

# ECO 745: Theory of International Economics

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Fall 2015 - Lecture 9

# Monopolistic Competition Review

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Krugman (1980) framework

- Firms produce differentiated products, otherwise homogeneous
- Autarky → Trade increases the number of varieties available to consumers
- Trade barriers affect how much consumers consume, but not what they consume

Key result:

$$\text{Exports}_{AB} = \text{Constant} \times \frac{\text{GDP}_A \times \text{GDP}_B}{(\text{Trade barriers}_{AB})^\sigma}$$

Where  $\sigma$  is the CES elasticity  $\Rightarrow \sigma \uparrow$  amplifies effect of trade barriers

# Monopolistic Competition with Firm Heterogeneity

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Melitz (2003) / Chaney (2008) framework

- Firms produce differentiated products and differ in their productivity levels (Pareto for Chaney)
- Autarky → Trade increases the number of varieties available to consumers
- Trade barriers affect how much consumers consume and what they consume

Key result:

$$\text{Exports}_{AB} = \text{Constant} \times \frac{\text{GDP}_A \times \text{GDP}_B}{(\text{Trade barriers}_{AB})^{\epsilon(\sigma)}}$$

Where  $\epsilon(\sigma)$  is the elasticity of trade with respect to trade barriers, and  $\epsilon'(\sigma) < 0$ , therefore  $\sigma \uparrow$  dampens the effect of trade barriers

# Monopolistic Competition with Firm Heterogeneity

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Why is  $\epsilon'(\sigma) < 0$ ? Suppose trade barriers fall, two effects:

- Intensive Margin: Existing firms export more
- Extensive Margin: New firms enter the export market
  - New entrants are less productive compared to preexisting exporters ( $\partial \bar{z}_d / \partial \tau, \partial \bar{z}_e / \partial \tau < 0$ )

$\sigma$  high: new exporters will be small as they have high prices.

$\sigma$  low: new exporters will be larger relative to existing exporters, since less substitution due to price

- $\sigma$  magnifies sensitivity of intensive margin and dampens sensitivity of extensive margin
- When productivity is Pareto,  $\sigma$ 's effects on extensive margin dominate

# Elasticity of Substitution and Elasticity of Trade Flows

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Have following expression for export flows in general asymmetric model

$$X_{ij} = w_i L_i \int_{\bar{z}_{ij}}^{\infty} y_{ij}(z) dF(z)$$

Therefore

$$dX_{ij} = \left( w_i L_i \int_{\bar{z}_{ij}}^{\infty} y_{ij}(z) dF(z) \right) d\tau_{ij} - \left( w_i L_i y_{ij}(\bar{z}_{ij}) F'(\bar{z}_{ij}) \times \frac{\partial \bar{z}_{ij}}{\partial \tau_{ij}} \right) d\tau_{ij} + \\ \left( w_i L_i \int_{\bar{z}_{ij}}^{\infty} y_{ij}(z) dF(z) \right) df_{ij} - \left( w_i L_i y_{ij}(\bar{z}_{ij}) F'(\bar{z}_{ij}) \times \frac{\partial \bar{z}_{ij}}{\partial f_{ij}} \right) df_{ij}$$

Where the left terms represent the intensive margin and the right terms the intensive margin

# Elasticity of Substitution and Elasticity of Trade Flows

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Let  $\zeta$  be the elasticity of trade flows with respect to variable costs and  $\xi$  be elasticity wrt fixed costs

$$\zeta := -\frac{d \log X_{ij}}{d \log \tau_{ij}}, \quad \xi := -\frac{d \log X_{ij}}{d \log f_{ij}}$$

Then  $\partial \zeta / \partial \sigma = 0$  and  $\partial \xi < 0$

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Then  $\partial \zeta / \partial \sigma = 0$  and  $\partial \xi < 0$

To see this for the elasticity wrt variable costs, can show that:

$$\zeta = \overbrace{(\sigma - 1)}^{\text{intensive margin elasticity}} + \overbrace{(\gamma - (\sigma - 1))}^{\text{extensive margin elasticity}} = \gamma$$

$\Rightarrow \partial \zeta / \partial \sigma = 0$

# Elasticity of Substitution and Elasticity of Trade Flows

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$$\zeta := -\frac{d \log X_{ij}}{d \log \tau_{ij}}, \quad \xi := -\frac{d \log X_{ij}}{d \log f_{ij}}$$

Then  $\partial \zeta / \partial \sigma = 0$  and  $\partial \xi < 0$

To see this for the elasticity wrt fixed costs, can show that:

$$\xi = \underbrace{\widetilde{(0)}}_{\text{intensive margin elasticity}} + \underbrace{\left(\frac{\gamma}{\sigma - 1} - 1\right)}_{\text{extensive margin elasticity}} = \frac{\gamma}{\sigma - 1} - 1$$

$\Rightarrow \partial \xi / \partial \sigma < 0$



# Model with Free Entry

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Melitz (2003) is the base framework for Chaney (2008)

- Besides Pareto distribution, primary difference is free entry
- Firms pay fixed cost,  $\phi$ , before knowing productivity
- After drawing productivity, same as before: fixed cost to produce + additional fixed cost to export

Firms enter until profits are zero in expectation. Continuum  $\Rightarrow$  total profits equal zero.

$$\pi = \mu \int_{\bar{z}}^{\infty} \overbrace{\left( p(z)c(z) - \frac{c(z)}{\bar{z}} - f \right)}^{\text{production profits}} dF(z) - \overbrace{\mu \phi}^{\text{prod. draw cost}} = 0$$

# Model with Free Entry

---

Firms enter until profits are zero in expectation. Continuum  $\Rightarrow$  total profits equal zero

In autarky, have

$$\pi = \mu \int_{\bar{z}}^{\infty} \overbrace{\left( p(z)c(z) - \frac{c(z)}{\bar{z}} - f \right)}^{\text{production profits}} dF(z) - \underbrace{\mu \bar{\phi}}_{\substack{\text{prod.draw} \\ \text{cost}}} = 0$$

Can still find production cutoff good same as last time (even easier since  $\pi = 0$ ):

$$\bar{z} = \left( \frac{f\mu\gamma}{((1-\rho)\gamma - \rho)\theta(L + \pi)} \right)^{\frac{1}{\gamma}} = \bar{z} = \left( \frac{f\mu\gamma}{((1-\rho)\gamma - \rho)\theta(L)} \right)^{\frac{1}{\gamma}}$$

But now have to compute equilibrium mass of potential entrants  $\mu$

# Potential Entrants under Free Entry

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Plug in prices and demand into profit function and solving for zero total profits yields:

$$\int_{\bar{z}}^{\infty} \left( c(z) \left( p(z) - \frac{1}{z} \right) - f \right) dF(z) = \phi$$
$$\int_{\bar{z}}^{\infty} \left( \left[ \frac{\rho((1-\rho)\gamma - \rho)\theta(L + \pi)}{\mu\gamma(1-\rho)\bar{z}^{\frac{\rho-(1-\rho)\gamma}{1-\rho}}} z^{\frac{1}{1-\rho}} \right] \left( \frac{1}{\rho z} - \frac{1}{\bar{z}} \right) - f \right) (\gamma z^{-\gamma-1}) dz = \phi$$
$$\bar{z}^{-\gamma} = \frac{(1-\rho)\theta L - \mu\phi}{\mu f}$$

And substituting the cutoff value,  $\bar{z}$ , we computed earlier gives

$$\frac{f\mu\gamma}{((1-\rho)\gamma - \rho)\theta(L)} = \frac{(1-\rho)\theta L - \mu\phi}{\mu f}$$

Therefore

$$\mu = \frac{\rho\theta L}{\gamma\phi}$$

# Extensive Margin in Free Entry

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We have the equilibrium number of potential entrants and production cutoff

$$\mu = \frac{\rho\theta L}{\gamma\phi}, \quad \bar{z} = \left( \frac{\rho f}{(\gamma(1 - \rho) - \rho)\phi} \right)^{\frac{1}{\gamma}}$$

This tells us:

- Fixed costs of production increase, then cutoff increases ( $f \uparrow \Rightarrow \bar{z} \uparrow$ ), but doesn't affect  $\mu$
- Higher entry costs  $\Rightarrow$  less entrants and lower production cutoff ( $\phi \uparrow \Rightarrow \mu \uparrow, \bar{z} \downarrow$ )
- Lower productivity dispersion/expected productivity  $\Rightarrow$  less entrants, lower cutoff ( $\gamma \uparrow \Rightarrow \mu \downarrow, \bar{z} \downarrow$ )
- Higher elasticity  $\Rightarrow$  more entrants, higher cutoff ( $\rho \uparrow \Rightarrow \mu \uparrow, \bar{z} \uparrow$ )

# Extensive Margin in Free Entry with Free Entry

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Nothing surprising when have free entry with international trade. Zero profit function becomes

$$\pi_j = \mu_j \overbrace{\int_{\bar{z}_d}^{\infty} \left( p_j(z)c_j(z) - \frac{c_j(z)}{z} - f_d \right) dF(z)}^{\text{production profits from domestic prod}} + \mu_j \overbrace{\int_{\bar{z}_e}^{\infty} \left( p_j^i(z)c_j^i(z) - \frac{c_j^i(z)}{z} - f_e \right) dF(z)}^{\text{production profits from exporting}} - \phi\mu_j = 0$$

And can solve for cutoffs and profits like normal. Same conclusions as fixed entrants apply

- Trade lowers the number of firms that produce in equilibrium
- Small firms exit, large firms produce more, average firm productivity increases

# Importance of Melitz

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- Developed a tractable trade framework with a well-defined concept of a firm (countries don't trade, firms trade)
- Strong and intuitive predictions for how extensive margin changes in reaction to trade
- Useful to examine how trade affects changes in average firm productivity levels, and reallocation from less to more productive firms
  - Side note: This is occasionally used to make statements about reallocation affecting TFP, but TFP is not affected by reallocation among firms in this framework. See Gibson (2006)
- Straightforward to extend model to multiple sectors, multiple factors or production, multiple asymmetric countries, etc, which makes it a very useful framework for quantitative work.

# Firm Level Data on Exporters

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Bernard, Jensen, Redding, Schott (2007) look at exporters among U.S. manufacturing firms

Key findings:

- Very few firms engage in international trade
- Among exporters, a small number account for most exports
- Exporters are more productive than non-exporters
- Exporters different in other ways too: higher wages, more skilled workers, more capital/worker

# Exporting Across Industries

*Table 2*  
**Exporting By U.S. Manufacturing Firms, 2002**

| <i>NAICS industry</i>               | <i>Percent of firms</i> | <i>Percent of firms that export</i> | <i>Mean exports as a percent of total shipments</i> |
|-------------------------------------|-------------------------|-------------------------------------|---|
| 311 Food Manufacturing              | 6.8                     | 12                                  | 15  |
| 312 Beverage and Tobacco Product    | 0.7                     | 23                                  | 7   |
| 313 Textile Mills                   | 1.0                     | 25                                  | 13  |
| 314 Textile Product Mills           | 1.9                     | 12                                  | 12  |
| 315 Apparel Manufacturing           | 3.2                     | 8                                   | 14  |
| 316 Leather and Allied Product      | 0.4                     | 24                                  | 13  |
| 321 Wood Product Manufacturing      | 5.5                     | 8                                   | 19  |
| 322 Paper Manufacturing             | 1.4                     | 24                                  | 9   |
| 323 Printing and Related Support    | 11.9                    | 5                                   | 14  |
| 324 Petroleum and Coal Products     | 0.4                     | 18                                  | 12  |
| 325 Chemical Manufacturing          | 3.1                     | 36                                  | 14  |
| 326 Plastics and Rubber Products    | 4.4                     | 28                                  | 10  |
| 327 Nonmetallic Mineral Product     | 4.0                     | 9                                   | 12  |
| 331 Primary Metal Manufacturing     | 1.5                     | 30                                  | 10  |
| 332 Fabricated Metal Product        | 19.9                    | 14                                  | 12  |
| 333 Machinery Manufacturing         | 9.0                     | 33                                  | 16  |
| 334 Computer and Electronic Product | 4.5                     | 38                                  | 21  |
| 335 Electrical Equipment, Appliance | 1.7                     | 38                                  | 13  |
| 336 Transportation Equipment        | 3.4                     | 28                                  | 13  |
| 337 Furniture and Related Product   | 6.4                     | 7                                   | 10  |
| 339 Miscellaneous Manufacturing     | 9.1                     | 2                                   | 15  |
| <b>Aggregate manufacturing</b>      | <b>100</b>              | <b>18</b>                           | <b>14</b>   |



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| <b>Aggregate manufacturing</b>      | <b>100</b>              | <b>18</b>                           | <b>14</b>   |

Few firms export

Among exporters, most output is not exported

# Export Premia in US Manufacturing

*Table 3*  
**Exporter Premia in U.S. Manufacturing, 2002**

|                            | <i>Exporter premia</i> |                        |  |
|----------------------------|------------------------|------------------------|--|
|                            | <i>(1)</i>             | <i>(2)</i>             | <i>(3)</i>                             |
| Log employment             | 1.19                   | 0.97                   |  |
| Log shipments              | 1.48                   | 1.08                   | 0.08                                   |
| Log value-added per worker | 0.26                   | 0.11                   | 0.10                                   |
| Log TFP                    | 0.02                   | 0.03                   | 0.05                                   |
| Log wage                   | 0.17                   | 0.06                   | 0.06                                   |
| Log capital per worker     | 0.32                   | 0.12                   | 0.04                                   |
| Log skill per worker       | 0.19                   | 0.11                   | 0.19                                   |
| Additional covariates      | None                   | Industry fixed effects | Industry fixed effects, log employment |

# Multiproduct and Multidestination Firms, 2000

## A: Share of Exporting Firms

| <i>Number of products</i> | <i>Number of countries</i> |             |            |            |             | <i>All</i> |
|---------------------------|----------------------------|-------------|------------|------------|-------------|------------|
|                           | <i>1</i>                   | <i>2</i>    | <i>3</i>   | <i>4</i>   | <i>5+</i>   |            |
| 1                         | 40.4                       | 1.2         | 0.3        | 0.1        | 0.2         | 42.2       |
| 2                         | 10.4                       | 4.7         | 0.8        | 0.3        | 0.4         | 16.4       |
| 3                         | 4.7                        | 2.3         | 1.3        | 0.4        | 0.5         | 9.3        |
| 4                         | 2.5                        | 1.3         | 1.0        | 0.6        | 0.7         | 6.2        |
| 5+                        | 6.0                        | 3.0         | 2.7        | 2.3        | 11.9        | 25.9       |
| <b>All</b>                | <b>64.0</b>                | <b>12.6</b> | <b>6.1</b> | <b>3.6</b> | <b>13.7</b> | <b>100</b> |

Most exporters only export 1 (or 2) product(s), and to only 1 destination

# Multiproduct and Multidestination Firms, 2000

## B: Share of Export Value

| <i>Number of products</i> | <i>Number of countries</i> |            |            |            |             | <i>All</i> |
|---------------------------|----------------------------|------------|------------|------------|-------------|------------|
|                           | <i>1</i>                   | <i>2</i>   | <i>3</i>   | <i>4</i>   | <i>5+</i>   |            |
| 1                         | 0.20                       | 0.06       | 0.02       | 0.02       | 0.07        | 0.4        |
| 2                         | 0.19                       | 0.12       | 0.04       | 0.03       | 0.15        | 0.5        |
| 3                         | 0.19                       | 0.07       | 0.05       | 0.03       | 0.19        | 0.5        |
| 4                         | 0.12                       | 0.08       | 0.08       | 0.04       | 0.27        | 0.6        |
| 5+                        | 2.63                       | 1.23       | 1.02       | 0.89       | 92.2        | 98.0       |
| <b>All</b>                | <b>3.3</b>                 | <b>1.5</b> | <b>1.2</b> | <b>1.0</b> | <b>92.9</b> | <b>100</b> |

Most exporters only export 1 (or 2) product(s), and to only 1 destination: Accounts for very small portion of trade

Most trade flows due to many product, many destination firms

# Multiproduct and Multidestination Firms, 2000

## C: Share of Employment

| <i>Number of products</i> | <i>Number of countries</i> |            |            |            |             | <i>All</i> |
|---------------------------|----------------------------|------------|------------|------------|-------------|------------|
|                           | <i>1</i>                   | <i>2</i>   | <i>3</i>   | <i>4</i>   | <i>5+</i>   |            |
| 1                         | 7.0                        | 0.0        | 0.0        | 0.0        | 0.0         | 7.1        |
| 2                         | 1.9                        | 2.6        | 0.1        | 0.0        | 0.0         | 4.6        |
| 3                         | 1.3                        | 1.0        | 0.8        | 0.0        | 0.2         | 3.3        |
| 4                         | 0.5                        | 0.4        | 0.3        | 0.2        | 0.2         | 1.6        |
| 5+                        | 3.5                        | 2.6        | 4.3        | 4.1        | 68.8        | 83.3       |
| <b>All</b>                | <b>14.2</b>                | <b>6.7</b> | <b>5.5</b> | <b>4.3</b> | <b>69.2</b> | <b>100</b> |

Many product, many destination firms responsible for majority of employment

# Export Premia for Multi-Product Firms, 1997

*Table 5*

**The Intensive and Extensive Margins of Exporters, 1997**

|                                      | <i>Exporter premia</i> |                        |
|--------------------------------------|------------------------|------------------------|
|                                      | (1)                    | (2)                    |
| <i>Log number of products</i>        | 0.23                   | 0.27                   |
| <i>Log mean shipments/# products</i> | 1.25                   | 0.73                   |
| <i>Additional covariates</i>         | None                   | Industry fixed effects |

Exporters produce more products (additional extensive margin), and produce more output per product (intensive margin)

# Exporters and Importers across Industries

Table 7

## Exporting and Importing by U.S. Manufacturing Firms, 1997

| <i>NAICS industry</i>               | <i>Percent of all firms</i> | <i>Percent of firms that export</i> | <i>Percent of firms that import</i> | <i>Percent of firms that import &amp; export</i> |
|-------------------------------------|-----------------------------|-------------------------------------|-------------------------------------|--|
| 311 Food Manufacturing              | 7                           | 17                                  | 10                                  | 7  |
| 312 Beverage and Tobacco Product    | 1                           | 28                                  | 19                                  | 13   |
| 313 Textile Mills                   | 1                           | 47                                  | 31                                  | 24   |
| 314 Textile Product Mills           | 2                           | 19                                  | 13                                  | 9  |
| 315 Apparel Manufacturing           | 6                           | 16                                  | 15                                  | 9  |
| 316 Leather and Allied Product      | 0                           | 43                                  | 43                                  | 30   |
| 321 Wood Product Manufacturing      | 5                           | 15                                  | 5                                   | 3  |
| 322 Paper Manufacturing             | 1                           | 42                                  | 18                                  | 15   |
| 323 Printing and Related Support    | 13                          | 10                                  | 3                                   | 2  |
| 324 Petroleum and Coal Products     | 0                           | 32                                  | 17                                  | 14   |
| 325 Chemical Manufacturing          | 3                           | 56                                  | 30                                  | 26   |
| 326 Plastics and Rubber Products    | 5                           | 42                                  | 20                                  | 16   |
| 327 Nonmetallic Mineral Product     | 4                           | 16                                  | 11                                  | 7  |
| 331 Primary Metal Manufacturing     | 1                           | 51                                  | 23                                  | 21   |
| 332 Fabricated Metal Product        | 20                          | 21                                  | 8                                   | 6  |
| 333 Machinery Manufacturing         | 9                           | 47                                  | 22                                  | 19   |
| 334 Computer and Electronic Product | 4                           | 65                                  | 40                                  | 37   |
| 335 Electrical Equipment, Appliance | 2                           | 58                                  | 35                                  | 30   |
| 336 Transportation Equipment        | 3                           | 40                                  | 22                                  | 18   |
| 337 Furniture and Related Product   | 6                           | 13                                  | 8                                   | 5  |
| 339 Miscellaneous Manufacturing     | 7                           | 31                                  | 19                                  | 15   |
| <b>Aggregate manufacturing</b>      | <b>100</b>                  | <b>27</b>                           | <b>14</b>                           | <b>11</b>  |

Many exporters don't import  
Most importers, also export

# Firm Level Data on Exporters and Markets Served

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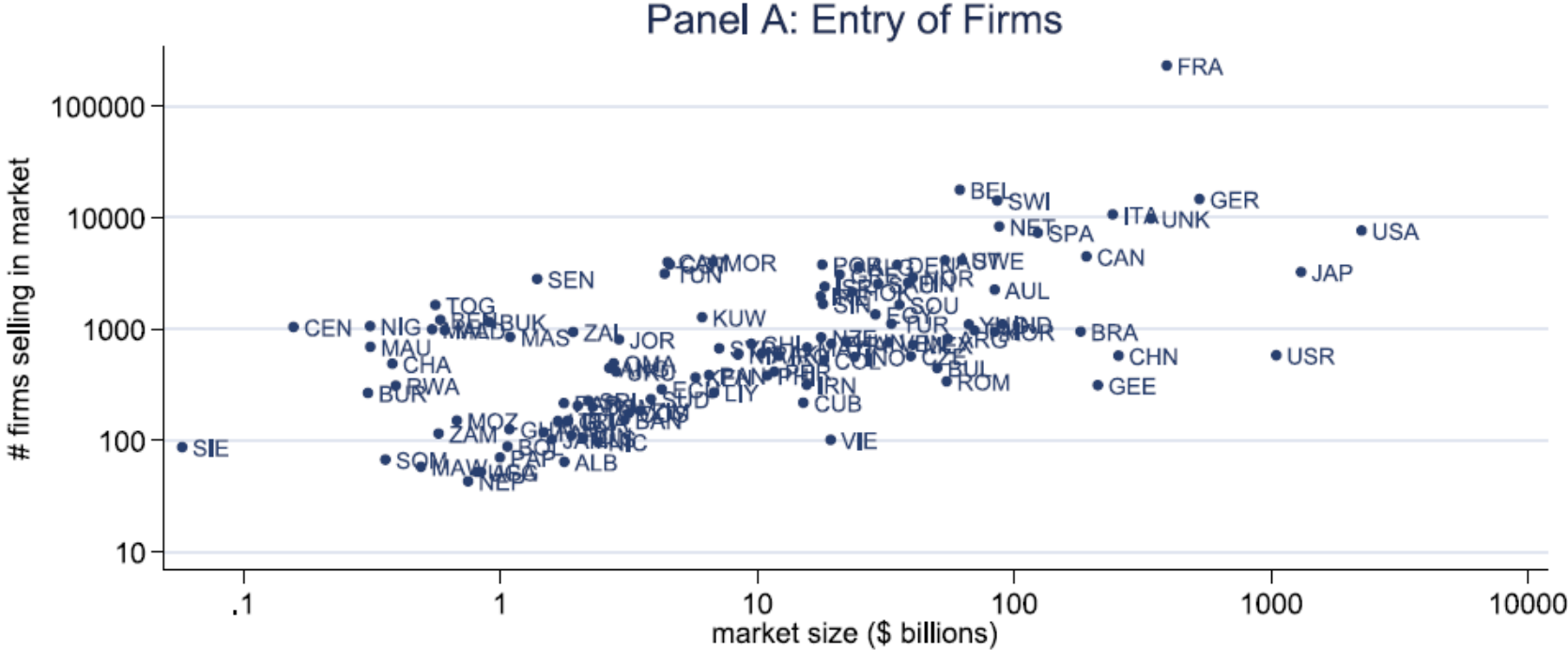
Eaton, Kortum, and Kramarz (2011) look at French exporters and the markets they export to

Key findings:

- Exporters export more to larger markets
- Sales distributions are similar across different market sizes
- Larger firms sell to more and smaller markets

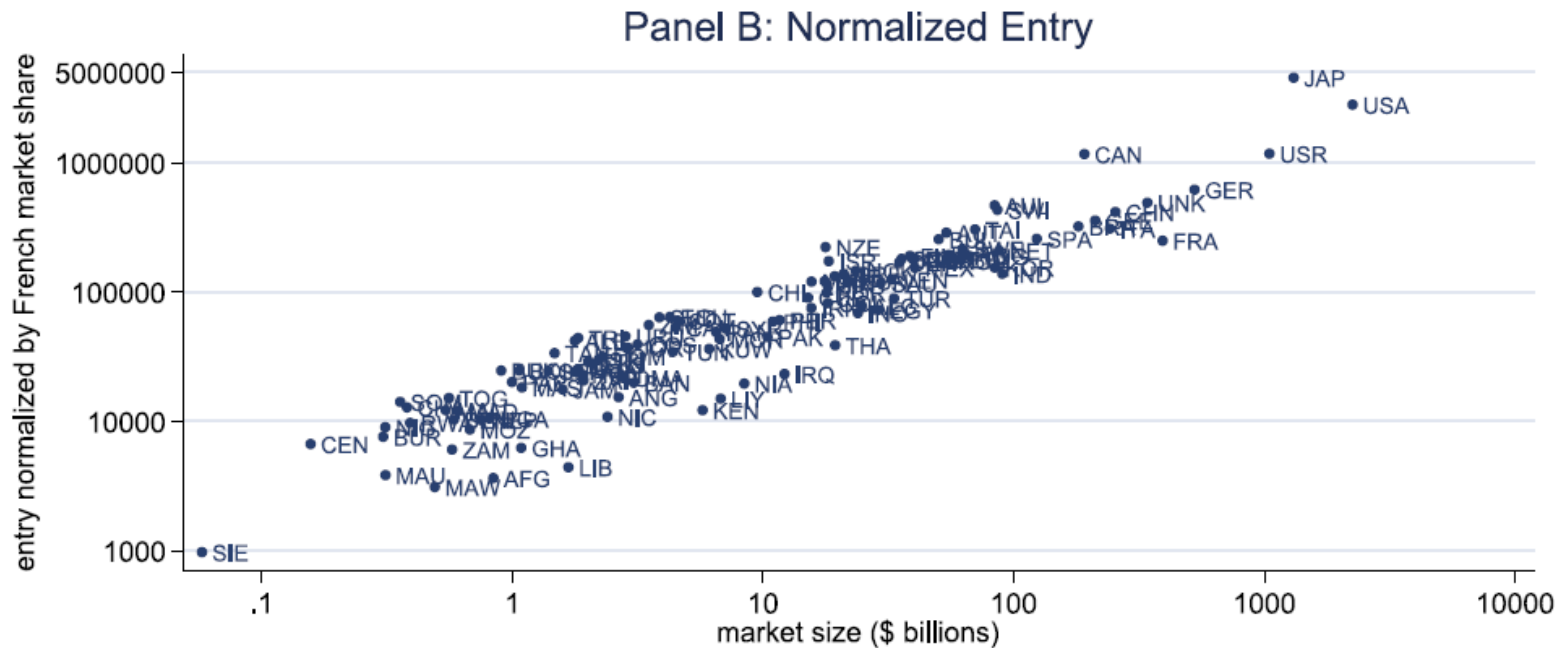


# Number of Exporters vs Market size



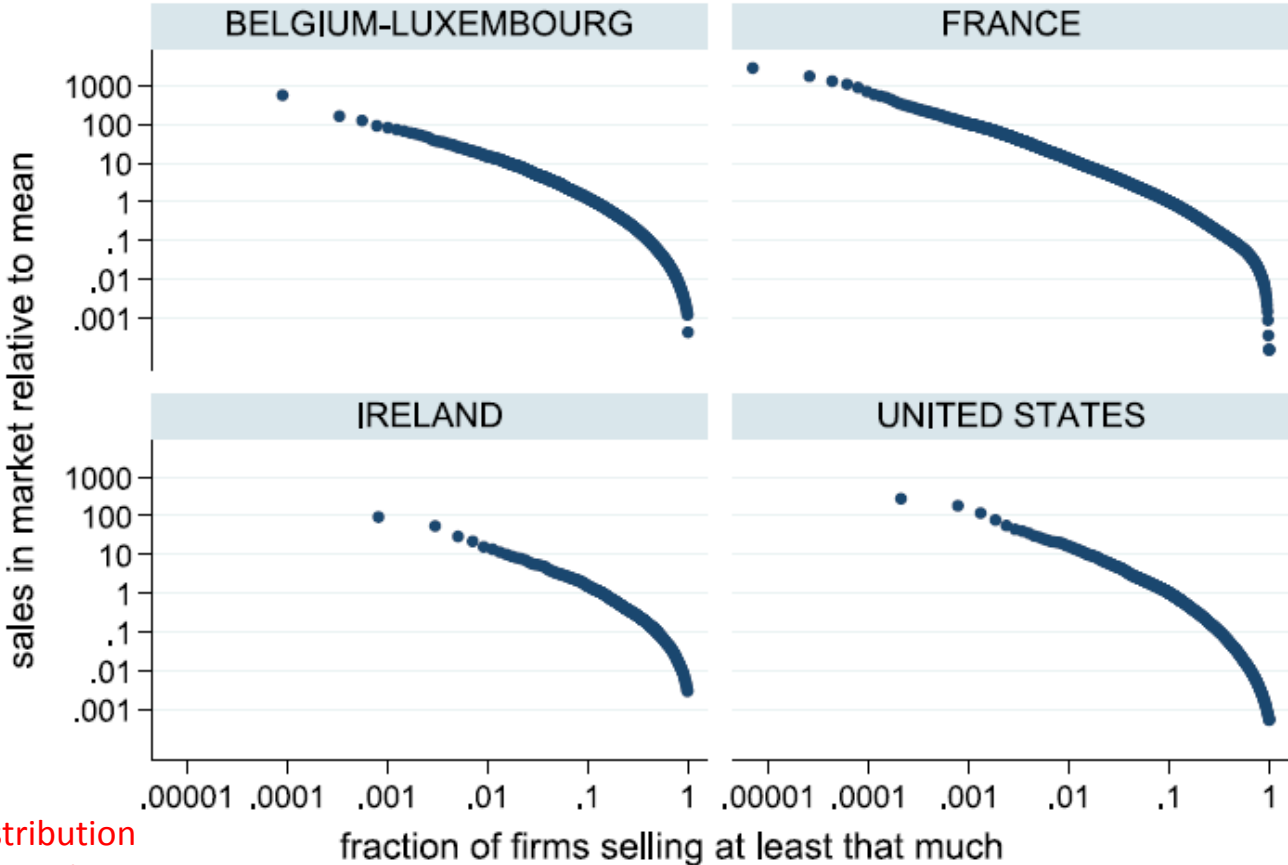
More exporters serve larger markets

# Number of Exporters vs Market size



Even stronger relationship after normalizing for French market share

# Sales Distribution of Firms



Similar sales distribution across different markets

# Exporters by Market

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TABLE I  
FRENCH FIRMS EXPORTING TO THE SEVEN MOST POPULAR DESTINATIONS

| Export Destination                     | Number of Exporters | Fraction of Exporters |
|--|---------------------|-----------------------|
| Belgium <sup>a</sup> (BE)              | 17,699              | 0.520                 |
| Germany (DE)                           | 14,579              | 0.428                 |
| Switzerland (CH)                       | 14,173              | 0.416                 |
| Italy (IT)                             | 10,643              | 0.313                 |
| United Kingdom (UK)                    | 9752                | 0.287                 |
| Netherlands (NL)                       | 8294                | 0.244                 |
| United States (US)                     | 7608                | 0.224                 |
| Any destination (all French exporters) | 34,035              |                       |

<sup>a</sup>Belgium includes Luxembourg.

This is despite large differences in number of firms servicing different markets and market size

From EKK (2011)

# Sales Distribution of Firms

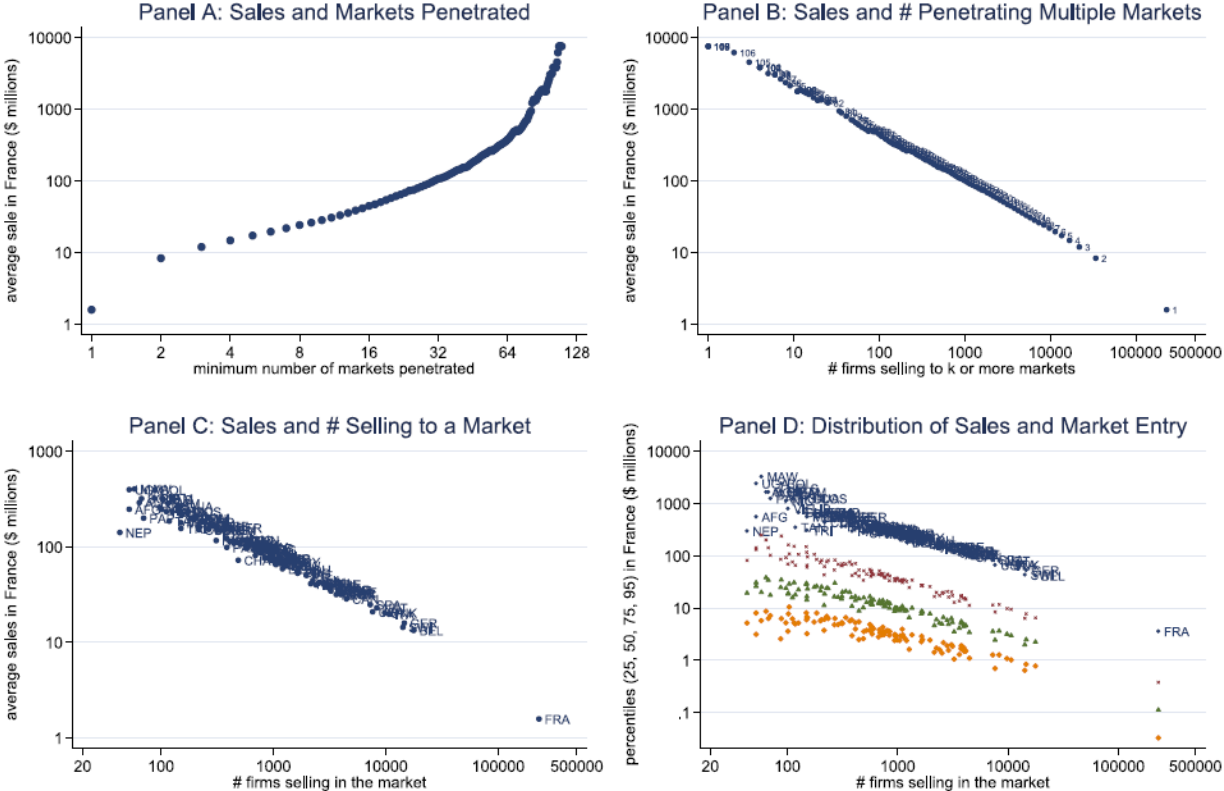
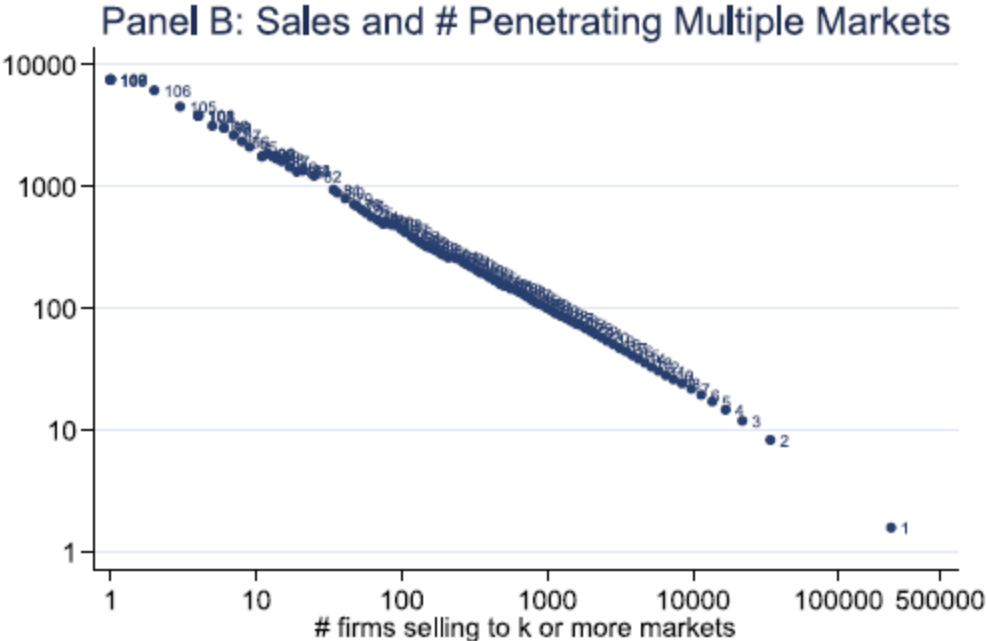


FIGURE 3.—Sales in France and market entry.

# Sales Distribution of Firms

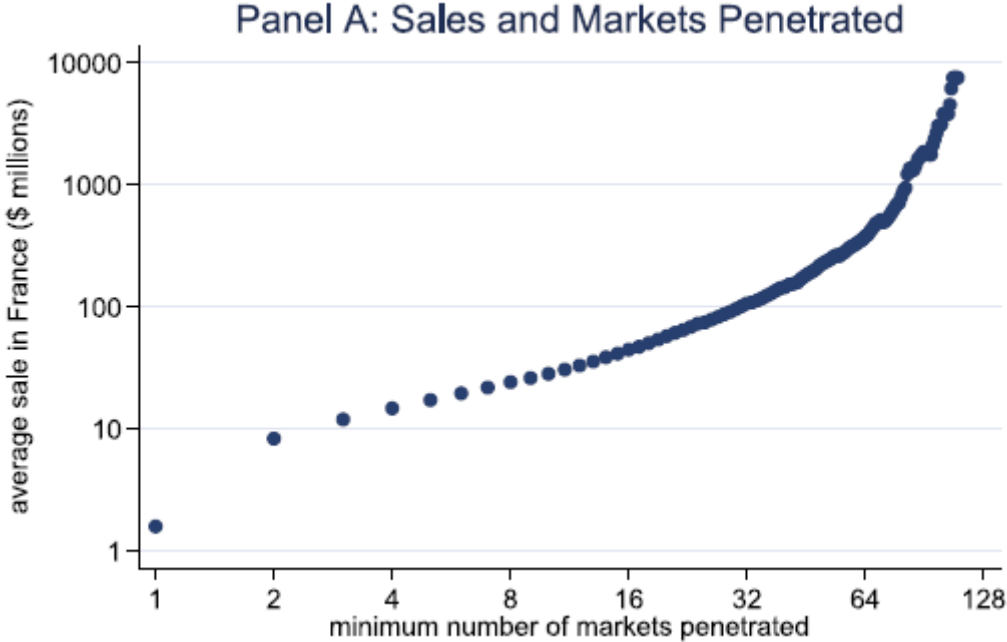
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Exporters that serve more markets have higher sales

# Sales Distribution of Firms

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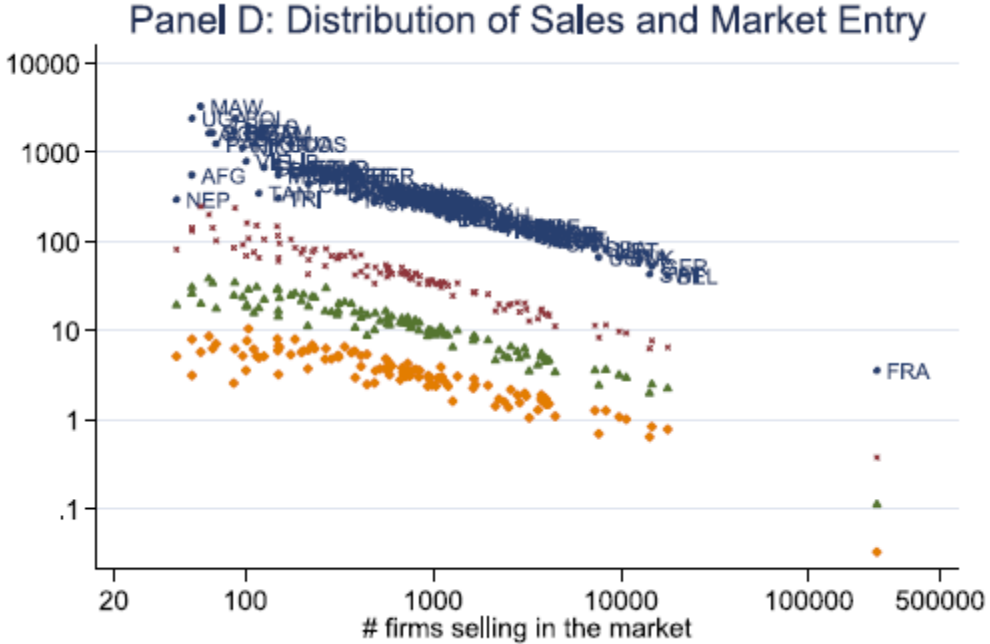


Exporters that serve more markets also have higher domestic sales





# Sales Distribution of Firms



This relationship holds across firms of varying sizes, and is not driven only by the largest firms (different colors represent the 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 95<sup>th</sup> percentile of sales in France)

# Investigating Firm-level Exporter Premia

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Large literature studying various exporter premia due to increasing availability of firm-level microdata and tractable firm-level trade frameworks

Small selection of exporter premia studied:

- Number of Products: Bernard, Jensen, Redding, and Schott (2007)
- Higher Wages: Frias, Kaplan, and Verhoogen (2009)
- Pollution: Holladay (2015)
- Innovation: Aw, Roberts, and Xu (2008)

# Why do we Observe Exporter Premia?

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Not clear what drives the observed differences across firms

- Firms that have high productivity choose to export (Selection)
- Firms may become more productive by exporting (Treatment)
  - Economies of scale, additional learning due to exporting, increased competition, incentives

Trefler and Lileeva (2009) and de Loecker (2011) find that most of it is selection, but some room for treatment effects.