Granular Comparative Advantage

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Exports are Granular


Across 32 developing countries, the largest exporting firm accounts on average for 17% of total manufacturing exports

- Our focus: French manufacturing

<table>
<thead>
<tr>
<th>Average export share of the largest firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing: 1 industry: 7%</td>
</tr>
<tr>
<td>2-digit: 23 sectors: 18%</td>
</tr>
<tr>
<td>3-digit: 117 sectors: 26%</td>
</tr>
<tr>
<td>4-digit: 316 sectors: 37%</td>
</tr>
</tbody>
</table>
Granularity

- Firm-size distribution is:
  1. fat-tailed (Zipf’s law)
  2. discrete

\[ \implies \text{Granularity} \]

- Canonical example: power law (Pareto) with shape \( \theta < 2 \)

- Intuitions from Gaussian world fail, even for very large \( N \):
  - a single draw can shape \( \sum_{i=1}^{N} X_i \)
  - average can differ from expectation (failure of LLN)
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  — a single draw can shape \( \sum_{i=1}^{N} X_i \)
  — average can differ from expectation (failure of LLN)

• Most common application: aggregate fluctuations

• The role of granularity for comparative advantage of countries is a natural question, yet has not been explored
  — Can a few firms shape country-sector specialization?
Trade Models

• Trade models acknowledge fat-tailed-ness but not discreteness
  — emphasis on firms, but each firm is infinitesimal (LLN applies)
  — hence, no role of individual firms in shaping sectoral aggregates

• Exceptions with discrete number of firms
  1. One-sector model of Eaton, Kortum and Sotelo (EKS, 2012)
  2. Literature on competition/markups
     (e.g., AB 2008, EMX 2014, AIK 2014, Neary 2015)
Trade Models

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- Our focus: can granularity explain sectoral trade patterns?
  1. sector-level comparative advantage (like DFS)
  2. firm heterogeneity within sectors (like Melitz)
  3. granularity within sectors (like EKS)

  ➔ relax the LLN assumption in a multi-sector Melitz model
  take seriously that a typical French sector has 350 firms
  with the largest firm commanding a 20% market share
Granularity

Our approach

Productivity draws, $\varphi$

- Fundamental vs Granular: Why do we care?
Granularity

Our approach

- Fundamental vs Granular
Granularity

Our approach

- Fundamental vs Granular: Why do we care?
This paper

• Roadmap:
  1. Basic framework with granular comparative advantage
  2. GE Estimation Procedure
     — SMM using French firm-level data
  3. Explore implications of the estimated granular model
     — many continuous-world intuitions fail
     — dynamic counterfactuals

Highlights of the results from the estimated model:
1. A parsimonious granular model fits many empirical patterns.
3. Granularity accounts for 20% of variation in export shares — most export-intensive sectors tend to be granular.
4. Granularity can explain much of the mean reversion in CA — more granular sectors are more volatile — death of a single firm can alter considerably the CA.
5. Policy in a granular economy: mergers and tariffs
This paper

• Roadmap:
  1. Basic framework with granular comparative advantage
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• Highlights of the results from the estimated model:
  1. A parsimonious granular model fits many empirical patterns. Moments of firm-size distribution explain trade patterns
  2. Granularity accounts for 20% of variation in export shares
     — most export-intensive sectors tend to be granular
  3. Granularity can explain much of the mean reversion in CA
     — more granular sectors are more volatile
     — death of a single firm can alter considerably the CA
  4. Policy in a granular economy: mergers and tariffs
Modeling Framework
Model Structure

1. Two countries: Home and Foreign
   — inelastically-supplied labor $L$ and $L^*$

2. Continuum of sectors $z \in [0, 1]$:
   \[
   Q = \exp \left\{ \int_0^1 \alpha_z \log Q_z \, dz \right\}
   \]

3. Sectors vary in comparative advantage: $T_z / T_z^* \sim \mathcal{N}(\mu_T, \sigma_T)$
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   \]

3. Sectors vary in comparative advantage: $T_z / T_z^* \sim \mathcal{N}(\mu_T, \sigma_T)$

4. Within a sector, a finite number of firms (varieties) $K_z$:
   \[
   Q_z = \left[ \sum_{i=1}^{K_z} q_{z,i}^{\frac{\sigma}{\sigma-1}} \right]^{\frac{\sigma}{\sigma-1}}
   \]

5. Each sector has an EKS market structure
EKS Sectors

- Productivity draws in a given sector $z$:
  - Number of (shadow) entrants: $\text{Poisson}(M_z)$
  - Entrants' productivity draws: $\text{Pareto}(\theta; \varphi_z)$

- Denote $N_\varphi$ number of firms with productivity $\geq \varphi$

$$N_\varphi \sim \text{Poisson}(T_z \cdot \varphi^{-\theta}), \quad T_z \equiv M_z \varphi_z^\theta$$

with $T_z/T^*_z$ shaping sector-level CA
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- Marginal cost: $c = w / \varphi$ at home and $\tau w / \varphi$ abroad

- Fixed cost of production and exports: $F$ in local labor
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  \]
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- Marginal cost: \( c = w/\varphi \) at home and \( \tau w/\varphi \) abroad

- Fixed cost of production and exports: \( F \) in local labor

- Oligopolistic (Bertrand) competition and variable markups
  - Atkeson-Burstein (2008): \( \{c_i\} \mapsto \{s_i, \mu_i, p_i\}_{i=1}^{K_z} \)
Market Entry and GE

- Assumption: sequential entry in increasing order of unit cost

\[ c_1 < c_2 < \ldots < c_K < \ldots, \quad \text{where} \quad c_i = \begin{cases} 
\frac{w}{\varphi_i}, & \text{if Home,} \\
\frac{\tau w^*/\varphi^*_i}{\varphi_i}, & \text{if Foreign}
\end{cases} \]

\[ \rightarrow \text{unique equilibrium} \]

- Profits: \( \Pi_i = \frac{s_i}{\varepsilon(s_i)} \alpha z Y - wF \)
Market Entry and GE

- Assumption: sequential entry in increasing order of unit cost

\[ c_1 < c_2 < \ldots < c_K < \ldots, \quad \text{where} \quad c_i = \begin{cases} \frac{w}{\varphi_i}, & \text{if Home,} \\ \frac{\tau w^*/\varphi^*_i}{}, & \text{if Foreign} \end{cases} \]

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- Profits: \( \Pi_i = \frac{s_i}{\varepsilon(s_i)} \alpha_z Y - wF \)

- Entry: \( \Pi_K^K \geq 0 \) and \( \Pi_K^{K+1} < 0 \) \( \rightarrow \) determines \( K_z \)
Market Entry and GE

- Assumption: sequential entry in increasing order of unit cost

\[ c_1 < c_2 < \ldots < c_K < \ldots, \quad \text{where} \quad c_i = \begin{cases} 
  \frac{w}{\phi_i}, & \text{if Home}, \\
  \frac{\tau w^*}{\phi_i^*}, & \text{if Foreign}
\end{cases} \]

\[ \rightarrow \text{unique equilibrium} \]

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- Entry: \( \Pi_K^K \geq 0 \) and \( \Pi_{K+1}^{K+1} < 0 \) \( \rightarrow \) determines \( K_z \)

- General equilibrium:
  - GE vector \( \mathbf{X} = (Y, Y^*, w, w^*) \)
  - Within-sector allocations \( \mathbf{Z} = \{K_z, \{s_z,i\}_{i=1}^{K_z}\}_{z \in [0,1]} \)
  - Labor market clearing and trade balance (linear in \( \mathbf{X} \))
  - Fast iterative algorithm
Properties of the Granular Model

• Foreign share:

\[ \Lambda_z \equiv \frac{X^*_z}{\alpha_z Y} = \sum_{i=1}^{K_z} (1 - \nu_{z,i})s_{z,i} \]

• Expected foreign share:

\[ \Phi_z = \mathbb{E} \left\{ \Lambda_z \mid T_z \cdot T^*_z \right\} = \frac{1}{1 + (\tau \omega)^\theta \cdot \frac{T_z}{T^*_z}} \]

• Granular residual:

\[ \Gamma_z \equiv \Lambda_z - \Phi_z : \quad \mathbb{E}_T \{ \Gamma_z \} = \mathbb{E}_T \{ \Lambda_z - \Phi_z \} = 0 \]

• Aggregate exports:

\[ X^* = Y \int_0^1 \alpha_z \Lambda_z dz = \Phi Y, \quad \Phi \equiv \int_0^1 \alpha_z \Phi_z dz \]
Estimation and Model Fit
Estimation procedure

- Data: French firm-level data (BRN) and Trade data
  - Firm-level domestic sales and export sales
  - Aggregate import data (Comtrade)
  - 119 4-digit manufacturing sectors

- Parametrize sector-level comparative advantage:
  - \( T(z)/T^*(z) \sim \log \mathcal{N}(\mu_T, \sigma_T) \)
  - Based on empirical distribution shown in Hanson et al. (2015)

- Stage 1: calibrate Cobb-Douglas shares \( \{\alpha_z\} \) and \( w/w^* \)
  - CD shares read from domestic sales + imports, by sector
  - \( w/w^* = 1.13 \), trade-weighted wage of France’s trade partners
  - Normalizations: \( w = 1 \) and \( L = 100 \)

- Stage 2: SMM procedure to estimate \( \{\sigma, \theta, \tau, F, \mu_T, \sigma_T\} \), while \( (Y, Y^*, L^*/L) \) are pinned down by GE
## Estimated Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>Std. error</th>
<th>Auxiliary variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma$</td>
<td>5</td>
<td>—</td>
<td>$\kappa = \frac{\theta}{\sigma-1}$ 1.077</td>
</tr>
<tr>
<td>$\theta$</td>
<td>4.307</td>
<td>0.246</td>
<td>$w/w^*$ 1.130</td>
</tr>
<tr>
<td>$\tau$</td>
<td>1.341</td>
<td>0.061</td>
<td>$L^*/L$ 1.724</td>
</tr>
<tr>
<td>$F \times 10^5$</td>
<td>0.946</td>
<td>0.252</td>
<td>$Y^*/Y$ 1.526</td>
</tr>
<tr>
<td>$\mu_T$</td>
<td>0.137</td>
<td>0.193</td>
<td>$\Pi/Y$ 0.211</td>
</tr>
<tr>
<td>$\sigma_T$</td>
<td>1.422</td>
<td>0.232</td>
<td></td>
</tr>
</tbody>
</table>
## Moment Fit

<table>
<thead>
<tr>
<th>Moments</th>
<th>Data, $\hat{m}$</th>
<th>Model, $\hat{M}(\hat{\Theta})$</th>
<th>Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Log number of firms, mean</td>
<td>$\log \hat{M}_z$</td>
<td>5.631</td>
<td>5.624</td>
</tr>
<tr>
<td>— st. dev.</td>
<td></td>
<td>1.451</td>
<td>1.222</td>
</tr>
<tr>
<td>2. Top-firm market share, mean</td>
<td>$\tilde{s}_{z,1}$</td>
<td>0.197</td>
<td>0.206</td>
</tr>
<tr>
<td>— st. dev.</td>
<td></td>
<td>0.178</td>
<td>0.149</td>
</tr>
<tr>
<td>3. Top-3 market share, mean</td>
<td>$\sum_{j=1}^{3} \tilde{s}_{z,j}$</td>
<td>0.356</td>
<td>0.343</td>
</tr>
<tr>
<td>— st. dev.</td>
<td></td>
<td>0.241</td>
<td>0.175</td>
</tr>
<tr>
<td>4. Imports/dom. sales, mean</td>
<td>$\tilde{\Lambda}_z$</td>
<td>0.365</td>
<td>0.351</td>
</tr>
<tr>
<td>— st. dev.</td>
<td></td>
<td>0.204</td>
<td>0.268</td>
</tr>
<tr>
<td>5. Exports/dom. sales, mean</td>
<td>$\tilde{\Lambda}_{z*}$</td>
<td>0.328</td>
<td>0.350</td>
</tr>
<tr>
<td>— st. dev.</td>
<td></td>
<td>0.286</td>
<td>0.346</td>
</tr>
<tr>
<td>6. Fraction of sectors with exports&gt;dom. sales</td>
<td>$\mathbb{P}\left{ \tilde{X}_z &gt; \tilde{Y}_z - \tilde{X}_z^* \right}$</td>
<td>0.185</td>
<td>0.092</td>
</tr>
</tbody>
</table>

### Regression coefficients†

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Data, $b$</th>
<th>Model, $b(\hat{\Theta})$</th>
<th>Loss (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12. export share on top-firm share</td>
<td>$\hat{b}_1$</td>
<td>0.215</td>
<td>0.243</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.156)</td>
<td>(0.104)</td>
<td></td>
</tr>
<tr>
<td>13. export share on top-3 share</td>
<td>$\hat{b}_3$</td>
<td>0.254</td>
<td>0.232</td>
<td>1.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.108)</td>
<td>(0.090)</td>
<td></td>
</tr>
<tr>
<td>14. import share on top-firm share</td>
<td>$\hat{b}_1^*$</td>
<td>−0.016</td>
<td>−0.020</td>
<td>0.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.097)</td>
<td>(0.079)</td>
<td></td>
</tr>
<tr>
<td>15. export share on top-3 share</td>
<td>$\hat{b}_3^*$</td>
<td>0.002</td>
<td>−0.005</td>
<td>0.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.074)</td>
<td>(0.069)</td>
<td></td>
</tr>
</tbody>
</table>
(a) Number of French firms

(b) Top market share

(c) Domestic import share

(d) Pareto shape of sales
Non-targeted Moments

• Correlation between top market share and number of firms:

\[ \tilde{s}_{z,1} = const + \gamma_M \cdot \log \tilde{M}_z + \gamma_Y \cdot \log \tilde{Y}_z + \epsilon^s_z \]

Data: \(-0.094, 0.018\) (0.008) (0.008)
Model: \(-0.064, 0.025\) (0.007) (0.006)

• Extensive margin of sales:

\[ \log \tilde{M}_z = c_d + \chi_d \cdot \log(\tilde{Y}_z - \tilde{X}_z^*) + \epsilon^d_z \]

Data: 0.563 (0.082)
Model: 0.861 (0.011)
Equilibrium markups

- Oligopolistic (Bertrand) markups: averages (blue bars) and 10–90% range (red intervals) across industry
- Monopolistic competition markup: \( \frac{\sigma}{\sigma-1} = 1.25 \) is lower bound for all oligopolistic markups
Quantifying Granular Trade
Decomposition of Trade Flows

- Variance decomposition of $X_z = \Lambda_z^* \alpha_z Y^*$ with $\Lambda_z^* = \Phi_z^* + \Gamma_z^*$:

$$\text{var}(\Lambda_z^*) = \text{var}(\Phi_z^*) + \text{var}(\Gamma_z^*),$$

$$\text{var}(\log X_z) \approx \text{var}(\log \alpha_z) + \text{var}(\log \Lambda_z^*)$$

Table: Variance decomposition of trade flows

<table>
<thead>
<tr>
<th></th>
<th>Common $\theta$</th>
<th>Sector-specific $\theta_z$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Granular contribution</td>
<td>$\frac{\text{var}(\Gamma_z^<em>)}{\text{var}(\Lambda_z^</em>)}$</td>
<td>17.0%</td>
</tr>
<tr>
<td>Export share contribution</td>
<td>$\frac{\text{var}(\log \Lambda_z^*)}{\text{var}(\log X_z)}$</td>
<td>57.2%</td>
</tr>
<tr>
<td>Pareto shape parameter</td>
<td>$\kappa_z = \frac{\theta_z}{\sigma - 1}$</td>
<td>1.08</td>
</tr>
<tr>
<td>Estimated Pareto shape</td>
<td>$\hat{\kappa}_z$</td>
<td>1.10</td>
</tr>
<tr>
<td>Top-firm market share</td>
<td>$s_{z,1}$</td>
<td><strong>0.21</strong></td>
</tr>
</tbody>
</table>
Export Intensity and Granularity

- Granularity does not create additional trade on average
- Yet, granularity creates skewness across sectors in exports
  - most export-intensive sectors are likely of granular origin

(a) Fraction of granular sectors

(b) Granular contribution to trade
Export Intensity and Granularity

- Granularity does not create additional trade on average
- Yet, granularity creates skewness across sectors in exports
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(a) Distribution of $\Lambda^*_z \mid \Phi^*_z$

(b) Distribution of $\Phi^*_z \mid \Lambda^*_z$
Properties of Granular Exports

- $\Gamma^*_z = \Lambda^*_z - \Phi^*_z$ are orthogonal with $\Phi^*_z$, $\log(\alpha^*_z Y^*)$ and $\log \tilde{M}_z$
- Best predictor of $\Gamma^*_z$ is $\tilde{s}_{z,1}$, the relative size of the largest firm

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tilde{s}_{z,1}$</td>
<td>0.335</td>
<td>0.373</td>
<td>0.379</td>
<td>0.357</td>
<td>0.354</td>
<td></td>
</tr>
<tr>
<td>$\tilde{s}^*_{z,1}$</td>
<td>-0.254</td>
<td></td>
<td>-0.268</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\log \tilde{M}_z$</td>
<td>-0.008</td>
<td>0.012</td>
<td>0.016</td>
<td></td>
<td>-0.011</td>
<td></td>
</tr>
<tr>
<td>$\log(\alpha^*_z Y)$</td>
<td></td>
<td>-0.005</td>
<td></td>
<td>0.013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Phi^*_z$</td>
<td>0.004</td>
<td></td>
<td></td>
<td>0.073</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.013</td>
<td>0.353</td>
<td>0.375</td>
<td>0.376</td>
<td>0.520</td>
<td>0.539</td>
</tr>
</tbody>
</table>
Identifying Granular Sectors

- Which sectors are granular? Neither $\Phi_z^*$, nor $\Gamma_z^*$ are observable

$$
P\{\Gamma_z^* \geq \vartheta \Lambda_z^* \mid \Lambda_z^*, r_z\} = \frac{\int_{\Lambda_z^*-\Phi_z^* \geq \vartheta \Lambda_z^*} g(\Phi_z^*, \Lambda_z^*, r_z) d\Phi_z^*}{\int_0^1 g(\Phi_z^*, \Lambda_z^*, r_z) d\Phi_z^*},
$$
Dynamics of Comparative Advantage
Dynamic Model

- Use the granular model with firm dynamics to study the implied time-series properties of aggregate trade
  - Shadow pull of firms in each sector with productivities \( \{\varphi_{it}\} \)
  - Productivity of the firms follows a random growth process:
    \[
    \log \varphi_{it} = \mu + \log \varphi_{i,t-1} + \nu \varepsilon_{it}, \quad \varepsilon_{it} \sim iid \mathcal{N}(0, 1)
    \]
    with reflection from the lower bound \( \underline{\varphi} \) and \( \mu = -\theta \nu^2 / 2 \)
  - Each period: static entry game and price setting equilibrium

- Calibrate idiosyncratic firm dynamics (volatility of shocks \( \nu \)) using the dynamic properties of market shares

- No aggregate shocks
Firm Dynamics and CA

- Empirical evidence in Hanson, Lind and Muendler (2015):
  1. Hyperspecialization of exports
  2. High Turnover of export-intensive sectors

<table>
<thead>
<tr>
<th>Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HLM</td>
<td>France</td>
</tr>
<tr>
<td>SR persistence</td>
<td>std($\Delta \tilde{s}_{z,i,t+1}$)</td>
<td>—</td>
</tr>
<tr>
<td>LR persistence</td>
<td>corr($\tilde{s}<em>{z,i,t+10}, \tilde{s}</em>{z,i,t}$)</td>
<td>—</td>
</tr>
<tr>
<td>Top-1% sectors export share</td>
<td>21%</td>
<td>17%</td>
</tr>
<tr>
<td>Top-3% sectors export share</td>
<td>43%</td>
<td>30%</td>
</tr>
<tr>
<td>Turnover I: remain in top-5% after 20 years</td>
<td>52%</td>
<td>—</td>
</tr>
<tr>
<td>Turnover II: remain in top-5% after 10 years</td>
<td>—</td>
<td>80%</td>
</tr>
</tbody>
</table>

- Idiosyncratic firm productivity dynamics explains the majority of turnover of top exporting sectors over time
Mean Reversion in CA

- Idiosyncratic firm dynamics in a granular model predicts mean reversion in comparative advantage
- In addition, granular sectors are more volatile

(a) Mean reversion in $\Lambda^*_z$

(b) Volatility of $\Delta \Lambda^*_z$
Death of a Large Firm

- Death (sequence of negative productivity shocks) of a single firm can substantially affect sectoral comparative advantage.
- In the most granular sectors, death of a single firm can push the sector from top-5% of CA into comparative disadvantage.
Granularity and reallocation

- Sectoral labor allocation:
  \[
  \frac{L_z}{L} \approx \alpha_z + \frac{\theta}{\sigma \kappa - 1} \frac{NX_z}{Y}
  \]

- Interaction between trade openness and granularity results in sectoral reallocation and aggregate volatility

**Figure:** Total and Sectoral Labor Reallocation (fraction of total \(L\))
Policy Counterfactuals
Policy counterfactuals

1. Misallocation and trade policy
   - policies that hinder growth of granular firms
   - why trade barriers often target individual foreign firm?

2. Merger analysis
Policy counterfactuals

1. Misallocation and trade policy
   — policies that hinder growth of granular firms
   — why trade barriers often target individual foreign firm?

2. Merger analysis

   • Welfare analysis of a policy:

   \[
   \hat{\mathcal{W}} \equiv d \log \frac{Y}{P} \\
   = \frac{wL}{Y} d \log w + \frac{dTR}{Y} + \int_0^1 \alpha_z \frac{d\Pi_z}{\alpha_z Y} dz - \int_0^1 \alpha_z d \log P_z dz
   \]

   and across sectors

   \[
   \hat{\mathcal{W}} = \int_0^1 \alpha_z \hat{\mathcal{W}}_z dz
   \]

   — In partial equilibrium: \( \hat{\mathcal{W}}_z = \frac{dTR_z + d\Pi_z}{\alpha_z Y} - d \log P_z \)

   — In general equilibrium: spillovers to other sectors via \((w, Y)\)
Merger

- Merger is more beneficial:
  1. The larger is the productivity spillover $\varrho \uparrow$
     \[
     \varphi'_{z,2} = \varrho \varphi_{z,1} + (1 - \varrho) \varphi_{z,2}.
     \]
     Baseline $\varrho = 0.5$. For low $\varrho = 0.1$
  2. The more open is the economy $\tau \downarrow$
  3. The more granular is the sector $\Gamma^*_z \uparrow$

(a) Welfare effect of a merger, $\hat{W}_Z$

(b) Decomposition of $\hat{W}_Z$, $\tau = 1.34$
Import Tariff

- Tariff on the top importer $\varsigma_{z,1}$ vs a uniform import tariff $\tilde{\varsigma}_z$
  - yielding the same tariff revenue
  - $\varsigma_{z,1} \succ \tilde{\varsigma}_z$, particularly in the foreign granular industries ($\Gamma_z \uparrow$)

(a) Uniform tariff

(b) Granular tariff

Quintiles of sectors by import granularity $\Gamma_z$
Conclusion
Conclusion

• The world is granular! \((at \ least, \ at \ the \ sectoral \ level)\)
  We better develop tools and intuitions to deal with it

• Applications:
  1. Innovation, growth and development
  2. Misallocation
  3. Industrial policy
  4. Cities and agglomeration
APPENDIX
The role of top draw, as the number of draws $N$ increases

$$\text{corr}\left(\max_i X_i, \sum_i X_i\right)$$

$$\frac{\max_i X_i}{\sum_i X_i}$$
Sectoral equilibrium

- Sectoral equilibrium system:

\[ p_i = \mu_i c_i, \]

\[ \mu_i = \frac{\varepsilon_i}{\varepsilon_i - 1} \]

where \( \varepsilon_i = \sigma (1 - s_i) + s_i, \)

\[ s_i = \left( \frac{p_i}{P} \right)^{1-\sigma} \]

where \( P = \left( \sum_{i=1}^{K} p_i^{1-\sigma} \right)^{1/(1-\sigma)}. \)
(a) Pareto shape, $\kappa_z = \frac{\theta_z}{\sigma-1}$

(b) Estimated Pareto, $\hat{\kappa}_z$

(c) Top-firm sales share, $\tilde{s}_{z,1}$

(d) Number of firms, $\tilde{M}_z$
Probability a sector remains among top-5% of export-intensive sectors
Trade effects of individual firm exit

(a) All sectors, deciles of $\Gamma^*_z$

(b) All sectors, deciles of $\Lambda^*_z$
Merger

Low spillover $\rho = 0.1$

Welfare effect of a merger, $\hat{W}_Z$

Decomposition of $\hat{W}_Z$, $\tau = 1.34$