Lecture 7c:

Firm Heterogeneity

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C181 – International Trade
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3- Facts on Firm Heterogeneity

Related topics to be discussed:

Facts on firm heterogeneity:

• Are all firms identical?
• Do all firms export?
• Are exporters smaller or larger than other firms?
• Are exporters more productive?
• Do firms tend to export to the same destinations?
• Does trade affect firms symmetrically?
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Are all firms identical?

The answer is obviously “no”

But the differences between firms are usually understated!!
FACT 1:

Firms are extremely heterogeneous:

• About 50% of US output from the 0.3% largest firms

Zipf’s law:

If \( n^{th} \) ranked firm has size \( s \), \( (n/2)^{th} \) firm has size \( 2s \)
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Do all firms exports?

Again, the answer is “no”
### Table 1—Plant-Level Export Facts

<table>
<thead>
<tr>
<th>Export status</th>
<th>Percentage of all plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>No exports</td>
<td>79</td>
</tr>
<tr>
<td>Some exports</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Export intensity of exporters (percent)</th>
<th>Percentage of exporting plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 10</td>
<td>66</td>
</tr>
<tr>
<td>10 to 20</td>
<td>16</td>
</tr>
<tr>
<td>20 to 30</td>
<td>7.7</td>
</tr>
<tr>
<td>30 to 40</td>
<td>4.4</td>
</tr>
<tr>
<td>40 to 50</td>
<td>2.4</td>
</tr>
<tr>
<td>50 to 60</td>
<td>1.5</td>
</tr>
<tr>
<td>60 to 70</td>
<td>1.0</td>
</tr>
<tr>
<td>70 to 80</td>
<td>0.6</td>
</tr>
<tr>
<td>80 to 90</td>
<td>0.5</td>
</tr>
<tr>
<td>90 to 100</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Note: The statistics are calculated from all plants in the 1992 Census of Manufactures.
FACT 2:

- Only a small fraction of firms export (21% of US firms in 1992)

FACT 3:

- Most exporters only export a small fraction of their output
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Are exporters larger?
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FACT 4:

• Exporters are much bigger:

  Total output 5.2 larger than non-exporters
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FACT 4:

- Exporters are much bigger:
  
  Total output 5.2 larger than non-exporters

... Even if you don’t count their export sales:

  Domestic sales 4.8 larger than non-exporters
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Are exporters more productive?
FACT 5:
- Exporters are more productive
  productivity premium: 33%

### Table 2—Plant-Level Productivity Facts

<table>
<thead>
<tr>
<th>Productivity measure</th>
<th>Variability (standard deviation of log productivity)</th>
<th>Advantage of exporters (exporter less nonexporter average log productivity, percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unconditional</td>
<td>0.75</td>
<td>33</td>
</tr>
<tr>
<td>Within 4-digit industries</td>
<td>0.66</td>
<td>15</td>
</tr>
<tr>
<td>Within capital-intensity bins</td>
<td>0.67</td>
<td>20</td>
</tr>
<tr>
<td>Within production labor-share bins</td>
<td>0.73</td>
<td>25</td>
</tr>
<tr>
<td>Within industries (capital bins)</td>
<td>0.60</td>
<td>9</td>
</tr>
<tr>
<td>Within industries (production labor bins)</td>
<td>0.64</td>
<td>11</td>
</tr>
</tbody>
</table>

**Notes:** The statistics are calculated from all plants in the 1992 Census of Manufactures. The “within” measures subtract the mean value of log productivity for each category. There are 450 4-digit industries, 500 capital-intensity bins (based on total assets per worker), 500 production labor-share bins (based on payments to production workers as a share of total labor cost). When appearing within industries there are 10 capital-intensity bins or 10 production labor-share bins.
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• Observed productivity differences in various countries:
  
  **US** (Bernard et al 1997), **Taiwan and Korea** (Aw, Chung and Roberts, 2000), **France** (Eaton Kortum Kramarz 2004), **Germany** (Bernard and Wagner 2001), **Columbia, Mexico, Morocco** (Clerides et al 1998), etc.

• Various dimensions (Bernard and Jensen 1999):

  Exporters pay higher wages, have higher capital-labor ratio, employ more skilled labor, have higher TFP, etc.
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Export destinations

FACT 6:

• Only a few exporters sell to many markets
Firms in France:
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Effect of trade

FACT 7:

• After trade liberalization, less productive firms exit the market while more productive firms expand
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Conclusions:

• Fact 1: Firms differ widely
• Fact 2: Few firms export
• Fact 3: And they export a small portion of their output
• Fact 4: Exporters are bigger
• Fact 5: Exporters are more productive
• Fact 6: Few firms export to many destinations
• Fact 7: Less productive firms more likely to exit after trade liberalization
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**Theory:**

Why differences in costs matter?

1- Different firms have different MC’s

2- Trade costs affect exporters

**Implications for:**

• Quantities,

• markups,

• profits,

• and export participation
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This lecture:

We will be able to explain

- Why firms have very different sizes
- Why trade makes unproductive firms disappear
- Why a trade liberalization can lead to an increase in aggregate productivity
- Why some firms export while other don’t
- Why export sales tend to be smaller than domestic sales
Sources of heterogeneity

1st step: understand heterogeneity among firms:

• We will assume that firms have the same fixed cost (e.g. R&D costs) but differ in their marginal cost.
Sources of heterogeneity

1\textsuperscript{st} step: understand heterogeneity among firms:

- We will assume that firms have the same fixed cost (e.g. R&D costs) but differ in their marginal cost.

2\textsuperscript{nd} step: understand difference between exporters and non-exporters:

- We will assume that there is a higher marginal cost associated with exporting.
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Optimal quantities and prices

- **Same demand system:** \( Q = S \cdot \left[1/n - b \left( P - \bar{P} \right) \right] \)

  yields again: \( MR = P - \frac{Q}{b \cdot S} \)

  → All firms face the same MR curve (as a function of Q)

- **Optimum:** More productive firms: lower/higher MR?
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Optimal quantities and prices

• **Same demand system**: \( Q = S \cdot \left[ \frac{1}{n} - b (P - \bar{P}) \right] \)

  yields again: \( MR = P - \frac{Q}{b \cdot S} \)

→ All firms face the same MR curve (as a function of Q)

• **Optimum**: \( MR = MC \)

→ Hence more productive firms will have a lower MR
→ And produce more
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Low-cost firm: equilibrium

Marginal cost, $MC$

Marginal revenue, $MR$

Price

Quantity

$P^M$

$Q^M$

$MR = MC$

Demand, $D$
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High-cost firm: equilibrium

Price

$P^M$

$MR = MC$

Marginal revenue, $MR$

$Q^M$

Marginal cost, $MC$

Demand, $D$

Quantity
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High-cost firm: equilibrium
Lower quantity $Q$

Price

$P^M$

Marginal revenue, $MR$

Marginal cost, $MC$

Demand, $D$

Quantity

$Q^M$
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High-cost firm:

Higher price $P$

Marginal cost, $MC$

Marginal revenue, $MR$

Equilibrium

$P^M$

$Q^M$

Demand, $D$

Price
High-cost firm:
Smaller markup $\mu$

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Price

$MR = MC$

Marginal revenue, $MR$

Marginal cost, $MC$

$P^M$

$Q^M$

Demand, $D$

High-cost firm: equilibrium

Smaller markup $\mu$
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Profits and “operating profits”:

- Profits:
  \[ \text{Profits} = \text{revenues} - \text{costs} \]
  \[ = P \cdot Q - (c \cdot Q + F) \]
  \[ = (P - AC) \cdot Q \]

- “Operating profits”:
  profits once fixed costs are incurred:
  \[ \text{OP} = \text{revenues} - \text{variable costs} \]
  \[ = P \cdot Q - c \cdot Q \]
  \[ = \text{markup} \times Q \]
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High-cost firm: equilibrium

Operating profits?
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High-cost firm: Smaller operating profits

Price

Marginal cost, $MC$

$MR = MC$

Marginal revenue, $MR$

Quantity

Demand, $D$

$Q^*$

$P^*$
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Operating Profit

\[ (P_1 - c_1) \times Q_1 \]

\[ (P_2 - c_2) \times Q_2 \]

Marginal cost, \( c_i \)
Profits and “operating profits”:

- **Profits:**
  \[ \text{Profits} = \text{Operating profits} - \text{Fixed costs} \]
  
  - profits are smaller for high-cost firms
  - High-cost firms more likely to end up with negative profits
Effect of trade:

- **Heterogeneous effect:**
  Does trade affect heterogeneous firms differently?
Effect of trade:

- **Heterogeneous effect:**

  How does trade affect MR?

\[
MR = P - \frac{Q}{bS} = \left( \frac{1}{bn} + \bar{P} \right) - \frac{2}{bS} * Q
\]
Effect of trade:

- **Heterogeneous effect:**
  
  How does trade affect MR?

\[ MR = P - \frac{Q}{bS} = \left(\frac{1}{bn} + \bar{P}\right) - \frac{2}{bS} \times Q \]

- Trade lowers prices:
  \(\rightarrow\) **lower intercept**

- Larger market size:
  \(\rightarrow\) **flatter slope**
Effect of trade on MR:

- Intercept: \( \bar{P} + \frac{1}{(b \times n)} \)
- Slope: \( \frac{1}{(S \times b)} \)

Cost, \( C \) and Price, \( P \)

Quantity
Effect of trade on quantities:

MR, MC

MR

New MR' 

Marginal revenue, MR

High MC

Low MC

Q' Q

Quantity
Effect of trade on operating profits:
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Effect of trade:

- **Heterogeneous effect:**
  - High-cost firms shrink, productive firms expand:
  - Profits increase for productive firms
  - High-cost firms have smaller profits and some of them exit
Effect of trade:

→ SELECTION effect:

- Productive firms thrive, unproductive firms exit:

**Key result:** trade leads to average productivity gains!
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Summary: Effects of trade

With homogenous firms (long run):
• Firms exit so that profits are zero at equilibrium
• Higher production per firm, lower costs, lower prices

With heterogeneous firms (long run):
• Only the least productive firms exit
• Only the most productive firms expand
• New source of gains: higher average productivity
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Illustration: effect of NAFTA in Canada

Productivity Gains

Estimates: 15% average productivity increase for Canada after NAFTA in sectors most affected
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Sources of heterogeneity

1st step: understand heterogeneity among firms:

NOW:

2nd step: understand difference between exporters and non-exporters:
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Export participation

Next questions to answer:

• Why few firms export?

• Why are exporters more productive?

• Why firms export less than they sell domestically?
Exporters vs. non-exporters

Trade costs:

- We will assume that there is a higher marginal cost associated with exporting:
  low-MC for domestic sale, high-MC for exports
Exporters vs. non-exporters

Consequences of trade costs:

- Exported quantities to another market tend to be small
- Markups on another market tend to be smaller
- Profits on another market tend to be smaller
Effect of trade costs on performance:

For the same firm:

Performance on the foreign market vs. domestic market

On the foreign market

On the domestic market

Marginal revenue, $MR$

Marginal cost on foreign market (MC + trade costs)

Marginal cost on domestic market

Price vs. Quantity

$P^M$

$Q^M$

Demand, $D$
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**Exporters vs. non-exporters**

Consequences of trade costs:

- Exported quantities to another market tend to be small
- Markups on another market tend to be smaller
- Profits on another market tend to be smaller

- **Hence not all firms export!**
Not all firms export:

(a) Domestic (Home) Market

(b) Export (Foreign) Market
Not all firms export:

\[ c_2 + t > P \] and MR

(a) Domestic (Home) Market

(b) Export (Foreign) Market
Exporters vs. non-exporters

Consequences of trade costs:

- Exported quantities to another market tend to be small
- Markups on another market tend to be smaller
- Profits on another market tend to be smaller

- Hence not all firms export
- Only the most productive firms export
Export participation: Summary and Intuition

- Why few firms export?
- Why are exporters more productive?

**Answer:** Because trade costs impose an additional burden on marginal costs that only the most productive firms can bear

- Why firms export less than they sell domestically?

**Answer:** Trade costs make firms relatively more performant at home
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Clicker question
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Clicker question

1- Do you expect more productive firms...

a) To sell more and have lower markups?

b) To sell more and have higher markups?

c) To sell less and have lower markups?

d) To sell less and have higher markups?
Clicker question

2- As a country opens to trade, do you expect...

a) All firms to expand?

b) All firms to shrink?

c) The smallest firms to shrink and the largest to expand?

d) The largest firms to shrink and the smallest to expand?
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Clicker question

3- A firm with a relatively higher MC is facing:

a) A lower MR curve

b) A higher MR curve

c) Same MR curve but moves upward along the curve