Firms and Economic Performance: A View From Trade Concentration in International Markets

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ASSA 2020 Annual Meeting

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we live in a "superstar" economy dominated by giant firms
- 10% of the world's public companies generate 80% of all profits (The Economist, 2016)
- sales' shares of top firm has increased (e.g., Autor et al., 2017)
- large firms dominate global markets (e.g., Melitz, 2003, Freund & Pierola, 2015)

two key questions:
1. what is the role of firms in explaining countries performance in global markets?
2. are global markets becoming more or less competitive?

little systematic evidence due to lack of comparable data
we use firm-level data on US imports
- compare firms from all countries selling to a single destination
What We Do

• quantify the importance of firms for explaining US imports
  ▶ map countries market shares into firm-level characteristics
    ★ number of firms
    ★ average attributes
    ★ firm heterogeneity: top firms
    ★ granularity: deviations from a continuous distribution
  ▶ exact decomposition of the margins of trade

• study concentration in US imports
  ▶ top firms dominate national industries
  ▶ but compete more in markets that are increasingly global
Assumptions: CES Demand

- consider a sector $i$ in a given market (US)
  - preferences over varieties in industry $i$

\[
C_i = \left\{ \sum_{\omega \in \Omega_i} [\gamma(\omega) c(\omega)]^{\frac{\sigma_i}{\sigma_i-1}} \right\}^{\frac{\sigma_i}{\sigma_i-1}}, \quad \sigma_i > 1
\]

- $\Omega_i = \text{available varieties } \omega \text{ in } i, \text{ consumption } c(\omega)$
- $\gamma(\omega) = \text{demand shifter (quality)}$

- demand for variety $\omega$

\[
p(\omega) c(\omega) = \tilde{\gamma}(\omega)^{\sigma_i-1} P_i^{\sigma_i} C_i
\]

- $p(\omega) = \text{price of variety } \omega$
- $\tilde{\gamma}(\omega) \equiv \gamma(\omega) / p(\omega) = \text{quality-to-price ratio = "appeal"}$
- $P_i = \text{price index in industry } i$
Decomposing Market Shares

- take the market share of origin \( o \) in industry \( i \), \( S_{oi} \), decompose:
  1. extensive vs intensive margin

\[
S_{oi} = \frac{N_{oi} \cdot \bar{r}_{oi}}{N_i \cdot \bar{r}_i}
\]

- \( N = \# \) of varieties, \( \bar{r} = \) average revenue per variety

- decompose the intensive margin

\[
\bar{r}_{oi} = \sqrt[1-\sigma_i]{\mathbb{E}(\tilde{\gamma}_{oi})} + \frac{1}{N_{oi}} \sum_{\omega \in \Omega_{oi}} \left[ \tilde{\gamma}(\omega)^{1-\sigma_i} - \mathbb{E}(\tilde{\gamma}_{oi})^{1-\sigma_i} \right]
\]

- when \( \sigma > 2 \) total sales are convex in \( \tilde{\gamma} \to \) superstar economy
  - sales increase in heterogeneity through reallocations from less to more attractive products
Data

- transaction-level US import data from Piers (IHS Markit)
  - universe of waterborne import transactions of the US in 2002 and 2012

- info on:
  - exporting firm
  - country of origin
  - exported product (6-digit HS)
  - value and quantity of the transaction

- final sample:
  - 1,350,574 firm-product-year observations
  - 366 manufacturing industries
  - 104 exporting countries
  - 83% of average export to the US per origin-sector-year
Structural Estimation

- to implement the decomposition we need $\sigma_i$ and $\tilde{\gamma}(\omega)$

- we use 4 estimates of elasticities of substitution:
  - Reverse-Weighting estimator (Redding & Weinstein, 2016) $\rightarrow \sigma_i^{RW}$
  - identify $\sigma_i$ from dispersion of sales $\rightarrow \sigma_i^{reg.base.}, \sigma_i^{reg.contr.}$
  - estimates from Broda & Weinstein (2006) $\rightarrow \sigma_i^{BW}$

- mean & median $\sigma_i$ well above 2

- then, calibrate $\tilde{\gamma}(\omega)$ to match observed sales
  - from sales:

$$\ln r(\omega) = \alpha_i \ln P_i + \ln C_i + (\sigma_i - 1) \ln \tilde{\gamma}(\omega)$$
Decomposing US Imports: Results

- market shares: extensive vs intensive margin
  - separately regress \( \ln N_{oi} - \ln N_i \) and \( \ln \bar{r}_{oi} - \ln \bar{r}_i \) on \( \ln S_{oi} \)

- intensive margin: average vs heterogeneity
  - regress \( \mathbb{E}(\tilde{\gamma}_{oi})^{\sigma_i - 1} \) and \( \sum_{\omega \in \Omega_{oi}} \left[ \frac{\tilde{\gamma}(\omega)^{\sigma_i - 1} - \mathbb{E}(\tilde{\gamma}_{oi})^{\sigma_i - 1}}{N_{oi}} \right] \) on \( \bar{r}_{oi} \)

Table 4 - Decomposition of Countries' Market Shares

<table>
<thead>
<tr>
<th></th>
<th>reg. base.</th>
<th>reg. contr.</th>
<th>RW</th>
<th>BW</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
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<tr>
<td>a) First step - Decomposition of market shares</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>N. of varieties</td>
<td>0.502***</td>
<td>0.502***</td>
<td>0.499***</td>
<td>0.505***</td>
</tr>
<tr>
<td></td>
<td>[0.003]</td>
<td>[0.003]</td>
<td>[0.003]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>Average revenue per variety</td>
<td>0.498***</td>
<td>0.498***</td>
<td>0.501***</td>
<td>0.495***</td>
</tr>
<tr>
<td></td>
<td>[0.003]</td>
<td>[0.003]</td>
<td>[0.003]</td>
<td>[0.003]</td>
</tr>
<tr>
<td>b) Second step - Decomposition of average revenue per variety</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average quality-to-price ratio</td>
<td>0.487***</td>
<td>0.480***</td>
<td>0.481***</td>
<td>0.492***</td>
</tr>
<tr>
<td></td>
<td>[0.075]</td>
<td>[0.106]</td>
<td>[0.114]</td>
<td>[0.118]</td>
</tr>
<tr>
<td>Heterogeneity in quality-to-price ratios</td>
<td>0.513***</td>
<td>0.520***</td>
<td>0.519***</td>
<td>0.508***</td>
</tr>
<tr>
<td></td>
<td>[0.075]</td>
<td>[0.106]</td>
<td>[0.114]</td>
<td>[0.118]</td>
</tr>
<tr>
<td>Obs.</td>
<td>24754</td>
<td>24754</td>
<td>17660</td>
<td>23622</td>
</tr>
</tbody>
</table>
Heterogeneity, Superstars and Granularity

- is heterogeneity driven by superstar firms?
  - on average, top firm in each country accounts for 25% of exports to the US
- but are superstar firms "exceptional"?
  - define "granularity" as exceptional deviations from a continuous distribution
  - identify it from the data and quantify its role
- assume quality-to-price ratio $\tilde{\gamma}$ is log-normal
  - then, market share of country $o$ relative to country $x$
    \[
    \ln \frac{S_{oi}}{S_{xi}} = \left[ \mathbb{E} (\ln r_{oi}) - \mathbb{E} (\ln r_{xi}) \right] + \frac{\mathbb{V} (\ln r_{oi}) - \mathbb{V} (\ln r_{xi})}{2} + \ln \frac{N_{oi}}{N_{xi}} + g_{oxi}
    \]
  - where $g_{oxi}$ "granular" residual: 0 if LLN applies
- we quantify $g_{oxi}$ and ask if it captures superstars
Table 6 - Decomposition of Countries' Market Shares under Log Normality

<table>
<thead>
<tr>
<th></th>
<th>Difference in av. log sales</th>
<th>Difference in var. of log sales</th>
<th>Difference in log n. of varieties</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) (2) (3) (4)</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>a) Baseline</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Log relative market share</td>
<td>0.236***</td>
<td>0.228***</td>
<td>0.487***</td>
<td>0.048***</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.001]</td>
<td>[0.000]</td>
<td>[0.000]</td>
</tr>
<tr>
<td>Obs.</td>
<td>1078915</td>
<td>1078915</td>
<td>1078915</td>
<td>1078915</td>
</tr>
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</table>

- the "granular" residual explains $< 5\%$

Table 7 - Decomposition of Countries' Market Shares under Log Normality: The Role of Superstar Firms

<table>
<thead>
<tr>
<th></th>
<th>Difference in av. log sales</th>
<th>Difference in var. of log sales</th>
<th>Difference in log n. of varieties</th>
<th>Residual</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) (2) (3) (4)</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>a) Excluding superstar firms (sales above triplet average by at least 2 std. dev.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log relative market share</td>
<td>0.272***</td>
<td>0.215***</td>
<td>0.527***</td>
<td>-0.014***</td>
</tr>
<tr>
<td></td>
<td>[0.000]</td>
<td>[0.001]</td>
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<td>[0.001]</td>
</tr>
<tr>
<td>Obs.</td>
<td>1078909</td>
<td>1078909</td>
<td>1078909</td>
<td>1078909</td>
</tr>
</tbody>
</table>

- it falls to zero if superstars are removed
Additional Results

1. Firm heterogeneity
   - correlates positively with market size
     - higher dispersion in countries richer, larger and closer to the US

2. Firm heterogeneity is important for welfare:
   - bottom vs top 25% heterogeneity origin $\rightarrow$ real consumption up by 20-32%

3. Firm heterogeneity driven mostly by "quality"
   - variation in prices explains little of variation in appeal
     - similar to Hottman, Redding & Weinstein (2016)
Concentration: Foreign vs National Firms

- is the US market becoming more or less competitive?
  - rise of superstars among national firms
  - vs more intense global competition

- changes in concentration, 2002-2012, by industry and origins
  - a) concentration among foreign firms from one country: ~
  - b) concentration among foreign firms from all countries: ↓
  - c) concentration among domestic firms: ↑

Table 1 - Descriptive Statistics on Concentration Measures

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</thead>
<tbody>
<tr>
<td>a) PIERS: Statistics by country-industry pair</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of sales by top-4 firms</td>
<td>0.79</td>
<td>0.21</td>
<td>-0.01</td>
<td>0.47</td>
</tr>
<tr>
<td>Herfindahl index</td>
<td>0.46</td>
<td>0.29</td>
<td>0.01</td>
<td>0.50</td>
</tr>
<tr>
<td>b) PIERS: Statistics by industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of sales by top-4 firms</td>
<td>0.37</td>
<td>0.23</td>
<td>-0.08</td>
<td>0.34</td>
</tr>
<tr>
<td>Herfindahl index</td>
<td>0.09</td>
<td>0.13</td>
<td>-0.03</td>
<td>0.32</td>
</tr>
<tr>
<td>c) COMPUSTAT: Statistics by industry</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share of sales by top-4 firms</td>
<td>0.88</td>
<td>0.15</td>
<td>0.05</td>
<td>0.70</td>
</tr>
<tr>
<td>Herfindahl index</td>
<td>0.55</td>
<td>0.30</td>
<td>0.13</td>
<td>0.73</td>
</tr>
</tbody>
</table>

Notes: Industries are defined at the 4-digit level of the Standard Industrial Classification (SIC).
Decomposing Top4 Shares

- decompose changes in market share of top4 firms

\[
\Delta \ln s_{top} = -\Delta \ln n^f + \Delta \ln n^p_{top} - \Delta \ln n^p + \Delta \ln \frac{\bar{r}_{top}}{\bar{r}}
\]

- \( n^f \) = number of firms, \( n^p \) = number of products per firm
- \( \bar{r} \) = average sales per product

Table 2 - Decomposition of the Share of Sales by the Top-4 Firms

<table>
<thead>
<tr>
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<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \Delta \ln s_{top}(i, o) )</td>
<td>-0.03</td>
<td>-0.27</td>
<td>-0.15</td>
<td>0.07</td>
<td>0.31</td>
</tr>
<tr>
<td>( -\Delta \ln n^f(i, o) )</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \ln n^p_{top}(i, o) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( -\Delta \ln n^p(i, o) )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \Delta \ln \frac{\bar{r}_{top}(i, o)}{\bar{r}(i, o)} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- results consistent with trade-driven reallocations:
  - number of firms has increased
  - firms are dropping products, top firms more
  - yet, relative sales per product by top firms has increased
Conclusion

- use US import data to study firms in global markets

main results:

- decomposition of countries’ market shares
  - extensive/intensive margin: 50%-50%
  - average/heterogeneity: 50%-50%
  - granularity: 5%

- variation in firm-level heterogeneity is important for explaining sales
  - important implications for quantitative trade models
  - heterogeneity is positively correlated with market size

- top firms compete more in global markets:
  - data consistent with the view that international competition goes hand-in-hand with national concentration
    - Melitz (2003); Bernard, Redding & Schott (2011); Melitz, Mayer & Ottaviano (2014)
Data: Country Coverage

Source: Piers (IHS Markit), US import data for 2002 and 2012. Darker colors indicate a higher number of manufacturing firms exporting to the US (map a)) or a higher ratio between the value of total manufacturing exports to the US obtained from Piers and the value obtained from customs data (map b)). All figures are averages between 2002 and 2012.
Each curve corresponds to the kernel density distribution of log exports to the United States for a different group of exporting countries. Rich (poor) countries are those whose real per-capita GDP (averaged between the years 2002 and 2012) is above (below) the 75th (25th) percentile. Each distribution is drawn by pooling together all the varieties exported by a group of countries to the United States over the two sample periods, and is centered around zero by deviating the log exports of each variety from the average log exports of the corresponding exporting country.