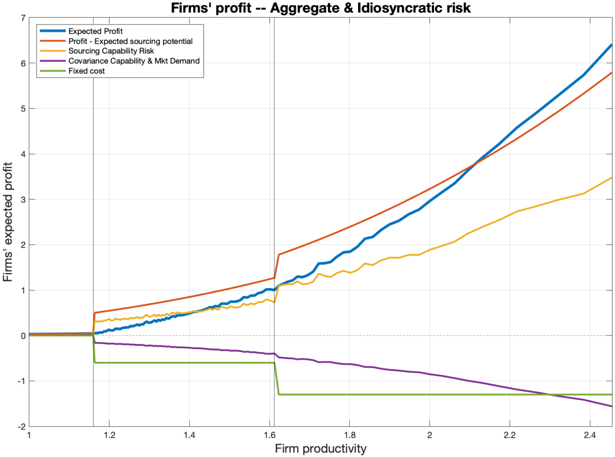


Figure 1: Three countries - Profit decomposition

▶ Idiosyncratic | Aggregate | No risk | Substitutes case | Parametrization

Learning from Decomposition

- Proposition: Proposition 3

  ⇒ Everything else equal, firms' profit increase from riskier countries (in terms of higher variance for idiosyncratic shocks)

- Proposition: Proposition 4

  a. Higher productivity firms' obtain higher profit from riskier countries, in terms of idiosyncratic shocks, than lower productivity firms
  b. Everything else equal, more productive firms benefit more from adding a country that is riskier (higher variance for idiosyncratic shocks) (Work in progress)

- Ambiguous result for aggregate risk (Work in progress):

  i. Higher variance: Option value of lower cost
  ii. Extra term: Covariance between sourcing capability and market demand

Outline

Firms' Profits and Sourcing

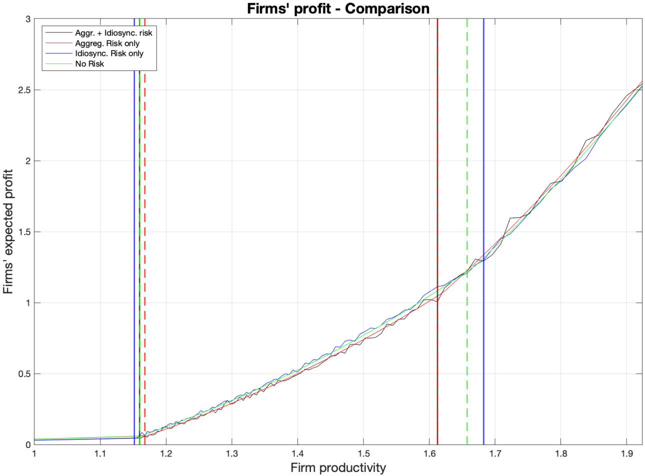


Figure 2: Optimal sourcing/Profits

▶ Share of firms Substitutes case

Outline

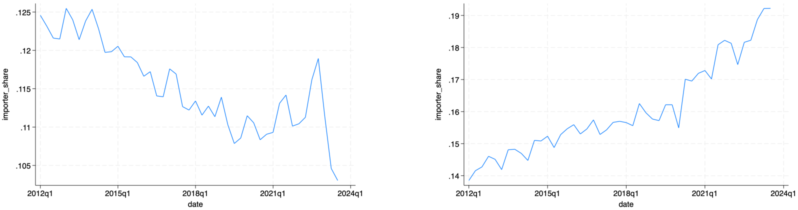
Data Description

- Databases:
  - **Customs**: import transactions at product-origin-firm level. Products defined at HS6 level. Quarterly data, 2012 - 2023
  - **Tax form 29**. Firm-level information on sales based on VAT records
  - **Unemployment insurance fund**: Firm-level information on employment and wage bill based on contributions to accounts
- Sectors: Mining; Manufacturing; Trade, Restaurants, and Hotels
- Firms' with positive sales and more than 5 employees
- Descriptive Statistics

Outline

1. Model
2. Decomposition
3. Numerical Experiment
4. Data
5. Structural Analysis
6. Next Steps

Share of importers by country of origin



(a) USA (b) China

Figure 3: Share of importers by country of origin

Structural Analysis

We want to estimate the parameters from our model: $[\bar{\gamma}_{ij}, \tilde{\gamma}^n_{ij}, f^n_{ij}]$. Steps:

i. Taking θ and σ from Antràs et al. (2017), we use $\theta = 1.789$ and $\sigma = 3.85$
   - $\Rightarrow$ So, $(\sigma - 1)/\theta = 1.593$

ii. Use difference in country's share of intermediate input purchases wrt Chile to obtain average sourcing potential,

iii. Use time difference in country's share of intermediate input purchases wrt Chile to obtain time difference aggregate shock and time difference idiosyncratic shock,

iiv. Use simulated method of moments to estimate fixed costs of sourcing and other distributional parameters (Jia (2008))

Overall approach

- With $\mathcal{I}_j^n$ given, use model derived relationship:

$$\mathcal{X}_{ij,t}^n = \frac{T_i(\tau_{ij}\bar{\gamma}_{ij,t}\tilde{\gamma}_{ij,t}^n w_i)^{-\theta}}{\Theta_{j,t}^n(\gamma)} \text{ if } i \in \mathcal{I}_j^n$$

- Rewrite firm-level equation as country FE and firm-level error term:
  1. Divide into country specific part and measurement error
  2. Take diff. and set domestic sourcing potential equal to 1 so that

$$\log \mathcal{X}_{ij,t}^n - \log \mathcal{X}_{jj,t}^n = \log \bar{\xi}_i + \log \epsilon_{i,t}^n$$

  3. Run OLS using data on firm's total imports from each country, wage bill, and total input usage to measure shares, to obtain $\bar{\xi}_i$

Step 2. Estimating Shocks

- Recall $\xi_{i,t} = T_i(\tau_{ij}\bar{\gamma}_{ij,t} w_i)^{-\theta}$ and $\epsilon^n_{i,t} = \tilde{\gamma}^n_{ij,t}$. Leverage the panel data structure, use first-difference equation to identify shocks:

$$(\log \mathcal{X}^n_{ij,t} - \log \mathcal{X}^n_{jj,t}) - (\log \mathcal{X}^n_{ij,t-4} - \log \mathcal{X}^n_{jj,t-4}) = \log \xi_{i,t-(t-4)} + \log \epsilon^n_{i,t-(t-4)}$$

$\Rightarrow$ Recover shocks as

  - $\log \xi_{i,t-(t-4)} = -\theta \log \bar{\gamma}_{i,t}/\bar{\gamma}_{i,t-4}$,
  - $\log \epsilon^n_{i,t-(t-4)} = -\theta \log \tilde{\gamma}^n_{i,t}/\tilde{\gamma}^n_{i,t-4}$

- Run OLS with origin-country – time fixed effects
  - Sourcing capability is simplified from the regression
  - Shocks occur after sourcing decisions are made

Step 3. Recover Shocks

- To recover $\hat{\gamma}_{ij,t}$, we have to make some assumptions. Specifically,
  1. Trend process
     - Linear: $\gamma_{ij,t} = \gamma_{ij,t+4}/(\gamma_{ij,t+4}/\gamma_{ij,t})$
  2. Initial values: $\gamma_{i0} = 1$, $\gamma_{i1} = 1$, $\gamma_{i2} = 1$, $\gamma_{i3} = 1$
  3. Parametric assumption depending on data (e.g., lognormal)
- Now, we can recover variance $\bar{\sigma}^2$ and $\tilde{\sigma}^2$
- Shocks are estimated as short/medium term

Step 4. Estimating Fixed Costs of Sourcing

- Use average 2012q1-2019q4 data.
- Firm-country FC depend on gravity var. and control of corruption
  - Model $f_{ij}^n \sim$ log-normal($\log \beta_{c,f}^n + \beta_{d,f}^n \log \text{distance}_{ij} + \log \beta_{c,f}^n \text{control of corruption}_i, \beta_{disp,f}^n$). We assume $f_{jj}^n = 1$
- SMM to estimate $\delta = [B(\bar{\gamma}), \beta_{c,f}^n, \beta_{d,f}^n, \beta_{l,f}^n, \beta_{C,f}^n, \beta_{\text{disp},f}^n]$
- Draw shocks Shocks. Moments selection: m_k data, $\hat{m}_k(\delta)$ simulated
  1. Share of importers for all firms
  2. Share of importers with firm sales below the median
  3. Share of firms that imports from each country: $(I-1) \times 1$ vector
  4. Share of firms whose input purchases from Chile are less than the median input purchases from Chile in the data
- High dimensionality combinatorial problem: Jia (2008)'s algorithm

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Next Steps

- Obtain the variance for the shocks, aggregate $\bar{\gamma}_{ij}$ and idiosyncratic $\tilde{\gamma}_{ij}^{n}$ (in progress)
- Obtain the values for mean sourcing potentials $\bar{\xi}_{ij}$ (in progress)
- Implement SMM to obtain (i) fixed cost (mean and variance), (ii) aggregate expenditure
- Counterfactuals: Different risk scenario and how they affect firms' sourcing decisions and other variables
  - Covid shock
    - Suppose variance of shock for all countries stayed constant 2020-2023
    - Suppose risk for specific country (e.g., China) stayed constant
  - Removing supply chain uncertainty
  - Climate Hazard
    - Increase in country risk, e.g., Central America/South East Asia, associated with a $2^{\circ}/3^{\circ}$ global warming in 2050 Climate
- Compare intensive margin and HHI

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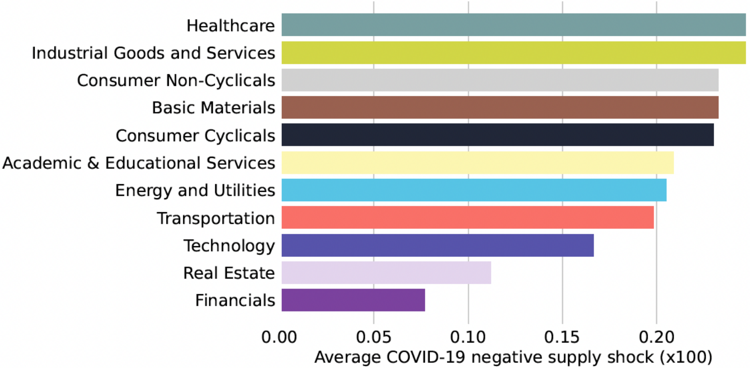
Negative supply shocks

(b) Average of *COVID-19 negative supply shock*$_{i,t}$

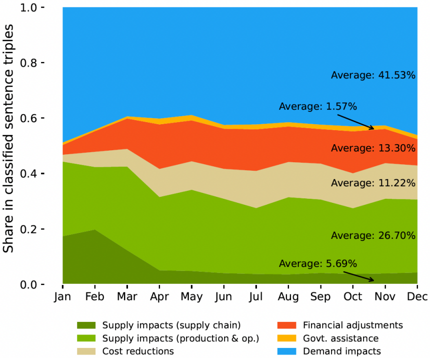


Notes: This figure plots the sector averages of *COVID-19 net demand shock*$_{i,t}$ and *COVID-19 negative supply shock*$_{i,t}$ for all firms with earnings conference calls between January and December 2020. The averages are multiplied by 100 for exposition purposes. The sector classification is based on a firm's "Economic Sector" from the Refinitiv Eikon database.

Source: Hassan et al. (2023)

Topic decomposition

Figure 5: Topic decomposition of COVID-19-related speech



Notes: This figure plots the share of each of five topics ('supply impacts' (i.e., 'supply chain' and 'production and operations'), 'cost reductions,' 'financial adjustments,' 'government assistance,' and 'demand impacts') in classified sentence triples mentioning COVID-19 in transcripts of earnings conference calls held from January through December 2020. A sentence triple is defined as three consecutive sentences (if available) by the same speaker with the middle sentence containing a COVID-19-related keyword. Sentence triples assigned to more than one topic are duplicated for the purpose of determining the denominator; by doing so, shares add up to one.

Source: Hassan et al. (2023)

Global Supply Chain Pressure Index (GSCPI)

Figure 4: Global supply chain pressures reached a peak and are back to normal

- Federal Reserve Bank of New York. The GSCPI integrates a number of commonly used metrics with the aim of providing a comprehensive summary of potential supply chain disruptions. Global transportation costs are measured by employing data from the Baltic Dry Index (BDI) and the Harpex index, as well as airfreight cost indices from the U.S. Bureau of Labor Statistics. The GSCPI also uses several supply chain-related components from Purchasing Managers' Index (PMI) surveys, focusing on manufacturing firms across seven interconnected economies: China, the euro area, Japan, South Korea, Taiwan, the United Kingdom, and the United States.
https://www.newyorkfed.org/research/policy/gscpi#/faq
- back

HHI for Chile: unweighted average

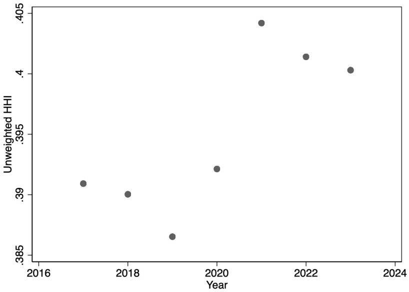


Figure 5: Aggregate Herfindhal-Hirschman Index

- Chilean Customs data: CIF value of imports at HS8 level.
- A higher HHI means less diversification, whereas a lower HHI means suppliers are less concentrated.
- back

Comparing literature

Paper	sourcing	shock to price	uncertainty	other reasons
Grossman et al. (2021)	Y	N	Y	N
Gervais (2021)	Y	Y	Y	N
Handley et al. (2020)	Y	Y	Y	Y
Antràs et al. (2017)	Y	N	N	N

Table 1: Literature comparison

▶ back

Preferences

- Households:

$$U_j(C_{oj}, C_{sj}) = C_{oj}^{1-\alpha} C_{sj}^{\alpha}$$

  - C_{oj} cons of outside sector and C_{sj} cons of sector of interest
  - Spend α of their income on consumption of good from sector of interest and $1-\alpha$ in consumption of outside sector good

$$C_{sj} = \left(\int_{\omega \in \Omega_j} y_j(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

  - Ω_j: set of available varieties in country $j \in I$ in relevant state of world

$$y_j(\omega) = C_{sj} \left(\frac{p_j(\omega)}{P_j} \right)^{-\sigma} = E_j P_j^{\sigma-1} p_j(\omega)^{-\sigma}$$

  - $p_j(\omega)$: the price of variety ω in country j. E_j: total expenditure, fixed, in our sector in country j. P_j: ideal price index

- back

Model: Technology and market structure

- For each variety ν, there is perfect substitution across countries, and imperfect substitution across inputs with CES ρ,

$$y_j(\omega) = \left(\int_0^1 m_j(\nu)^{\frac{\rho-1}{\rho}} d\nu \right)^{\frac{\rho}{\rho-1}}$$

- Minimizing the cost:

$$s_i(\nu, \varphi; \mathcal{I}_j(\varphi)) = \arg \min_{i \in \mathcal{I}_j(\varphi)} \left\{ w_i a_i(\nu, \varphi) \tau_{ij} \gamma_{ij}(\varphi) \right\}$$

- Productivity $1/a_i(\nu, \varphi)$ follows a Fréchet distribution

$$\mathbb{P}(a_i(\nu, \varphi) \geq a) = e^{-T_i a^{\theta}}, \text{ with } T_i > 0$$

where T_i governs the state of technology in country i, while θ determines the variability of productivity draws across inputs.

- Intermediate input technology: $m_j(\nu) = \ell_i / a_i(\nu, \varphi)$
- back back back

Model: Facts/Motivation

- Importers are twice as large and about 12% more productive than non-importers. US: Antràs et al. (2017), and Bernard et al. (2007).
- More productive firms source from more countries. US: Antràs et al. (2017). **Heterogeneous firms.**
- Extensive and intensive margins of sourcing differ. Table **Fixed cost of sourcing.**
- Intermediate good trade is 2/3 of international trade flows. Feenstra (1998), Hummels et al. (2001), Johnson and Noguera (2017). Focus only on intermediate good trade. **Final good is non tradable.**
- Increase in price index from supply chain disruptions. Alessandria et al. (2023), LaBelle and Santacreu (2022). **Shock to price.**
- Multi-sourcing is more likely when there's uncertainty. Chung (2017), Gervais (2018), Gervais (2021). Motivation.
- Increase in HHI with increase in uncertainty for Chile. Motivation
- back

Extensive and Intensive margin

Countries	Value of imports (9 0's CLP)	Number of firms
United States	3296	7322
China	3113	14848
Brazil	1628	2442
Argentina	1075	1540
Germany	551	2787
Spain	356	2560
Mexico	352	1315
Japan	348	1061
Peru	328	1127
Colombia	273	713

Table 2: Extensive and intensive margin comparison full sample 2023q2

▶ back

Model: Discussion of Assumptions

- Timing decision:
  - We observe ex-post data.
- Final-good firm is owned by risk-neutral managers:
  - Firms maximize expected profits.
  - Check by including SDF in the final-good firm's profit function.
  - Gervais (2021), Gervais (2018): risk-averse managers.
- Fréchet assumption:
  - Tractability. Because of extreme value, there is always a firm with high productivity/low price in at least one country for each variety.
  - ρ is not relevant. Extension: check for Leontief case.
- Final-good firms bear all the risk:
  - Risk neutral monopolistically competitive final-good firms and perfectly competitive intermediate-good firm.
- Supply chain shocks separate from iceberg costs:
  - For exposition purposes.
- Carry same assumptions as in Antràs et al. (2017).
- Back

Model: Discussion of Assumptions from Antràs et al. (2017)

- firm specificity of inputs: gives reason for fixed costs,
- final goods cannot be traded internationally: focus on imports,
- all final good producers combine measure one of inputs in production: simplifies structural estimation,
- wages are pinned down by outside sector: tractability,
- different market structures between intermediate and final good firms: intermediate-sector could be monopolistically competitive and would obtain similar results.

Model: Price Index

- The price index is:

$$P_j(\bar{\gamma}) = \left(\int_{\tilde{\varphi}} \int_{\tilde{\gamma}(\varphi)} p_j(\varphi, \gamma)^{1-\sigma} d\tilde{\Psi}_j^{\varphi}(\tilde{\gamma}) dG_j(\varphi) \right)^{\frac{1}{1-\sigma}}$$

with

$$p_j(\varphi, \gamma) = \frac{\sigma}{\sigma - 1} \underbrace{\frac{1}{\varphi} \left(\eta \Theta_j(\varphi, \boldsymbol{\gamma})\right)^{-1/\theta}}_{c_j(\varphi, \gamma)} \text{ and } \eta = \left[\Gamma\left(\frac{\theta + 1 - \rho}{\theta}\right)\right]^{\frac{\theta}{1-\rho}}$$

- back

Proposition

- Proposition: The solution $\mathbb{1}_{ij}(\varphi) \in \{0,1\}_{i=1}^{I}$ to the optimal sourcing problem is
  (a) a firm's expected sourcing capability times the market demand $\mathbb{E}(\Theta_j(\varphi,\gamma)^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})) = \mathbb{E}((\sum_{i=1}^{I} \mathbb{1}_{ij}(\varphi) T_i(\tau_{ij}\gamma_{ij}(\varphi) w_i)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$ is nondecreasing in φ;
  (b) if $(\sigma-1)/\theta \geq 1$, then $\mathcal{I}_j(\varphi_L) \subset \mathcal{I}_j(\varphi_H)$ for $\varphi_H \geq \varphi_L$, where $\mathcal{I}_j(\varphi) = \{i : \mathbb{1}_{ij} = 1\}$.
- Weighted sum of supermodular functions is supermodular + Antràs et al. (2017) for proof of supermodularity. True if $\gamma_{ij}(\varphi) > 0$.
- Solves dimensionality problem. Can use Jia (2008)'s
- This means
  (i) More productive firms choose a larger sourcing capability (either by selecting more countries to source from or selecting better countries).
  (ii) When $(\sigma-1)/\theta \geq 1$, so $card(\mathcal{I}_j(\varphi))$ is necessarily weakly increasing in φ, which implies a Pecking order.
- back

Proof of proposition 1 (1/2)

(a) Two firms with productivity $\varphi_H > \varphi_L$. Denote $\mathcal{I}_j(\varphi_H) = \{i : \mathbb{1}_{ij}(\varphi_H) = 1\}$ and $\mathcal{I}_j(\varphi_L) = \{i : \mathbb{1}_{ij}(\varphi_L) = 1\}$, and $\mathcal{I}_j(\varphi_H) \neq \mathcal{I}_j(\varphi_L)$ (if $\mathcal{I}_j(\varphi_H) = \mathcal{I}_j(\varphi_L)$, it holds trivially). For firm φ_H to prefer $\mathcal{I}_j(\varphi_H)$ over $\mathcal{I}_j(\varphi_L)$:

$$\mathbb{E}(\varphi_H^{\sigma-1}(\eta\Theta_j(\mathcal{I}_j(\varphi_H,\gamma(\varphi_H))))^{\frac{\sigma-1}{\theta}}B_j(\gamma)) - w_j\sum_{i\in\mathcal{I}_j(\varphi_H)} f_{ij} > \mathbb{E}(\varphi_H^{\sigma-1}(\eta\Theta_j(\mathcal{I}_j(\varphi_L,\gamma(\varphi_L))))^{\frac{\sigma-1}{\theta}}B_j(\gamma)) - w_j\sum_{i\in\mathcal{I}_j(\varphi_L)} f_{ij}$$

and

$$\mathbb{E}(\varphi_L^{\sigma-1}(\eta\Theta_j(\mathcal{I}_j(\varphi_H,\gamma(\varphi_H))))^{\frac{\sigma-1}{\theta}}B_j(\gamma)) - w_j\sum_{i\in\mathcal{I}_j(\varphi_H)} f_{ij} < \mathbb{E}(\varphi_L^{\sigma-1}(\eta\Theta_j(\mathcal{I}_j(\varphi_L,\gamma(\varphi_L))))^{\frac{\sigma-1}{\theta}}B_j(\gamma)) - w_j\sum_{i\in\mathcal{I}_j(\varphi_L)} f_{ij}$$

- Combining these two, we find

$$[\varphi_H^{\sigma-1} - \varphi_L^{\sigma-1}][\mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_H,\gamma(\varphi)))^{\frac{\sigma-1}{\theta}}B_j(\gamma)) - \mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_L,\gamma(\varphi)))^{\frac{\sigma-1}{\theta}}B_j(\gamma))]\eta^{\frac{\sigma-1}{\theta}} > 0$$

- Back

Proof of proposition 1 (2/2)

- Given $\varphi_H > \varphi_L$ and the fact that γ's are the same and the expectations formed about these i.i.d. shocks are the same, $\mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_H, \gamma(\varphi_H)))^{\frac{\sigma-1}{\theta}} B_j(\gamma)) > \mathbb{E}(\Theta_j(\mathcal{I}_j(\varphi_L, \gamma(\varphi_L)))^{\frac{\sigma-1}{\theta}} B_j(\gamma))$.

(b) When $(\sigma - 1)/\theta > 1$, the expected profit function features increasing differences in $\mathbb{1}_{ij}, \mathbb{1}_{kj}$ for $i, k \in \{1, \ldots, I\}$ with $i \neq k$. Furthermore, it also features increasing differences in $(\mathbb{1}_{ij}, \varphi)$ for any $i \in I$. We use Topki's theorem, which states that if f is supermodular in (x, θ) and D is a lattice, then $x^*(\theta) = \arg\max_{x \in D} f(x, \theta)$ is nondecreasing in θ, so we can then conclude that $\mathcal{I}_j(\varphi_L) \subseteq \mathcal{I}_j(\varphi_H)$ for $\varphi_H \geq \varphi_L$.

Proposition 2 (1/2)

- Proposition 2: $\forall i \in \{1, \ldots, I\}$, define mapping $V_{ij}(\varphi, \mathcal{I})$ to be one when including country i in the sourcing strategy $\mathcal{I}$ raises firm-level expected profits $\mathbb{E}(\pi_j(\varphi, \mathcal{I}))$, and a value of zero otherwise. Then, when $(\sigma - 1)/\theta \geq 1$, $V_{ij}(\varphi, \mathcal{I}') \geq V_{ij}(\varphi, \mathcal{I})$ for $\mathcal{I} \subseteq \mathcal{I}'$.

- Consider first the case, $i \neq \mathcal{I}_j(\varphi)$. The mapping defined in Proposition 2 is such that $V_{ij}(\varphi, \gamma, \mathcal{I}) = 1$ if

$$\varphi^{\sigma-1}\eta^{\frac{\sigma-1}{\theta}}[\mathbb{E}(\Theta_j(\mathcal{I} \cup i)^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})) - \mathbb{E}(\Theta_j(\mathcal{I})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))] > f_{ij}$$

and $V_{ij}(\varphi, \gamma, \mathcal{I}) = 0$ otherwise. Because of increasing differences, the term $\mathbb{E}(\Theta_j(\mathcal{I} \cup i)^{\frac{\sigma-1}{\theta}}) - \mathbb{E}(\Theta_j(\mathcal{I})^{\frac{\sigma-1}{\theta}})$ is increasing by the addition of elements to the set $\mathcal{I}$ (for $(\sigma - 1)/\theta > 1$). As a result, for $\mathcal{I} \subseteq \mathcal{I}'$, we cannot possibly have $V_{ij}(\varphi, \gamma, \mathcal{I}) = 1$ and $V_{ij}(\varphi, \gamma, \mathcal{I}') = 0$. Instead, we must have either $V_{ij}(\varphi, \gamma, \mathcal{I}) = V_{ij}(\varphi, \gamma, \mathcal{I}') = 0$, $V_{ij}(\varphi, \gamma, \mathcal{I}) = V_{ij}(\varphi, \gamma, \mathcal{I}') = 1$ or $V_{ij}(\varphi, \gamma, \mathcal{I}) = 0$ and $V_{ij}(\varphi, \gamma, \mathcal{I}') = 1$.

Proposition 2 (2/2)

- Second, consider the case $i \in \mathcal{I}$. The mapping $V_{ij}(\varphi, \gamma, \mathcal{I})$ defined in Proposition 2 is such that

$$\varphi^{\sigma-1}\eta^{\frac{\sigma-1}{\theta}}[\mathbb{E}(\Theta_j(\mathcal{I})^{\frac{\sigma-1}{\theta}}B_j(\bar{\gamma})) - \mathbb{E}(\Theta_j(\mathcal{I} \setminus i)^{\frac{\sigma-1}{\theta}}B_j(\bar{\gamma}))] > f_{ij}$$

  and $V_{ij}(\varphi, \gamma, \mathcal{I}) = 0$ otherwise. Similarly to above, the term $\mathbb{E}(\Theta_j(\mathcal{I})^{\frac{\sigma-1}{\theta}}) - \mathbb{E}(\Theta_j(\mathcal{I} \setminus i)^{\frac{\sigma-1}{\theta}})$ is increased by the addition of elements to the set $\mathcal{I}$. As a result, for $\mathcal{I} \subseteq \mathcal{I}'$, we cannot possibly have $V_{ij}(\varphi, \gamma, \mathcal{I}) = 1$ and $V_{ij}(\varphi, \gamma, \mathcal{I}') = 0$. Instead, we must have either $V_{ij}(\varphi, \gamma, \mathcal{I}) = V_{ij}(\varphi, \gamma, \mathcal{I}') = 0$, $V_{ij}(\varphi, \gamma, \mathcal{I}) = V_{ij}(\varphi, \gamma, \mathcal{I}') = 1$ or $V_{ij}(\varphi, \gamma, \mathcal{I}) = 0$ and $V_{ij}(\varphi, \gamma, \mathcal{I}') = 1$.
- Thus, we can conclude that $V_{ij}(\varphi, \gamma, \mathcal{I}') \geq V_{ij}(\varphi, \gamma, \mathcal{I}')$ for $\mathcal{I} \subseteq \mathcal{I}'$ as stated in the proposition.
- back

Model: Closing the model, Gravity and HHI

- Closing the model:
  - Outside sector, freely tradable, and big enough to pin down wages. Using free entry condition, and Fubini's theorem, we obtain FEC

$$N_j = \frac{\alpha L_j}{\sigma \left(\int_{\tilde{\varphi}_j}^{\infty} \sum_{i \in \mathcal{I}_j(\varphi)} f_{ij} dG_j(\varphi) + f_{ej} \right)}$$

- Gravity:

$$M_{ij}(\bar{\gamma}) = \frac{E_j}{P_j(\bar{\gamma})^{1-\sigma}/N_j} \times \frac{Q_i}{\sum_k \frac{E_k}{P_k(\bar{\gamma})^{1-\sigma}/N_k} (\tau_{ik}\bar{\gamma}_{ik})^{-\theta} \Lambda_{ik}(\bar{\gamma})} \times (\tau_{ij}\bar{\gamma}_{ij})^{-\theta} \times \Lambda_{ij}(\bar{\gamma})$$

with $Q_i = \sum_k M_{ik}$: total prod. of int. inputs in country i. Ext. forces

- Model implied HHI:

$$HHI_j = \sum_{i=1}^{I} \left(\frac{T_i (\tau_{ij}\bar{\gamma}_{ij} w_i)^{-\theta} \Lambda_{ij}(\bar{\gamma})}{\sum_{k=1}^{I} T_k (\tau_{kj}\bar{\gamma}_{kj} w_k)^{-\theta} \Lambda_{kj}(\bar{\gamma})} \right)^2$$

- Back

Proposition 3

- Using Second Order Stochastic Dominance, with $\tilde{V}ar_{\tilde{\gamma}_{ij}(\varphi)} \geq Var_{\tilde{\gamma}_{\ell j}(\varphi)}$:

$$\mathbb{E}((T_i(\tau_{ij}\gamma_{ij}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})) - \mathbb{E}((T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

$$\geq \mathbb{E}((T_i(\tau_{ij}\gamma_{\ell j}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma})) - \mathbb{E}((T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

- So, ceteris paribus, firms prefer countries with a higher variance on their idiosyncratic shocks.
- Back

Proposition

- Using Second Order Stochastic Dominance, with $\tilde{V}ar_{\tilde{\gamma}_{ij}(\varphi)} \geq Var_{\tilde{\gamma}_{\ell j}(\varphi)}$:

$$[\varphi_H^{\sigma-1} - \varphi_L^{\sigma-1}]\mathbb{E}((T_i(\tau_{ij}\gamma_{ij}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$
$$\geq [\varphi_H^{\sigma-1} - \varphi_L^{\sigma-1}]\mathbb{E}((T_i(\tau_{ij}\gamma_{\ell j}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

- Ceteris paribus, more productive firms prefer riskier countries
- For $Var_i > Var_l$

$$\mathbb{E}((T_i(\tau_{ij}\tilde{\gamma}_{ij}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$
$$\geq \mathbb{E}((T_l(\tau_{lj}\tilde{\gamma}_{lj}(\varphi)w_l)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

- Using SOSD:

$$[\varphi_H^{\sigma-1} - \varphi_L^{\sigma-1}]\mathbb{E}((T_i(\tau_{ij}\tilde{\gamma}_{ij}(\varphi)w_i)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$
$$\geq [\varphi_H^{\sigma-1} - \varphi_L^{\sigma-1}]\mathbb{E}((T_l(\tau_{lj}\tilde{\gamma}_{lj}(\varphi)w_l)^{-\theta} + T_k(\tau_{kj}\gamma_{kj}(\varphi)w_k)^{-\theta})^{\frac{\sigma-1}{\theta}} B_j(\bar{\gamma}))$$

- Back

Profit decomposition

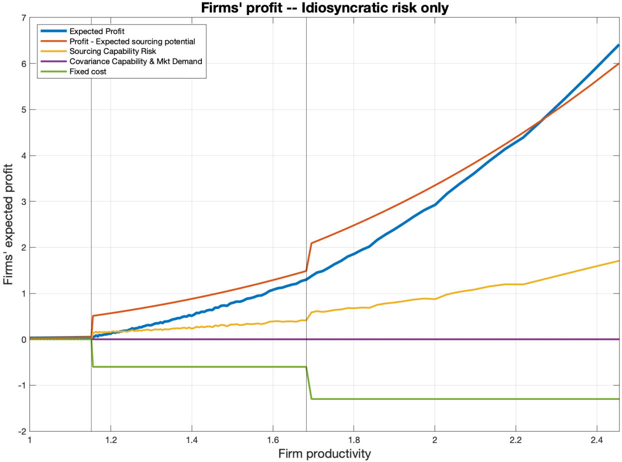


Figure 6: Profit decomposition – Idiosyncratic shocks

Back

Profit decomposition

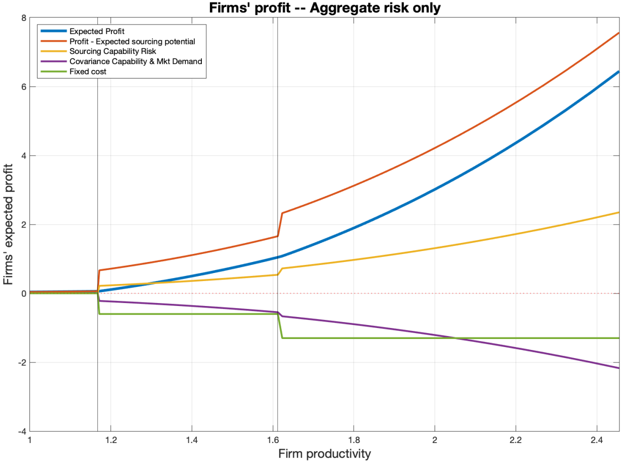


Figure 7: Profit decomposition – Aggregate shocks

Back

Profit decomposition

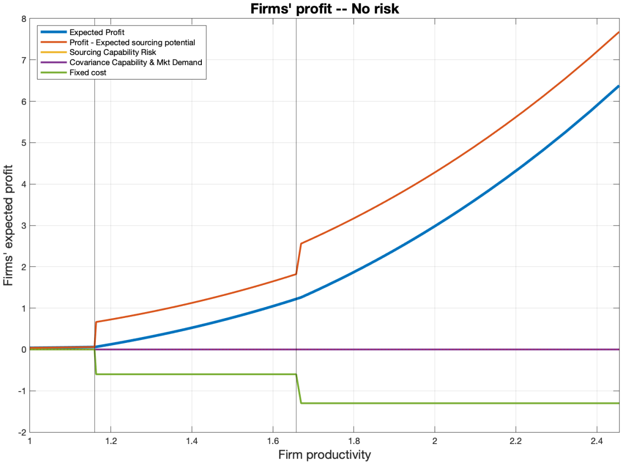


Figure 8: Profit decomposition – No shocks

Back

Profit decomposition

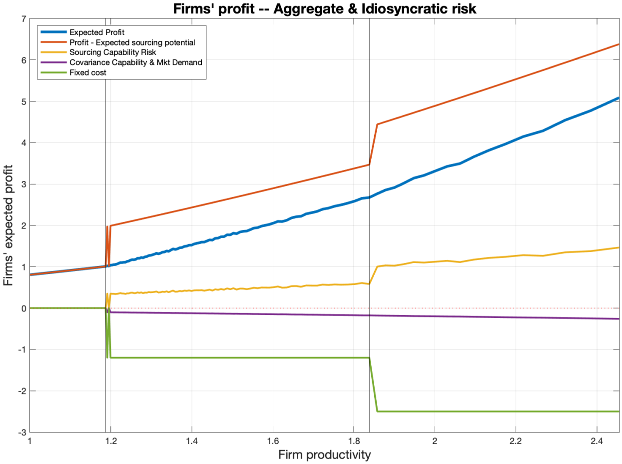


Figure 9: Profit decomposition – No shocks

Back

Profit decomposition

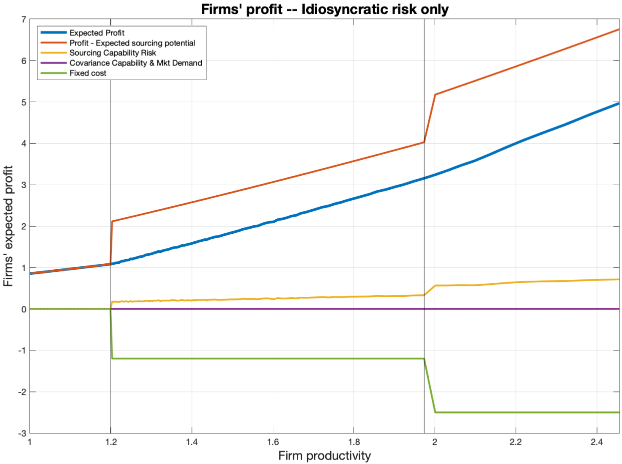


Figure 10: Profit decomposition – No shocks

Profit decomposition

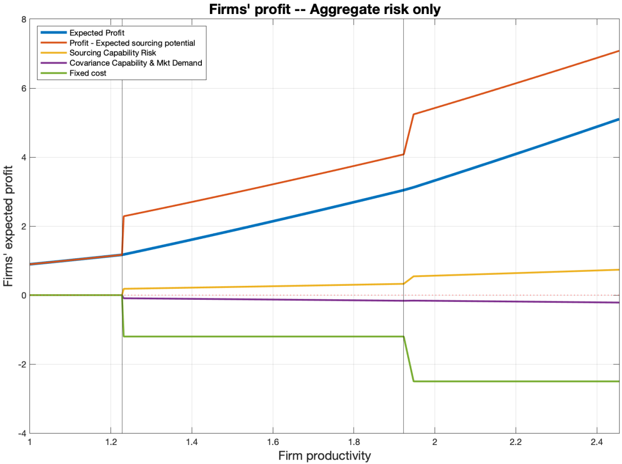


Figure 11: Profit decomposition – No shocks

Parametrization

Variable	Value	
σ_γ	SD of trade cost for disruption	25%
μ_γ	Average trade cost for disruption	1
ρ	Substitutability accross intermediates varieties	2
I_j	Number of countries	3
ξ_{11}	Home Sourcing Potential	1
ξ_{21}	Foreign 1 Sourcing Potential	3
ξ_{31}	Foreign 2 Sourcing Potential	1
Complementarity for $\sigma - 1/\theta = 1.583$		
σ	Elasticity of final demand	3.85
θ	Productivity Fréchet distribution shape	1.789

▶ Simple case Back

Profit decomposition

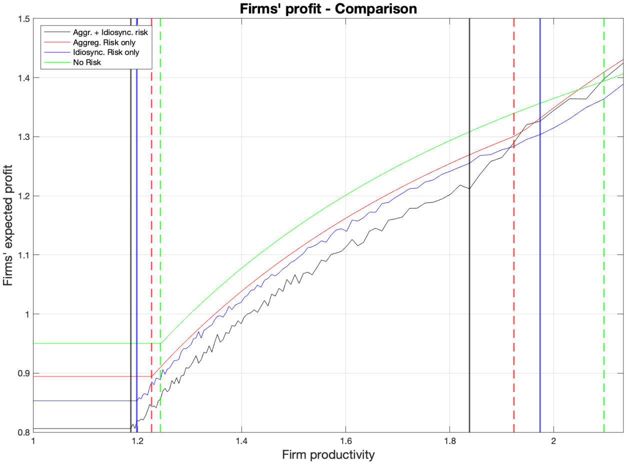


Figure 12: Profit decomposition – No shocks

Back

Simple Case: Share of Firms

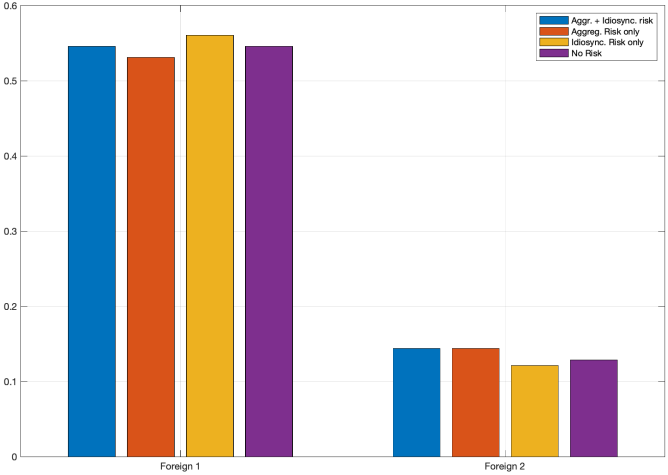


Figure 13: Share of firms

Jia's algorithm

- Proposition: For all $i \in \{1, \ldots, I\}$, define mapping $V_{ij}(\varphi, \mathcal{I})$ to be one whenever including country i in the sourcing strategy $\mathcal{I}$ raises firm-level expected profits $\mathbb{E}(\pi_j(\varphi, \mathcal{I}))$, and a value of zero otherwise. Then, when $(\sigma - 1)/\theta \geq 1$, $V_{ij}(\varphi, \mathcal{I}') \geq V_{ij}(\varphi, \mathcal{I})$ for $\mathcal{I} \subseteq \mathcal{I}'$
- Jia's algorithm: Define mapping, $V_i^n(\mathcal{I}) = 1$ if marginal benefit of adding country i is positive, and zero otherwise. For $(\sigma - 1)/\theta > 1$, Proposition 2 shows this mapping is increasing function of $\mathcal{I}$. Jia (2008): when starting from set $\underline{\mathcal{I}}$ (no countries), iterative adding each country to the set leads to lower bound of the firm's sourcing strategy. So, optimal sourcing strategy contains at least countries with $V_i^n(\mathcal{I}) = 1$. Similarly, when starting from set $\bar{\mathcal{I}}$ (all countries), and removing countries one-by-one, leads to upper bound for the optimal sourcing strategy. Should the two sets not perfectly overlap, only necessary to evaluate profits resulting from all possible combinations contained in the upper but not the lower bound set.
- back

Free entry condition

- Free entry condition:

$$\int_{\tilde{\varphi}_j}^{\infty}\int_{\bar{\gamma}}\int_{\tilde{\gamma}(\varphi)}\left[\varphi^{\sigma-1}(\eta\Theta_j(\varphi,\boldsymbol{\gamma}))^{\frac{\sigma-1}{\theta}}B_j(\gamma)-w_j\sum_{i\in\mathcal{I}_j(\varphi)}f_{ij}\right]d\tilde{\Psi}_j(\varphi)d\bar{\Psi}_j(\varphi)dF(\boldsymbol{\gamma})=w_jf_{ej}$$

  We change orders of integrals (Fubini's theorem), and we obtain firm entry

$$N_j=\frac{\alpha L_j}{\sigma\left(\int_{\tilde{\varphi}_j}^{\infty}\sum_{i\in\mathcal{J}_j(\varphi)}f_{ij}dG_j(\varphi)+f_{ej}\right)}$$

- back

Extended gravity forces

- Define importer-specific term as in Antràs et al. (2017)

$$\Lambda_{ij}(\bar{\gamma}) = \frac{K_j(\bar{\gamma})}{\Xi_j} \int_{\tilde{\varphi}_{ij}}^{\infty} \int_{\tilde{\gamma}_{ij}(\varphi)} \mathbb{1}_{ij}(\varphi)\varphi^{\sigma-1}(\Theta_j(\varphi,\gamma))^{\frac{\sigma-1}{\theta}-1} T_j(\tau_{jj}\tilde{\gamma}_{jj}(\varphi)w_j)^{-\theta} d\tilde{\Psi}_j^{\varphi}(\tilde{\gamma})dG_j(\varphi)$$

  - Controls for extended gravity forces, $K_j(\bar{\gamma}) = (\sigma-1)\eta^{(\sigma-1)/\theta} N_j B_j(\bar{\gamma})$, $\Xi_j \equiv (\sigma-1)\eta^{(\sigma-1)/\theta} T_j(\tau_{jj}\tilde{\gamma}_{jj}(\varphi)w_j)^{-\theta} N_j B_j(\bar{\gamma})$.
- back

Simple case: 2 countries with shocks

- We have H, and F. Choices: Exit, H, FH. Shocks are i.i.d.

$$\bar{\gamma}_i = \begin{cases} 1 & \text{wp } 1-\bar{\pi}_i \\ \bar{\delta}_i & \text{wp } \bar{\pi}_i \end{cases}, \qquad \tilde{\gamma}_i^{\varphi} = \begin{cases} 1 & \text{wp } 1-\tilde{\pi}_i^{\varphi} \\ \tilde{\delta}_i^{\varphi} & \text{wp } \tilde{\pi}_i^{\varphi} \end{cases}$$

- with $i = \{H, F\}$. Assume: $T_H = T_F = w_H = \tau_H = 1$.
- For firm that sources from Home only (H):

$$\mathbb{E}(\pi) = \varphi^{\sigma-1}\eta^{\frac{\sigma-1}{\theta}} \sum_{\gamma} \mathbb{P}(\bar{\gamma}_H, \bar{\gamma}_F, \tilde{\gamma}_F^{\varphi}, \tilde{\gamma}_H^{\varphi}) \underbrace{(\bar{\gamma}_H \tilde{\gamma}_H^{\varphi})^{1-\sigma}}_{\text{Sourcing capability}} \underbrace{B(\bar{\gamma}_H, \bar{\gamma}_F)}_{\text{Market demand}} - \underbrace{f_H}_{\text{Fixed cost}}$$

- Firm that sources from Home and Foreign, expected profits are:

$$\mathbb{E}(\pi) = \varphi^{\sigma-1}\eta^{\frac{\sigma-1}{\theta}} \sum_{\gamma} \mathbb{P}(\bar{\gamma}_H, \bar{\gamma}_F, \tilde{\gamma}_F^{\varphi}, \tilde{\gamma}_H^{\varphi}) \underbrace{\left((\tau_F \bar{\gamma}_F \tilde{\gamma}_F^{\varphi} w_F)^{-\theta} + (\bar{\gamma}_H \tilde{\gamma}_H^{\varphi})^{-\theta} \right)^{\frac{\sigma-1}{\theta}}}_{\text{Sourcing capability}} \underbrace{B(\bar{\gamma}_H, \bar{\gamma}_F)}_{\text{Market demand}} - \underbrace{(f_F + f_H)}_{\text{Fixed costs}}$$

- For a given firm, we have $2^4 = 16$ probabilities
- back

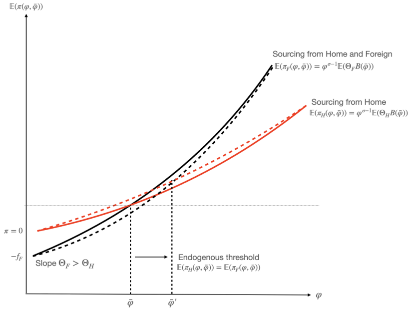
Simple case: 2 countries with shocks

- We have four different price indices depending on realizations of the aggregate shocks $\bar{\gamma}_H$ and $\bar{\gamma}_F$. Idiosyncratic shocks get washed away.

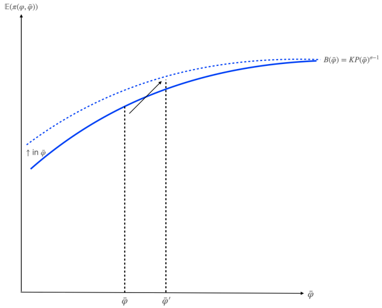
$$P(\bar{\gamma}_H, \bar{\gamma}_F)^{\sigma-1} = \left(\frac{\sigma}{\sigma-1}\right)^{-1} \eta^{\frac{1}{\theta}} \left(s_1(\tilde{\varphi}, \bar{\varphi})(\bar{\gamma}_H)^{1-\sigma} + s_2(\bar{\varphi})((\bar{\gamma}_H)^{-\theta} + (\tau_F \bar{\gamma}_F w_F)^{-\theta})^{\frac{\sigma-1}{\theta}} \right)^{-1}$$

- With $B(\bar{\gamma}_H, \bar{\gamma}_F) = K \times P(\bar{\gamma}_H, \bar{\gamma}_F)^{\sigma-1}$; K constant.
- For this example, we assumed φ distributes Uniform, we can also assume it distributes Pareto: $G_j(\varphi) = 1 - (\underline{\varphi}_j/\varphi)^{\kappa}$.
- Find $\bar{\varphi}$ by equating expected utility between different sourcing strategies: $\mathbb{E}(\pi_H) = \mathbb{E}(\pi_F)$.

Simple case: aggregate shock to foreign



(a) Cutoff



(b) Effect of cutoff on market demand

Figure 14: Simple 2 country example

- Idiosyncratic shocks won't affect $B(\bar{\gamma})$, so it would be the same effect as in Antràs et al. (2017) for a decrease in the sourcing potential.

Simple case: effect of shocks on intermediate input purchase

- Given $B_j(\bar{\gamma})$, and $\sigma - 1 > \theta$, an increase in idiosyncratic, or aggregate, shock decreases sourcing potential and intermediate input purchases from everywhere.
- For an increase in aggregate shocks, $B_j(\bar{\gamma})$ will increase. This will counteract part of the decrease because of sourcing potential and capability, decreasing the negative effect of the shock on firms' profits.
  - The higher $\bar{\varphi}$, the more firms source only from home, so the market demand, $B_j(\bar{\gamma})$, is less affected by foreign uncertainty and intermediate input purchases decrease everywhere.

SDF

For SDF we use:

$$U_j(C_{oj}, C_{sj}) = v(C_o^{1-\alpha} C_{sj}^{\alpha}) \qquad \eta = -\frac{v''(c)c}{v'(c)}$$

where

$$v(C_o^{1-\alpha} C_{sj}^{\alpha}) = \frac{(C_o^{1-\alpha} C_{sj}^{\alpha})^{1-\epsilon}}{1-\epsilon}$$

▶ Back

Descriptive Statistics

Table 3: Descriptive statistics

Date	n firm	empl	wage bill	imports	inputs	sales	domestic	share imp firms
2012q1-2015q4	32,790	1,366	4,576	13,717	63,353	27,731	45,059	0.238
2016q1-2019q4	35,650	1,527	5,365	12,720	62,993	27,822	44,908	0.239
2020q1-2023q3	35,991	1,535	5,707	16,272	75,464	36,170	53,485	0.255

- 2 and 7 sectors
- Sales stats
- back

Descriptive statistics

Table 4: Using 7 sectors: mining; manufacturing; electricity, gas, and water; construction; business, restaurants, and hotels; transportation, information, and communications; financial activities

Date	n firm	empl	wage bill	imports	inputs	sales	domestic	import %
2012q1	48,371	2,160	7,340	15,152	80,934	33,823	78,831	0.18
2012q2	48,857	2,177	7,425	15,743	82,387	34,380	80,110	0.18
2012q3	49,604	2,183	8,087	16,185	81,595	31,130	79,035	0.18
2012q4	50,759	2,261	8,645	16,515	93,230	37,953	90,807	0.18
2013q1	50,251	2,290	8,809	15,677	88,916	34,092	86,479	0.18
2013q2	50,909	2,293	8,686	16,151	87,650	35,053	85,269	0.18
2013q3	51,287	2,267	8,674	16,476	84,710	32,611	82,376	0.18
2013q4	52,081	2,320	8,918	15,753	87,963	35,107	85,783	0.18
2014q1	51,278	2,334	8,392	14,736	79,773	31,983	77,479	0.17
2014q2	51,644	2,308	8,326	14,624	81,126	33,125	79,056	0.17
2014q3	51,844	2,279	8,271	15,001	77,870	31,109	75,719	0.18
2014q4	52,716	2,356	8,386	14,309	80,834	32,875	78,679	0.18
2015q1	52,630	2,377	8,088	12,647	73,029	30,389	71,083	0.17
2015q2	53,239	2,353	8,159	12,283	73,930	29,762	71,922	0.17
2015q3	53,698	2,346	7,750	12,768	69,864	29,283	67,963	0.17
2015q4	54,538	2,402	7,809	12,102	71,663	29,344	69,758	0.18
2016q1	54,595	2,463	7,861	10,680	65,857	27,803	64,103	0.17
2016q2	54,951	2,440	8,059	10,972	71,034	28,196	69,343	0.17
2016q3	55,322	2,420	8,492	12,404	72,685	27,165	70,783	0.17
2016q4	55,593	2,462	8,732	12,531	76,436	30,372	74,497	0.18
2017q1	55,295	2,482	8,907	12,609	74,304	29,257	72,457	0.17
2017q2	55,325	2,463	8,754	12,677	72,614	28,086	70,709	0.17
2017q3	55,711	2,462	9,332	13,415	74,623	31,386	72,587	0.18
2017q4	56,644	2,543	9,930	14,158	86,443	37,640	84,284	0.18
2018q1	56,670	2,578	10,557	14,215	91,232	40,827	89,000	0.17
2018q2	57,138	2,547	10,163	15,292	88,157	43,344	85,857	0.18
2018q3	57,297	2,532	9,809	15,723	84,601	33,640	82,139	0.18
2018q4	58,034	2,621	10,056	15,868	101,620	38,926	99,289	0.18
2019q1	57,701	2,649	10,284	14,318	84,655	38,628	82,435	0.18
2019q2	57,573	2,614	10,018	14,141	89,738	33,356	87,644	0.18
2019q3	57,677	2,589	9,940	14,555	81,592	35,344	79,390	0.18
2019q4	57,278	2,625	9,585	13,681	80,519	36,021	78,445	0.18
2020q1	56,857	2,639	9,076	12,411	75,290	31,886	73,415	0.17
2020q2	51,300	2,330	7,972	10,362	68,711	29,940	66,943	0.17
2020q3	51,058	2,283	8,537	11,882	72,287	36,782	70,321	0.19
2020q4	54,486	2,458	9,496	12,970	83,132	34,688	80,944	0.20
2021q1	55,621	2,521	10,247	15,642	91,799	43,157	89,129	0.19
2021q2	56,837	2,510	10,421	17,034	92,894	41,269	90,014	0.20
2021q3	58,826	2,563	10,212	20,484	102,860	46,306	99,344	0.20
2021q4	60,745	2,668	10,244	22,109	104,549	44,836	100,804	0.20
2022q1	59,705	2,710	10,731	21,805	116,132	46,727	112,550	0.19
2022q2	59,315	2,691	10,547	23,035	107,022	50,866	103,468	0.19
2022q3	58,821	2,658	10,110	22,775	101,517	43,392	97,964	0.19
2022q4	58,684	2,706	10,707	19,427	106,638	42,052	103,593	0.19
2023q1	58,684	2,717	12,323	17,284	109,795	49,147	107,224	0.19
2023q2	58,294	2,657	12,467	17,214	108,777	47,681	106,039	0.19
2023q3	55,959	2,587	4,052	17,960	68,842	33,887	66,030	0.20

Descriptive statistics

Table 5: Using 3 sectors: mining; manufacturing; Business, restaurants, and hotels

Date	n firm	empl	wage bill	imports	inputs	sales	domestic	import %
2012q1	30,907	1,286	4,089	13,867	63,318	29,266	61,571	0.24
2012q2	31,262	1,292	4,105	14,330	64,243	28,745	62,380	0.24
2012q3	31,666	1,281	4,449	14,924	64,005	26,556	61,948	0.24
2012q4	32,225	1,328	4,758	15,252	73,254	31,235	71,161	0.25
2013q1	32,001	1,358	4,889	14,567	70,306	29,332	68,285	0.24
2013q2	32,444	1,360	4,793	14,948	68,619	30,164	66,661	0.24
2013q3	32,578	1,332	4,739	15,281	66,242	27,871	64,197	0.24
2013q4	33,071	1,373	4,919	14,714	69,205	29,713	67,234	0.24
2014q1	32,749	1,396	4,657	13,652	62,729	27,441	60,846	0.23
2014q2	32,944	1,381	4,623	13,388	63,489	28,506	61,668	0.23
2014q3	33,035	1,365	4,616	13,833	60,897	26,528	59,017	0.24
2014q4	33,539	1,414	4,693	13,028	63,663	28,135	61,850	0.24
2015q1	33,433	1,435	4,568	11,440	56,688	26,011	55,003	0.23
2015q2	33,778	1,410	4,571	11,147	56,439	24,196	54,852	0.23
2015q3	34,045	1,396	4,357	11,804	54,374	25,069	52,676	0.24
2015q4	34,465	1,431	4,365	11,309	55,950	24,870	54,249	0.24
2016q1	34,428	1,481	4,449	9,754	50,825	23,812	49,341	0.23
2016q2	34,645	1,459	4,540	9,977	54,921	23,740	53,438	0.23
2016q3	34,784	1,439	4,799	11,247	55,386	22,487	53,723	0.24
2016q4	34,960	1,481	4,953	11,477	58,590	25,022	56,880	0.24
2017q1	34,906	1,508	5,112	11,583	57,413	24,789	55,798	0.23
2017q2	34,864	1,494	5,003	11,709	56,051	23,610	54,349	0.24
2017q3	35,110	1,485	5,352	12,433	57,166	27,081	55,362	0.24
2017q4	35,573	1,543	5,686	13,289	67,227	31,844	65,305	0.24
2018q1	35,724	1,571	6,076	13,270	71,833	30,465	69,803	0.24
2018q2	36,184	1,549	5,829	14,181	68,838	30,392	66,788	0.24
2018q3	36,354	1,533	5,637	14,588	65,173	28,769	63,001	0.24
2018q4	36,670	1,589	5,758	14,812	82,557	33,548	80,467	0.24
2019q1	36,584	1,605	5,894	13,356	65,901	33,663	63,990	0.24
2019q2	36,482	1,572	5,686	13,140	70,368	27,494	68,495	0.24
2019q3	36,531	1,551	5,640	13,551	63,135	27,646	61,171	0.24
2019q4	36,238	1,570	5,403	12,716	62,311	30,694	60,471	0.25
2020q1	35,954	1,578	5,134	11,502	58,635	26,987	57,025	0.23
2020q2	31,960	1,401	4,577	9,437	54,521	25,781	52,960	0.24
2020q3	32,003	1,379	4,916	10,772	56,947	32,734	55,235	0.26
2020q4	33,989	1,463	5,428	12,021	65,988	29,735	64,006	0.26
2021q1	34,827	1,497	5,811	14,414	73,446	35,291	71,059	0.26
2021q2	35,563	1,477	5,878	15,898	73,180	35,703	70,606	0.26
2021q3	36,981	1,515	5,790	18,776	79,743	40,270	76,638	0.27
2021q4	38,301	1,579	5,779	20,642	83,593	38,996	80,160	0.26
2022q1	37,843	1,613	6,082	20,489	87,621	41,386	84,362	0.25
2022q2	37,647	1,595	5,948	21,064	85,461	44,673	82,274	0.25
2022q3	37,313	1,573	5,711	20,650	80,283	36,244	77,066	0.25
2022q4	37,172	1,609	6,080	17,994	84,605	35,491	81,839	0.26
2023q1	36,836	1,612	6,932	15,667	85,264	42,155	82,980	0.25
2023q2	36,581	1,569	6,971	15,538	82,653	39,558	80,264	0.26
2023q3	35,651	1,540	2,281	16,385	55,164	29,649	52,645	0.26

Descriptive statistics

Table 6: Using 2 sectors: mining; manufacturing

Date	n firm	empl	wage bill	imports	inputs	sales	domestic	import %
2012q1	11,406	529	1,998	5,797	30,013	21,188	29,460	0.24
2012q2	11,612	534	2,006	5,656	30,224	20,657	29,652 0.24	
2012q3	11,673	525	2,169	5,562	29,349	18,820	28,734	0.25
2012q4	11,807	539	2,309	5,780	34,958	22,493	34,343	0.25
2013q1	11,668	550	2,368	5,744	33,994	20,696	33,382	0.24
2013q2	11,828	551	2,322	5,916	31,439	20,923	30,826	0.24
2013q3	11,784	535	2,272	5,554	29,591	19,472	29,043	0.24
2013q4	11,805	544	2,344	5,376	30,792	20,997	30,239	0.24
2014q1	11,627	551	2,225	5,076	28,475	19,315	27,935	0.23
2014q2	11,633	550	2,214	5,106	28,938	20,302	28,412	0.24
2014q3	11,637	539	2,199	5,257	27,123	19,000	26,565	0.24
2014q4	11,767	550	2,227	4,816	27,974	20,057	27,463	0.24
2015q1	11,625	558	2,182	3,932	25,741	17,659	25,273	0.23
2015q2	11,681	554	2,172	3,860	25,068	16,293	24,643	0.24
2015q3	11,711	545	2,045	3,755	23,499	16,866	23,056	0.24
2015q4	11,745	548	2,034	3,660	24,390	15,254	23,972	0.24
2016q1	11,667	555	2,044	3,053	21,808	14,075	21,436	0.24
2016q2	11,706	549	2,078	3,176	22,297	15,818	21,934	0.25
2016q3	11,716	537	2,179	3,426	22,556	14,727	22,162	0.25
2016q4	11,647	543	2,235	3,644	24,364	16,510	23,945	0.25
2017q1	11,495	553	2,307	3,907	23,991	16,223	23,568	0.25
2017q2	11,520	545	2,245	3,869	23,843	15,462	23,427	0.25
2017q3	11,517	539	2,385	3,677	23,210	17,336	22,792	0.25
2017q4	11,564	552	2,525	4,294	27,709	19,714	27,267	0.25
2018q1	11,533	567	2,721	4,420	32,491	19,940	32,019	0.25
2018q2	11,656	562	2,600	4,906	29,279	20,425	28,762	0.25
2018q3	11,624	551	2,506	4,445	26,894	19,322	26,411	0.25
2018q4	11,585	561	2,527	5,003	41,939	22,742	41,425	0.25
2019q1	11,503	573	2,608	4,453	28,089	18,488	27,584	0.25
2019q2	11,434	563	2,500	4,514	27,949	18,033	27,493	0.26
2019q3	11,403	554	2,469	4,280	26,504	18,248	26,033	0.26
2019q4	11,286	557	2,377	4,325	27,313	17,742	26,851	0.26
2020q1	11,263	567	2,285	4,275	26,328	17,705	25,890	0.25
2020q2	10,667	528	2,094	3,401	23,910	16,632	23,491	0.24
2020q3	10,624	524	2,263	3,432	24,940	24,526	24,523	0.27
2020q4	11,060	543	2,452	3,805	27,359	19,301	26,904	0.27
2021q1	11,195	560	2,634	4,454	30,741	23,172	30,216	0.27
2021q2	11,449	557	2,666	4,964	30,762	23,025	30,180	0.27
2021q3	11,608	556	2,564	5,613	31,573	26,038	30,907	0.28
2021q4	11,842	568	2,549	6,481	33,405	26,450	32,639	0.27
2022q1	11,683	581	2,701	6,844	34,938	24,832	34,187	0.26
2022q2	11,727	584	2,643	7,048	36,290	28,511	35,554	0.26
2022q3	11,673	578	2,541	6,971	35,193	25,451	34,484	0.26
2022q4	11,537	581	2,689	5,970	36,765	24,042	36,142	0.26
2023q1	11,383	584	3,110	5,509	39,103	26,482	38,554	0.26
2023q2	11,251	570	3,105	5,250	37,961	26,903	37,413	0.27
2023q3	10,770	555	1,008	5,223	24,662	22,460	24,086	0.28

Descriptive statistics

Table 7: Using 7 sectors: mining; manufacturing; electricity, gas, and water; construction; business, restaurants, and hotels; transportation, information, and communications; financial activities

Date	sales	sales p25	sales p50	sales p75
2012q1	6516573.4	17407.93	68050.53	472792.9
2012q2	6122975.1	17249.11	68369.4	470302.8
2012q3	5859885.3	17439.63	67780.95	462813.1
2012q4	6782514.3	19844.29	78110.59	538909.9
2013q1	5876156.6	18371.35	68870.5	469271.1
2013q2	6392722.9	18343.93	70947.05	473035.9
2013q3	5886444.9	17103.53	65475.44	451964.4
2013q4	6228793.9	18753.52	72189.07	513196.1
2014q1	5530273.8	16015.27	59569.81	411257.1
2014q2	5880411.4	16206.53	61454.34	416637.5
2014q3	5564077	15547.79	59800.9	402413.5
2014q4	5643524.4	16756.14	64550.74	458627.9
2015q1	5227732.1	14983.82	55405.49	383630.6
2015q2	4859727.3	16145.64	59313.09	397836.5
2015q3	5076937.2	16099.65	59966.86	397069.4
2015q4	4225830.8	17181.07	65445.08	423709.4
2016q1	4013409.1	15711.14	57889.87	360249.5
2016q2	4503909.1	17114.17	62135.84	385333.6
2016q3	3962392.2	17948.43	65859.8	394146
2016q4	4441226.9	19701.21	71945.85	434833.2
2017q1	4521254	18627.64	66627.52	392287.4
2017q2	4078102.7	18214.8	64294.91	381098.9
2017q3	4759935.6	18664.88	66100.8	380348.1
2017q4	5202691.4	21878.97	79051.01	473454.2
2018q1	5292835.3	21707.36	76467.03	445771.8
2018q2	5765677.6	21203.85	75757.47	451743.3
2018q3	5372625.5	19352.28	68714.12	403848.8
2018q4	5449502.7	21530.86	77840.84	460832.7
2019q1	5574621.6	20484.85	71980.88	412821.6
2019q2	4945875.5	20518.81	71407.76	420306.9
2019q3	5073085.3	20046.06	70853.48	412397
2019q4	5385548.4	20306.45	73079.65	441148.4
2020q1	4883432.6	17882.33	62661.89	383288.3
2020q2	4886369	12211.58	50035.78	334669
2020q3	5212520.1	15785.6	65887.99	423880.6
2020q4	5512195.2	21492.49	82987.93	490317.1
2021q1	5786055	20566.59	77906.37	458469.4
2021q2	5997427.7	20139.89	77542.22	468052.7
2021q3	6641070.7	21554.09	80767.65	474148.3
2021q4	5896739.1	23220.99	84713.65	472500.6
2022q1	5944252.3	21590	77064.7	436741.3
2022q2	6998264.5	21914.57	76511.57	440474.6
2022q3	6372804.1	20624.26	72597.26	429518.5
2022q4	6136392.2	23066.27	80513.91	468908.4
2023q1	6478125.1	24396.03	82299.15	466076
2023q2	6730867.5	25350.57	85395.76	485418.9
2023q3	5140277.7	16796.87	58102.23	332718.3

Descriptive statistics

Table 8: Using 3 sectors: mining; manufacturing; Business, restaurants, and hotels

Date	sales	sales p25	sales p50	sales p75
2012q1	8531999.1	24367.48	107400.7	740264.9
2012q2	7944768.7	24235.72	107606.3	751661.8
2012q3	7643472.7	24298.4	105911.7	738288.5
2012q4	8872458.5	27401.96	122262.4	840053.4
2013q1	7697250.4	25132.04	107635.7	742559.8
2013q2	8369361.6	25398.07	110718.3	753564.6
2013q3	7674903.3	24081.29	102931	730617.6
2013q4	8125907.6	25894.4	116059.6	795410.6
2014q1	7206848	21908.14	94471.23	654284.6
2014q2	7672295.4	22024.68	96834.8	672142.3
2014q3	7252593.8	21551.72	94493.75	654297.8
2014q4	7366132.5	22915.95	103521.9	730103.1
2015q1	6866767.8	20596.58	86852.48	629260.1
2015q2	6163620.8	22670.57	93473.02	648746.9
2015q3	6642423.5	23687.09	96338.14	633530.8
2015q4	5492403.4	25395.85	103658.8	675987.3
2016q1	5252934.3	23820.51	91513.93	580382.3
2016q2	5885583.7	25530.35	98056.59	614497.4
2016q3	5123872.6	26886.06	103337.1	637852.4
2016q4	5784206	29317.62	112091.4	702581.9
2017q1	5900490.4	28220.59	104505.2	626563.1
2017q2	5280207.3	27306.46	100564.9	603135
2017q3	6229151.5	27982.65	102884.1	609685.8
2017q4	6774764.4	32971.89	122250.7	749264.2
2018q1	6867432.5	32744.9	119029	697702.8
2018q2	7426169.5	31848.54	116826.8	725796
2018q3	7033250.8	28868.45	105801.8	628769.4
2018q4	7129710.3	32031.39	119763.7	749639.1
2019q1	7329316.7	30559.46	109673.6	674121.3
2019q2	6345434.5	30115.88	109510.5	684064.2
2019q3	6451802.7	29667.28	107954.9	649796.2
2019q4	7030735	29811.04	109587.3	688922.6
2020q1	6347586.7	26327.61	96109.14	611624.6
2020q2	6461602.4	17358.68	81000.5	556489.8
2020q3	6862886.8	24920.28	109431.6	704534.2
2020q4	7304608.1	34231.33	134329.1	808331.6
2021q1	7634428.4	32458.47	125442.3	758856.9
2021q2	7947967	31220.64	127428.9	767262.6
2021q3	8798777.7	34388.27	131331.8	786485.9
2021q4	7803533.5	36081.84	132554.5	757806.9
2022q1	7850360	33271.5	121830.6	725769.6
2022q2	9254359.4	32760.96	119212.1	725410
2022q3	8283375.2	31027.56	113017.2	694463.3
2022q4	7983325.6	34062.97	122832.7	763838.6
2023q1	8553412.5	36020.54	124361	753230.6
2023q2	8802929.2	36853.82	130312.1	769020.4
2023q3	6739956.5	24116.24	85712.72	524538.5

Descriptive statistics

Table 9: Using 2 sectors: mining; manufacturing

Date	sales	sales p25	sales p50	sales p75
2012q1	19176769	24958.17	131148.8	1519092
2012q2	17569772	24856.97	128959.8	1512334
2012q3	16729962	24442.79	127311.9	1522714
2012q4	19557240	27602.78	143346	1615763
2013q1	16740029	25220.24	132426.3	1563228
2013q2	18432695	25550.84	132387.1	1551868
2013q3	16849973	23883.7	124580.7	1537751
2013q4	17849623	26466.58	147335.9	1663655
2014q1	16107819	22123.13	110588.1	1441539
2014q2	17461285	22767.23	120607.1	1510614
2014q3	16540666	21898.86	115512.5	1420411
2014q4	16578949	22816.42	122890.3	1497831
2015q1	15607176	20403.66	102491.3	1304917
2015q2	13777706	22169.85	112143.2	1383945
2015q3	15437208	21120.9	110316.2	1334633
2015q4	12007396	22162.02	114210.1	1300879
2016q1	11623879	20239.04	99686.72	1268632
2016q2	13477436	22829.38	112962.4	1268303
2016q3	11224699	23445.97	115088.5	1296674
2016q4	12834885	25333	126223.8	1352206
2017q1	13299347	24584.33	119634.9	1365657
2017q2	11946511	23539.16	117699.3	1280754
2017q3	14244192	24420.84	120302.4	1324435
2017q4	15214602	28514.95	144560.4	1581691
2018q1	16030358	28347.36	142233.9	1594738
2018q2	17653455	28517.41	147570.9	1672918
2018q3	16996789	25131.41	123572.4	1462968
2018q4	16807310	28528.48	146347.1	1761645
2019q1	15873598	26898.45	134645.4	1722279
2019q2	14900330	27710.35	147001	1717938
2019q3	15485321	26660.01	135803	1626072
2019q4	15803972	26710.45	136799.2	1679945
2020q1	15026059	23100.74	120764.7	1583586
2020q2	15015250	18335.11	102755.4	1379240
2020q3	15812284	22488	124465.2	1671952
2020q4	16762986	29212.16	156839.2	1881098
2021q1	17907234	27996.43	150123.1	1810982
2021q2	18477744	28207.55	147394.6	1870709
2021q3	21020515	29433.11	152281.3	1865103
2021q4	18474564	30567.34	151201.7	1881394
2022q1	18788781	27957.73	143490.4	1897935
2022q2	21038388	28911.69	140706.1	1917021
2022q3	20042559	27471.92	131351.1	1834512
2022q4	19060181	30088.5	145362.8	2052366
2023q1	20496604	32094.01	154282.3	1971833
2023q2	21884849	33798.34	162763.2	2000832
2023q3	17855425	22388.95	110758.6	1453578

Descriptive statistics

Table 10: Using 2 sectors: mining; manufacturing

Date	n firm	empl	wage bill	imports	inputs	sales	domestic	import %
2012q1-2015q4	11,688	544	2,193	5,053	28,848	19,375	28,312	0.240
2016q1-2019q4	11,583	554	2,390	4,056	26,887	17,773	26,445	0.250
2020q1-2023q3	11,315	562	2,487	5,283	31,595	23,702	31,011	0.265

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Descriptive statistics

Table 11: Descriptive statistics

Date	sales	sales p25	sales p50	sales p75
2012q1-2015q4	7,524,584	24,126	105,130	724,541
2016q1-2019q4	6,404,334	29,603	110,338	676,268
2020q1-2023q3	7,911,700	32,116	121,627	743,627

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Moments: Share of importers for all firms

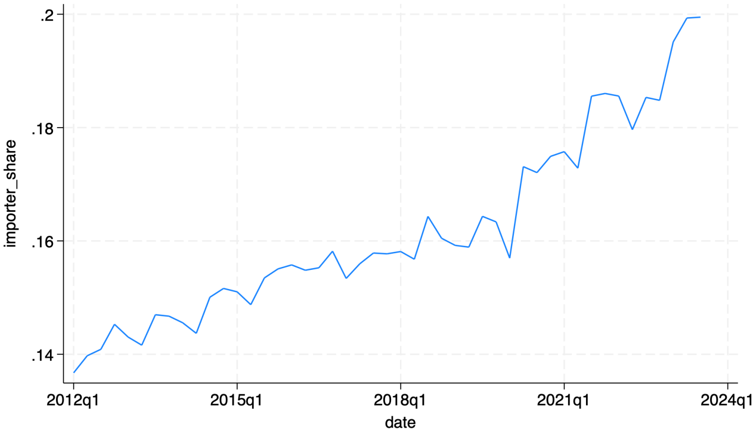

Figure 15: 7 sectors

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Moments: Share of importers for all firms

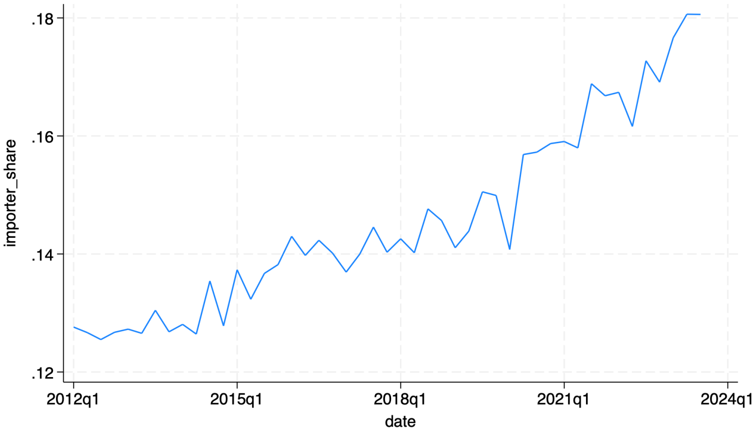

Figure 16: 2 sectors

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Moments: Share of importers w/firm sales below median

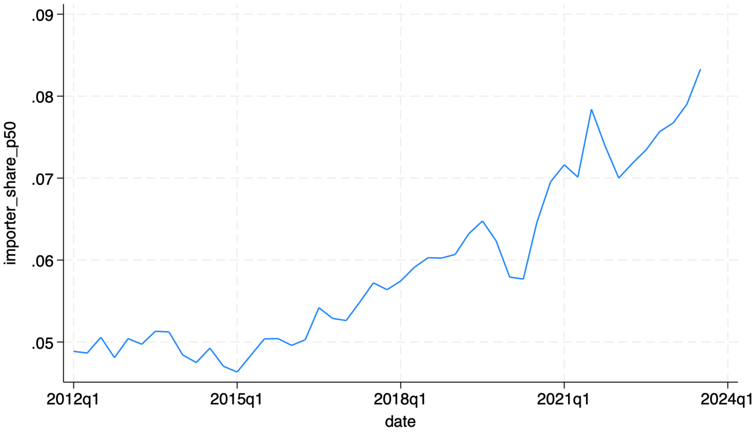

Figure 17: 7 sectors

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Moments: Share of importers w/firm sales below median

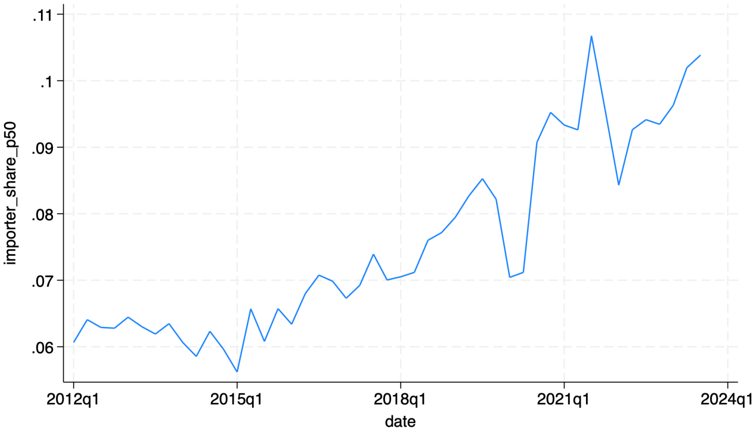

Figure 18: 2 sectors

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Moments: Share of importers for all firms

Table 12: Using 7 sectors: mining; manufacturing; electricity, gas, and water; construction; business, restaurants, and hotels; transportation, information, and communications; financial activities

date	importer	n firm	importer share
2012q1	8457	48340	.1749483
2012q2	8686	48829	.1778861
2012q3	8844	49587	.1783532
2012q4	9245	50736	.1822178
2013q1	8859	50215	.1764214
2013q2	9092	50880	.178695
2013q3	9132	51254	.1781715
2013q4	9355	52045	.1797483
2014q1	8775	51248	.1712262
2014q2	8819	51623	.1708347
2014q3	9058	51812	.1748244
2014q4	9267	52687	.1758878
2015q1	8838	52608	.1679973
2015q2	9018	53208	.1694858
2015q3	9333	53665	.1739122
2015q4	9554	54507	.1752802
2016q1	9174	54566	.1681267
2016q2	9435	54921	.1717922
2016q3	9639	55288	.1743416
2016q4	9708	55555	.1747458
2017q1	9422	55259	.1705062
2017q2	9585	55296	.1733398
2017q3	9808	55679	.1761526
2017q4	10129	56610	.178926
2018q1	9856	56641	.1740082
2018q2	10114	57108	.177103
2018q3	10183	57259	.177841
2018q4	10443	57999	.1800548
2019q1	10115	57670	.1753945
2019q2	10393	57542	.1806159
2019q3	10472	57652	.1816416
2019q4	10505	57257	.183471
2020q1	9820	56842	.1727596
2020q2	8851	51273	.172625
2020q3	9780	51023	.1916783
2020q4	10652	54463	.1955823
2021q1	10806	55595	.19437
2021q2	11124	56812	.1958037
2021q3	11797	58799	.2006327
2021q4	11848	60719	.1951284
2022q1	11031	59681	.1848327
2022q2	11015	59302	.1857442
2022q3	11170	58800	.189966
2022q4	11368	58650	.1938278
2023q1	11129	58666	.189701
2023q2	11175	58271	.1917764
2023q3	11077	55942	.1980087

Moments: Share of importers for all firms

Table 13: Using 3 sectors: mining; manufacturing; business, restaurants, and hotels

date	importer	n firm	importer share
2012q1	7251	30879	.2348198
2012q2	7466	31242	.2389732
2012q3	7617	31651	.2406559
2012q4	7898	32206	.2452338
2013q1	7592	31970	.2374726
2013q2	7771	32422	.2396829
2013q3	7778	32553	.2389334
2013q4	7917	33043	.2395969
2014q1	7511	32728	.2294977
2014q2	7574	32927	.230024
2014q3	7768	33011	.2353155
2014q4	7910	33516	.2360067
2015q1	7559	33413	.2262293
2015q2	7727	33754	.228921
2015q3	7988	34017	.2348238
2015q4	8132	34441	.2361139
2016q1	7830	34401	.2276097
2016q2	8063	34619	.2329068
2016q3	8233	34755	.2368868
2016q4	8273	34930	.2368451
2017q1	8079	34882	.2316094
2017q2	8224	34840	.2360505
2017q3	8417	35087	.2398894
2017q4	8649	35549	.243298
2018q1	8428	35702	.2360652
2018q2	8639	36163	.2388906
2018q3	8696	36326	.2393878
2018q4	8866	36647	.2419298
2019q1	8607	36554	.2354599
2019q2	8812	36459	.2416961
2019q3	8883	36514	.2432766
2019q4	8867	36222	.244796
2020q1	8289	35944	.2306087
2020q2	7578	31938	.2372722
2020q3	8258	31979	.258232
2020q4	8951	33976	.2634507
2021q1	9071	34807	.2606085
2021q2	9345	35546	.2628988
2021q3	9898	36964	.267774
2021q4	9923	38278	.2592351
2022q1	9377	37825	.2479048
2022q2	9289	37637	.246805
2022q3	9418	37298	.2525068
2022q4	9526	37147	.2564406
2023q1	9282	36822	.2520775
2023q2	9370	36564	.256263
2023q3	9322	35639	.2615674

Moments: Share of importers for all firms

Table 14: Using 2 sectors: mining; manufacturing

date	importer	n firm	importer share
2012q1	2689	11376	.2363748
2012q2	2801	11580	.2418826
2012q3	2835	11635	.2436614
2012q4	2917	11784	.247539
2013q1	2801	11636	.2407185
2013q2	2848	11804	.2412741
2013q3	2816	11758	.2394965
2013q4	2850	11783	.2418739
2014q1	2707	11604	.2332816
2014q2	2724	11613	.2345647
2014q3	2788	11615	.2400344
2014q4	2819	11740	.2401192
2015q1	2692	11600	.232069
2015q2	2743	11659	.2352689
2015q3	2795	11675	.2394004
2015q4	2825	11715	.2411438
2016q1	2727	11643	.234218
2016q2	2850	11678	.2440486
2016q3	2874	11701	.24562
2016q4	2844	11623	.2446873
2017q1	2824	11473	.2461431
2017q2	2857	11496	.2485212
2017q3	2878	11498	.2503044
2017q4	2899	11536	.2513003
2018q1	2826	11513	.2454617
2018q2	2886	11633	.2480873
2018q3	2887	11603	.248815
2018q4	2921	11560	.2526817
2019q1	2883	11481	.2511105
2019q2	2921	11417	.2558465
2019q3	2929	11375	.2574945
2019q4	2939	11266	.2608734
2020q1	2746	11245	.2441974
2020q2	2555	10647	.2399737
2020q3	2800	10599	.2641759
2020q4	3014	11047	.2728342
2021q1	2983	11164	.2671981
2021q2	3054	11424	.2673319
2021q3	3209	11579	.2771397
2021q4	3182	11816	.2692959
2022q1	2949	11649	.2531548
2022q2	3013	11702	.2574773
2022q3	3017	11641	.2591702
2022q4	3019	11515	.2621798
2023q1	2960	11359	.2605863
2023q2	3016	11220	.2688057
2023q3	2981	10746	.2774056

Moments: Share of importers w/firm sales below median

Table 15: Using 7 sectors: mining; manufacturing; electricity, gas, and water; construction; business, restaurants, and hotels; transportation, information, and communications; financial activities

date	importer	n firm	importer share p50
2012q1	1181	24170	.0488622
2012q2	1188	24415	.0486586
2012q3	1254	24794	.0505768
2012q4	1220	25368	.0480921
2013q1	1266	25108	.0504222
2013q2	1265	25440	.0497248
2013q3	1315	25627	.0513131
2013q4	1333	26022	.0512259
2014q1	1241	25624	.0484312
2014q2	1226	25812	.0474973
2014q3	1276	25906	.049255
2014q4	1239	26343	.0470334
2015q1	1219	26304	.0463428
2015q2	1287	26604	.0483762
2015q3	1352	26833	.0503857
2015q4	1374	27254	.0504146
2016q1	1353	27283	.0495913
2016q2	1381	27460	.0502913
2016q3	1498	27644	.054189
2016q4	1469	27778	.0528836
2017q1	1454	27629	.0526259
2017q2	1517	27648	.0548683
2017q3	1593	27839	.0572219
2017q4	1596	28305	.0563858
2018q1	1627	28321	.0574485
2018q2	1688	28554	.0591161
2018q3	1726	28630	.0602864
2018q4	1747	29000	.0602414
2019q1	1750	28835	.0606901
2019q2	1819	28771	.0632234
2019q3	1867	28826	.0647679
2019q4	1785	28628	.0623515
2020q1	1646	28421	.0579149
2020q2	1479	25637	.0576901
2020q3	1649	25511	.0646388
2020q4	1894	27232	.0695505
2021q1	1991	27798	.0716239
2021q2	1992	28406	.070126
2021q3	2305	29399	.078404
2021q4	2244	30360	.073913
2022q1	2089	29840	.0700067
2022q2	2129	29651	.071802
2022q3	2159	29400	.0734354
2022q4	2219	29325	.0756692
2023q1	2251	29333	.0767395
2023q2	2302	29135	.0790115
2023q3	2330	27971	.0833006

Moments: Share of importers w/firm sales below median

Table 16: Using 3 sectors: mining; manufacturing; business, restaurants, and hotels

date	importer	n firm	importer share
2012q1	1179	15439	.076365
2012q2	1188	15621	.0760515
2012q3	1203	15825	.076019
2012q4	1199	16103	.0744582
2013q1	1264	15985	.0790741
2013q2	1229	16211	.0758127
2013q3	1290	16277	.0792529
2013q4	1261	16522	.0763225
2014q1	1220	16364	.0745539
2014q2	1197	16463	.0727085
2014q3	1256	16506	.0760935
2014q4	1229	16758	.0733381
2015q1	1190	16706	.0712319
2015q2	1297	16877	.0768502
2015q3	1382	17009	.0812511
2015q4	1397	17221	.0811219
2016q1	1446	17200	.0840698
2016q2	1475	17310	.0852109
2016q3	1531	17378	.0880999
2016q4	1516	17465	.0868022
2017q1	1564	17441	.0896738
2017q2	1571	17420	.0901837
2017q3	1715	17543	.0977598
2017q4	1644	17774	.0924947
2018q1	1713	17851	.095961
2018q2	1765	18082	.0976109
2018q3	1783	18163	.0981666
2018q4	1763	18324	.0962126
2019q1	1801	18277	.0985392
2019q2	1844	18229	.1011575
2019q3	1898	18257	.1039601
2019q4	1803	18111	.0995528
2020q1	1656	17972	.0921433
2020q2	1441	15969	.0902373
2020q3	1638	15990	.102439
2020q4	1856	16988	.1092536
2021q1	1932	17403	.1110153
2021q2	1966	17773	.1106172
2021q3	2266	18482	.1226058
2021q4	2230	19139	.116516
2022q1	2150	18913	.1136784
2022q2	2131	18818	.1132426
2022q3	2190	18649	.1174326
2022q4	2192	18574	.1180144
2023q1	2234	18411	.1213405
2023q2	2252	18282	.1231813
2023q3	2254	17820	.1264871

Moments: Share of importers w/firm sales below median

Table 17: Using 2 sectors: mining; manufacturing

date	importer	n firm	importer share p50
2012q1	345	5688	.060654
2012q2	371	5790	.064076
2012q3	366	5818	.0629082
2012q4	370	5892	.062797
2013q1	375	5818	.0644551
2013q2	372	5902	.0630295
2013q3	364	5879	.0619153
2013q4	374	5892	.0634759
2014q1	352	5802	.0606687
2014q2	340	5807	.05855
2014q3	362	5808	.0623278
2014q4	350	5870	.0596252
2015q1	326	5800	.0562069
2015q2	383	5829	.065706
2015q3	355	5838	.0608085
2015q4	385	5857	.0657333
2016q1	369	5821	.0633912
2016q2	397	5839	.0679911
2016q3	414	5850	.0707692
2016q4	406	5811	.0698675
2017q1	386	5736	.0672943
2017q2	398	5748	.0692415
2017q3	425	5749	.0739259
2017q4	404	5768	.0700416
2018q1	406	5757	.0705228
2018q2	414	5816	.0711829
2018q3	441	5802	.0760083
2018q4	446	5780	.0771626
2019q1	456	5740	.0794425
2019q2	472	5709	.0826765
2019q3	485	5688	.0852672
2019q4	463	5633	.0821942
2020q1	396	5622	.0704376
2020q2	379	5324	.0711871
2020q3	481	5300	.0907547
2020q4	526	5523	.0952381
2021q1	521	5582	.0933357
2021q2	529	5712	.092612
2021q3	618	5789	.1067542
2021q4	565	5908	.095633
2022q1	491	5825	.0842918
2022q2	542	5851	.0926337
2022q3	548	5821	.0941419
2022q4	538	5757	.0934514
2023q1	547	5680	.0963028
2023q2	572	5610	.1019608
2023q3	558	5373	.1038526

Social planner

- We want to study if firms' choices on the set of countries to import from are efficient. The social planner maximizes welfare

$$\max_{\{c_j,\ell_j\}} \sum_j \lambda_j \frac{(C_{oj}^{1-\alpha} C_{sj}^{\alpha})^{1-\epsilon}}{1-\epsilon} \text{ s.t. } C_j = \left(\int_{\omega \in \Omega_j} U(C_j) = C_{sj}(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right)^{\frac{\sigma}{\sigma-1}}$$

- subject to resource constraints for each good, with the Lagrange multipliers associated with that. FOC:

$$[\tilde{\mu}_j(\omega)] \qquad y_j(\omega) \leq \varphi \left(\int q_{ij}(\nu)^{\frac{\rho-1}{\rho}} d\nu \right)^{\frac{\rho}{\rho-1}}$$

$$[\mu_{ij}(\omega,\nu)] \qquad \tau_{ij}\gamma_{ij} q_{ij}(\nu) \leq \frac{\ell_i}{a_i(\nu)}$$

$$[\upsilon_i] \qquad \int_\omega \int_\nu \ell_i(\omega,\nu) \leq \bar{L}_i$$

Social planner

- Similar as before, but this time we have an expression for $\tilde{\mu}$ from the FOC for the variables $y_j(\omega)$, $q_{ij}(\omega,\nu)$.

$$[y_j(\omega)] \qquad U'(C_j)\,C_j^{1/\sigma}\,y_j^{-1/\sigma} = \tilde{\mu}_j(\omega)$$

$$[q_j(\omega,\nu)] \qquad \tilde{\mu}_j(\omega)\,\varphi^{\frac{\rho-1}{\rho}}\,y_j^{\frac{1}{\rho}}\,q^{\frac{-1}{\rho}} = \tau_{ij}\gamma_{ij}\mu_{ij}(\omega,\nu)a_i(\nu)$$

$$[\ell_i(\omega,\nu)] \qquad \mu_{ij}(\omega,\nu) = \upsilon_i$$

1. $\tilde{\mu}_j(\omega)$ denotes the shadow value of good $y_j(\omega)$
2. optimal choice of quantities q_j is a function of prices: shadow price of good i and trade costs τ_{ij}
3. the price of labor in country i is equalized to υ_i across firms ω and varieties ν

Social planner

- We have the same Fréchet distribution for $a_i(\nu)$ from EK, allowing to express the share of intermediate input purchases (replacing prices by shadow values $\tilde{p}_j(\omega) \equiv \tilde{\mu}_j(\omega)$ and $w_i = \upsilon_i = \mu_{ij}(\omega, \nu)$

$$\mathcal{X}_{ij} = \frac{T_i(\tau_{ij}\gamma_{ij}\upsilon_i)^{-\theta}}{\widetilde{\Theta}_j} \text{ if } j \in \mathcal{I}_j$$

and $\mathcal{X}_{ij}(\gamma) = 0$ otherwise, where

$$\widetilde{\Theta}_j(\varphi, \boldsymbol{\gamma}) \equiv \sum_{k \in \mathcal{I}_j} T_k(\tau_{kj}\gamma_{kj}\upsilon_k)^{-\theta}$$

The term $\widetilde{\Theta}_j(\varphi, \boldsymbol{\gamma})$ summarizes the sourcing capability of producer φ in country j, given the input costs and chain disruptions

Social planner

- As a result, the structure is identical only for the difference between price and shadow value:

$$U'(C_j)C_j^{1/\sigma}y_j^{-1/\sigma} = \tilde{\mu}_j(\omega) \neq \tilde{p}_j(\omega) = \frac{\sigma-1}{\sigma}P_jC_j^{1/\sigma}y_j^{-1/\sigma}$$
$$U'(C_j) \neq \frac{\sigma-1}{\sigma}P_j$$

- Two sources of inefficiencies:
  - Markups $\mathcal{M} = \frac{\sigma-1}{\sigma}$: wedge in price setting, profit and sourcing
  - Volatility of marginal utility: $U'(C_j) \neq P_j$ in general

    We have equality if $E_j/C_j = P_j = U'(C_j)$, which could happen in the particular case $E_j = 1$ and $U(C_j) = \log(C_j)$ hence $P_j = 1/C_j$.

- Both change the expected level of profit (markups) and the volatility across state-of-the-worlds (supply chain disruption).
- As a result, it changes the diversification choice of the firm $\mathcal{I}$ and imports q_{ij}

Step 4. Estimating Aggregate Shock

- We estimate:

$$\begin{aligned}\log \hat{\xi}_{i,t+1} - \log \hat{\xi}_{i,t} = \beta_0 &+ \beta_1 \log R\&D_{i,(t+1)-t} + \beta_k \log \text{capital}_{i,(t+1)-t} \\ &+ \beta_F \log \text{number of firms}_{i,(t+1)-t} - \theta \log w_{i,(t+1)-t} \\ &- \theta(\beta_c + \beta_d \log \text{distance}_{ij,(t+1)-t} + \log \beta_l \text{language}_{ij,(t+1)-t} \\ &+ \beta_C(\text{corrup}_{i,(t+1)-t}) + \log \iota_{i,(t+1)-t}\end{aligned}$$

  with $\log \iota_{i,(t+1)-t} = \log \gamma_{\overline{ij},t+1} - \log \gamma_{\overline{ij},t}$.
- We don't use this equation to recover θ because of the lack of time variation on wages/population.
- back

Step 5. Estimating Fixed Costs of Sourcing

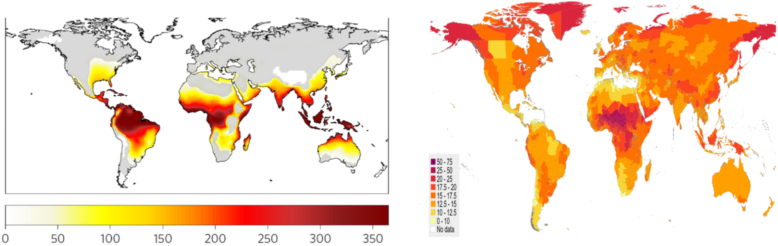
- Given φ, distribution of γ, and guess for $\mathcal{I}^n$ for the firm's sourcing strategy $\mathcal{I}_n$, define the marginal benefit of including country i in the sourcing strategy $\mathcal{I}$:

$$\begin{cases} \varphi^{\sigma-1}\eta^{(\sigma-1)/\theta}[\mathbb{E}(B_j(\bar{\gamma})\Theta_j(\mathcal{I}\cup i)) - \mathbb{E}(B_j(\bar{\gamma})\Theta_j(\mathcal{I}))] - f_{ij}^n & \text{if } i \notin \mathcal{I} \\ \varphi^{\sigma-1}\eta^{(\sigma-1)/\theta}[\mathbb{E}(B_j(\bar{\gamma})\Theta_j(\mathcal{I})) - \mathbb{E}(B_j(\bar{\gamma})\Theta_j(\mathcal{I}\setminus j))] - f_{ij}^n & \text{if } i \in \mathcal{I} \end{cases}$$

- back

Step 4. Estimating Fixed Costs of Sourcing

- Draw shocks:
  - Draw aggregate and idiosyncratic shocks γ from previous distributions
  - Firm productivity φ from a Pareto distribution
  - Draw firm-level fixed costs from Normal distribution (WIP)
- back



(a) Deadly heat days

(b) Probability of 10-years precipitation

Figure 19: Local impact of climate change - Scenario 8.5 (Business as usual)

- Climate risk translates into a damage function $d(T_{i,t}, P_{i,t})$ for temperature $T_{i,t}$, and precipitation $P_{i,t}$ in country i, affecting productivity and price and the variance in γ_{ij}
- back