The Changing Firm and Country Boundaries of US Manufacturers in Global Value Chains

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Tuck School at Dartmouth and NBER

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Any views expressed are those of the author and not those of the US Census Bureau, the Bureau of Economic Analysis, the National Bureau of Economic Research, or the Centre for Economic Policy Research. The Census Bureau and the Bureau of Economic Analysis have reviewed this data product to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. This research was performed at a Federal Statistical Research Data Center under FSRDC Project Number 1975 (CBDRB-FY23-P1975-R10185), CES Project 1530 (release on 7/15/2019), and CES Project 6907751 (BEA-FY23-P6907751-R2).

Motivation

- There are two main concerns about US manufacturing and globalization
  - Loss of jobs to foreign places
  - Loss of a domestic knowledge base related to manufacturing
- Considerable policy efforts aimed at restoring US manufacturing
  - Increased US tariffs
  - New incentives for domestic production
- Yet existing evidence suggests that US manufacturing is changing rather than failing
  - Firms with US manufacturing plants are adding non-manufacturing establishments
  - Some US manufacturers shed all in-house production to focus on design and marketing

A broader view of the manufacturing process

- Manufacturing goods involves three stages
  1. Product design and innovation
  2. Physical (or chemical) transformation activities
  3. Distribution and marketing
- Reductions in communication costs have increased fragmentation of these stages
  - Firms may 'outsource' tasks to other firms
  - Firms may 'offshore' stages to foreign countries

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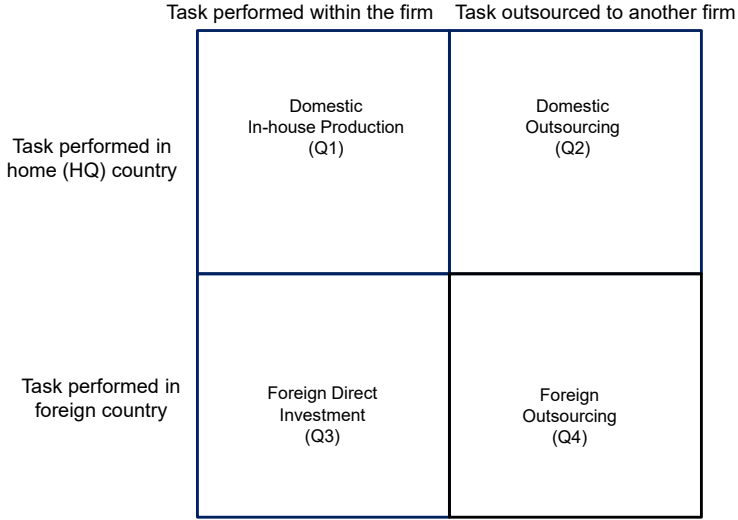
  - Firms may 'outsource' tasks to other firms
  - Firms may 'offshore' stages to foreign countries
- US statistical agencies only classify physical transformation activities in manufacturing

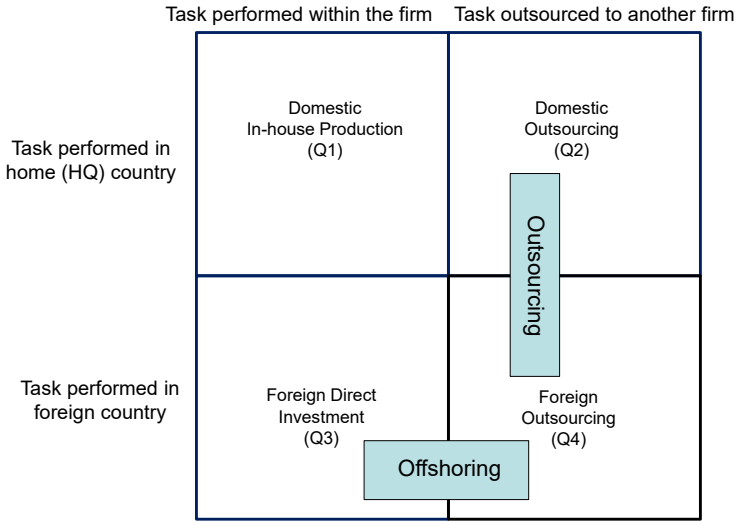
This talk

- How do US firms organize goods production across firm and country boundaries?
- How do theory and empirical work need to adapt to capture changing boundaries?

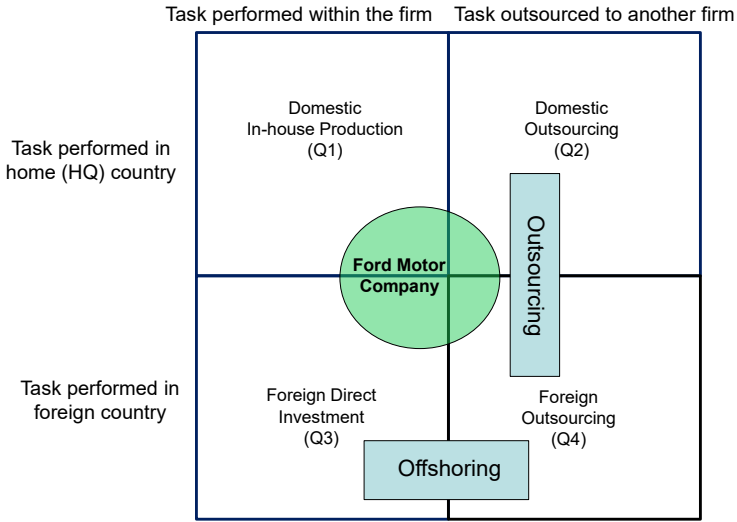
Firm versus country boundaries for physical transformation tasks



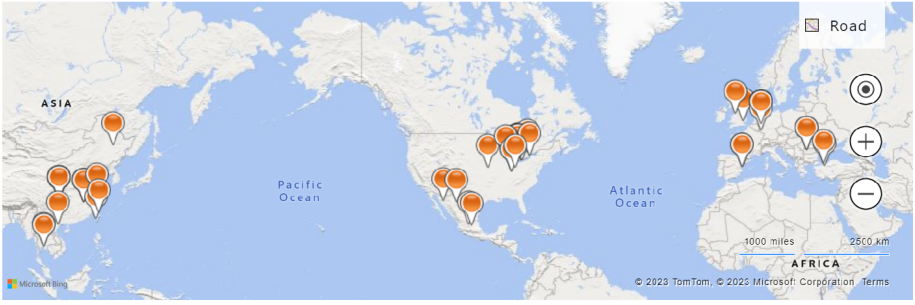
Firm versus country boundaries for physical transformation tasks



Firm versus country boundaries for physical transformation tasks



Ford Motor Company manufacturing plant locations

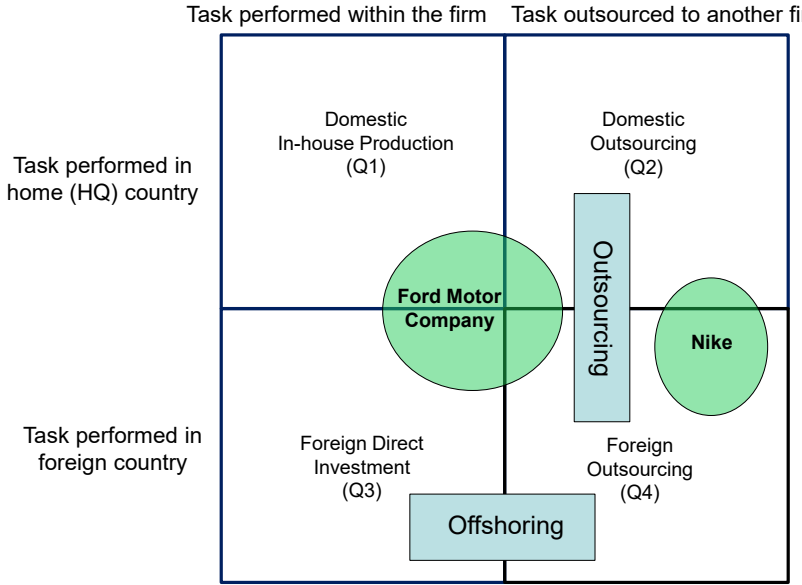


SELECT OFFICE OR PLANT TYPE

ASSEMBLY ENGINE FORGING STAMPING TRANSMISSION

Texas Instruments manufacturing plant locations

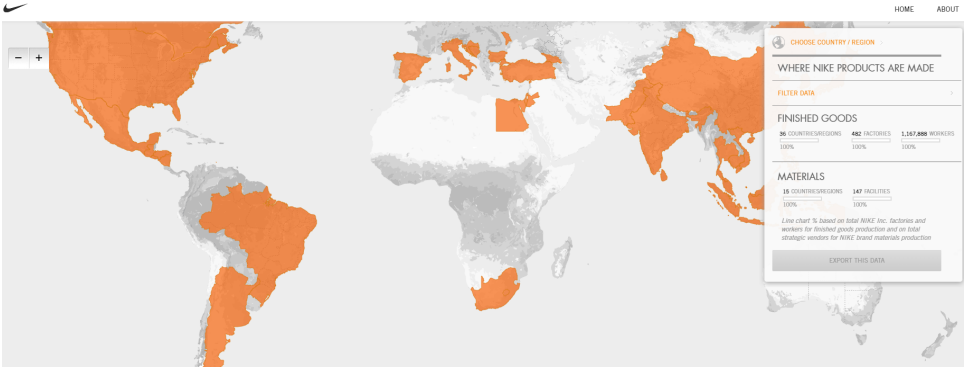
Firm versus country boundaries for physical transformation tasks



Consider Nike

The key to Nike's efficiency is its low overhead manufacturing costs. Instead of owning and operating its own factories, Nike's footwear division solicits the services of independent contract manufacturers located in fourteen countries around the world. The bulk of the independent factories — 96% — are in Vietnam, China, and Indonesia, though no single facility accounts for any more than 5% of Nike's total footwear output.

Where Nike's products are made



Main Contributions

- US firms that manufacture in-house in foreign plants in 2007 also manufacture in US
  - Firms with integrated manufacturing plants (almost) always produce domestically
  - Manufacturing comprises the majority of their US employment and sales
- Emergence of 'Factoryless-Goods Producers' (FGPs) that outsource physical tasks
  - This outsourced manufacturing is also overwhelming offshored
  - Increase over time in import intensity, especially from China
- Both forms of globalization performed by firms that are relatively knowledge intensive

Outline

1. Overview of US data sources and their limitations
2. Evidence on US firms with in-house physical transformation tasks *anywhere* in the world
3. Evidence on US 'factoryless goods producers' that outsource physical tasks
4. Implications for future work

US data sources

- Census Bureau's Longitudinal Business Database (LBD)
  - All private, employer, non-farm establishments from 1976 to 2019
  - Firm identifiers (I fix clearly spurious longitudinal breaks)
  - Employment, payroll, location, industry by establishment
- Census Bureau's Economic Censuses provide
  - Establishment sales every 5 years, 1977 - 2017
  - Census of Wholesale Trade: questions on contract manufacturing starting in 2002
- Customs Trade Transactions: US imports and exports by firm, product, and country
  - Linked to the LBD (Longitudinal Firm Trade Transactions Database)
  - Related-party trade indicator
- Bureau of Economic Analysis data on foreign direct investment
  - BEA US Direct Investment Abroad (outward FDI, BE-11)
  - BEA Foreign Direct Investment in the United States (inward FDI, BE-12)

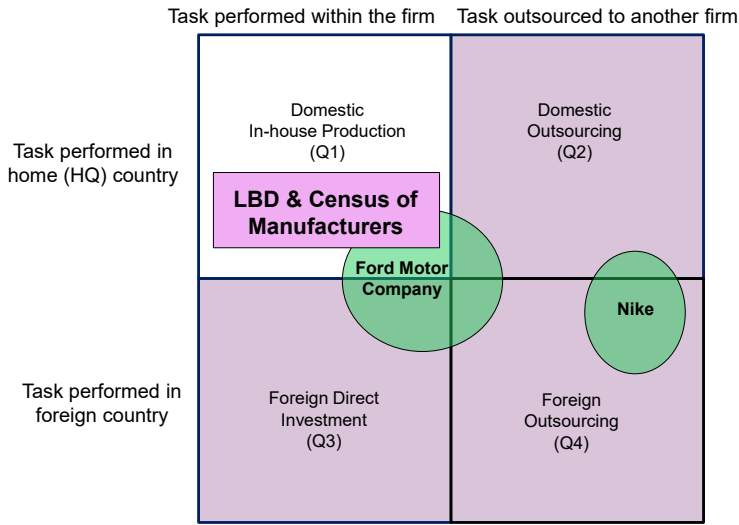
Statistical agencies define manufacturing narrowly

- Industry codes based on North American Industrial Classification System (NAICS)
  - Replaced the Standard Industrial Classification System (SIC) in 1997-2002
  - LBD contains consistent NAICS codes developed by Fort and Klimek (2018)
- The same firm may have multiple establishments across multiple industries
  - All employees in an establishment are assigned to a single industry code
- Manufacturing comprises

  ... establishments engaged in the mechanical, physical, or chemical transformation of materials, substances, or components into new products

  - An R&D lab at Bristol Myers Squibb is coded as NAICS 5417 (Professional Services)
  - The same R&D lab was classified in Pharmaceutical manufacturing under SIC

Coverage of manufacturing by traditional datasets



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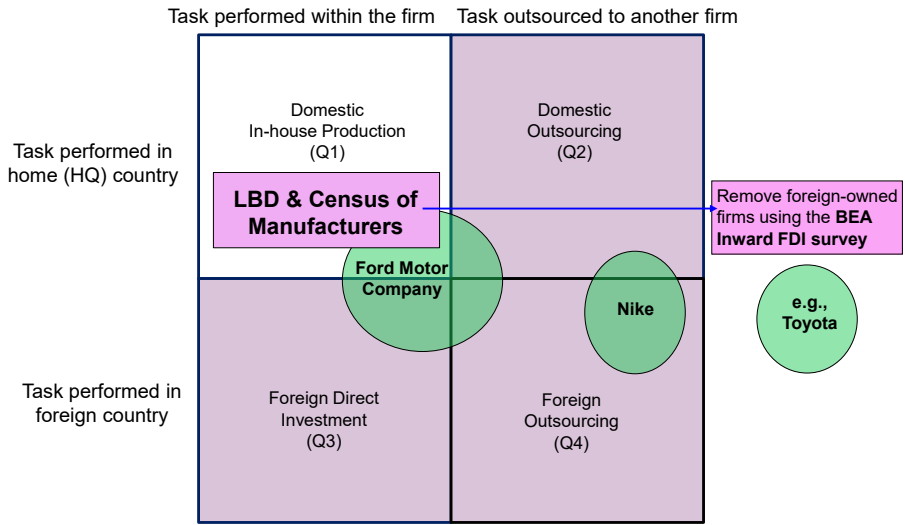

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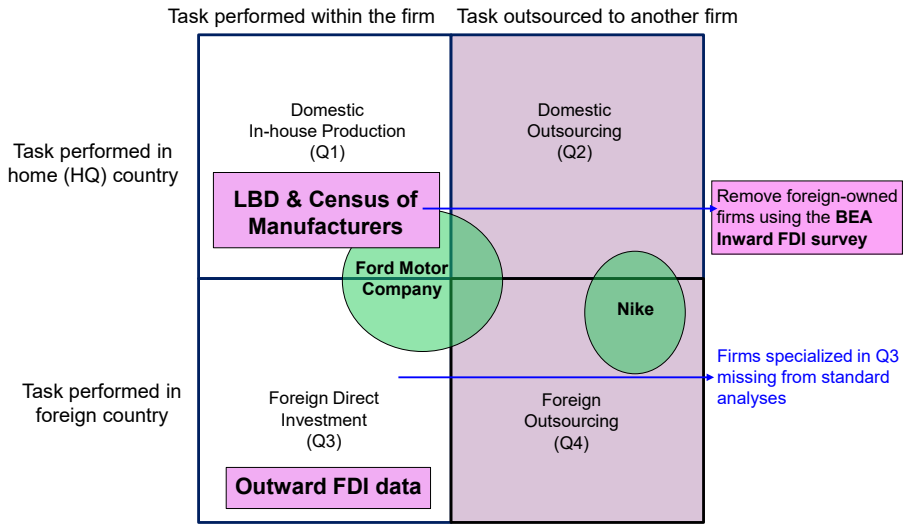

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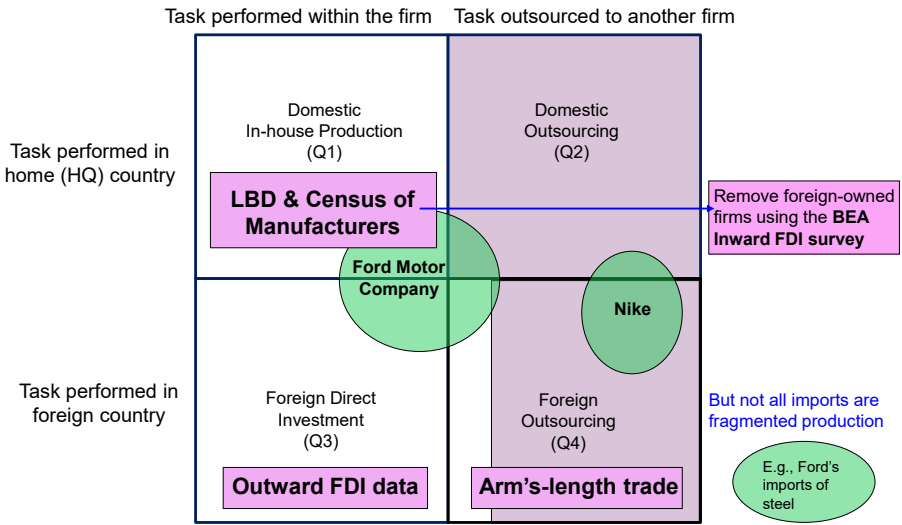

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Identifying US firms that manufacture in-house *anywhere* in the world

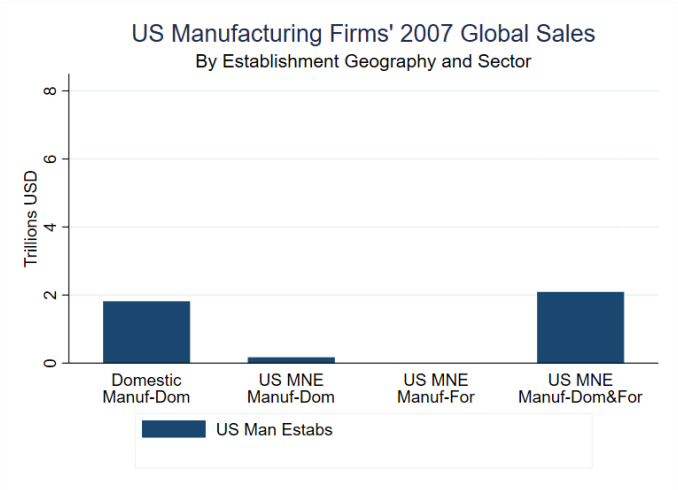
- Newly merged 2007 dataset that combines
  - LBD, Economic Censuses, and US Customs Trade Transactions
  - BEA Inward and Outward Surveys to identify majority-owned FDI
- Identify ALL US firms' foreign manufacturing plants using BEA Outward FDI survey
- Remove foreign-owned firms using BEA Inward FDI survey
- Measure full range of US firms' in-house US and foreign activities using LBD and EC
- Capture universe of imports and exports by related-party status using LFTTD

US firms that manufacture goods anywhere in the world in 2007

		Share of US Aggregates					
		Total		Manuf		Trade	
	Firms	Emp	Sales	Emp	Sales	Imports	Exports
US Firms that Manuf	243,700	0.20	0.29	0.88	0.78	0.42	0.58
Domestic Firms	242,000	0.10	0.09	0.58	0.35	0.09	0.12
US MNEs	1,700	0.10	0.20	0.30	0.43	0.33	0.46
All Firms in US	4,320,700	0.80	0.71	0.12	0.22	0.59	0.41

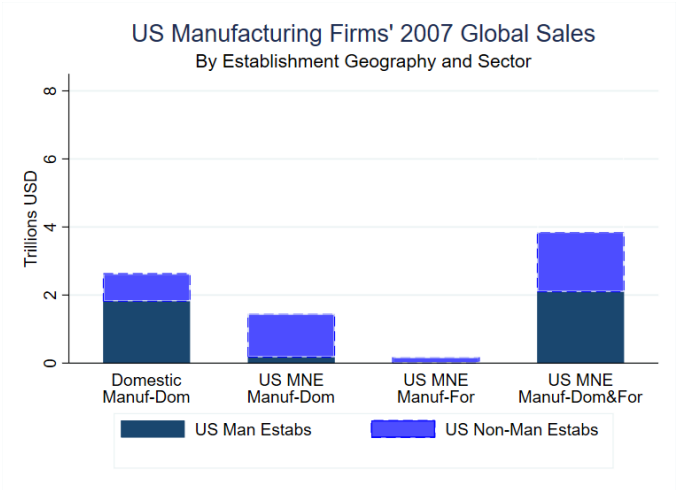
- Categorize US MNEs based on locations of their manufacturing plants:
  - US only (Manuf-Dom)
  - Foreign only (Manuf-For)
  - US and Foreign (Manuf-Dom&For)

Total sales by US firms with manufacturing plants in 2007



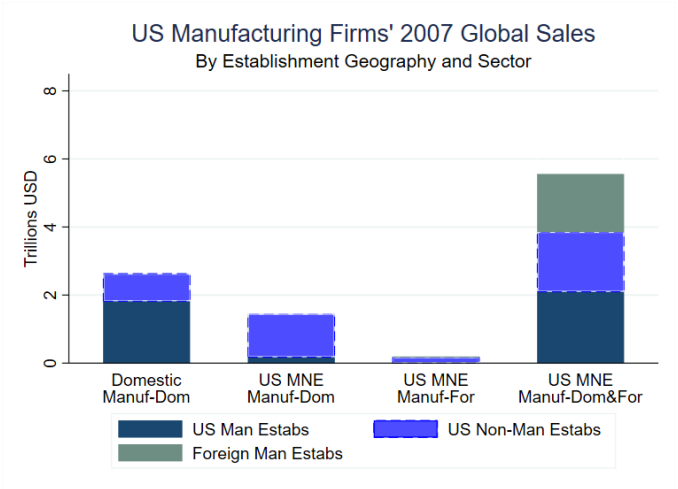
- US MNEs with domestic and foreign manufacturing plants dominate US M sales
  - There are only 1,200 of these firms

Total sales by US firms with manufacturing plants in 2007



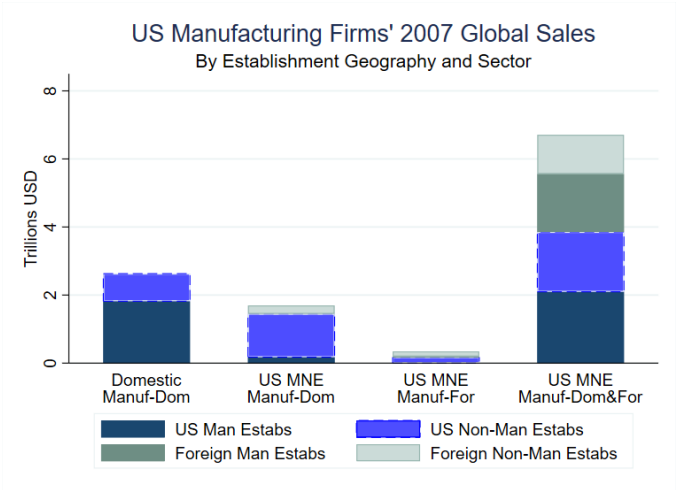
- US MNEs with domestic and foreign manufacturing plants dominate all sales
  - 54% of their US sales are by manufacturing plants

Total sales by US firms with manufacturing plants in 2007



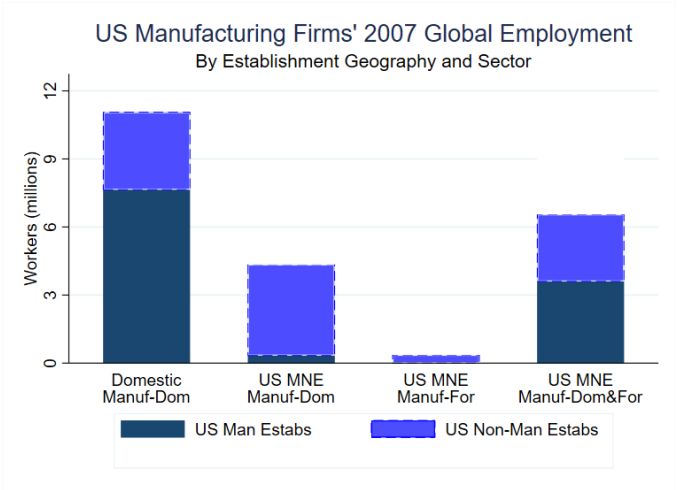
- US MNEs with domestic and foreign manufacturing plants dominate foreign M sales

Total sales by US firms with manufacturing plants in 2007



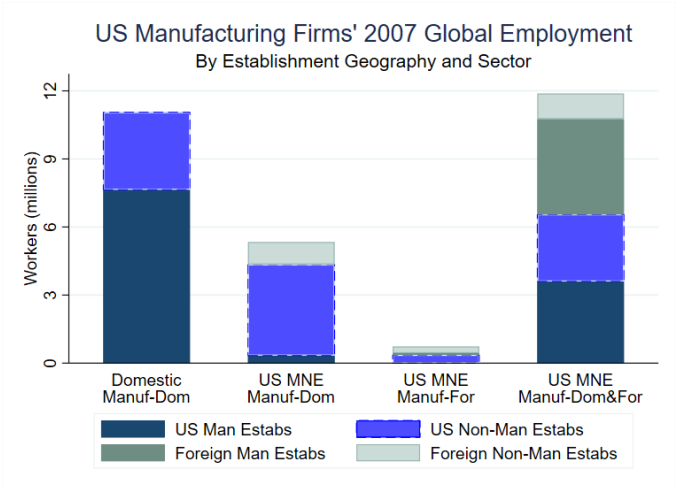
- Almost no sales by US MNEs that *only* have have foreign manufacturing plants
- US MNEs with domestic and foreign M plants generate 55% of M sales from US plants

Global employment patterns for US manufacturers are similar



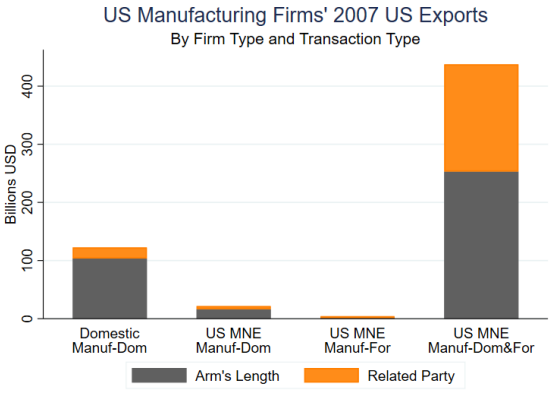
- US MNEs with domestic and foreign manufacturing plants dominate employment
  - 55% of their US employment is in manufacturing plants

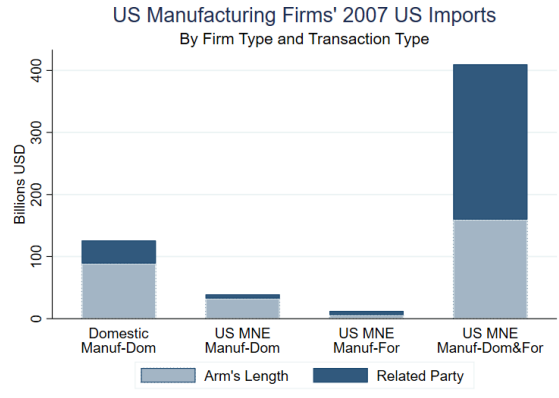
Global employment patterns for US manufacturers are similar



- Almost no employment by US MNEs that *only* have have foreign manufacturing plants

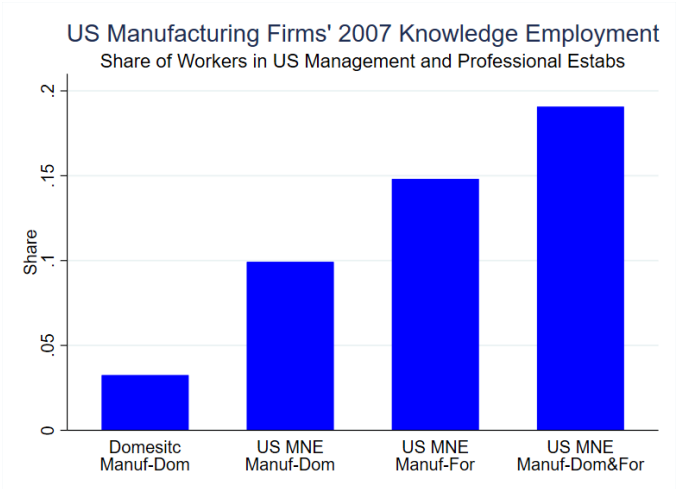
US exports and imports by US manufacturers





- MNEs with domestic and foreign plants dominate US manufacturers' trade flows
  - 39% of their imports and 58% of exports are with arm's-length partners

US employment in knowledge establishments for US manufacturers



- MNEs have substantially larger shares of emp in 'knowledge' estabs
  - Professional, Scientific, and Technical Services & Management (NAICS 54 & 55)

Summary of new facts on in-house manufacturers

- Firms with foreign manufacturing plants also manufacture in the United States
  - The majority of their US employment and sales are by M plants
  - 46% of their global M emp and 55% of their global M sales are by US M plants
  - They dominate sales and trade flows (including exports)
- "In-the-firm" coincides with a significant portion "in-the-country"
- US firms with foreign M plants have higher shares of domestic 'knowledge' workers

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Creative use of the Census of Wholesale Trade

- 2017 Census of Wholesale Trade Special Inquiry (Item 27) asked establishments
  - Did this establishment contract for manufacturing from other firms?
  - Were these purchases from companies in the US, outside the US, or both?

ITEM 27: MANUFACTURING ACTIVITIES - MANUFACTURING BY AFFILIATED COMPANIES INSIDE THE U.S.

In 2017, did this establishment have any manufacturing done on its behalf by any **affiliated** companies **inside the U.S.**?

- ○ Yes
- ○ No

ITEM 27: MANUFACTURING ACTIVITIES - MANUFACTURING BY UNAFFILIATED COMPANIES INSIDE THE U.S.

In 2017, did this establishment have any manufacturing done on its behalf by any **unaffiliated** companies **inside the U.S.**?

- ○ Yes
- ○ No

ITEM 27: MANUFACTURING ACTIVITIES - MANUFACTURING DONE OUTSIDE THE U.S.

In 2017, did this establishment have any manufacturing done on its behalf **outside the U.S.**?

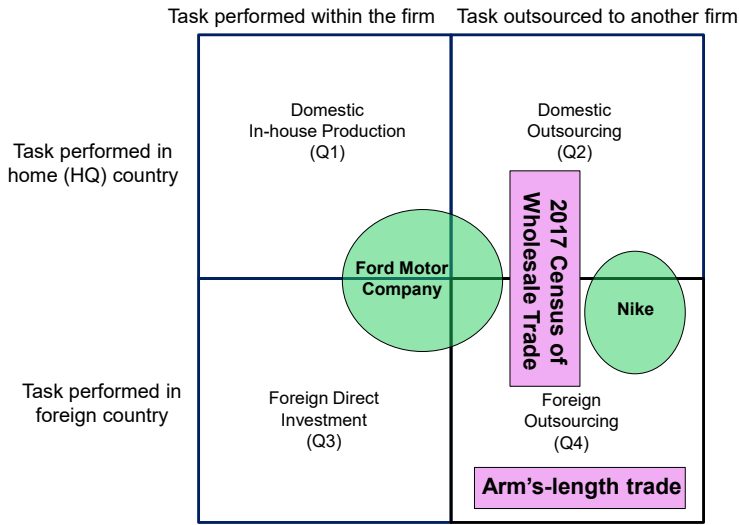
Include manufacturing done outside the U.S. by both affiliated and unaffiliated companies.

- ○ Yes
- ○ No

Definition of Factoryless Goods Producer versus Merchant Wholesaler

- Factoryless goods producer is a firm that has:
  - 1+ wholesale estabs that contract for manufacturing in 2017
  - No M plants in 2017
- Traditional (or merchant) wholesaler is a firm that has:
  - 1+ wholesale estabs that report *not* contracting for manufacturing
  - 0 wholesale estabs that report contracting for manufacturing in 2017
  - No M plants in 2017
- Merchant wholesalers sell goods to other firms and do not manufacture
  - Manufacturers' sale branches are excluded since I drop firms with US M plants

Identifying US factoryless goods producers



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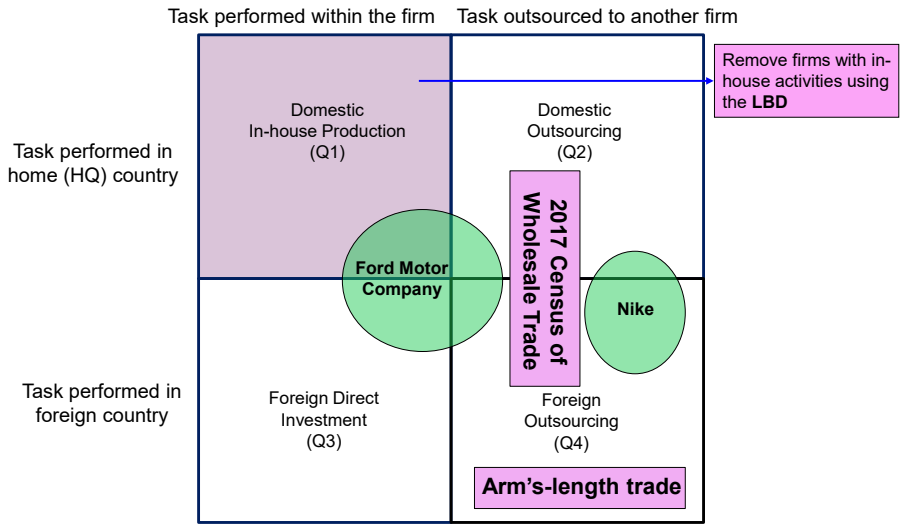

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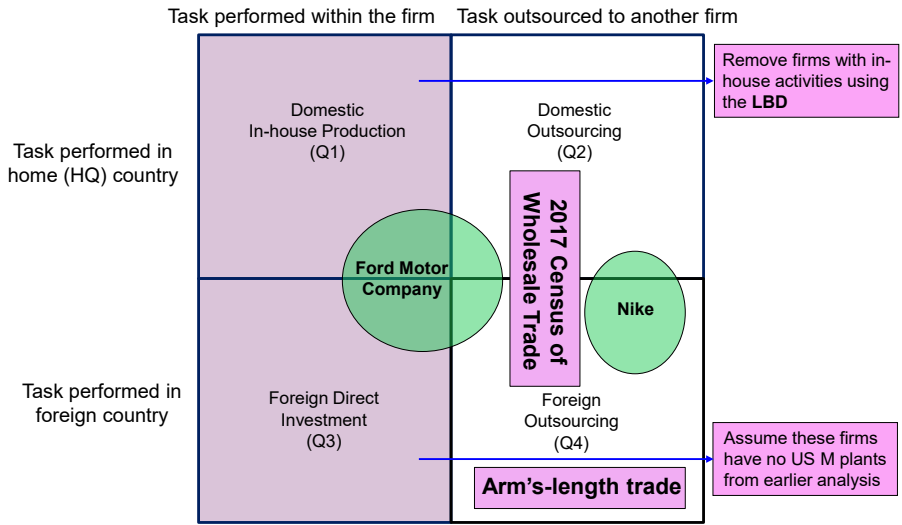
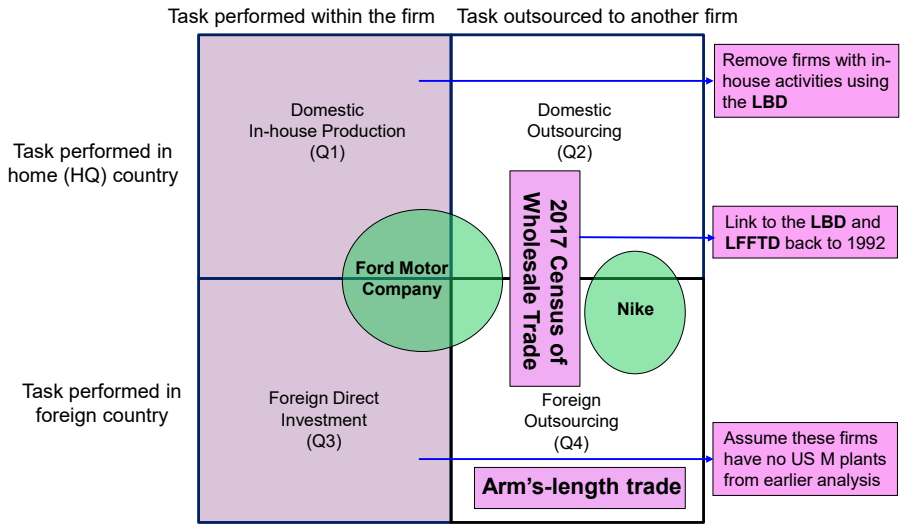


Identifying US factoryless goods producers



Sector coverage of the factoryless goods producer data

- Potential sample is all wholesale estabs at firms without M plants
  - These estabs comprise 89% of firms and 68% of employment in published totals
- In practice, about half of firms have no estabs that answer the questions

	Firms	Emp	Share of Total				
	(000s)	(millions)	Firms	Emp	Sales	Imports	Exports
Firms Outside Sample	129	5,012	0.49	0.50	0.39	0.45	0.37
Firms In Sample	137	5,069	0.51	0.50	0.61	0.55	0.63
FGPs	37.3	960	0.14	0.10	0.13	0.32	0.20
Non-FGPs	99.5	4,109	0.37	0.41	0.49	0.24	0.43
Total	266	10,081	1.00	1.00	1.00	1.00	1.00

Factoryless goods producers (FGPs) characteristics in 2017

	Firms	Avg Emp	$\frac{Pay}{Emp}$	$\frac{Sales}{Emp}$	$\frac{Imports}{Sales}$	$\frac{RPImports}{Imports}$	$\frac{ChinaImports}{Imports}$
FGPs	37,300	26	76	773	0.25	0.49	0.36
Non-FGPs	99,500	41	56	696	0.05	0.31	0.27

- FGPs are smaller, pay higher wages, are more productive, and are more import intensive

Factoryless goods producers are more prevalent in recent cohorts

	Factoryless Goods Producers			Merchant Wholesalers		
By Entry Cohort	Firms	Share of Emp	Avg Emp	Firms	Share of Emp	Avg Emp
1992	7,700	0.50	62	27,000	0.65	99
1997	3,700	0.08	21	10,000	0.10	39
2002	4,500	0.10	21	12,000	0.08	27
2007	6,000	0.12	19	14,500	0.07	19
2012	6,500	0.11	17	15,500	0.06	15
2017	8,900	0.10	10	20,500	0.05	10
Totals	37,300	1.00	26	99,500	1.00	41

- FGPs are more likely and have higher employment shares in later cohorts

Factoryless goods producers are more prevalent in recent cohorts

	Factoryless Goods Producers			Merchant Wholesalers		
By Entry Cohort	Firms	Share of Emp	Avg Emp	Firms	Share of Emp	Avg Emp
1992	7,700	0.50	62	27,000	0.65	99
1997	3,700	0.08	21	10,000	0.10	39
2002	4,500	0.10	21	12,000	0.08	27
2007	6,000	0.12	19	14,500	0.07	19
2012	6,500	0.11	17	15,500	0.06	15
2017	8,900	0.10	10	20,500	0.05	10
Totals	37,300	1.00	26	99,500	1.00	41

- FGPs are more likely and have higher employment shares in later cohorts
- FGPs' smaller size is partly explained by their younger age

Factoryless goods producers are more prevalent in recent cohorts

	Factoryless Goods Producers			Merchant Wholesalers		
By Entry Cohort	Firms	Share of Emp	Avg Emp	Firms	Share of Emp	Avg Emp
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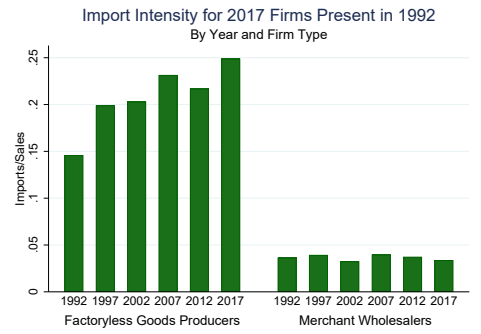
2007	6,000	0.12	19	14,500	0.07	19
2012	6,500	0.11	17	15,500	0.06	15
2017	8,900	0.10	10	20,500	0.05	10
Totals	37,300	1.00	26	99,500	1.00	41

- Focus on the cohort of 1992 firms and follow them back in time

Factoryless goods producers are increasingly import intensive



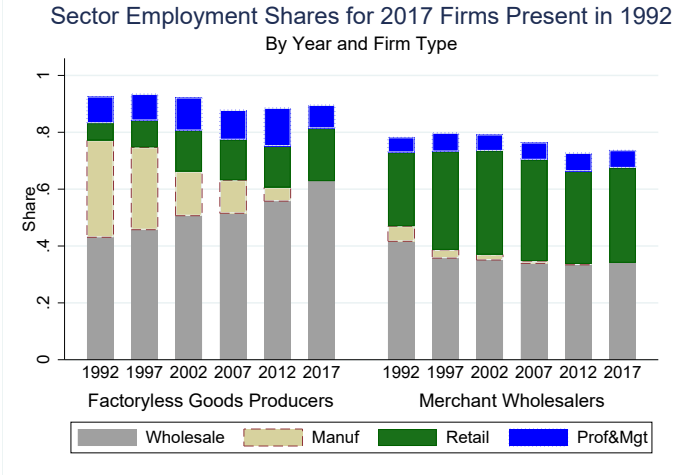
- FGPs are more import intensive, with greater increases over time
- FGPs imports from China grow relatively more after 2002
- Compare to imports/sales ratio of 0.11 for US MNEs with US and foreign manuf plants

Factoryless goods producers import from twice as many countries

	$\frac{Imports}{Sales}$	$\frac{RPImports}{Imports}$	$\frac{ChinaImports}{Imports}$	Avg. Num. Imports	Country-Products Exports
Factoryless goods producers					
1992	0.15	0.57	0.08	14.28	7.79
1997	0.20	0.57	0.11	17.74	10.77
2002	0.20	0.56	0.15	17.39	11.49
2007	0.23	0.54	0.29	21.10	11.88
2012	0.22	0.58	0.34	20.06	13.25
2017	0.25	0.63	0.37	20.68	13.07
Merchant Wholesalers					
1992	0.04	0.43	0.06	8.28	7.78
1997	0.04	0.44	0.11	9.07	10.02
2002	0.03	0.40	0.18	8.53	9.96
2007	0.04	0.29	0.23	9.55	8.65
2012	0.04	0.25	0.23	9.96	10.86
2017	0.03	0.25	0.25	10.50	10.83

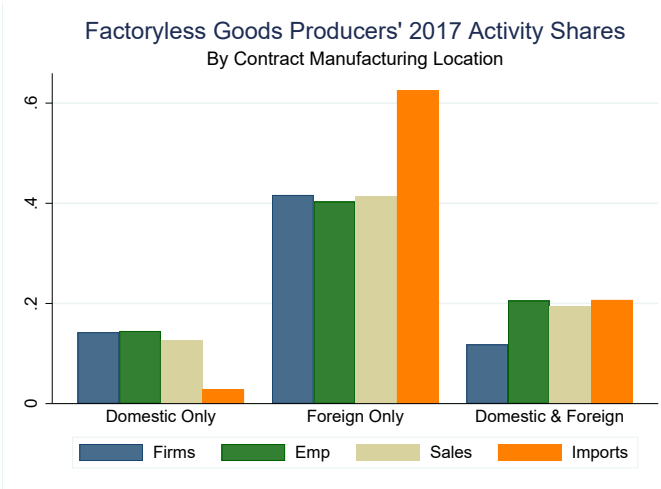
Approximately 7,700 FGPs and 27,000 Non-FGP wholesale firms are alive from 1992-2017.

Factoryless goods producers shifted out of manufacturing



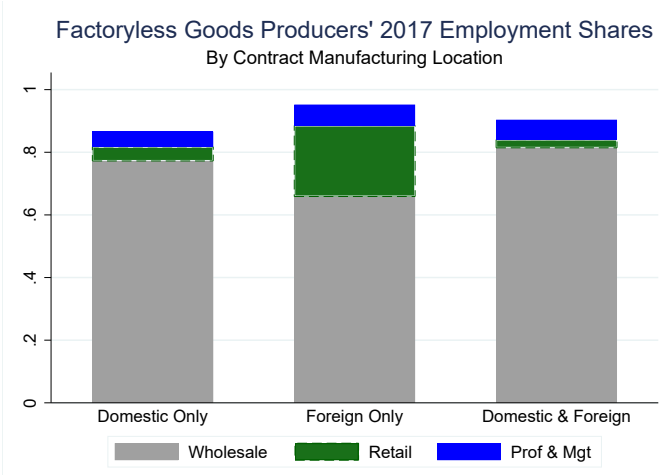
- Merchant wholesalers are more retail intensive
- Factoryless goods producers have more workers in 'knowledge' estabs

Factoryless goods producers primarily source from foreign firms



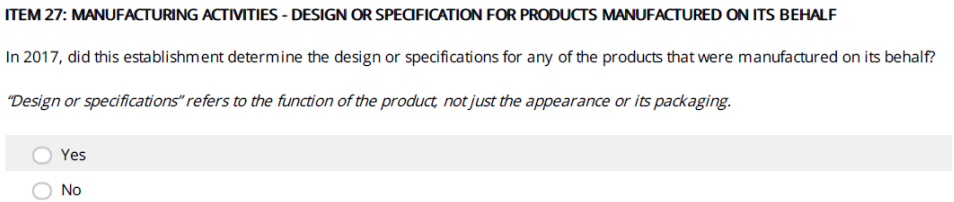
- Among 2007 factoryless goods producers, domestic sourcing was most prevalent
- Imports and contracting from foreign firms are strongly related

Factoryless goods producers' employ US retail and knowledge workers



- Factoryless goods producers with foreign suppliers have most US employment in retail

Factoryless goods producers were also asked about design activity



ITEM 27: MANUFACTURING ACTIVITIES - DESIGN OR SPECIFICATION FOR PRODUCTS MANUFACTURED ON ITS BEHALF

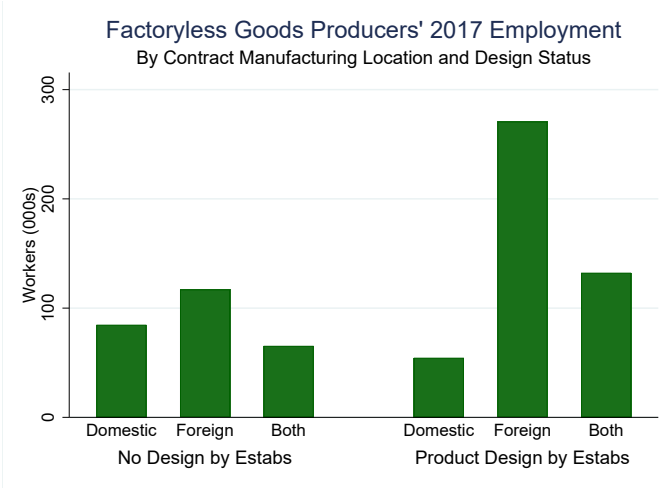
In 2017, did this establishment determine the design or specifications for any of the products that were manufactured on its behalf?

"Design or specifications" refers to the function of the product, not just the appearance or its packaging.

- ◯ Yes
- ◯ No

- Limited/no responses for merchant wholesalers (no 'products manufactured on its behalf')

Factoryless goods producers' sourcing locations and design activity



- Most activity by factoryless good producers that offshore is at firms that design products

Summary of new facts on factoryless goods producers

- Factoryless goods producers (FGPs) are relatively new and outwardly focused
  - More prevalent in younger cohorts
  - Higher import intensities that grow over time
  - Older FGPs had higher US manufacturing employment shares in the past
- "Outside-the-firm" increasingly coincides with "outside-the-country"

Outline

1. Overview of US data sources and their limitations
2. Evidence on US firms with in-house physical transformation tasks *anywhere* in the world
3. Evidence on US 'factoryless goods producers' that outsource physical tasks
4. Implications for future work

Sharp bifurcation between two organizational forms

- Transnational manufacturers
  - Firms with foreign manufacturing plants also own US manufacturing plants
  - These firms produce similar goods in-house across multiple countries
  - Think Ford
- Factoryless goods producers
  - Firms that outsource physical transformation tasks increasingly also offshore them
  - Think Nike
- Both firm types disproportionately hire US 'knowledge' workers
  - Manufacturing multinationals also linked to disproportionate R&D and patenting
  - Factoryless goods producers linked to greater patenting and trademarks (Kamal 2020)

Mapping the data to models on firm boundary and location decisions

- Helpman, Melitz, Yeaple (2004): Horizontal FDI that substitutes for exports
- Antràs and Helpman (2004)
  - Vertical model in with headquarter services and input production

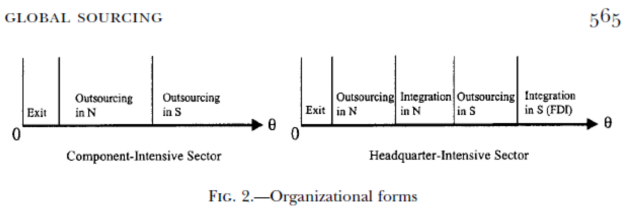


FIG. 2.—Organizational forms

Source: Antràs and Helpman (2004)

  - Vertical integration is only optimal in headquarter-intensive industries
  - Integration and offshoring are orthogonal decisions related only through productivity

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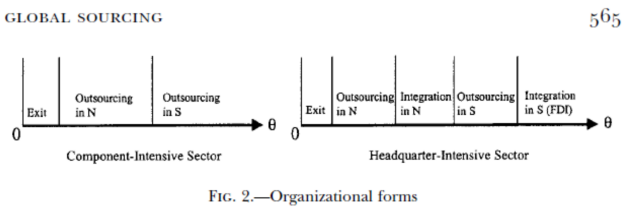

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  - Vertical integration is only optimal in headquarter-intensive industries
  - Integration and offshoring are orthogonal decisions related only through productivity

Bifurcation occurs within industries: Semiconductors

- Texas Instruments, report by Kyle Flesser

  Our technology groups work closely with our businesses and our manufacturing operations to ensure differentiation, manufacturability, optimal technology usage and cost efficiency for our analog and embedded processing products early in the design process.

- Qualcomm Website

  Qualcomm is a company of inventors with diverse skills and backgrounds, who are driven to improve communication around the globe.

- Contractability and fixed-cost differences are not sufficient to explain patterns
- Outsourcing and offshoring decisions seem to be related

Rise of factoryless goods producers affects empirical strategies

- Common approach is to exploit cross-industry variation in trade flows
  - Regress change in industry employment on change in industry trade flows
  - Reallocation across firms and sectors is not captured
- Apple shut down all its US manufacturing plants in 2004 and began outsourcing to China
  - Decline in Apple's US manufacturing employment is captured
  - Rise in Apple's US retail and innovation activities are missed
- Computer and electronics manufacturing dominates import growth and innovation

Conclusion

- US firms produce final goods in foreign countries they import to the United States
  - Intermediate input trade is insufficient to measure global value chains
  - Measures of US value added in these goods are probably incorrect
- Some foreign production using US factors never enters US commercial space
  - Gap between US GDP and GNP may reflect this phenomenon
- In both cases, US GDP and productivity growth will be mismeasured
  - Apple's value added from its iPads estimated at $6 billion in 2011 (Bayard et al. 2015)
  - US computer manufacturing value added declined approximately $6 billion in 2011
- Potential for US knowledge creation to be leveraged abroad even higher in services

Appendix

US firms that manufacture goods somewhere in the world

Sample share of aggregate activity

			Firms Share of Total				
		Firms	Manuf Emp	All Emp	Sales	Imports	Exports
Total in Sample		243,700	0.88	0.20	0.29	0.42	0.58
By MNE Status	Manuf Locations						
US MNE	Foreign	150	0.00	0.00	0.01	0.01	0.00
US MNE	US	350	0.03	0.04	0.05	0.03	0.02
US MNE	US & Foreign	1,200	0.27	0.06	0.14	0.29	0.43
Domestic	US	242,000	0.58	0.10	0.09	0.09	0.13
Total Outside Sample		4,320,700	0.12	0.80	0.71	0.59	0.42
Foreign MNE	US	2,200	0.12	0.03	0.10	0.26	0.21
Foreign MNE	None in US	5,400	0.00	0.03	0.04	0.07	0.03
US MNE	None	1,100	0.00	0.09	0.11	0.04	0.02
Domestic	None	4,312,000	0.00	0.65	0.46	0.22	0.16

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2017 wholesale firms with no manufacturing estabs

2017 FGP Characteristics by Entry Cohort

	Firms	Share of Emp	Avg Emp	$\frac{Pay}{Emp}$	$\frac{Sales}{Emp}$	$\frac{Imports}{Sales}$	$\frac{RPImports}{Imports}$	$\frac{ChinaImports}{Imports}$
All FGPs	37,300	1.00	26	76	773	0.25	0.49	0.36
Entry Cohort								
1992	7,700	0.50	62	77	736	0.25	0.63	0.37
1997	3,700	0.08	21	72	747	0.23	0.40	0.37
2002	4,500	0.10	21	74	837	0.23	0.35	0.34
2007	6,000	0.12	19	77	791	0.25	0.36	0.36
2012	6,500	0.11	17	74	843	0.27	0.47	0.35
2017	8,900	0.10	10	76	816	0.27	0.29	0.39
All Non-FGPs	99,500	1.00	41	56	696	0.05	0.31	0.27
Entry Cohort								
1992	27,000	0.65	99	51	593	0.03	0.25	0.25
1997	10,000	0.10	39	80	798	0.06	0.51	0.30
2002	12,000	0.08	27	67	967	0.06	0.37	0.39
2007	14,500	0.07	19	55	1060	0.07	0.33	0.27
2012	15,500	0.06	15	57	782	0.08	0.24	0.24
2017	20,500	0.05	10	61	809	0.08	0.22	0.22

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