

Empirical evidence on offshoring, reorganization, and innovation

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CAED

September 23, 2017

This presentation draws on joint work with Pol Antràs, Andrew Bernard, Justin Pierce, Peter Schott, Valerie Smeets, Felix Tintelnot, and Frederic Warzynski.

Disclaimer: This work is unofficial and thus has not undergone the review accorded to official Census Bureau publications. All U.S. data results have been reviewed to ensure that no confidential information is disclosed. The views expressed in the paper are those of the authors and not necessarily those of the U.S. Census Bureau.

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 - ▶ Distributional consequences particularly challenging
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- Some debate about the role of trade versus technology
 - ▶ Empirical evidence on role for trade (esp. China)
 - ▶ New work also points to role for technology
- Proponents of trade protection gaining traction
 - ▶ Brexit vote in UK
 - ▶ *"It's a horrible deal." "We're getting destroyed in Korea."* President Trump, on Korus

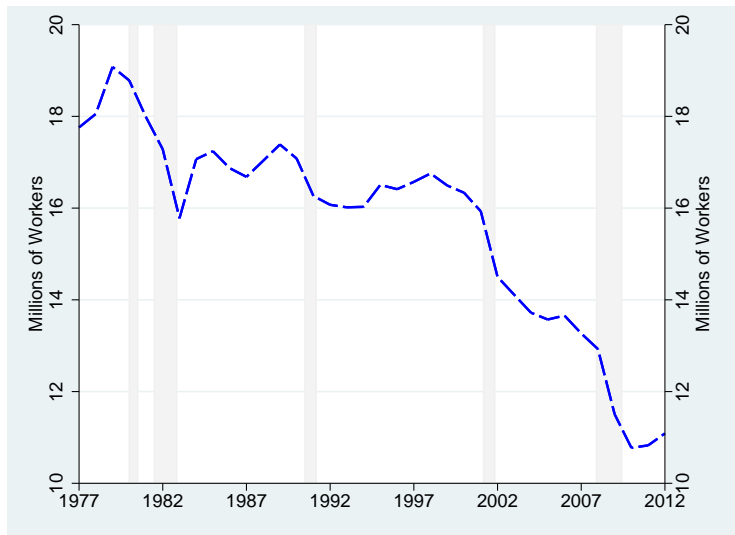
Goals of this presentation

- Margins of US manufacturing firms' employment from 1977 - 2012
 - ▶ Examine manufacturing and non-manufacturing employment
 - ▶ Role of firm and establishment births/deaths/expansions/contractions
 - ▶ Relationship with trade and technology
- Relate facts to offshoring and foreign sourcing
 - ▶ Manufacturing firms have non-manufacturing employment
 - ▶ Emergence of factoryless goods producers
 - ▶ What do firms do with remaining domestic resources?
- Convince you that we need a broader understanding of manufacturing
 - ▶ Design, marketing, and services all interrelated
 - ▶ New organization of production will likely affect innovation
 - ▶ These issues require new approach to research and data collection

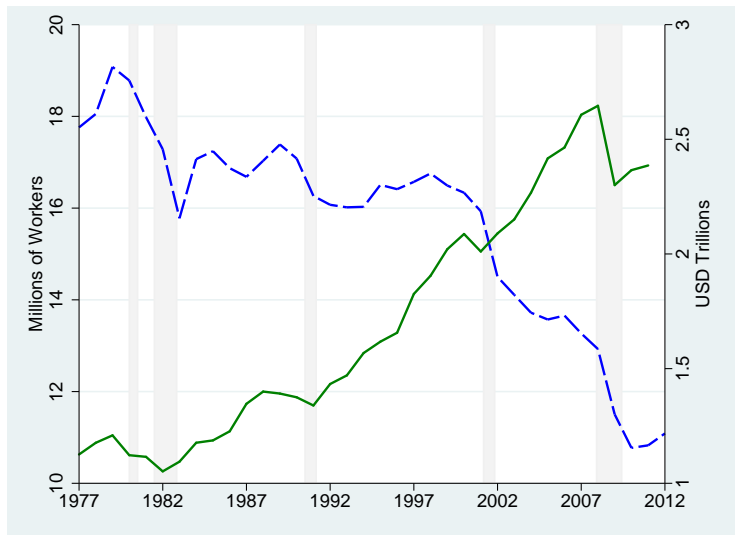
US manufacturing employment

- New project with J. Pierce and P. Schott

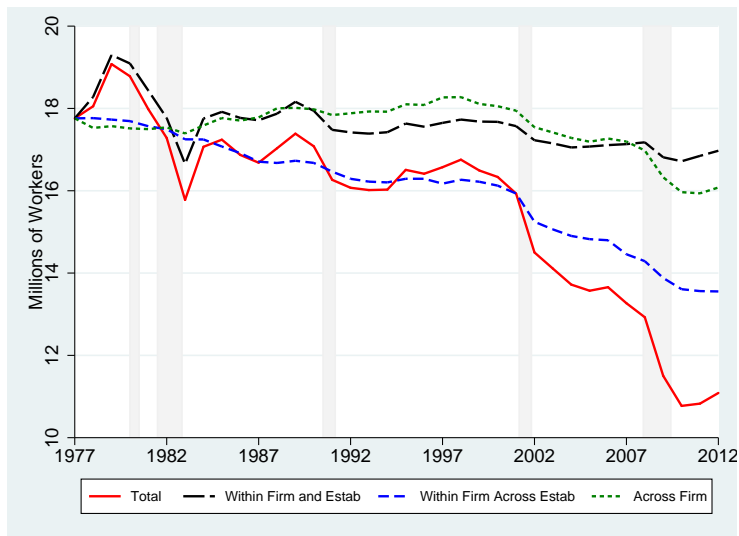
US manufacturing employment



US manufacturing employment *and* real value added

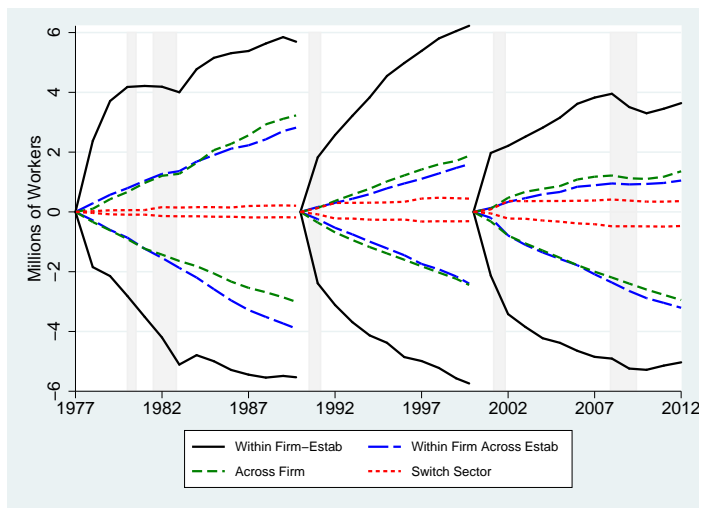


US manufacturing employment by net margin



- Over 60% of decline occurs within firm, across establishments

US manufacturing firm employment by gross margins

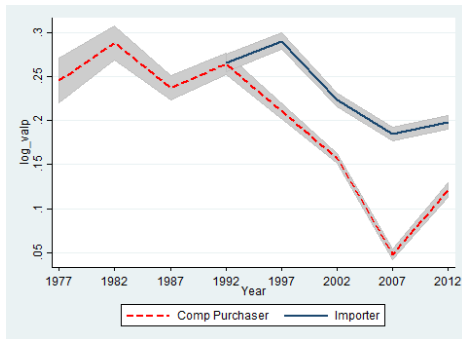
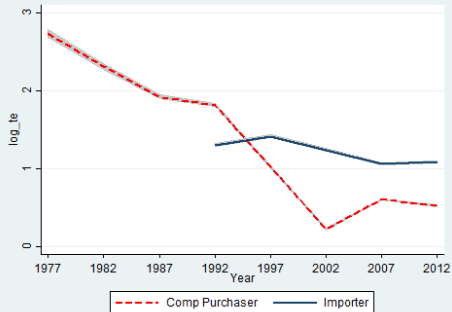


- Decrease in churn and disproportionate increase in deaths
- Increase in switching

Role for trade or technology?

- Very hard to identify a causal impact
- Trade studies focus on difference-in-difference approach
 - ▶ Document negative impact on manuf emp from Chinese imports
 - ▶ Autor, Dorn, and Hanson (2013) industry variation in imports
 - ▶ Pierce and Schott (2016) exploit industry variation in reduction of uncertainty
- Acemoglu and Restrepo (2017) suggest role for robots
- Fort (2017) shows trade and technology inter-related!
 - ▶ Evidence that technology facilitates fragmentation
 - ▶ Documents relationship at the plant, firm, and industry level

Manufacturing firms' technology and trade premia

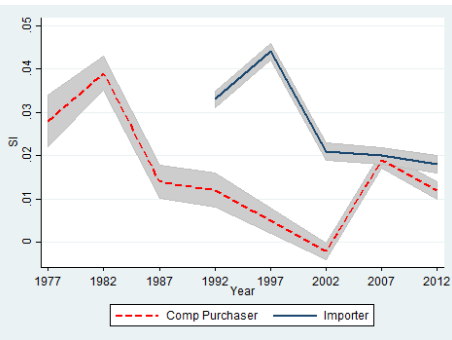


(a) log manuf employment

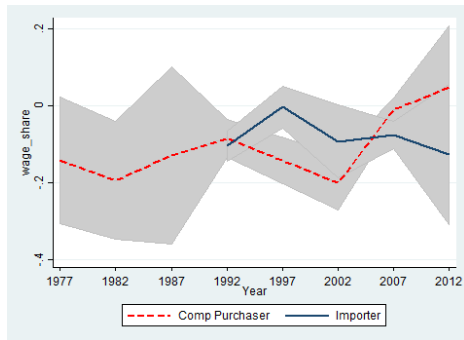
(b) log value added per worker

- Regress emp and productivity on dummy for computer purchases or importing
- Estimates for each Census year

Manufacturing firms' technology and trade premia



(a) skill intensity



(b) labor share

Panel regressions of US manufacturers' characteristics and computer purchases, pre-2000s

| Dependent variable listed in column header | | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------------|---------------------|---------------------|---------------------|
| | log manuf emp | log firm emp | log(VA) | $\log(\frac{VA}{worker})$ | log(wage) | skill intensity | labor share |
| <i>CompPurch_f</i> | 0.208*** (0.006) | 0.178*** (0.005) | 0.242*** (0.007) | 0.034*** (0.005) | 0.232*** (0.006) | -0.002 (0.001) | -0.012 (0.023) |
| Constant | 3.102*** (0.002) | 3.144*** (0.002) | 6.753*** (0.003) | 3.651*** (0.002) | 5.439*** (0.002) | 0.225*** (0.000) | 0.717*** (0.019) |
| Firm FEs | yes | yes | yes | yes | yes | yes | yes |
| Year FEs | yes | yes | yes | yes | yes | yes | yes |
| Observations | 539,700 | 539,700 | 539,700 | 539,700 | 539,700 | 539,700 | 539,700 |
| Clusters (firms) | 299,300 | 299,300 | 299,300 | 299,300 | 299,300 | 299,300 | 299,300 |

- Years are: 1977, 1982, 1987, 1992
- Growing firms purchase computers.
- No clear changes in skill intensity or labor share.

Panel regressions of US manufacturers' characteristics and computer purchases, 2000s

| Dependent variable listed in column header | | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------------|---------------------|----------------------|---------------------|
| | log manuf emp | log firm emp | log(VA) | $\log(\frac{VA}{worker})$ | log(wage) | skill intensity | labor share |
| <i>CompPurch_f</i> | 0.072*** (0.002) | 0.062*** (0.002) | 0.113*** (0.003) | 0.042*** (0.003) | 0.089*** (0.002) | -0.002*** (0.001) | -0.045** (0.022) |
| Constant | 3.035*** (0.002) | 3.085*** (0.002) | 7.144*** (0.003) | 4.109*** (0.002) | 6.467*** (0.002) | 0.292*** (0.001) | 0.636*** (0.020) |
| Firm FEs | yes | yes | yes | yes | yes | yes | yes |
| Year FEs | yes | yes | yes | yes | yes | yes | yes |
| Observations | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 |
| Clusters (firms) | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 |

- Years are: 2002, 2007, 2012
- Growing firms purchase computers.
- Skill intensity and labor share are falling.

Panel regressions of US manufacturers' characteristics and importing, pre-2000s

| Dependent variable listed in column header | | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------------|---------------------|---------------------|---------------------|
| | log manuf emp | log firm emp | log(VA) | $\log(\frac{VA}{worker})$ | log(wage) | skill intensity | labor share |
| <i>Importer_F</i> | 0.145*** (0.007) | 0.152*** (0.007) | 0.170*** (0.009) | 0.025*** (0.007) | 0.160*** (0.007) | 0.001 (0.002) | 0.005 (0.031) |
| Constant | 2.951*** (0.001) | 3.025*** (0.001) | 6.791*** (0.002) | 3.841*** (0.001) | 6.037*** (0.001) | 0.272*** (0.000) | 0.626*** (0.010) |
| Firm FEs | yes | yes | yes | yes | yes | yes | yes |
| Year FEs | yes | yes | yes | yes | yes | yes | yes |
| Observations | 314,600 | 314,600 | 314,600 | 314,600 | 314,600 | 314,600 | 314,600 |
| Clusters | 223,200 | 223,200 | 223,200 | 223,200 | 223,200 | 223,200 | 223,200 |

- Years are: 1992, 1997
- Growing firms start importing.
- No clear changes in skill intensity or labor share.

Panel regressions of US manufacturers' characteristics and importing, 2000s

| Dependent variable listed in column header | | | | | | | |
|--|---------------------|---------------------|---------------------|---------------------------|---------------------|----------------------|----------------------|
| | log manuf emp | log firm emp | log(VA) | $\log(\frac{VA}{worker})$ | log(wage) | skill intensity | labor share |
| <i>Importer_F</i> | 0.151*** (0.003) | 0.138*** (0.003) | 0.173*** (0.004) | 0.023*** (0.004) | 0.156*** (0.003) | -0.005*** (0.001) | -0.103*** (0.038) |
| Constant | 3.060*** (0.001) | 3.106*** (0.001) | 7.194*** (0.002) | 4.134*** (0.001) | 6.503*** (0.001) | 0.291*** (0.000) | 0.621*** (0.010) |
| Firm FEs | yes | yes | yes | yes | yes | yes | yes |
| Year FEs | yes | yes | yes | yes | yes | yes | yes |
| Observations | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 | 412,500 |
| Clusters | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 | 229,800 |

- Years are: 2002, 2007, 2012
- Growing firms start importing.
- Skill intensity and labor share are falling.
- Neg/sig coefficients on manuf emp for industry import penetration, as in AFT (2017)

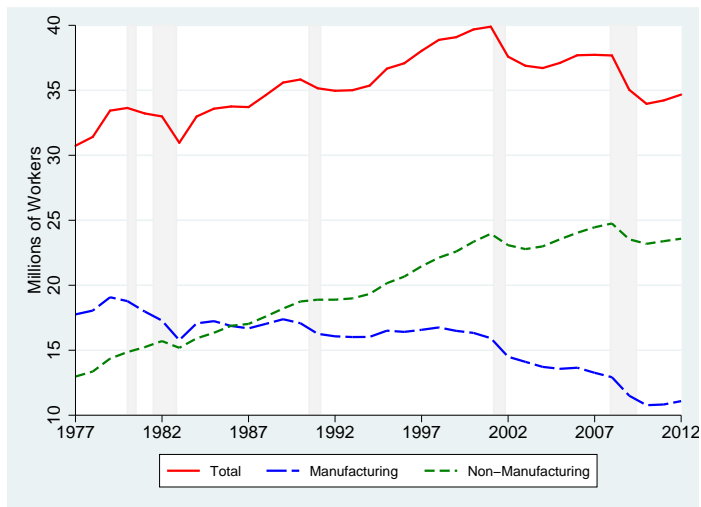
Probability of firm death as a function of trade and technology

Dependent variable is an indicator equal to one if the firm dies before the next census

| | Pre-2000s | | During 2000s | | | |
|---------------------------------|----------------------|---------|----------------------|---------|---------|---------|
| <i>CompPurch_f</i> | -0.148*** (0.003) | | -0.071*** (0.002) | | | |
| <i>Importer_f</i> | -0.120*** (0.003) | | -0.117*** (0.002) | | | |
| <i>ElecNetworks_f</i> | | | -0.105*** (0.002) | | | |
| <i>Robots_f</i> | | | -0.212*** (0.028) | | | |
| Year Fes | yes | yes | yes | yes | yes | yes |
| R2 | 0.05 | 0.07 | 0.06 | 0.06 | 0.06 | 0.05 |
| Observations | 593,200 | 344,500 | 304,200 | 304,200 | 304,200 | 304,200 |

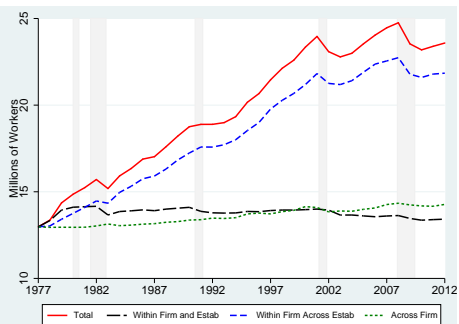
- Firms that implement technologies and import less likely to die over the next 5 years
- Within a firm, plants that purchase computers are also less likely to die

Total employment at US manufacturing firms



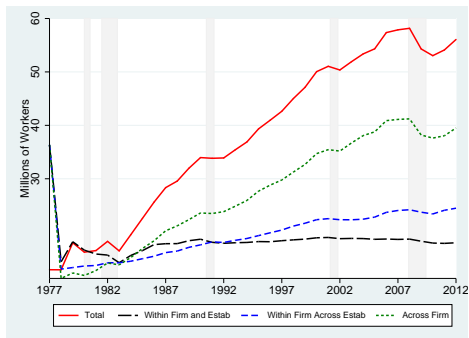
- Firms with 1+ manufacturing establishments over period

Non-manufacturing employment by net margins



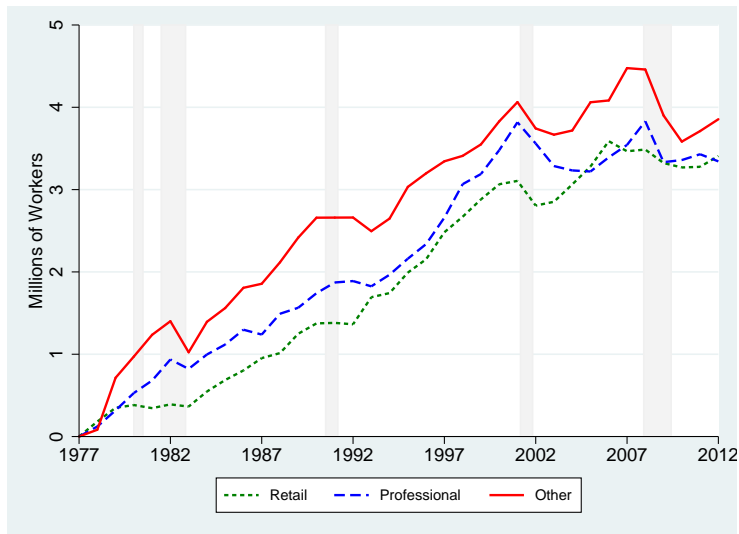
(a) Manufacturing firms

- Panel a: 80% of growth within firm, across estabs
- Panel b: emp growth driven by new firms

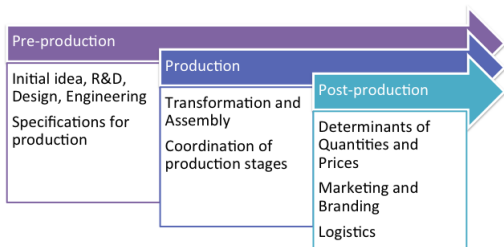


(b) Non-manufacturing firms

US manufacturing firms' non-manufacturing employment by sector



Manufacturing is more than just physical transformation



- Factoryless-goods producers (FGPs) design and market, but do not “manufacture”
- Exist in US wholesale sector (and possibly others)
- Joint papers with A. Bernard

2007 FGP-related questions

Form WH-42301 (12/04/2006)

Page 12

26 SPECIAL INQUIRIES - Continued

C. OTHER ESTABLISHMENT ACTIVITIES

- 1.** Did this establishment design, engineer, or formulate the manufactured products that it sold, produced, or shipped?

0318 Yes

0319 No

- 2.** Which of the following best describes this establishment's primary activity? (Mark "X" only ONE box.)

0362 Providing contract manufacturing services for others

0363 Transforming raw materials or components into new products that this establishment owns or controls

0364 Reselling goods manufactured by others (with or without minor final assembly)

0365 Other - Specify ↴

0366

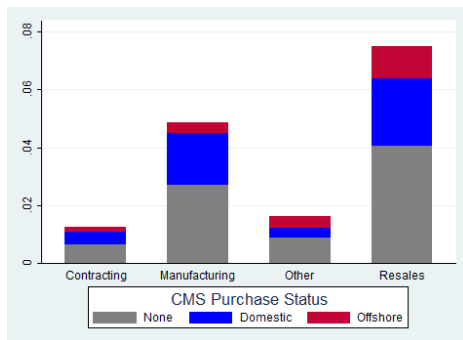
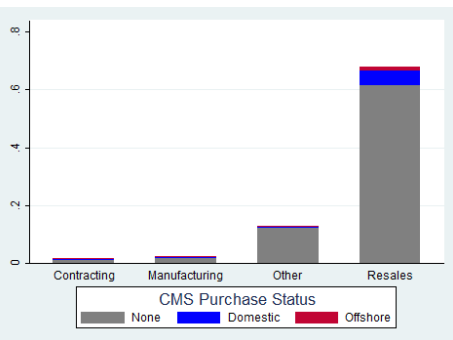
- 3.** Did this establishment purchase contract manufacturing services from other companies or other establishments of your company to process materials or components that this establishment owns or controls?

0496 Yes, primarily with establishments WITHIN the 50 States and the District of Columbia

0497 Yes, primarily with establishments OUTSIDE of the 50 States and the District of Columbia

0498 No

Plant-level FGP information



(a) No Design at Plant (84.8%)

(b) Design at Plant (15.2%)

• An FGP firm is a firm with

- ▶ at least one wholesale establishment that designs goods *and* is involved with manufacturing, and
- ▶ no manufacturing establishments.

Firm characteristics by FGP status

| Status | Firms | 2007 Average firm | | | |
|----------|--------|-------------------|----------------|------------------|-------|
| | | Total Employment | Wages (\$000s) | Number of Plants | Age |
| Non-FGPF | 98,800 | 22.13 | 46.79 | 1.38 | 14.82 |
| FGPF | 13,500 | 49.81 | 51.51 | 2.33 | 13.72 |

- FGP firms are larger, pay higher wages, but are younger than traditional wholesalers

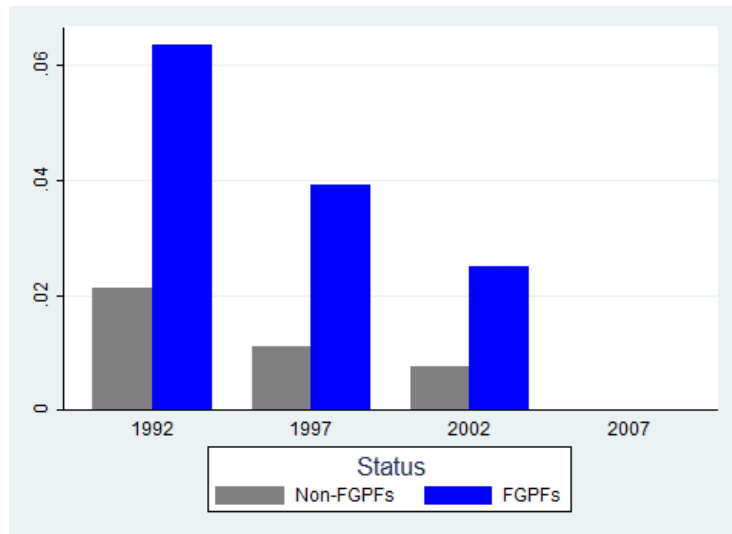
Average sectoral employment by FGP status

| Status | 2007 Average firm employment in | | | |
|----------|---------------------------------|----------|-------|-----------------------------|
| | Wholesale | Services | Other | Management & Prof. Services |
| Non-FGPF | 14.91 | 2.05 | 3.60 | 1.04 |
| FGPF | 24.36 | 15.27 | 5.44 | 2.96 |

Services are all services except management and professional and technical services. Other includes retail, agriculture, mining, construction, transportation, and the public administration.

- FGP firms are more active across other sectors, especially services

2007 wholesale firms' average employment shares in the past



Import behavior by FGP status

| Status | Importer Share | 2007 Firm Mean | | |
|----------|----------------|------------------|---------------|-------------|
| | | Imports (\$000s) | Imports/Sales | Imports/Emp |
| Non-FGPF | 0.35 | 3,566 | 0.86 | 273,804 |
| FGPF | 0.50 | 4,998 | 0.38 | 143,978 |

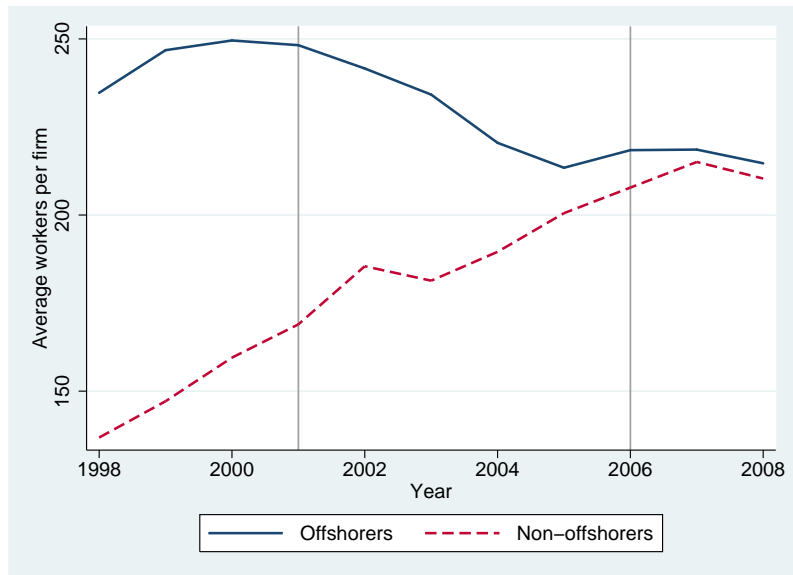
Sales are firm sales in wholesale. Emp is total firm employment across all sectors.

- FGPFs are more likely to import
- Conditional on importing, FGPFs have higher imports, but imports are relatively less important than domestic activity
- Fragmented type of production process focused on innovation

How does offshoring affect domestic activities and innovation?

- Existing work focuses on importers
 - ▶ Neg. wage/emp effects for low skill workers in Hummels et al. (2014)
 - ▶ Negative wage/emp effects in Monarch et al. (2016)
 - ▶ Antràs, Fort, and Tintelnot (2017) show importers grow sales and input use, including *domestic* input usage
- In “Offshoring and Reorganization” we focus on these questions
 - ▶ w/A. Bernard, V. Smeets, and F. Warzynski
 - ▶ 2007 offshoring survey by Statistics Denmark
 - ▶ Relocation of core activity to foreign regions between 2001-2006

Average firm employment by firms' offshoring status



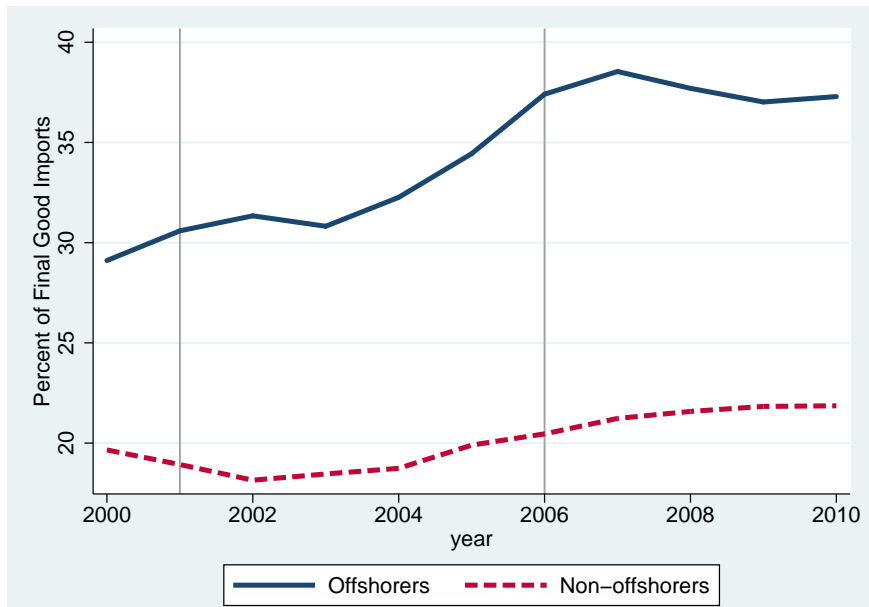
Share of firms that import from the region to which they offshore

| | |
|-----------------------------------|------|
| China | 0.96 |
| EU-12 | 0.93 |
| EU-15 | 0.89 |
| Other Asian countries and Oceania | 0.93 |
| Other European countries | 0.95 |
| India | 0.82 |
| US and Canada | 1.00 |

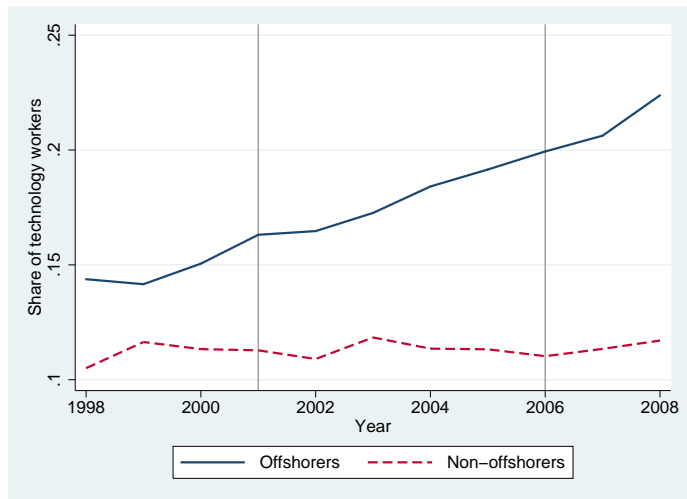
| | |
|--------------------------|------|
| All offshoring firms | 0.95 |
| All non-offshoring firms | 0.70 |

Notes: A firm is considered to import from a region if we observe any positive imports between 2001 and 2006.

Share of final good imports



Share of technology workers by firms' offshoring status



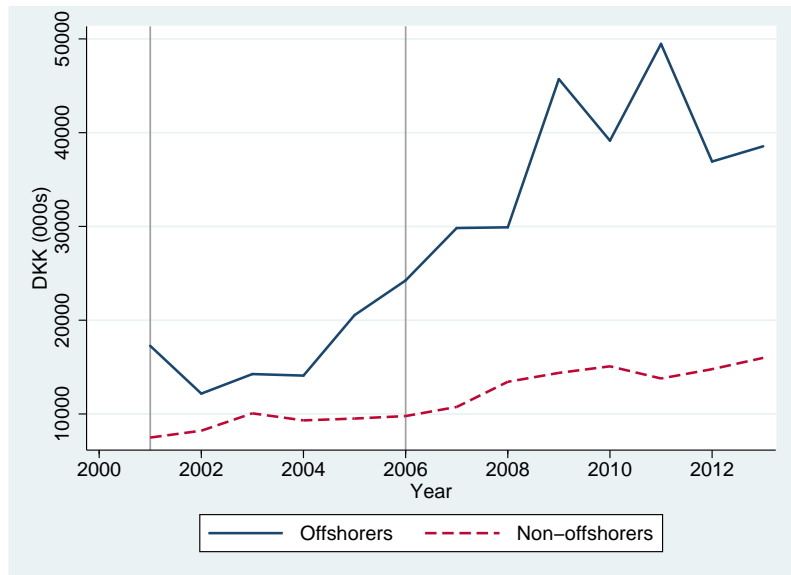
- 1/3 of tech stayers switch occupation within the firm
- Net increase in level of tech workers at offshoring firms

Product switching by offshore status, relative to firm's industry average

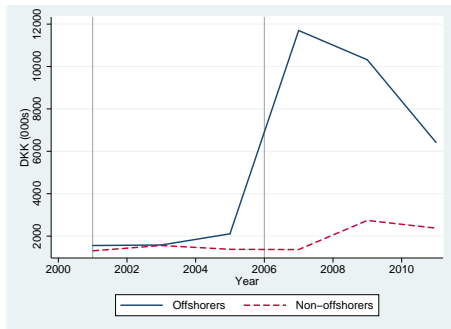
| | No. of Products | | Product changes from 2000-2007 | | |
|----------------|-----------------|------|--------------------------------|---------|------------|
| | 2000 | 2007 | Continued | Dropped | Introduced |
| Non-offshorers | 0.94 | 0.90 | 0.95 | 0.91 | 0.81 |
| Offshorers | 1.28 | 1.46 | 1.22 | 1.46 | 1.94 |
| Total | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

Notes: There are 1,220 firms (207 offshorers) with production data.

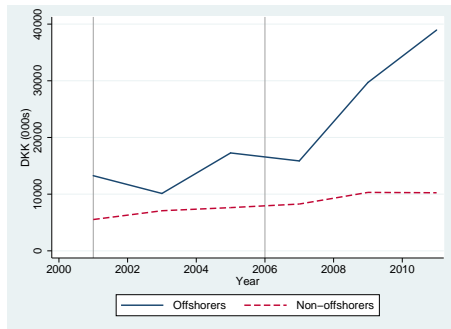
Average R&D expenditure by offshore status



Average product and process R&D expenditure by offshore status



Process R&D

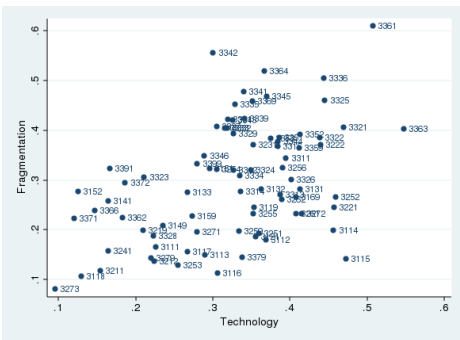


Product R&D

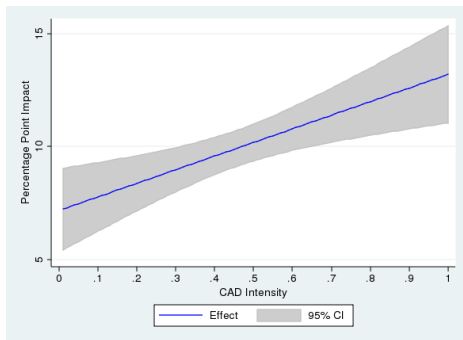
Conclusion: a data collection wish list

- More information on the entire firm production process
 - ▶ Wholesale, services, HQ
 - ▶ Input usage in these establishments
 - ▶ Activities within the establishments (e.g., design)
- Plant-level adoption of technology
 - ▶ Use versus expenditures
 - ▶ Within firm heterogeneity
- Same classification system for inputs, products, and trade flows
- Linkage of firms' domestic and foreign activities
 - ▶ Multinational firm activity abroad
 - ▶ Include measures of outsourced activity

Technology and production fragmentation related



(a) Industry-level relationship



(b) Plant-level relationship