The empirics of firm heterogeneity and international trade

Based on
Bernard, Jensen, Redding, Schott (2011) NBER WP17627
EMPIRICAL CHALLENGES TO NEOCLASSICAL AND NEW TRADE THEORIES
Failure of theories to account for firm/plant level empirics

- Traditional theories of IT emphasize comparative advantage (variation in opportunity costs of production across countries and industries that generates inter-industry trade) as the basis for international trade.
- New theories of IT instead focus on increasing returns to scale and consumer love of variety as the basis for international trade, as in Krugman (1980), Helpman (1981) and Ethier (1982). These theories explain intra-industry trade.
- Helpman & Krugman (1985) combine the two theories and provide a relatively successful explanation for patterns of trade across countries and industries (Helpman, 1999).
- A key simplification in this theoretical literature was the assumption of a representative firm within each industry.
- The late 1980s and 1990s onwards: increased availability of micro datasets on firms and plants. It became clear that there was vast heterogeneity across producers within industries, in terms of size, productivity, capital and skill-intensity, and wages.
- Then an emerging empirical literature began to explore the idea that this heterogeneity was systematically related to trade participation in ways that could be influential for aggregate outcomes.
Micro evidence-1: export participation

- Typically a minority of plants in the industry export.
- Considerable variation in export market participation rates across industries.
- Exporting firms ship a relatively small share of their total shipments abroad, again there is substantial variation across industries.

<table>
<thead>
<tr>
<th>NAICS Industry</th>
<th>Percent of Firms</th>
<th>Percent of Firms that Export</th>
<th>Mean Exports as a Percent of Total Shipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>311 Food Manufacturing</td>
<td>6.8</td>
<td>11.6</td>
<td>14.8</td>
</tr>
<tr>
<td>312 Beverage and Tobacco Product</td>
<td>0.7</td>
<td>22.9</td>
<td>7.4</td>
</tr>
<tr>
<td>313 Textile Mills</td>
<td>1.0</td>
<td>25.1</td>
<td>12.5</td>
</tr>
<tr>
<td>314 Textile Product Mills</td>
<td>1.9</td>
<td>12.2</td>
<td>11.7</td>
</tr>
<tr>
<td>315 Apparel Manufacturing</td>
<td>3.2</td>
<td>7.7</td>
<td>13.5</td>
</tr>
<tr>
<td>316 Leather and Allied Product</td>
<td>0.4</td>
<td>24.4</td>
<td>13.4</td>
</tr>
<tr>
<td>321 Wood Product Manufacturing</td>
<td>5.5</td>
<td>8.5</td>
<td>18.5</td>
</tr>
<tr>
<td>322 Paper Manufacturing</td>
<td>1.4</td>
<td>23.8</td>
<td>9.0</td>
</tr>
<tr>
<td>323 Printing and Related Support</td>
<td>11.9</td>
<td>5.5</td>
<td>14.4</td>
</tr>
<tr>
<td>324 Petroleum and Coal Products</td>
<td>0.4</td>
<td>17.8</td>
<td>11.5</td>
</tr>
<tr>
<td>325 Chemical Manufacturing</td>
<td>3.1</td>
<td>36.1</td>
<td>14.3</td>
</tr>
<tr>
<td>326 Plastics and Rubber Products</td>
<td>4.4</td>
<td>28.1</td>
<td>10.3</td>
</tr>
<tr>
<td>327 Nonmetallic Mineral Product</td>
<td>4.0</td>
<td>9.5</td>
<td>12.1</td>
</tr>
<tr>
<td>331 Primary Metal Manufacturing</td>
<td>1.5</td>
<td>30.2</td>
<td>10.4</td>
</tr>
<tr>
<td>332 Fabricated Metal Product</td>
<td>19.9</td>
<td>14.3</td>
<td>11.6</td>
</tr>
<tr>
<td>333 Machinery Manufacturing</td>
<td>9.0</td>
<td>33.0</td>
<td>15.5</td>
</tr>
<tr>
<td>334 Computer and Electronic Product</td>
<td>4.5</td>
<td>38.3</td>
<td>21.3</td>
</tr>
<tr>
<td>335 Electrical Equipment, Appliance,</td>
<td>1.7</td>
<td>37.7</td>
<td>12.9</td>
</tr>
<tr>
<td>336 Transportation Equipment</td>
<td>3.4</td>
<td>28.0</td>
<td>13.0</td>
</tr>
<tr>
<td>337 Furniture and Related Product</td>
<td>6.4</td>
<td>6.5</td>
<td>10.1</td>
</tr>
<tr>
<td>339 Miscellaneous Manufacturing</td>
<td>9.1</td>
<td>1.6</td>
<td>14.9</td>
</tr>
<tr>
<td>Aggregate Manufacturing</td>
<td>100.0</td>
<td>17.6</td>
<td>14.1</td>
</tr>
</tbody>
</table>

Source: Bernard et al. (2007).

Notes: Data are from the 2002 U.S. Census of Manufactures. Column 2 summarizes the distribution of manufacturing firms across three-digit NAICS manufacturing industries. Column 3 reports the share of firms in each industry that export. The final column reports mean exports as a percent of total shipments across all firms that export in the noted industry.
Micro evidence-2: exporter characteristics

- Exporters are systematically different from non-exporters: exporters are larger, more skill intensive, more capital intensive, and more productive.

- These findings are consistent with old trade theory forces of comparative advantage (US is skill- and capital- abundant).

- However similar findings are reported for developing countries (Alvarez & Lopez, 2005).

- Potential explanations for include technology-skill complementarity (Burstein & Vogel, 2010), and sorting by product quality within industries (Verhoogen, 2008).

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Employment</td>
<td>1.19</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>Log Shipments</td>
<td>1.48</td>
<td>1.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Log Value Added per Worker</td>
<td>0.26</td>
<td>0.11</td>
<td>0.10</td>
</tr>
<tr>
<td>Log TFP</td>
<td>0.02</td>
<td>0.03</td>
<td>0.05</td>
</tr>
<tr>
<td>Log Wage</td>
<td>0.17</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Log Capital per Worker</td>
<td>0.32</td>
<td>0.12</td>
<td>0.04</td>
</tr>
<tr>
<td>Log Skill per Worker</td>
<td>0.19</td>
<td>0.11</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Additional Covariates: None, Industry Fixed Effects, Log Employment

Source: Bernard et al. (2007).

Notes: Data are for 2002 and are from the U.S. Census of Manufactures. All results are from bivariate OLS regressions of firm characteristic in first column on a dummy variable indicating firm's export status. Columns two and three include industry fixed effects and industry fixed effects plus log firm employment, respectively, as additional controls. Total factor productivity (TFP) is computed as in Caves et al (1982). Capital and skill per worker are capital stock and non-production workers per total employment, respectively. All results are significant at the 1 percent level.
Micro evidence-3: sunk costs and selection into exporting

• The direction of causality?
  – high productivity induce firms to self-select into export markets
  – or exporting cause productivity growth through learning by exporting.
• An extensive body of research confirms that high productivity precedes entry into export markets.
• These findings are suggestive of sunk costs of entry into export markets that only the most productive firms find it profitable to incur (Roberts & Tybout, 1997).
• Whether there is also learning by exporting is less clear.
• Most research confirms these findings, however, some studies have found evidence of productivity improvements following export market entry (Van Biesebroeck, 2005)
• Recent research also has provided evidence that export market entry may increase the return to other complementary investments such as technology adoption, as examined theoretically in Atkeson & Burstein (2010), Constantini and Melitz (2008) and shown empirically in Bustos (2011), Lileeva & Trefler (2010).
Micro evidence -4: trade liberalization, reallocation, and productivity growth

- Empirical analysis revealed new channels through which trade liberalization can affect the aggregate economy: within-industry productivity growth arising from decreasing trade costs
  - trade liberalization reforms are typically accompanied by the contraction and exit of low-productivity firms and the expansion and entry into export markets of high-productivity firms.
  - pro-competitive effect in reducing mark-ups of price over marginal cost
- Pavcnik (2002) finds that roughly two-thirds of the 19 percent increase in aggregate productivity of Chilean industries is due to the relatively greater survival and growth of high productivity plants. A similar pattern of results is found in a large number of studies of trade liberalization reforms in developing countries, as surveyed in Tybout (2003).
  - Within-industry reallocations of resources in these studies typically dominate cross-industry reallocations of resources.
- Another source of aggregate productivity growth following trade liberalization is improvements in productivity within plants or firms (one-third in Pavcnik, 2002).
A recent new perspective

HETEROGENEOUS FIRM THEORIES
New new trade theory

• The empirical challenges from micro data have led to the development of recent theories of firm heterogeneity and international trade

• The seminal study of Melitz (2003) introduces firm heterogeneity into Krugman's (1980) model of intra-industry trade: produces a tractable and flexible framework that has become a standard platform for analyzing issues in international trade.
Melitz’2003

• Potential firms can enter an industry by paying a fixed entry cost (sunk). Potential entrants face ex ante uncertainty concerning their productivity.
• Once the sunk entry cost is paid, a firm draws its productivity from a fixed distribution and productivity remains fixed thereafter.
• Firms produce horizontally differentiated varieties within the industry under monopolistic competition.
• The existence of a fixed production cost implies that firms drawing a productivity level below the zero-profit productivity cutoff would make negative profits and exit the industry.
• Fixed and variable costs of exporting ensure that only those active firms that draw a productivity above a higher export productivity cutoff find it profitable to export.
• Trade liberalization implies
  – high-productivity exporting firms experience increased revenue through greater export market sales;
  – the most productive non-exporters now find it profitable to enter export markets, thereby increasing the fraction of exporting firms;
  – in contrast, low productivity firms exit
  – contraction in the revenues of surviving firms that only serve the domestic market.
• Each of these responses reallocates resources towards high-productivity firms and raises aggregate productivity through a change in industry composition.
More theoretical frameworks

- Melitz (2003) addresses a number of the empirical challenges from microdata
  - Together firm heterogeneity and fixed exporting costs imply that only some firms export and these exporters are more productive than non-exporters.
  - The productivity advantage of exporting firms reflects self-selection into export markets rather than learning by exporting.
  - Finally, the self-selection of firms into export markets ensures that trade liberalization has uneven effects on low and high-productivity firms and hence raises aggregate productivity through a change in industry composition.

- However, constant elasticity of substitution (CES) preferences in Melitz (2003) ensures constant firm mark-ups of price over marginal cost.

- Bernard et al. (2003) and Melitz & Ottaviano (2008) develop models of firm heterogeneity in which firm mark-ups are endogenous.
  - then trade liberalization can have a pro-competitive effect in reducing the price charged by a given firm through a lower mark-up.
More theoretical frameworks-2

• In models with variable mark-ups, a firm with a given productivity can also charge different mark-ups in the domestic and export markets.
  – De Loecker & Warzynski, 2011 (Slovenian data), provides empirical evidence of differences in mark-ups between exporters and non-exporters

• In Bernard et al. (2007), heterogeneous firms are integrated into the standard trade paradigm of Helpman & Krugman (1985). Simultaneously explains
  – why some countries export more in certain industries than in others (endowment-driven comparative advantage)
  – why two-way trade is observed within industries (firm-level horizontal product differentiation combined with increasing returns to scale)
  – why, within industries, some firms export and others do not (self-selection driven by trade costs)

• Is consistent with the empirical findings

• The fraction of exporting firms and the share of exports in firm shipments vary systematically with comparative advantage.
A more recent new perspective-1

GRAVITY AND THE EXTENSIVE AND INTENSIVE MARGINS
Micro founded gravity equation

- Chaney (2008), Arkolakis et al. (2008): Melitz model plus Pareto distribution of productivities leads to gravity equation for aggregate bilateral flows.
  - but the elasticity of trade flows with respect to variable trade costs depends on the shape parameter of the Pareto distribution for productivity (through extensive margin of export), not on the elasticity of substitution between varieties (through intensive margin of export)
Implication for welfare analysis

• Broda & Weinstein (2006) quantify empirically the contributions of product variety to welfare gains from trade in US over 1972-2001:
  – show that the unmeasured growth in product variety from U. S. imports has been an important source of gains;
  – the number of imported product varieties has increased by a factor of three;
  – the value to U. S. consumers of the expanded import varieties to be 2.6 percent of GDP.

• Arkolakis et al. (2011) (the special case of the Melitz model with a Pareto distribution for productivity): a country's share of trade with itself is a sufficient statistic for the welfare gains from opening the closed economy to trade.
Heterogeneity in foreign market participation

• A key implication of the Melitz (2003) model is that the extensive margin of the number of exporting firms should vary systematically with export market size, since in larger markets firms of lower productivity can generate sufficient variable profits to cover the fixed costs of exporting.

• Eaton et al. (2004, 2011) establish this and a number of other empirical regularities using French export data by firm and destination market
  – the number of French firms selling to a market (relative to French market share) increases with market size according to an approximately log linear relationship (fig.);
  – this pattern of firm export market participation exhibits an imperfect hierarchy, where firms selling to less popular markets are more likely to sell to more popular markets, but do not always do so;
  – export sales distributions are remarkably similar across markets of very different size and extent of French participation: while the upper tail is approximately Pareto distributed, there are departures from a Pareto distribution in the lower tail where small export shipments are observed;
  – average sales in France are higher for firms selling to less popular foreign markets and to more foreign markets.
More heterogeneity is needed

• Eaton (2011): develop a model which properties depend on five key parameters
  – a composite parameter that includes both the elasticity of substitution and the Pareto shape parameter
  – the convexity of marketing costs (on the share of consumers on the given market)
  – the variance of demand shocks
  – the variance of entry shocks
  – the correlation between demand and entry shocks.

• Use simulated method of moments to estimate these parameters using moments of the French export data by firm and destination market.

• Parameterized model is shown to provide a good fit to the observed data
  – firm productivity accounts for around half of the observed variation across firms in export market participation, but explains substantially less of the variation in exports conditional on entering a market.
Explaining zeros in bilateral trade flows

- Helpman et al. (2008) find that around one half of the country pairs do not trade with one another. To account for this
  - develop a multi-country version of the Melitz (2003) model, in which firm productivity is drawn from a truncated Pareto distribution and fixed trade costs are heterogeneous across destinations.
  - no firm exports between a pair of countries if the productivity threshold for exporting exceeds the upper limit of the productivity distribution in each country.
  - controlling for both the non-random selection of positive trade flows and the extensive margin of exporting firms has quantitatively important implications for estimates of the effects of standard trade frictions on trade flows.
  - of these two corrections, controlling for the extensive margin of the number of heterogeneous firms that export is quantitatively more important than controlling for the non-random selection of positive trade flows.

- Eaton et al. (2011) argue that the existence of a finite number of firms provides an alternative potential explanation for zero bilateral trade flows
  - even if the productivity distribution is unbounded from above, the existence of a finite number of firms implies that there is a positive probability that no firm draws a productivity above the threshold for exporting between a pair of countries
  - using data on bilateral trade in manufactures among 91 countries to show that the model accounts for the pattern of zero trade flows while maintaining the good fit of the standard gravity equation among country pairs with positive trade flows.
A more recent new perspective-2

MULTI-PRODUCT FIRMS
Heterogeneity in number of exported products

- One reason why international trade is so concentrated is that larger exporters not only export more of a given product to a given destination than smaller exporters, but also export more products to more destinations.

### A. Share of Exporting Firms

<table>
<thead>
<tr>
<th>Number of Products</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40.4</td>
<td>1.2</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
<td>42.2</td>
</tr>
<tr>
<td>2</td>
<td>10.4</td>
<td>4.7</td>
<td>0.8</td>
<td>0.3</td>
<td>0.4</td>
<td>16.4</td>
</tr>
<tr>
<td>3</td>
<td>4.7</td>
<td>2.3</td>
<td>1.3</td>
<td>0.4</td>
<td>0.5</td>
<td>9.3</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>1.3</td>
<td>1.0</td>
<td>0.6</td>
<td>0.7</td>
<td>6.2</td>
</tr>
<tr>
<td>5+</td>
<td>6.0</td>
<td>3.0</td>
<td>2.7</td>
<td>2.3</td>
<td>11.9</td>
<td>25.9</td>
</tr>
<tr>
<td>All</td>
<td>64.0</td>
<td>12.6</td>
<td>6.1</td>
<td>3.6</td>
<td>13.7</td>
<td>100.0</td>
</tr>
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</table>

### B. Share of Export Value

<table>
<thead>
<tr>
<th>Number of Products</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.4</td>
</tr>
<tr>
<td>2</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.1</td>
<td>0.5</td>
</tr>
<tr>
<td>3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>4</td>
<td>0.1</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>0.3</td>
<td>0.6</td>
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<tr>
<td>5+</td>
<td>2.6</td>
<td>1.2</td>
<td>1.0</td>
<td>0.9</td>
<td>92.2</td>
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<tr>
<td>All</td>
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<td>1.5</td>
<td>1.2</td>
<td>1.0</td>
<td>92.9</td>
<td>100.0</td>
</tr>
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</table>

### C. Share of Employment

<table>
<thead>
<tr>
<th>Number of Products</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5+</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>7.1</td>
</tr>
<tr>
<td>2</td>
<td>1.9</td>
<td>2.6</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
<td>4.6</td>
</tr>
<tr>
<td>3</td>
<td>1.3</td>
<td>1.0</td>
<td>0.8</td>
<td>0.0</td>
<td>0.2</td>
<td>3.3</td>
</tr>
<tr>
<td>4</td>
<td>0.5</td>
<td>0.4</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>1.6</td>
</tr>
<tr>
<td>5+</td>
<td>3.5</td>
<td>2.6</td>
<td>4.3</td>
<td>4.1</td>
<td>68.8</td>
<td>83.3</td>
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<tr>
<td>All</td>
<td>14.2</td>
<td>6.7</td>
<td>5.5</td>
<td>4.3</td>
<td>69.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Source: Bernard et al. (2007).

Notes: Data are from the 2000 LFTTD. Table displays the joint distribution of U.S. manufacturing firms that export (top panel), their export value (middle panel) and their employment (bottom panel), according to the number of products firms export (rows) and their number of export destinations (columns). Products are defined as ten-digit Harmonized System categories.
Extensive margins of products and destinations

  - In order to enter, firms incur a sunk entry cost, which reveals their ability.
  - Firms then choose among a continuum of products and many export markets.
  - Firm profitability depends upon the interaction of firm ability, which is common across products, and firm-product attributes, which are idiosyncratic across products and possibly also across export destinations.
  - Firms face fixed costs in serving each market and in supplying each product to each market.
  - Higher ability firms can generate sufficient variable profits to cover the product fixed cost at a lower value of product attributes and hence supply a wider range of products to each market.
  - For sufficiently low values of firm ability, the excess of variable profits over product fixed costs in the small range of profitable products does not cover the fixed cost of serving the market and therefore the firm does not supply the market.
  - The lowest-ability firms exit, intermediate-ability firms serve only the domestic market and the highest ability firms export.
  - Within exporters, products with the worst attributes are supplied only to the domestic market, while products with the best attributes are exported to the largest number of markets.
Implication for aggregate relations

- Decompose aggregate bilateral trade between any two countries \((X_{ij})\) into
  - the extensive margin of the number of firm-product observations with positive exports \((O_{ij})\)
  - the intensive margin of average firm-product exports conditional on positive trade \((x_{ij} = X_{ij}/O_{ij})\)

\[
X_{ij} = O_{ij} \bar{x}_{ij}, \quad \bar{x}_{ij} = \left( \frac{X_{ij}}{O_{ij}} \right),
\]

- Where extensive margin in turn is decomposed into
  - the extensive margins of the number of exporting firms \((M_{ij})\)
  - the number of exported products \((N_{ij})\)
  - and a density term \((D_{ij} = O_{ij}/(M_{ij}N_{ij}))\) that captures the extent to which each firm exports each product:

\[
O_{ij} = M_{ij} N_{ij} D_{ij}, \quad D_{ij} = \left( \frac{O_{ij}}{M_{ij}N_{ij}} \right)
\]
## Multi dimensional margins of trade

<table>
<thead>
<tr>
<th></th>
<th>$\ln(\text{Value}_c)$</th>
<th>$\ln(\text{Avg Exports}_c)$</th>
<th>$\ln(\text{Obs}_c)$</th>
<th>$\ln(\text{Firms}_c)$</th>
<th>$\ln(\text{Products}_c)$</th>
<th>$\ln(\text{Density}_c)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln(\text{Distance}_c)$</td>
<td>-1.37</td>
<td>0.05</td>
<td>-1.43</td>
<td>-1.17</td>
<td>-1.1</td>
<td>0.84</td>
</tr>
<tr>
<td></td>
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<td>0.1</td>
<td>0.17</td>
<td>0.15</td>
<td>0.15</td>
<td>0.13</td>
</tr>
<tr>
<td>$\ln(\text{GDP}_c)$</td>
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<td>0.23</td>
<td>0.78</td>
<td>0.71</td>
<td>0.55</td>
<td>-0.48</td>
</tr>
<tr>
<td></td>
<td>0.04</td>
<td>0.02</td>
<td>0.04</td>
<td>0.03</td>
<td>0.03</td>
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<tr>
<td></td>
<td>1.83</td>
<td>1.07</td>
<td>1.81</td>
<td>1.59</td>
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<td>1.37</td>
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<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
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<td>$R^2$</td>
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<td>0.37</td>
<td>0.75</td>
<td>0.76</td>
<td>0.68</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Source: Bernard et al. (2011).

Notes: Table reports results of OLS regressions of U.S. export value or its components on trading-partners' GDP and great-circle distance (in kilometers) from the United States. All five columns are country-level regressions. Heteroscedasticity robust standard errors are noted below each coefficient. Data are for 2002.
Decomposing aggregate export effects

• Reductions in variable trade costs raise aggregate exports through
  – within-firm product extensive margin: an increase in the share of products exported to a given country by incumbent exporters
  – within-firm country extensive margin: an increase in the average number of countries to which a given product is supplied by incumbent firms
  – the across-firm extensive margin: the entry of lower-ability firms that previously only served the domestic market into export markets

• In contrast, selection within firms implies that reductions in variable trade costs have ambiguous effects on the intensive margin of average exports per firm-product because they increase exports of a given firm and product, but induce entry into export markets of firms and products with smaller export values.
Other approaches to multi-product and multi-destination exports

• While Ottaviano&Thisse (1999) and Allanson&Montagna (2005) modeled firms and products symmetrically

• More recent research focuses on the idea that firms have core competences:
  – Eckel&Neary (2010) consider a model of flexible manufacturing where each firm faces rising marginal costs in producing products further from its core competence. Firms are large relative to the market and hence face a cannibalization effect, where introducing additional products diminishes the demand for the firm's existing products.
  – Javorcik et al. (2010) consider an augmented version of this model, in which firms can make endogenous investments in the quality of each product and in their overall brand. Using Mexican trade transaction data, they provide empirical evidence in support of the model's key predictions for the relationship between product prices and sales rank within the firm.
Other approaches to multi-product and multi-destination exports-2

• Other recent research has concentrated on monopolistically-competitive models of multiple-product firms without cannibalization effects:
  – In Mayer et al. (2011), firms face a product ladder, where productivity/quality declines discretely for each additional variety produced. Together with variable mark-ups, this generates the prediction that firm sales are more skewed towards core competences in more competitive markets. French export data provide strong empirical support for this prediction of the model.
  – In Arkolakis&Muendler (2010), firms face declining productivity for each additional variety supplied to a market and market entry costs that are increasing in the number of varieties supplied to a market. Using Brazilian trade transaction data, they present evidence in support of the model's prediction of a positive relationship between the number of products that a firm exports to a market and average exports per product.
  – In contrast, in Nocke&Yeaple (2006), firms with higher organizational capability produce more products and have higher marginal costs for all products, which generates a negative relationship between firms' extensive and intensive margins.
A more recent new perspective-3

FIRM IMPORTING
Facts on firm level importing

• Firm importing displays many of the same features as firm exporting. Bernard et al. (2007) find that for U.S. manufacturing firms
  – importing is somewhat rarer than exporting and there is substantial variation across industries;
  – the shares of exporting and importing firms are significantly positively correlated (0.87) across industries;
  – around 41 percent of exporters also import while 79 percent of importers also export;
  – the share of export-only firms is positively and significantly correlated with industry skill intensity, while the share of import-only firms is negatively but not significantly correlated with industry skill intensity.
## Trading premia in U.S. manufacturing, 1997

<table>
<thead>
<tr>
<th></th>
<th>Exporter Premia</th>
<th>Importer Premia</th>
<th>Exporter &amp; Importer Premia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Log Employment</td>
<td>1.50</td>
<td>1.40</td>
<td>1.75</td>
</tr>
<tr>
<td>Log Shipments</td>
<td>0.29</td>
<td>0.26</td>
<td>0.31</td>
</tr>
<tr>
<td>Log Value Added per Worker</td>
<td>0.23</td>
<td>0.23</td>
<td>0.25</td>
</tr>
<tr>
<td>Log TFP</td>
<td>0.07</td>
<td>0.12</td>
<td>0.07</td>
</tr>
<tr>
<td>Log Wage</td>
<td>0.29</td>
<td>0.23</td>
<td>0.33</td>
</tr>
<tr>
<td>Log Capital per Worker</td>
<td>0.17</td>
<td>0.13</td>
<td>0.20</td>
</tr>
<tr>
<td>Log Skill per Worker</td>
<td>0.04</td>
<td>0.06</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Source: Bernard et al. (2007)

Notes: Data are for 1997 and are for firms that appear in both the U.S. Census of Manufacturers and the LFTTD. All results are from bivariate OLS regressions of firm characteristic in first column on dummy variable noted at the top of each column as well as industry fixed effects and firm employment as additional controls. Employment regressions omit firm employment as a covariate. Total factor productivity (TFP) is computed as in Caves et al (1982). Capital and skill per worker are capital stock and non-production workers per total employment, respectively. All results are significant at the 1 percent level.

Results suggest that trade liberalization is likely to benefit the largest, most productive, most skill- and capital-intensive firms within industries, not only through enhanced access to export markets, but also through improved availability of imported intermediate inputs.
Trade liberalization might work through both export and import channels

• While empirical studies of the impact of trade liberalization on productivity have typically focused on reductions in tariffs in output markets, more recent evidence suggests that reductions in tariffs on imported intermediate inputs may be a prominent source of productivity gains.

• Amiti & Konings (2007) use manufacturing census data from Indonesia, which contains plant-level information on imported intermediate inputs, to construct separate measures of input and output tariffs.
  – Following the trade liberalization that occurred in the 1990s, they find that reductions in input tariffs are associated with an increase in productivity of around 12 percent for firms that import their inputs, which is around twice as large as the effect for reductions in output tariffs.
Effects through import channels

• Input tariffs may affect productivity through a number of potential channels
  – learning about foreign technologies
  – expansion in the variety of intermediate inputs available for production
  – access to higher-quality intermediate inputs

• Goldberg et al. (2010) study India's trade liberalization in the early 1990s to find that:
  – around two thirds of the growth in imports of intermediate inputs is accounted for by the extensive margin of newly imported products;
  – in industries that experienced greater tariff reductions, there is a larger increase in total value, a greater reduction in prices and a larger expansion in variety of imported intermediate inputs.
  – availability of new intermediate inputs expanded the technological possibilities of firms, so industries that saw greater increases in the variety of imported intermediate inputs also experienced greater increases the range of products produced by Indian firms.
A more recent new perspective-4

PRODUCT QUALITY
Heterogeneity in export goods prices

- Even within narrowly-defined product categories, such as the 8,000+ products of the ten-digit Harmonized System (HS) classification, there is tremendous variation in unit values across trade partners.
- This variation in prices is strongly related to country endowments, with more capital and skill-abundant countries supplying varieties with higher prices within narrow product categories.
  - capital and skill-abundant countries use their endowments to supply products of higher quality, and this higher product quality is reflected in a higher price.
Price variation and trade patterns

• Manova and Zhang (2011) use Chinese trade transaction data to highlight a number of systematic features of exports and imports by firm, product and destination that are consistent with heterogeneity in product quality:
  – across firms selling a given product, firms that charge higher export prices earn greater revenues in each destination, have bigger worldwide sales, and export to more markets;
  – across destinations within a firm-product, firms set higher prices in richer, larger, bilaterally more distant and overall less remote countries;
  – firms that export pay a wider range of input prices and source inputs from more countries.

• Taken together these features of the data are consistent with a heterogeneous firm model where more successful exporters use higher-quality inputs to produce higher-quality goods and firms vary the quality of their products across destinations.
Price variation and trade patterns

- Kugler & Verhoogen (2011) using Colombian census of manufactures data highlight the relationship between firm export and import decisions:
  - within narrowly defined industries, larger firms charge more for their outputs and pay more for their inputs than smaller firms
  - similar differences exist between exporters and non-exporters.

- This pattern of results is consistent with an extension of Melitz (2003), in which firms endogenously choose both input and output quality and there is a complementarity between the quality of inputs and outputs.
Underlying problem with quality measure

- The empirical challenge is that firms supply horizontally differentiated varieties in Melitz (2003) and the specification of consumer preferences in which all varieties enter utility symmetrically implicitly imposes a choice of units in which to measure the quantity of each variety.

- There is no necessary relationship between this normalization and the units in which physical quantities of output are measured for each firm in the data. As a result, data on physical quantities of output cannot be directly compared across firms in the presence of horizontal product differentiation, which complicates the interpretation of variation in unit values across firms.
A more recent new perspective-5

INTERMEDIARIES
Facts on wholesalers

• Bernard et al. (2010) examine the differences between wholesalers, retailers and other categories of U.S. trading firms using data from the U.S. Linked/Longitudinal Firm Trade Transaction Database (LFTTD)
  – While wholesale firms comprise 35 percent of exporters and 42 percent of importers, they account for only 8 percent of export value and 15 percent of import value.
  – Retailers are less prevalent and smaller than wholesalers, accounting for 9 percent of exporters and 13 percent of importers but only 1 percent of export and import value.
  – In contrast, firms with operations that span wholesale or retail and other sectors (typically large firms) comprise around only 5 percent of exporters and importers, but account for more than 60 percent of export value and more than 50 percent of import value.
  – Therefore the vast majority of trade is undertaken by a relatively small number of large traders that vertically integrate wholesale/retail activities within firm boundaries.,

• Bernard et al. (2010) use Italian trade transaction data to show that
  – the share of exports mediated by wholesalers is positively correlated with proxies for country-specific fixed costs, including the World Bank's Doing Business measures of the number of documents for importing, cost of importing and time to import.
Intermediaries to deal with fixed costs of exporting

• Ahn et al. (2011) using Chinese trade transaction data and consider a different definition of intermediaries based on firms having the English-equivalent meaning of importer, exporter, and/or trading in their name.
  – Such intermediary firms account for around $168 billion of China's exports or around 22 percent of the total.

• The paper develops a model in which intermediaries are used by relatively small firms that do not find it profitable to incur the fixed costs of directly exporting to foreign markets by themselves to derive that:
  – intermediaries export relatively more products per destination market than other trading firms;
  – intermediaries account for larger export shares in smaller markets and markets with higher trade costs.
Two-ways intermediation

- Blum et al. (2011) provide further indirect evidence on intermediation using matched importer-exporter transaction data for Chile and Colombia.
  - the distributions of bilateral exports and imports between Chile and Columbia are highly skewed across firms. More than half of exporters sell to only one importer, whereas the 99th percentile exporter sells to 19 importers. Similarly, more than half of importers deal with only one exporter, whereas the 99th percentile importers deals with 9 exporters.
  - More generally, while one party to a transaction can be small and engage with few other traders, the other party to the transaction is typically large and deals with many other traders.

- This pattern of results is consistent with the idea that efficient trades involve large trade volumes, which can be achieved either by small importers matching with large exporters or small exporters matching with large importers.

- The paper develops a theoretical model in which firms choose whether to access markets directly or indirectly via intermediaries:
  - since the direct exporting technology is characterized by increasing returns to scale, it is used by large exporters selling directly to many importers;
  - in contrast, the intermediation technology is employed by large importers that spread the costs of intermediation over many small exporters.
FOREIGN DIRECT INVESTMENT

A more recent new perspective-6
Multinational firms can not be ignored

• Bernard et al. (2009): U.S.-based multinationals mediate more than 90 percent of U.S. trade.

• Helpman et al. (2004) generalize heterogeneous firms to allow horizontal FDI:
  – firms choose between incurring a fixed cost of exporting or a fixed cost of establishing an overseas affiliate
  – if the fixed costs of FDI are sufficiently high relative to the fixed costs of exporting, the most productive firms serve the foreign market through FDI;
  – firms with an intermediate range of productivities export; firms with a lower range of productivities only serve the domestic market.
  – with a Pareto productivity distribution, the importance of FDI relative to exporting is decreasing in the shape parameter of the Pareto productivity distribution (increasing in firm productivity dispersion).

• Consistent with this prediction, Helpman et al. (2004) show that the share of total foreign market sales accounted for by the sales of foreign affiliates is larger in industries with smaller estimated shape parameters for the distribution of firm sales.
### Table 3—Exports Versus FDI

#### Narrow sample (N = 961)

<table>
<thead>
<tr>
<th></th>
<th>U.S. std. dev</th>
<th>Europe std. dev</th>
<th>France std. dev</th>
<th>Europe reg. coeff</th>
<th>France reg. coeff</th>
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<tbody>
<tr>
<td>FREIGHT</td>
<td>-1.040</td>
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<td>-1.019</td>
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<td>(-3.917)</td>
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<td>FP</td>
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<td>0.932</td>
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<td>0.947</td>
<td>0.934</td>
</tr>
<tr>
<td></td>
<td>(10.159)</td>
<td>(7.827)</td>
<td>(8.059)</td>
<td>(7.453)</td>
<td>(7.450)</td>
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<td>DISPERSE</td>
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<td>-1.491</td>
</tr>
<tr>
<td></td>
<td>(-8.374)</td>
<td>(-5.250)</td>
<td>(-6.644)</td>
<td>(-4.535)</td>
<td>(-4.470)</td>
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<tr>
<td>KL</td>
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<td>-0.495</td>
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<td>-0.626</td>
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<td>0.007</td>
<td>0.006</td>
<td>-0.002</td>
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<tr>
<td></td>
<td>(-2.197)</td>
<td>(0.150)</td>
<td>(0.144)</td>
<td>(0.125)</td>
<td>(-0.047)</td>
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<tr>
<td>$R^2$</td>
<td>0.373</td>
<td>0.340</td>
<td>0.364</td>
<td>0.332</td>
<td>0.334</td>
</tr>
</tbody>
</table>

#### Wide sample (N = 1,175)

<table>
<thead>
<tr>
<th></th>
<th>U.S. std. dev</th>
<th>Europe std. dev</th>
<th>France std. dev</th>
<th>Europe reg. coeff</th>
<th>France reg. coeff</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREIGHT</td>
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<td></td>
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<td>(7.994)</td>
<td>(7.318)</td>
<td>(7.243)</td>
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<tr>
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<td>(-4.132)</td>
<td>(-3.924)</td>
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<tr>
<td>KL</td>
<td>-0.793</td>
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<td>-0.576</td>
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<td>0.021</td>
<td>0.015</td>
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<td>(-1.914)</td>
<td>(0.367)</td>
<td>(0.446)</td>
<td>(0.326)</td>
<td>(0.153)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.338</td>
<td>0.305</td>
<td>0.325</td>
<td>0.298</td>
<td>0.298</td>
</tr>
</tbody>
</table>

*Notes:* T-statistics are in parentheses (calculated on the basis of White standard errors). Constant and country dummies are suppressed.
Cross destination heterogeneity of FDI

• Yeaple (2009) use Bureau of Economic Analysis (BEA) microdata on U.S. firms and their overseas affiliates to provide further evidence in support of theories of heterogeneous firms and FDI.
  – Consistent with firm selection, more productive U.S. firms own affiliates in a larger number of countries and these affiliates generate greater revenue from sales in their host countries.
  – Consistent with country selection, as a country becomes more attractive to U.S. multinationals, it attracts progressively smaller and less productive firms.
• While the model accounts for many features of the data, there are others that are less well explained:
  – the dispersion in the number of foreign countries entered is smaller than predicted by the model given the observed dispersion in U.S. market shares
  – large firms invest in too few foreign locations and small firms invest in too many
  – the largest firms are underrepresented among the least attractive locations.
Joint decision on export and FDI

• Irarrazabal et al. (2010) use Norwegian data to show that patterns of multinational activity by firm and destination market exhibit a number of similarities with the patterns of trade by firm and destination market in Eaton et al. (2011)
  – in particular, while total affiliate sales and the number of foreign affiliates are less sensitive to distance than exports, they both decline with distance.
• This gravity-equation relationship is inconsistent with a simple model of horizontal FDI, in which FDI should become more attractive as a mode for serving the foreign market as trade costs increase.
• To explain these findings, Irarrazabal et al. (2010) extend the model of firm heterogeneity and FDI of Helpman et al. (2004) to incorporate traded intermediate inputs and find empirical support for the extended model.
• Ramondo and Rodriguez-Clare (2010) develop an extension of Eaton and Kortum (2002) to analyze the joint determination of patterns of trade and FDI, that incorporates both of these modes of serving foreign markets.
  – Within this framework, the welfare gains from trade can be more than twice as large as in a model with only trade, while the gains from multinational production are slightly lower than in a model with only multinational production.
A more recent new perspective-7

LABOR MARKETS
Wage and skill heterogeneity

• Melitz model: trade liberalization affects firms unevenly but workers symmetrically.
• Oi & Idson 1999: employer-size wage premium
• Bernard & Jensen 1995, 1997: wage differences between exporters and non-exporters even after controlling for firm size
• Recent literature suggests two types of reasons why wages vary with revenues across firms:
  – Labor market frictions
Labor market frictions

• Workers with the same characteristics can be paid different wages by different firms

• Sources of imperfection:
  – search and matching frictions, where bargaining over the surplus from production can potentially induce wages to vary with revenue across firms (Davidson et al. 2008, Cosar et al. 2011, and Helpman et al. 2010)
  – efficiency or fair wages, where the wage that induces effort or is perceived to be fair varies with revenue across firms (Amiti & Davis 2011, Davis & Harrigan 2011, and Egger & Kreickemeier 2009).

• These models allow trade liberalization to affect wage inequality
Within sector, between firms wage inequality

• Helpman et al. (2011) use Brazilian employer-employee and trade transaction data and provide evidence on the quantitative importance of this new mechanism for understanding the relationship between wage inequality and trade. Consistent with this class of theoretical models
  – wage inequality between firms within sector-occupations accounts for a substantial proportion of the level and growth of overall wage inequality
  – this between-firm wage inequality remains important after controlling for observable worker characteristics.

• These results are very important as the decades long existing empirical studies inspired by neoclassical trade theory focus on changes in relative wages between different sectors and types of workers and abstract from an important channel through which trade liberalization can affect wage inequality.
Some conclusions

• While early empirical studies examined export behavior using plant or firm-level data, the more recent availability of customs data on individual trade transactions has enhanced our ability to look inside the black box of the firm and led to an explosion of research across a broad range of areas.

• There remain many fundamental issues ahead
  – the micro foundations of trade costs: theories of heterogeneous firms and international trade posit the existence of fixed and variable trade cost parameters, but there is still little understanding of what these parameters capture
  – further exploration of the boundaries of the firm
  – further consideration of the relationship between findings from disaggregated data and the economy's aggregate response to trade