New Perspectives on the Decline of US Manufacturing Employment

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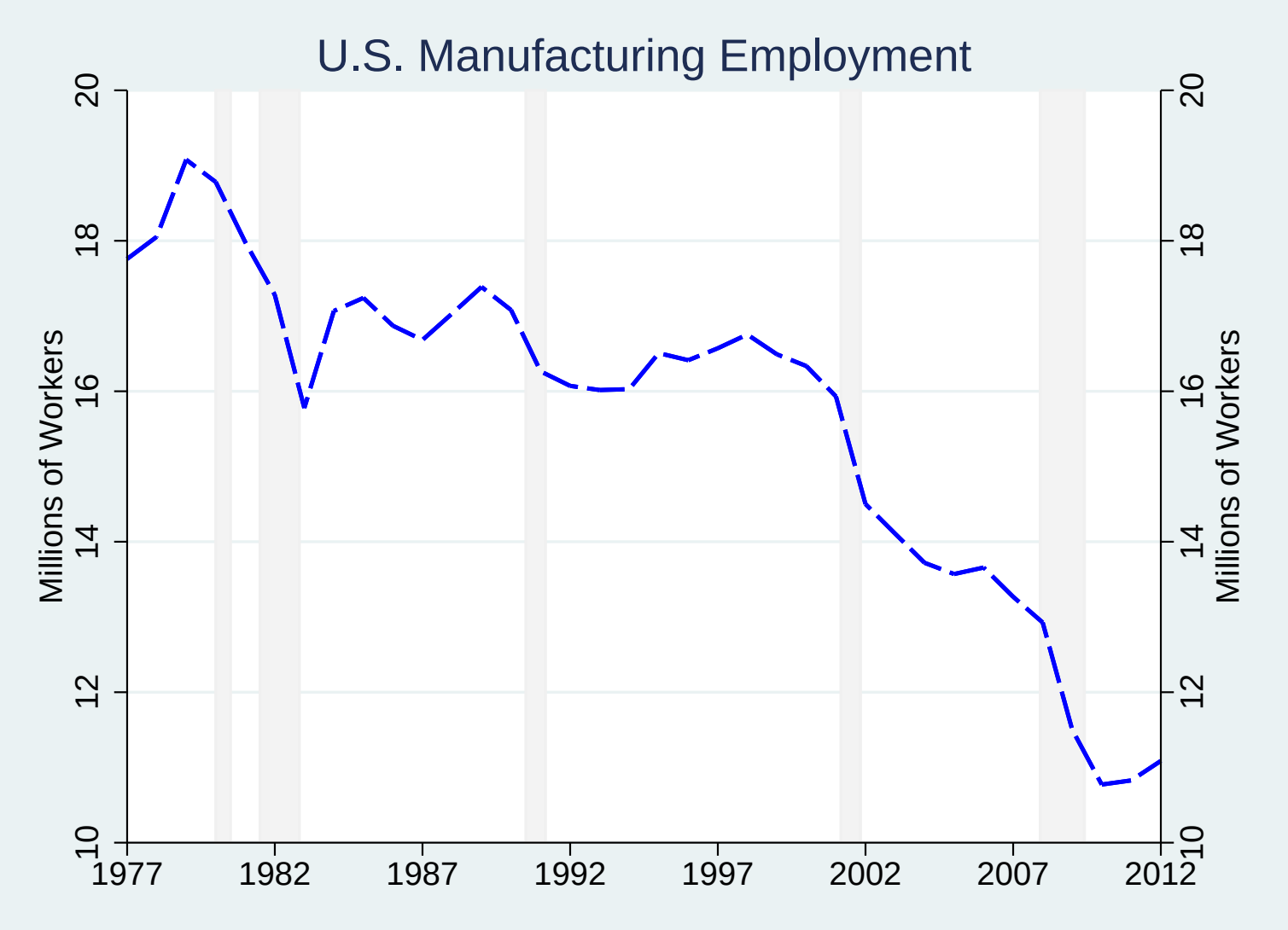
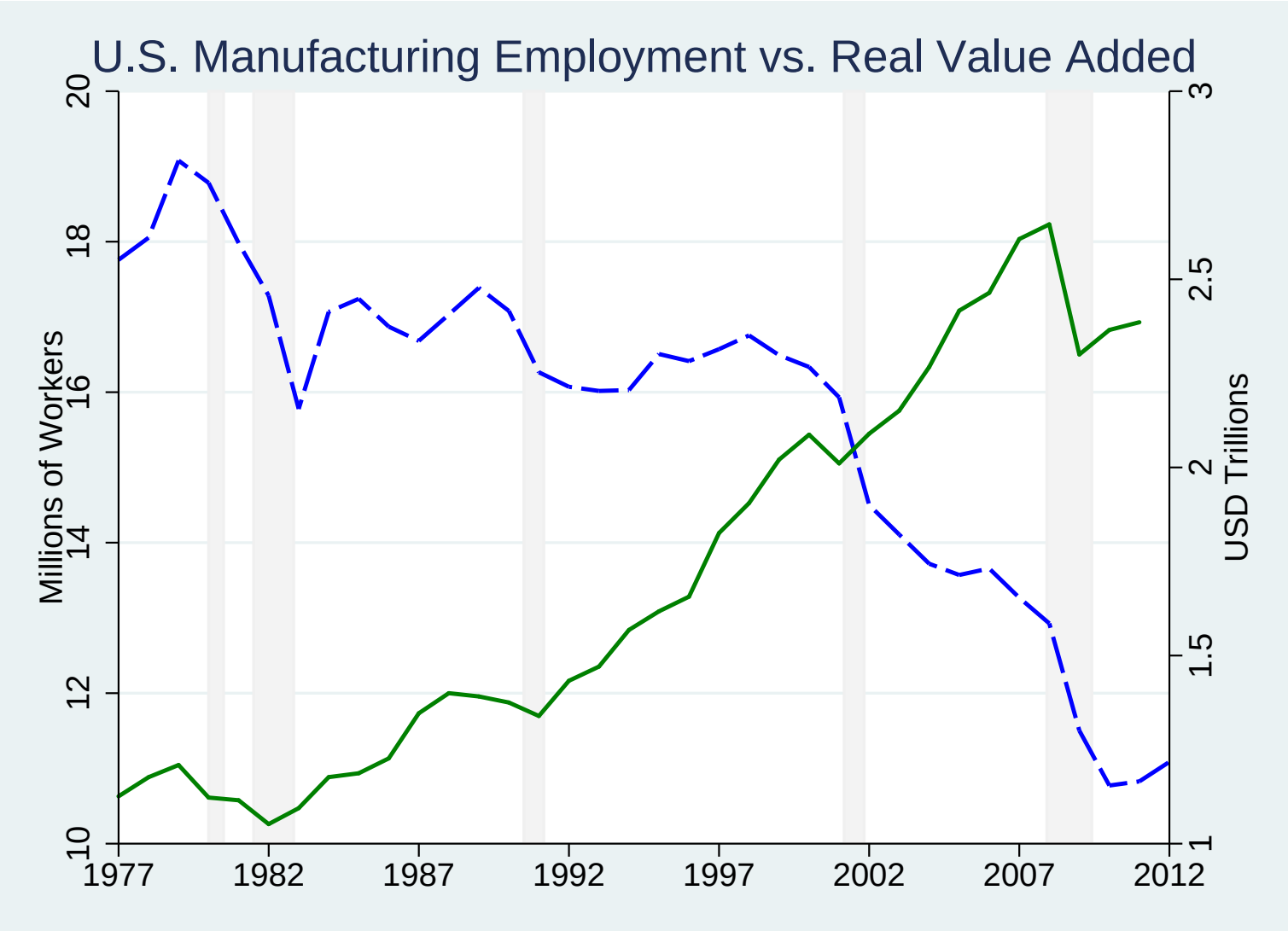
Disclaimer: Any opinions and conclusions expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Census Bureau, the Board of Governors or its research staff. All results have been reviewed to ensure that no confidential information has been disclosed.

US manufacturing employment is on the decline



US manufacturing employment *versus* real value added



Explanations for the decline

- Import competition, especially from China

  Bernard, Jensen, and Schott (2006); Autor, Dorn, Hanson (2013); Acemoglu et al. (2016), Pierce and Schott (2016); Caliendo, Dvorkin, and Parro (2017); Autor et al. (2016)

- Foreign sourcing and offshoring

  Harrison and McMillan (2011); Antràs, Fort, and Tintelnot (2017); Boehme, Flaaen, and Pandalai-Nayar (2017) ; Kovak, Oldenski, and Sly (2018)

- Technology adoption and automation

  Autor, Levy, Murname (2003); Autor and Dorn (2013); Acemoglu and Restrepo (2017); Graetz and Michaels (2017)

Can we distinguish effects of trade versus technology?

- Some papers attempt to disentangle trade and technology
  - Technology affects polarization: Goos, Manning, Solomans (2014)
  - Trade matters most for employment loss, esp after 2000: ADH (2015)
- But, technology facilitates trade and production fragmentation

  Fort (2017); Steinwender (2018); Juhasz and Steinwender (2018)
- And, trade induces technology and R&D investment (*or reduces it*)

  Bernard et al. (2006); Khandelwal (2013); Boler, Moxnes, and Ultveit-Moe (2015); Bloom, Draca, Van Reenen (2016); Bernard et al. (2018); (*Autor et al. (2017)*)

Trade or technology? (WSJ 2017.3.16 article)

"When Drew Greenblatt bought ...a small Baltimore maker of wire baskets for bagel shops, he knew nothing about robotics. That was 1998, and workers made products manually using 1950s equipment....

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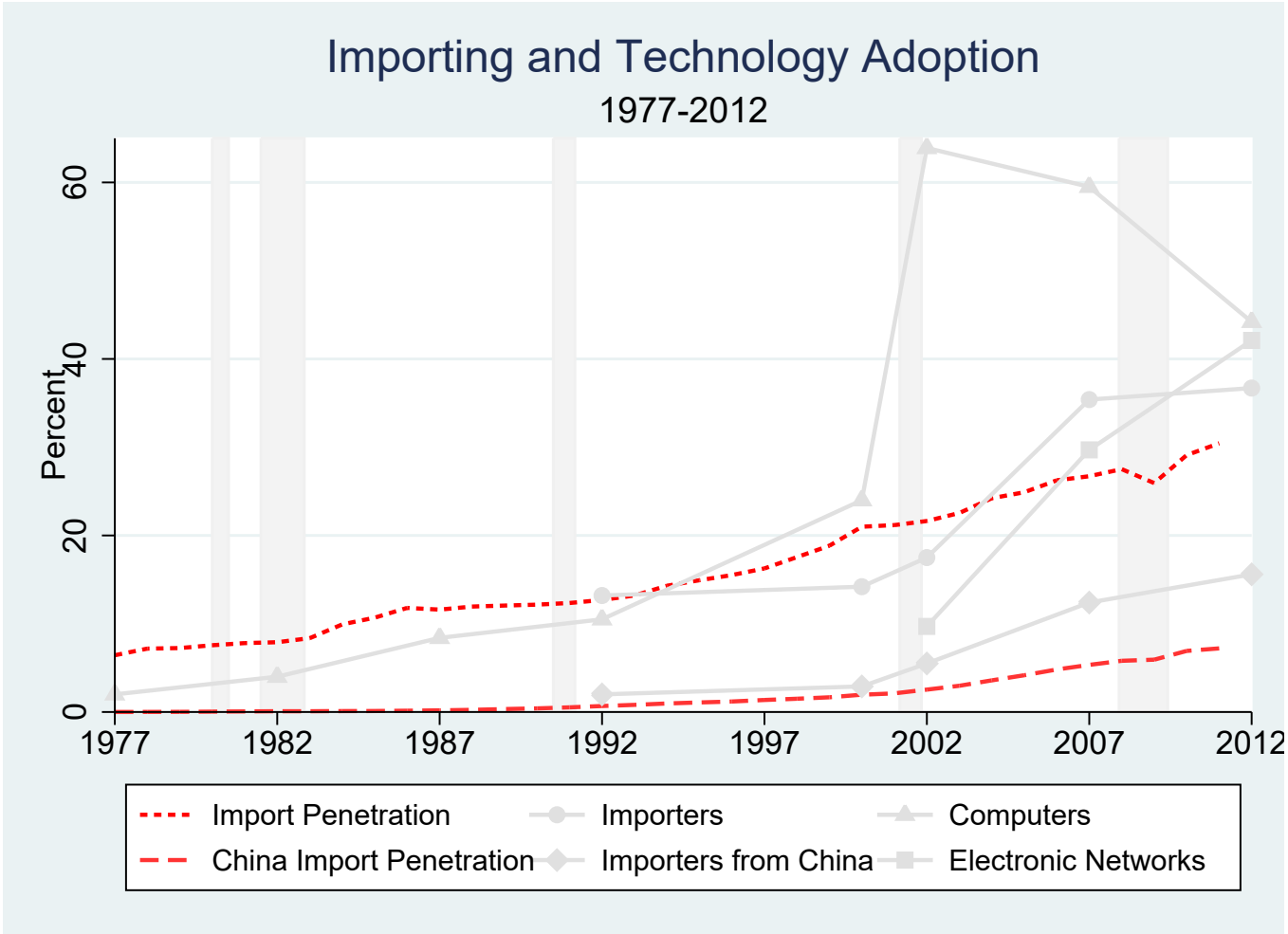
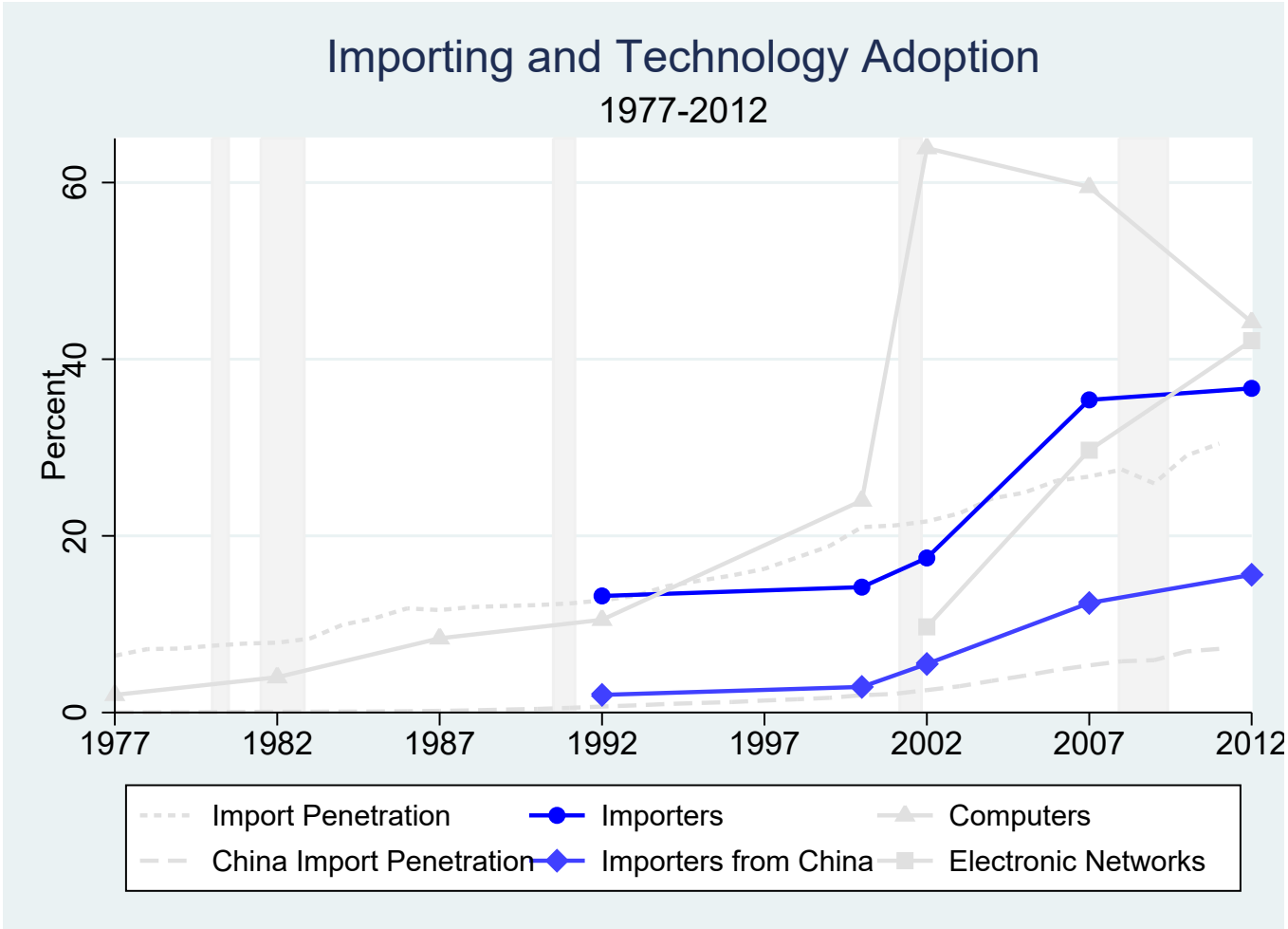
What if Marlin imported its robots?

Concurrent increases in importing and technology use



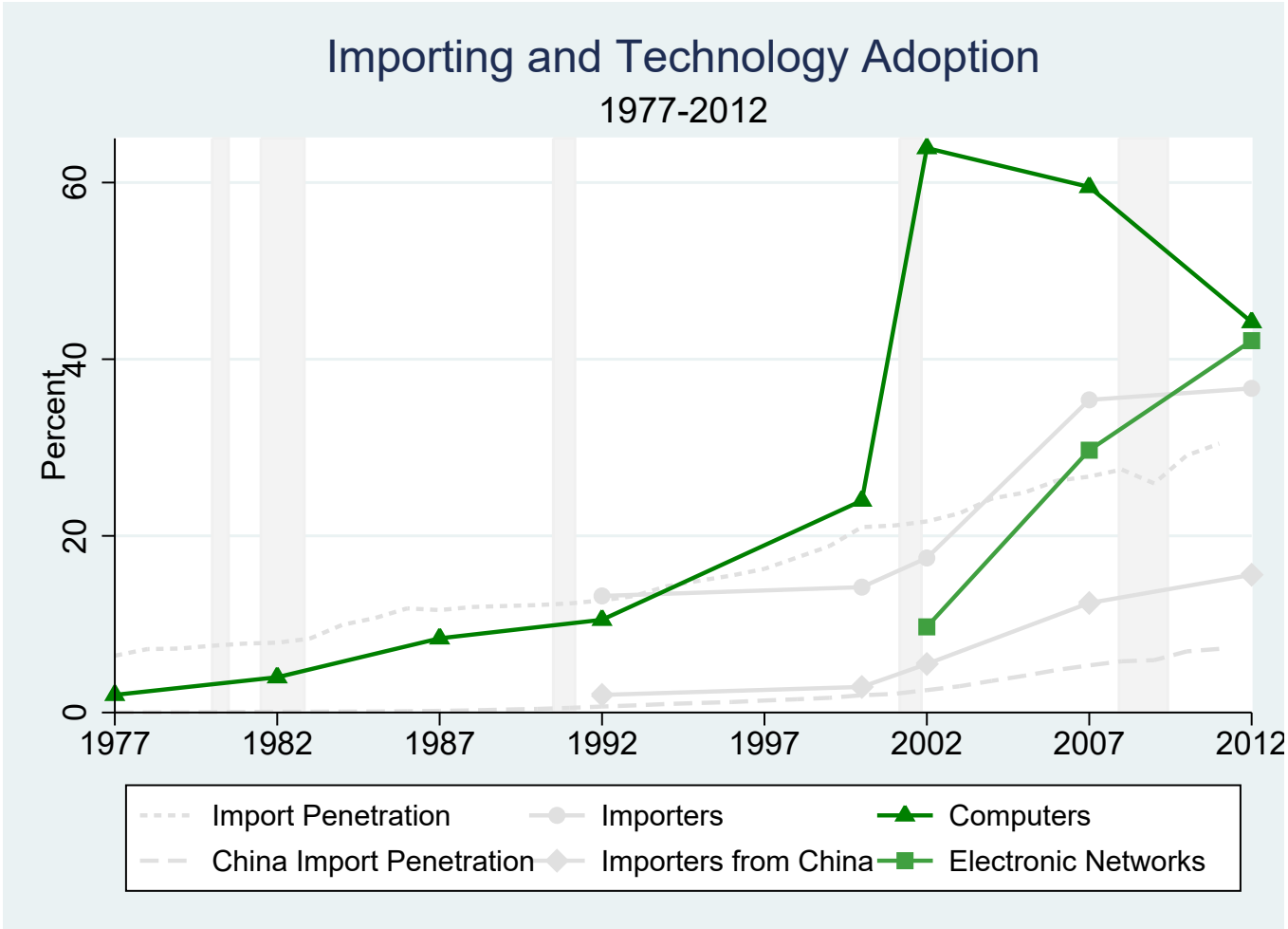
- Import penetration rising from 1980s
- Chinese import penetration increases most in 2000s

Concurrent increases in importing and technology use



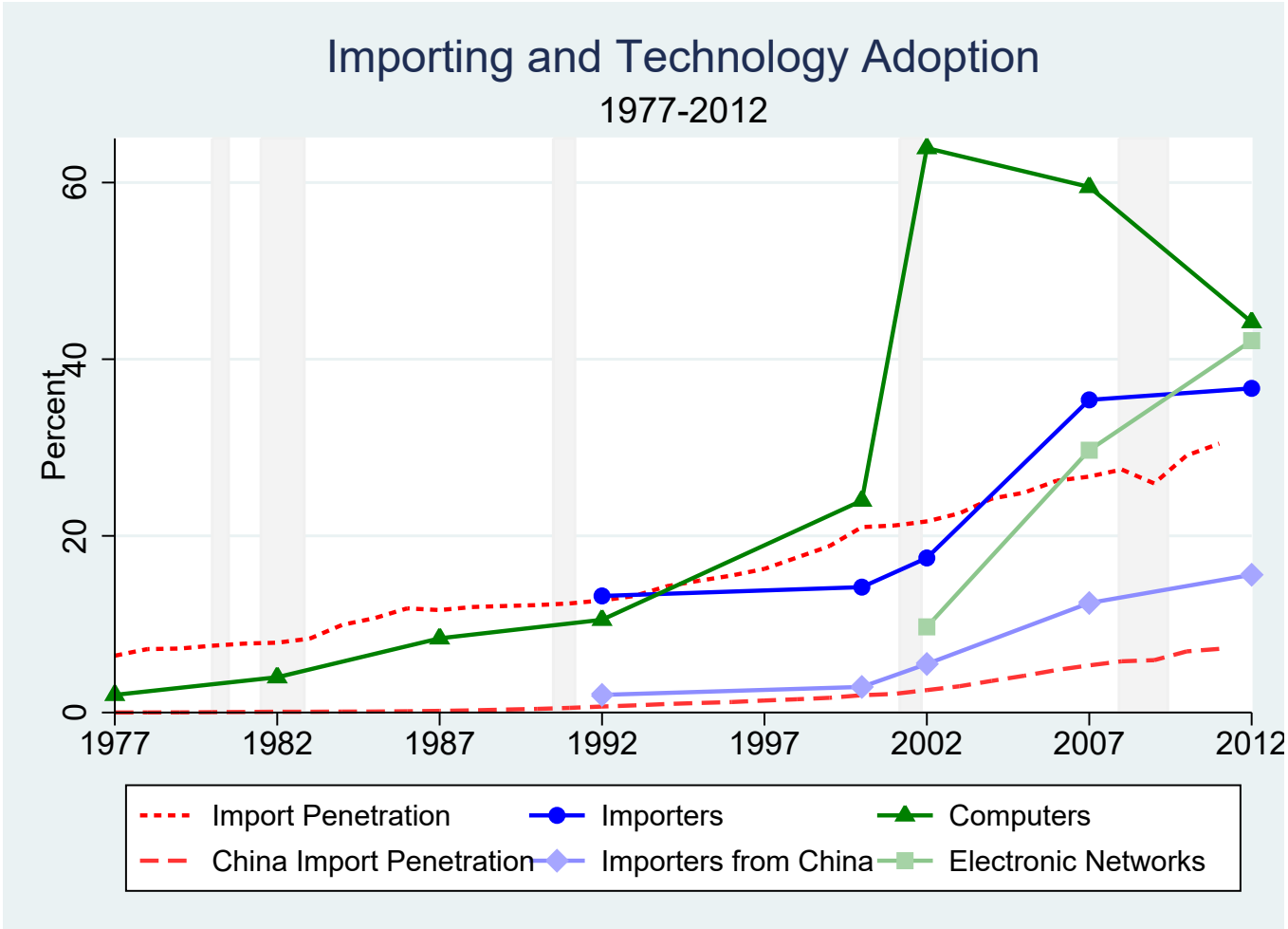
- Direct importing by manufacturers rises, esp in 2000s

Concurrent increases in importing and technology use



- Huge surge in share of plants purchasing computers in early 2000s
- Plant use of electronic networks to control/coordinate shipments rises

Concurrent increases in importing and technology use



- Considerable rise in importing
- Concurrent increases in technology use

Where (and how) manuf employment declines occur

- Industry-level margins of adjustment
  - Real value added grows even as employment declines within sectors
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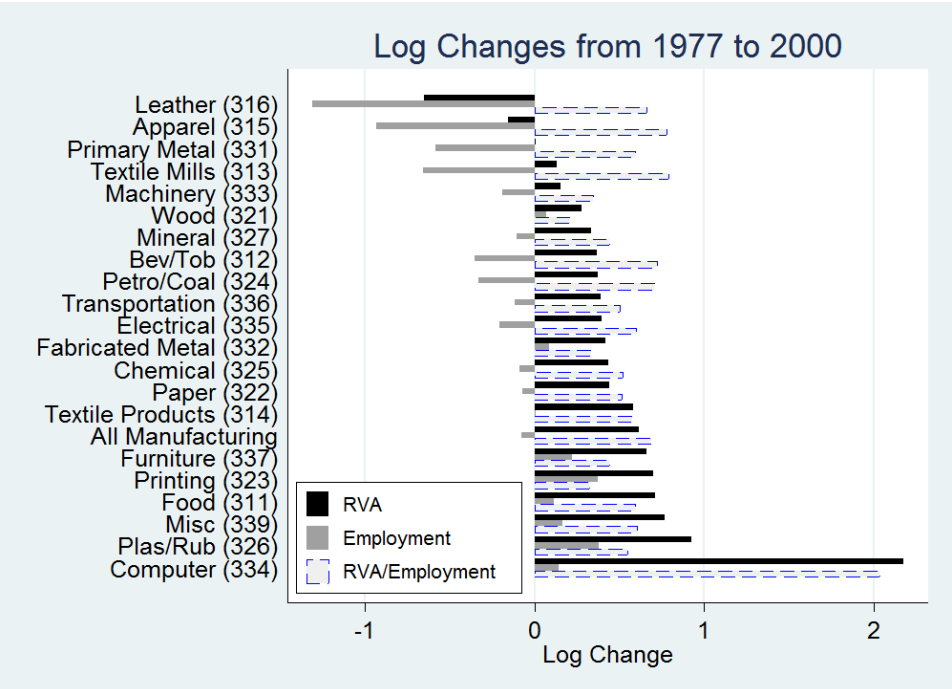
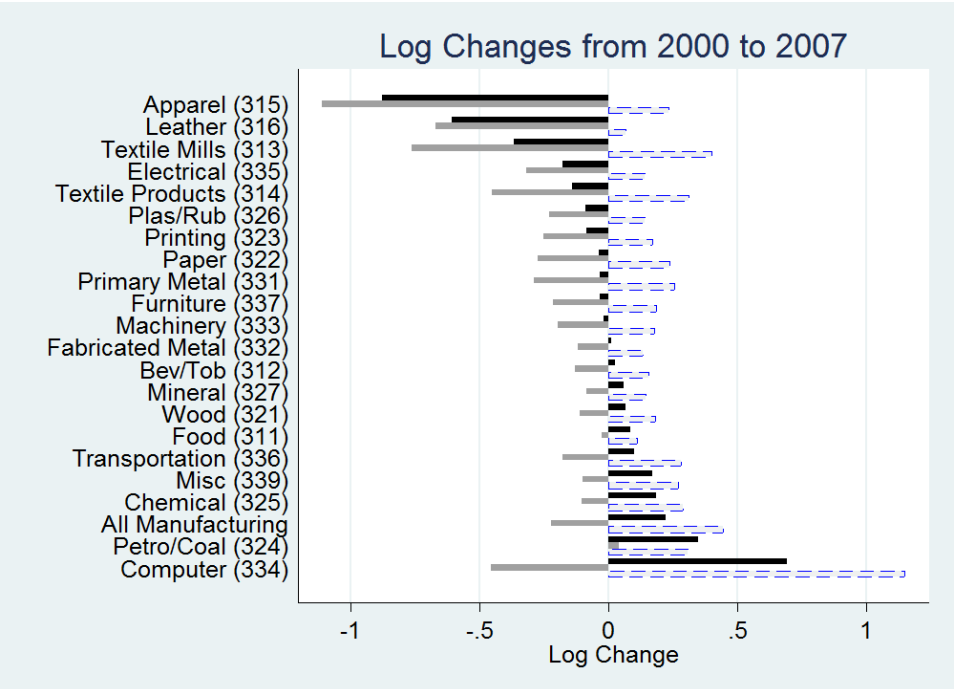
- Regional margins of adjustment
  - Pre-2000, manufacturing employment declines in only 3 regions
  - Firm death concentrated in just 2 regions
- Non-manufacturing employment at manufacturing firms grows
  - Non-manuf emp growth offsets man emp declines (pre-2000)
  - Growth concentrated in retail and services

Some reallocation occurs across industries

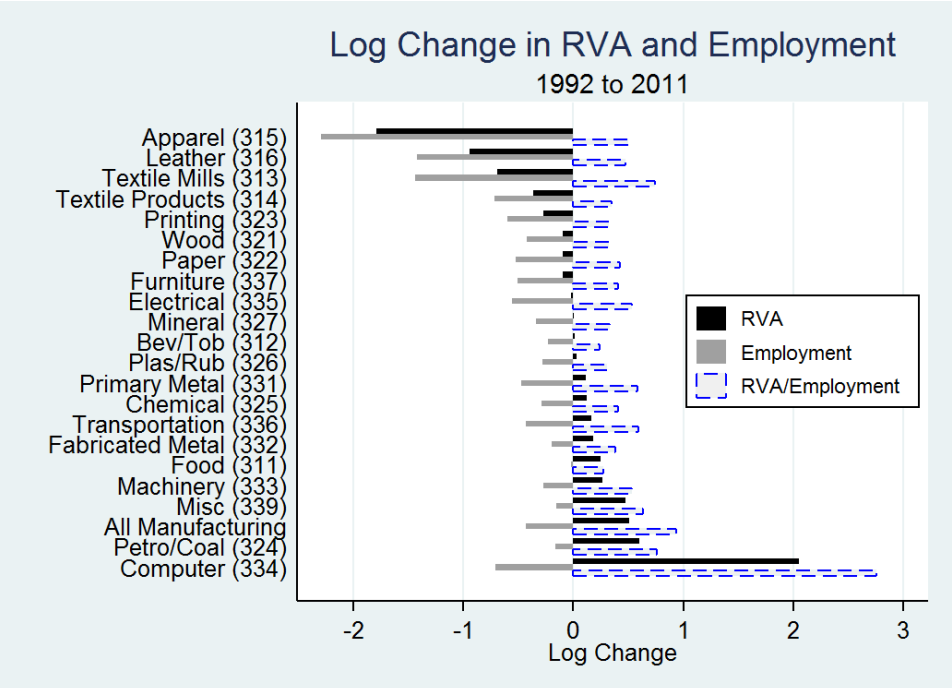
Changes in Real Value Added and Employment

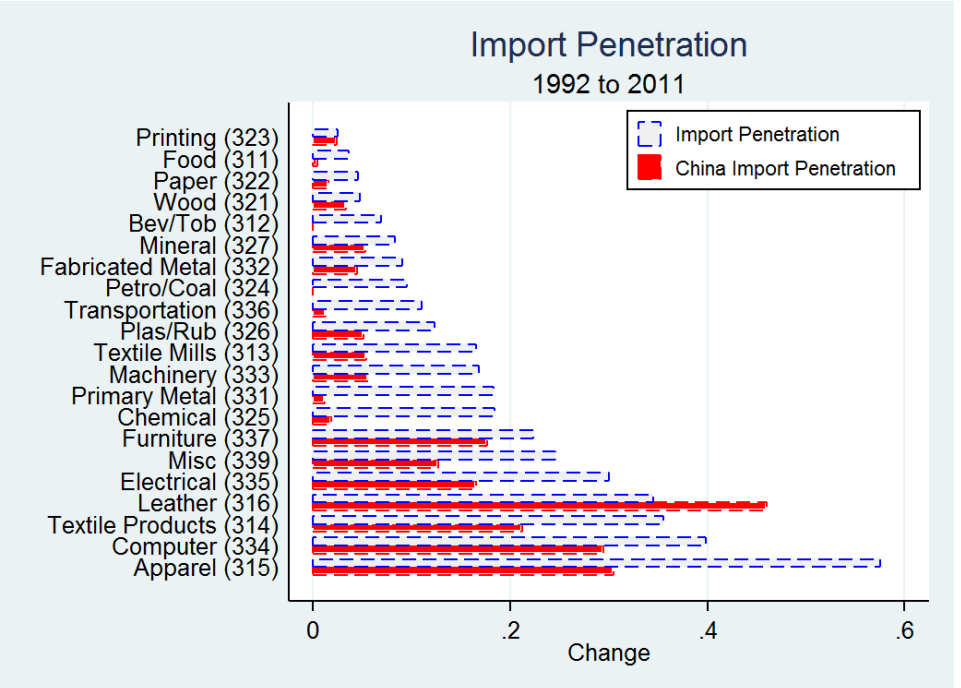




- Majority of RVA growth driven by Computers
- Divergence between emp and output not just a cross-industry story
- Fewer sectors with RVA growth in 2000s

Import penetration high in declining sectors





- Apparel, leather, and textiles decline and face imports

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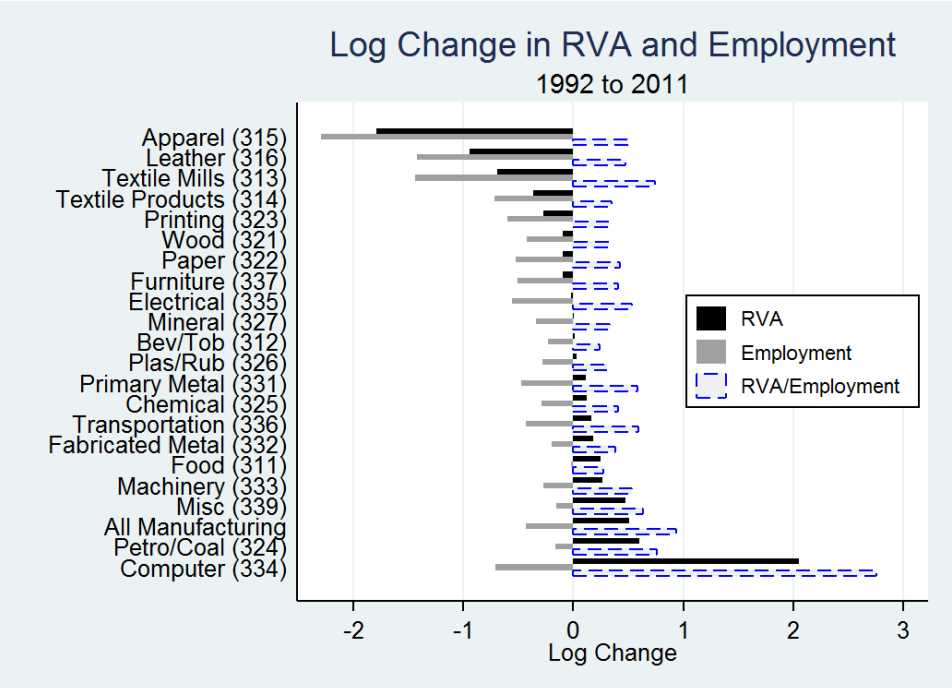
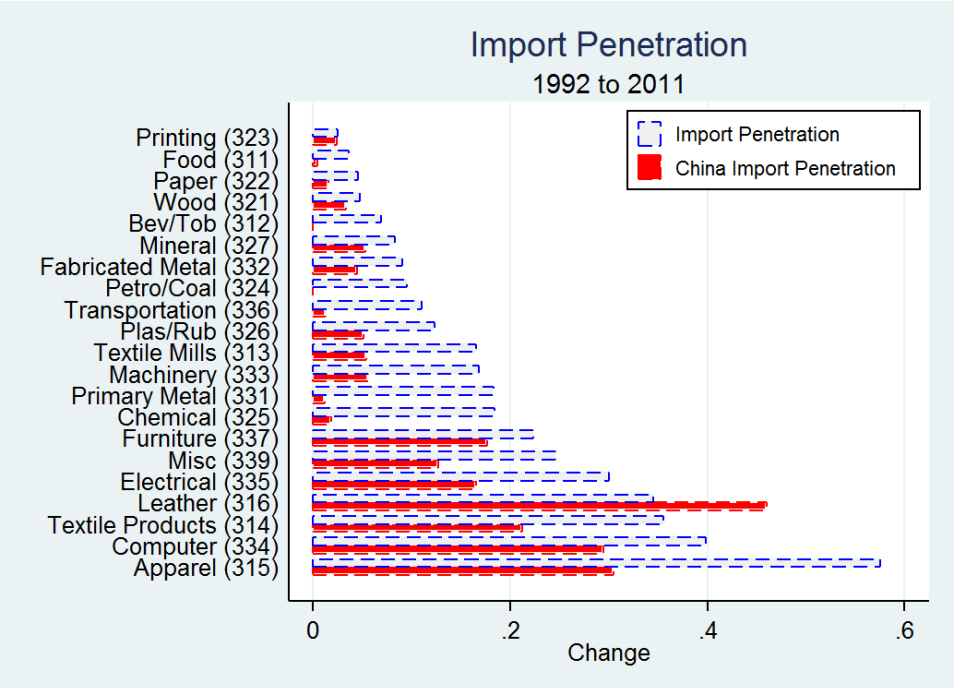
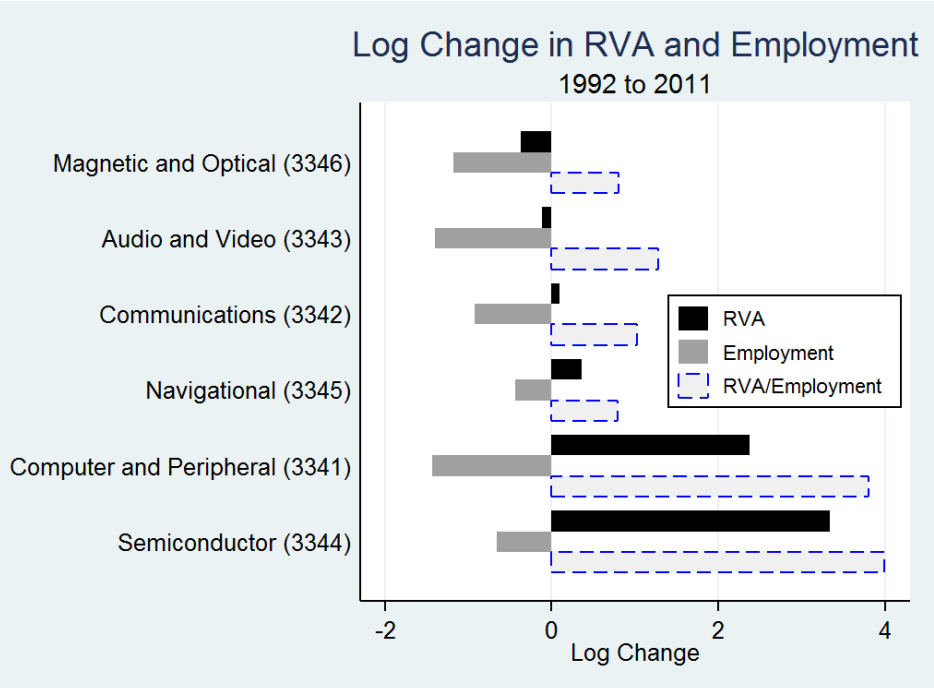
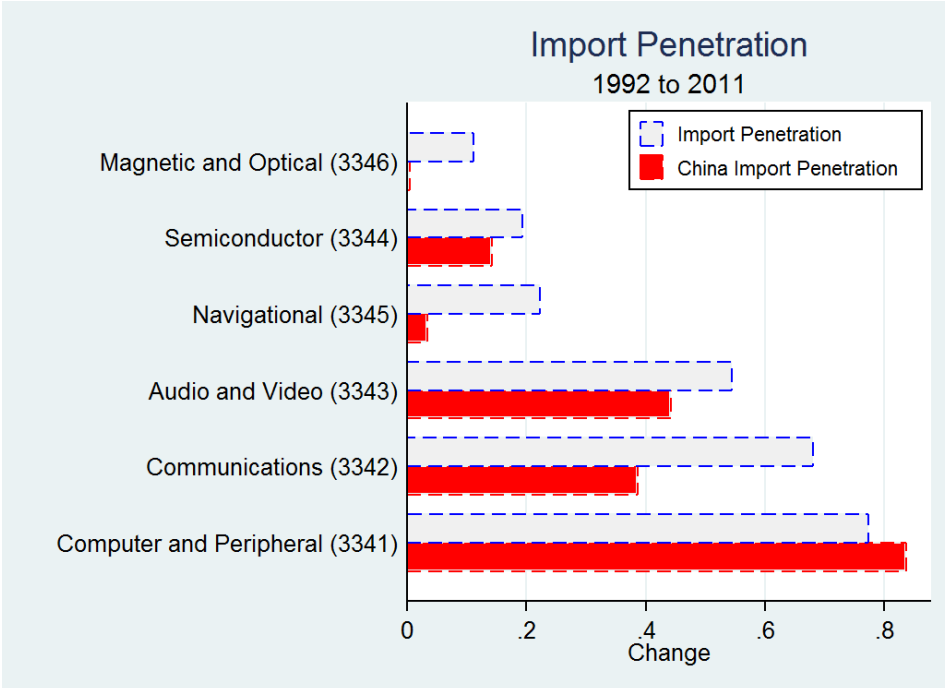




- Apparel, leather, and textiles decline and face imports
- Computers has second highest import penetration growth
  - Despite being main contributor to RVA growth
  - Suggests distinct effects of import competition vs. offshoring

Some similar patterns within Computer and Electronics





- Semiconductors accounts for 71% of RVA growth over this period
- Computers accounts for 11% of RVA growth over this period
- Both industries with offshoring and Factoryless Goods Production

Data

- Longitudinal Business Database (LBD)
  - All private, employer, non-farm establishments from 1977 - 2015
  - Location, employment, payroll
  - Firm identifiers assign estabs to firms
  - Use consistent NAICS codes from Fort and Klimek (2016)
- Census of Manufactures
  - All manufacturing establishments every 5 years, 1977 - 2012
  - Purchase of computers (except in 1997)
  - Use of electronic networks to control or coordinate shipments in 2002
- Longitudinal Foreign Trade Transaction Database
  - Customs data from 1992 - 2015
  - Firm-level import by country and product
  - Identify imports of industrial robots after 1996 (HS code 84.7950.0000)

Definitions

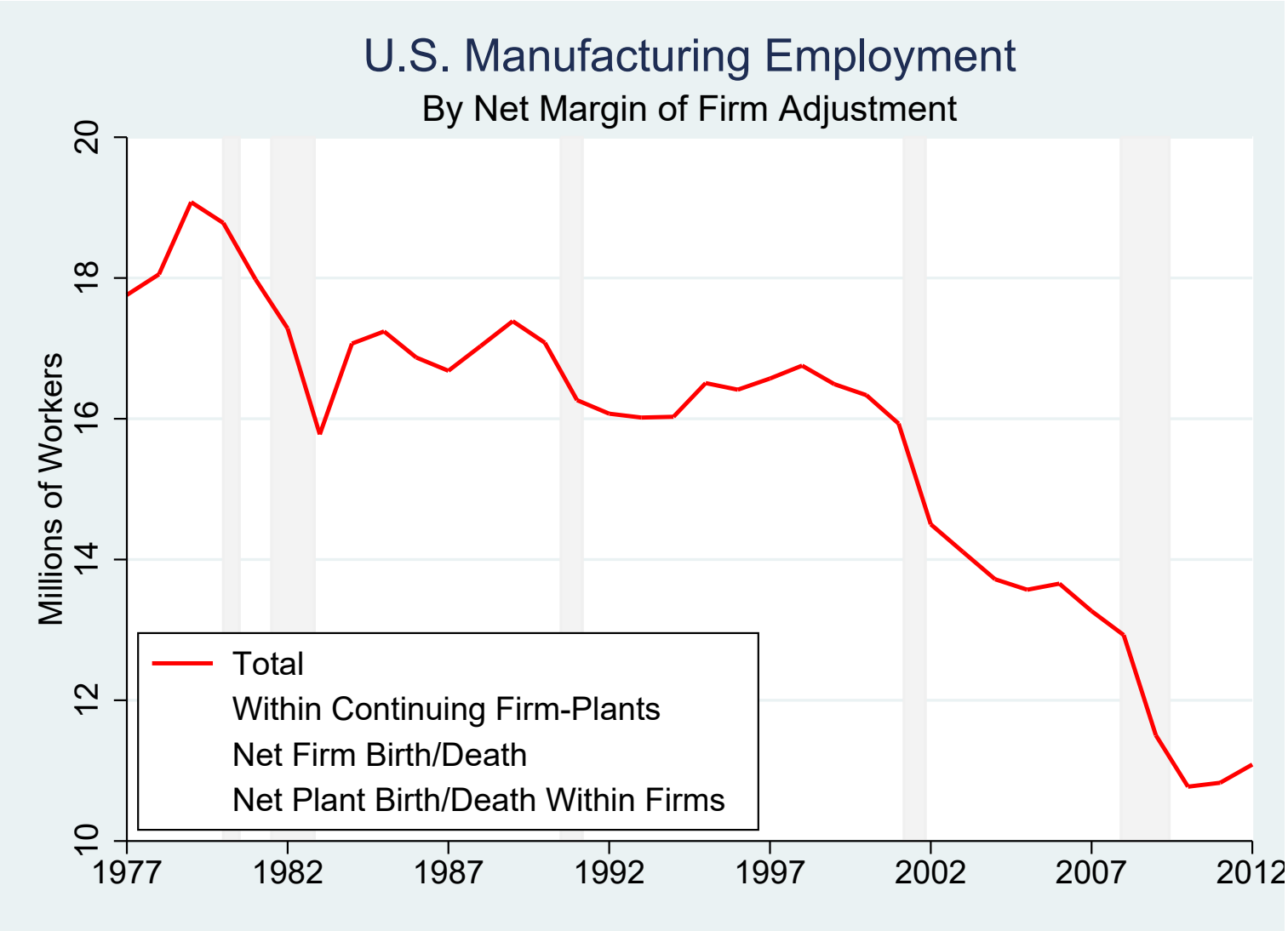
- Classification of employment
  - Employment generally classified based on establishment's industry
  - An establishment's industry can change across years
- Manufacturing Firms defined as:
  - Firm that ever has a manufacturing plant between 1977 - 2012
  - Big firms often have both manuf and non-manuf estabs
- Firm birth/death (Haltiwanger et al. 2013)
  - Birth: all establishments are new
  - Death: all establishments in the firm exit (forever)

Decomposing employment losses across firm-level margins

- Net margins of firm adjustment, based on firm's 1977 status
  - Net firm birth since 1977
  - Continuing firms (birth/death of estabs and continuing estabs)
  - Also redefine firm and plant status by decade
- Gross margins of firm adjustment
  - Net margins mask differences in churn
  - Potentially different stories for low versus high churn gross margins

$$\Delta Emp_t = (Emp_t^{FB} - Emp_t^{FD}) + (Emp_t^{CFBE} - Emp_t^{CFDE}) + (Emp_t^{CFCE^+} - Emp_t^{CFCE^-})$$

The decline is not spread evenly across net margins



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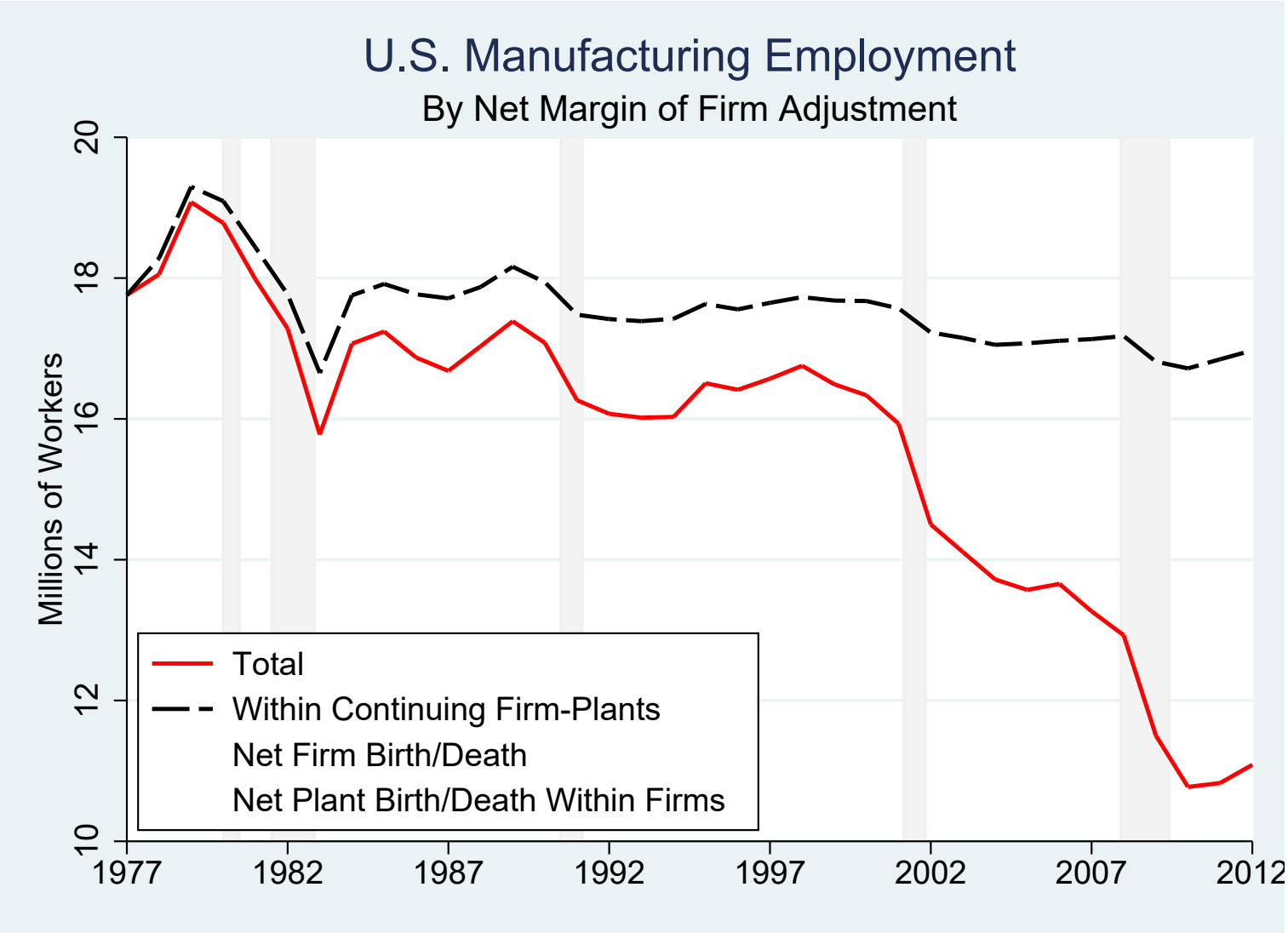

- Continuing firm-plants account for 12% of aggregate decline

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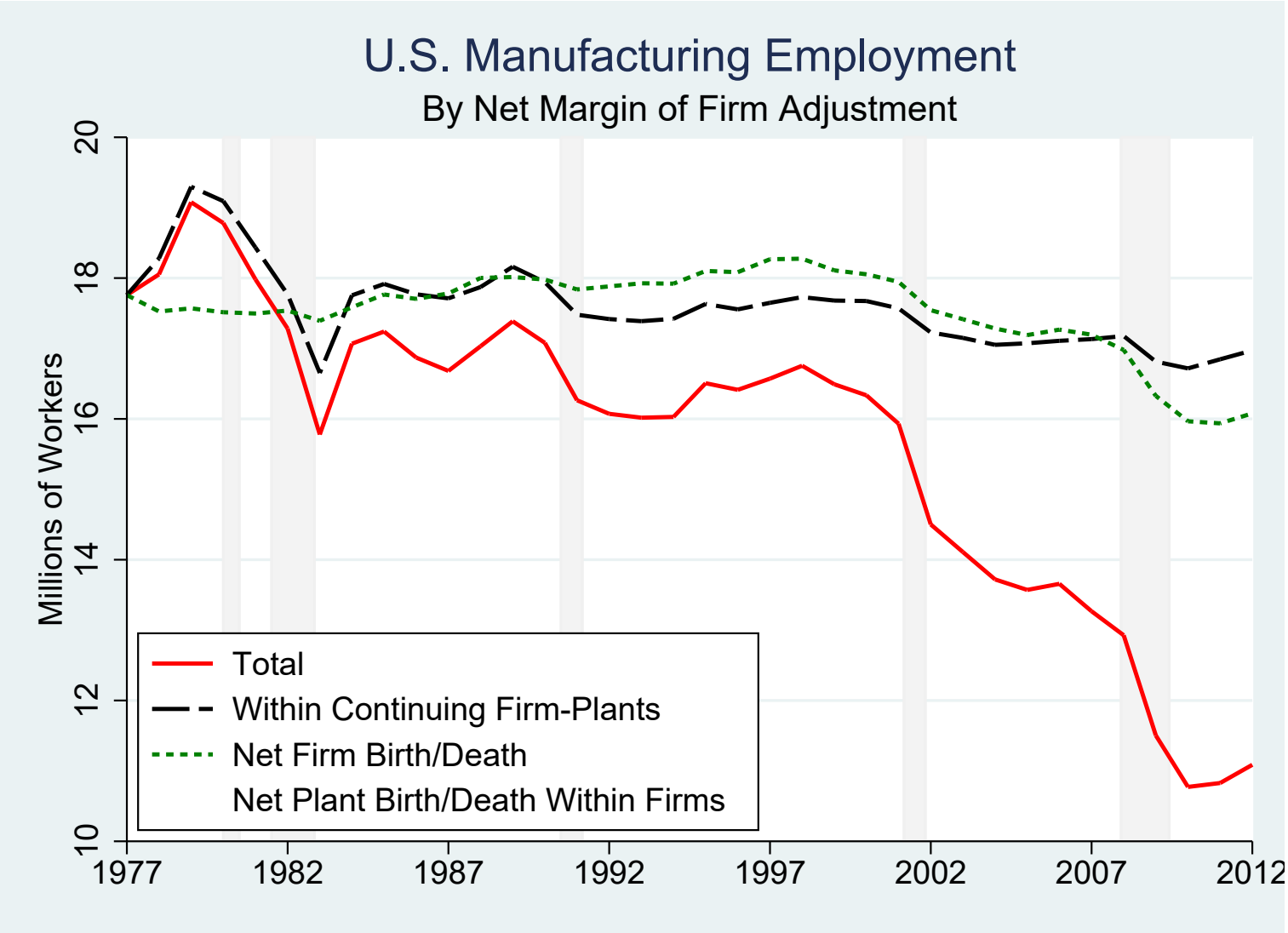
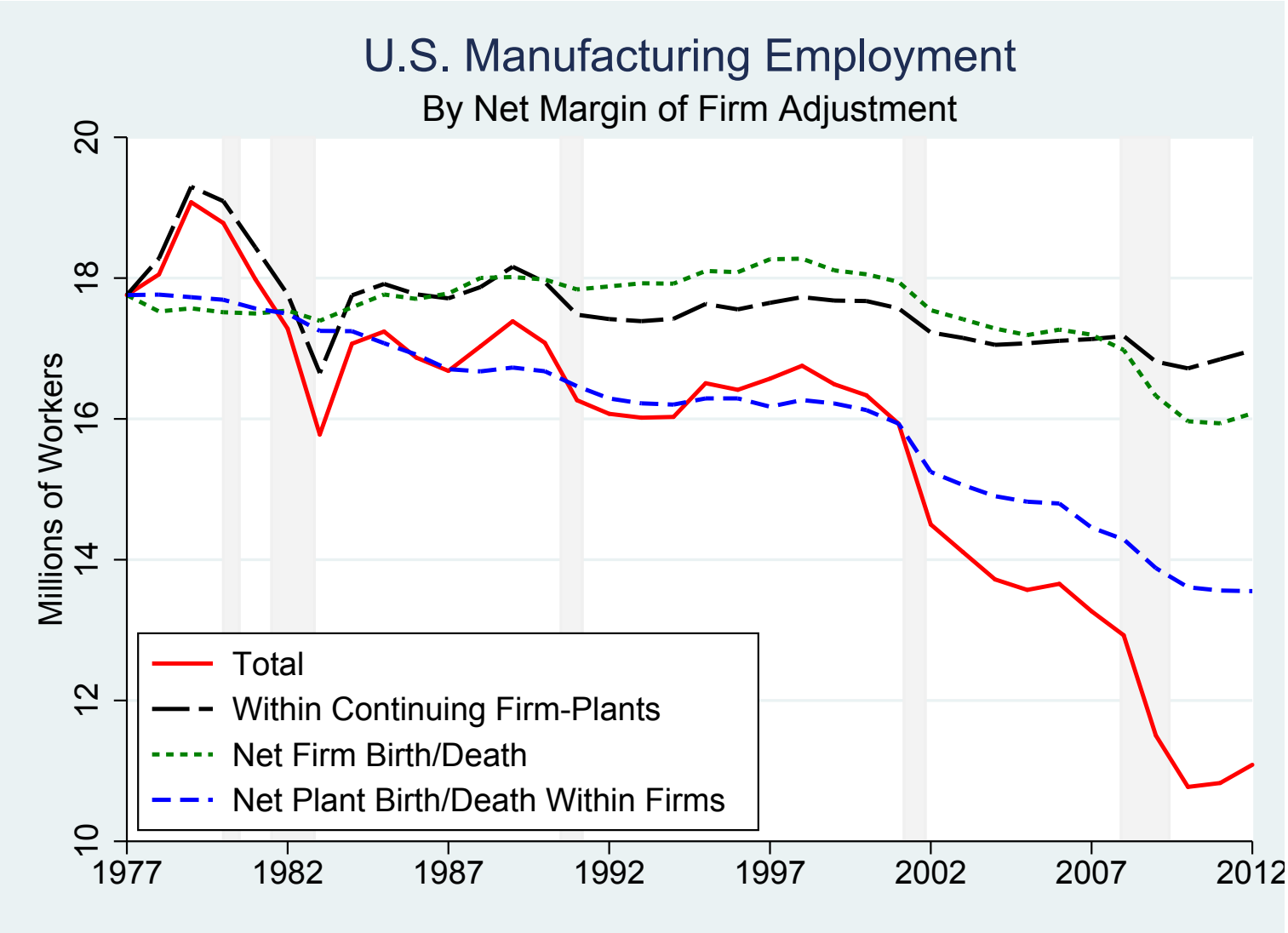


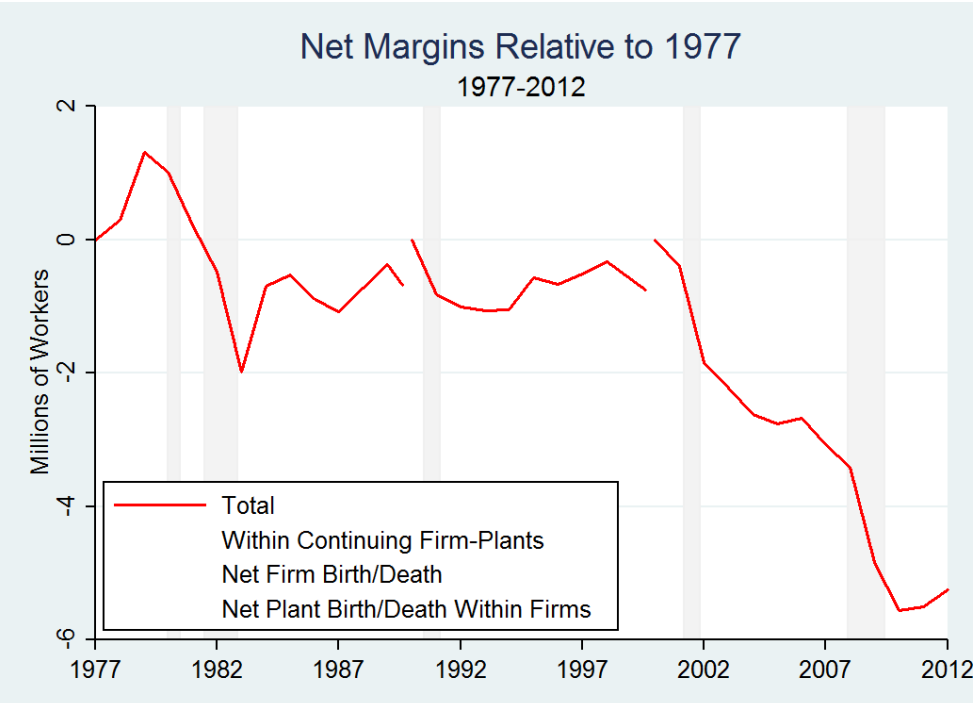
- Employment changes at firm births minus deaths are 25% of total

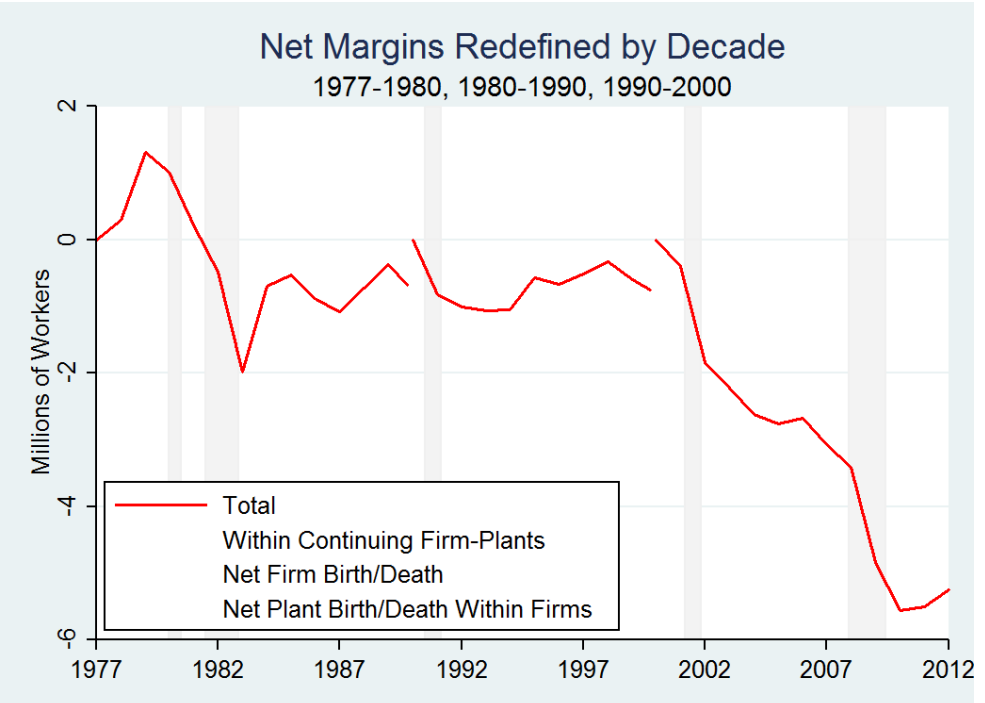
The decline is not spread evenly across net margins



- Continuing firms' net plant closures account for 63% of aggregate

Net margin contributions differ by decade





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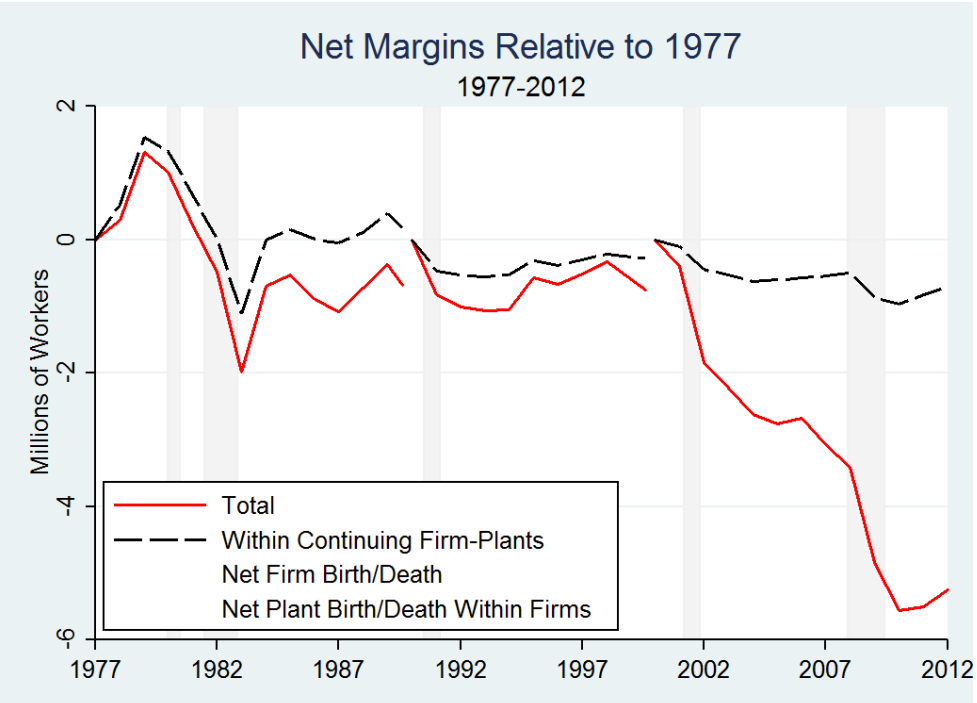
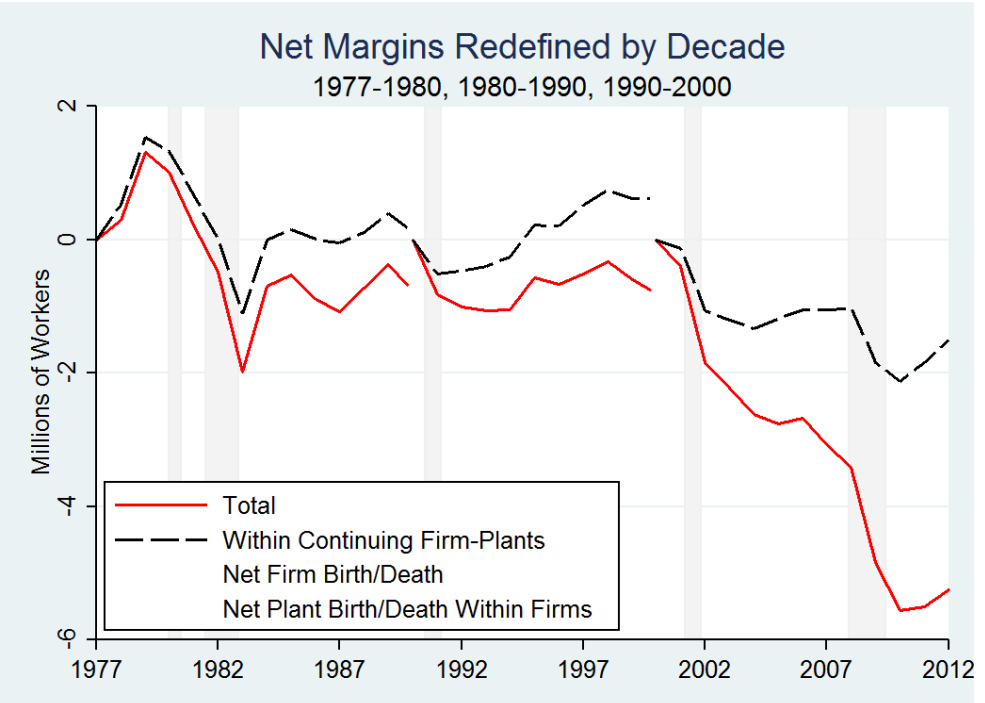
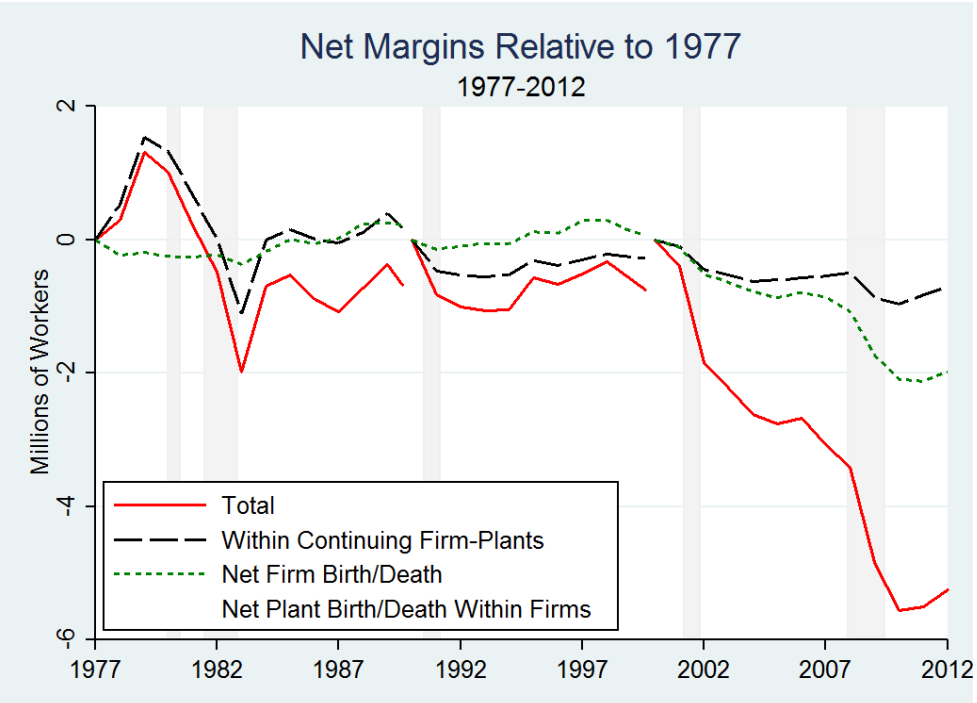
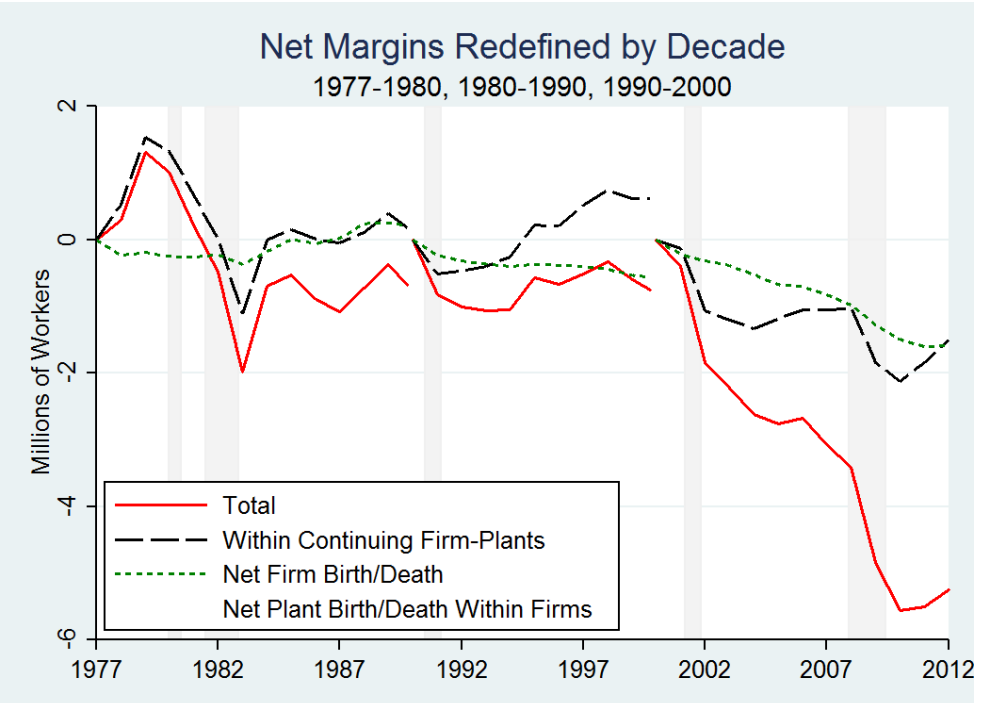




- Plants at firms born in 1980s grow in 1990s, legacies stable in 2000s

Net margin contributions differ by decade





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- Firms born after 1990 do not contribute emp on net

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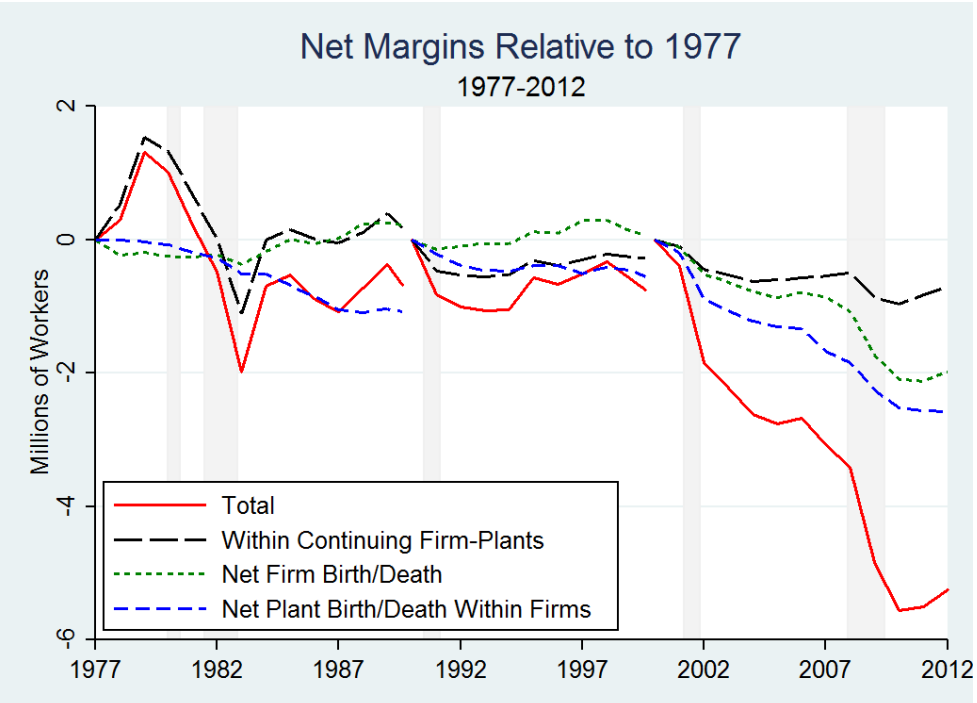
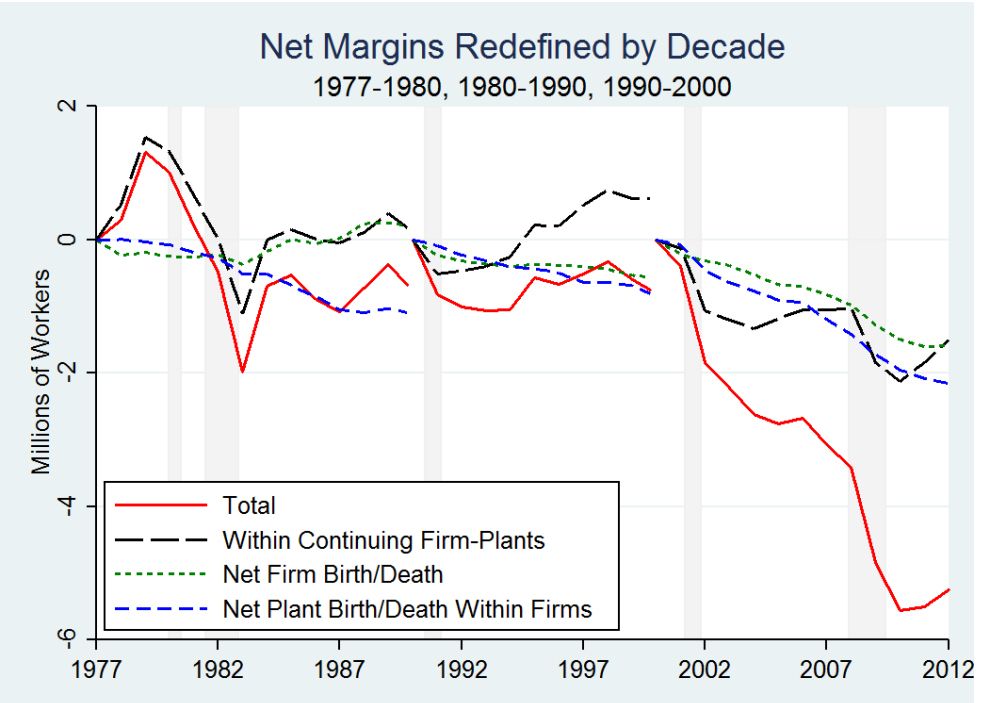




- Plants at firms born in 1980s do grow in 1990s
- Firms born after 1990 do not contribute emp on net
- Legacy plants shrink less if they survive

Summary of key results

- 75% of overall decline occurs within firm
- 63% due to net plant death within 1977 incumbents
- Net firm death becomes important in 2000s
- Surviving legacy plants resilient

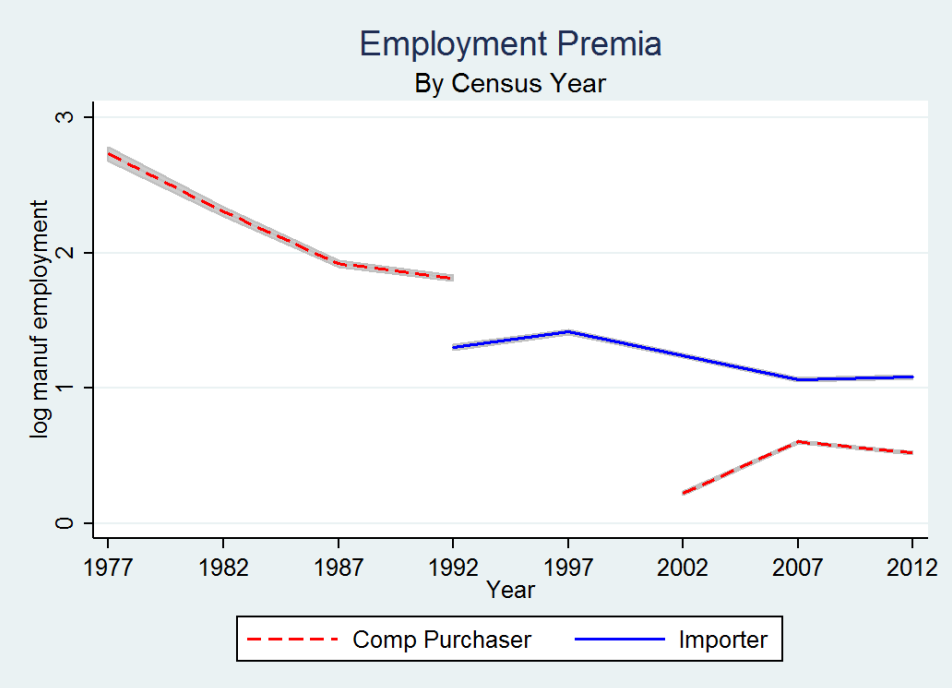
Is adoption of trade and tech easier for incumbents?

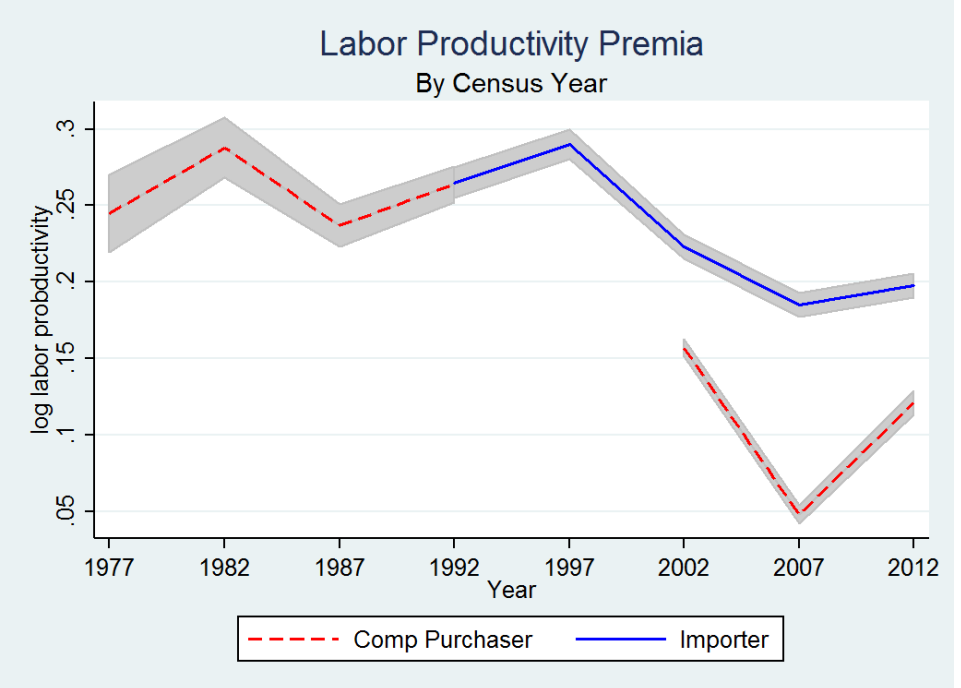
- Estimate size and productivity advantages by year

$$ln(Attribute_f^t) = \alpha + \beta_t Activity_f^t + \eta_j^t + \varepsilon_f^t$$

- Attributes: employment, productivity
- Activities: importing, purchasing computers, importing robots, using electronic networks
- Estimate separately by year

Adopters are larger and more productive





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- Importer premia relatively flat

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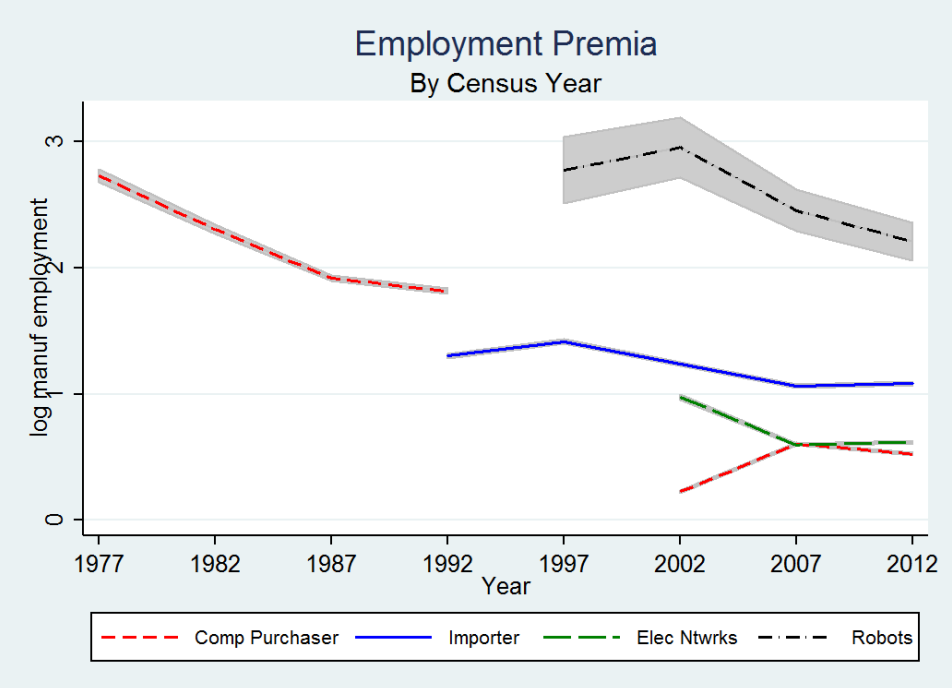

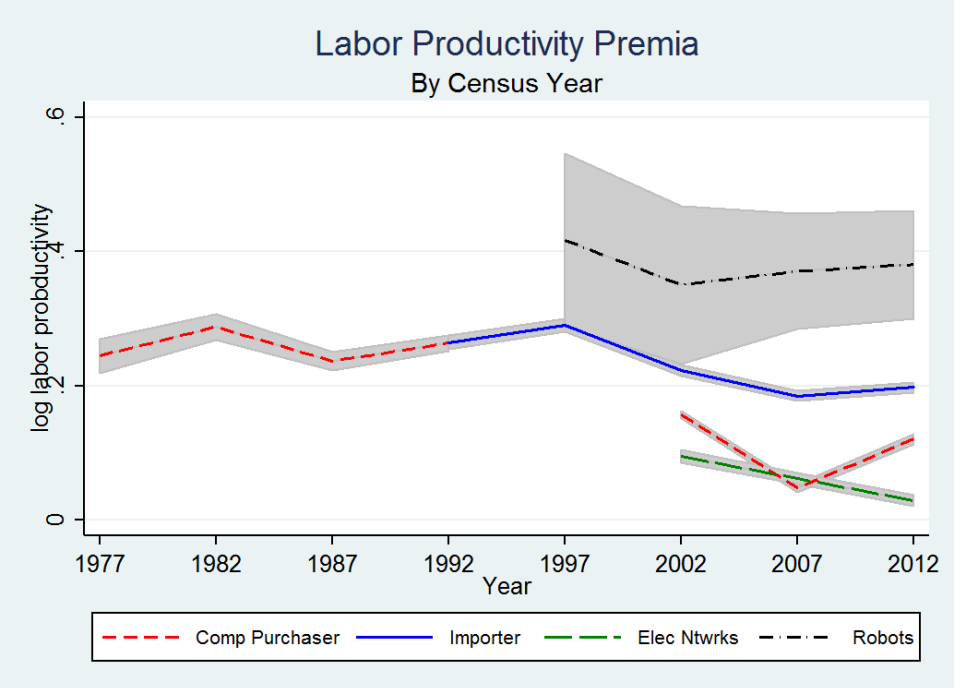

- Computer purchase premia fall dramatically over time
- Importer premia relatively flat
- Only the very biggest firms import robots
- Premia generally falling

Does plant closure within firms relate to trade or tech?

- Estimate probability that plant i, in firm f, and industry j exits over next 5 years

$$Pr(Death_{ijf}^{t:t+5} = 1|X_{ijf}^{t}) = \alpha + \beta Activity_{ijf}^{t} + \gamma ln(emp_{ijf}^{t}) + \eta_{f}^{t} + \delta^{t}$$

- Activities: purchasing computers, using electronic networks, concurrent changes in industry import penetration
- Estimate separately for pre and post 2000
- Control for plant size

Extensive margins relate to trade and technology

Dep var is an indicator equal to one if a plant exits in the next 5 years

	Plant Death	
	Pre 2000	2000s
$CompPurch^{t}_{pf}$	-0.057***	0.00
	(0.003)	(0.003)
Initial log of firm emp	Yes	Yes
Fixed Effects	Firm and Year	

Notes: Each cell is a separate regression. * p<0.10, ** p<0.05, *** p<0.01
Standard errors for regressions with ind import penetration clustered at the ind level.

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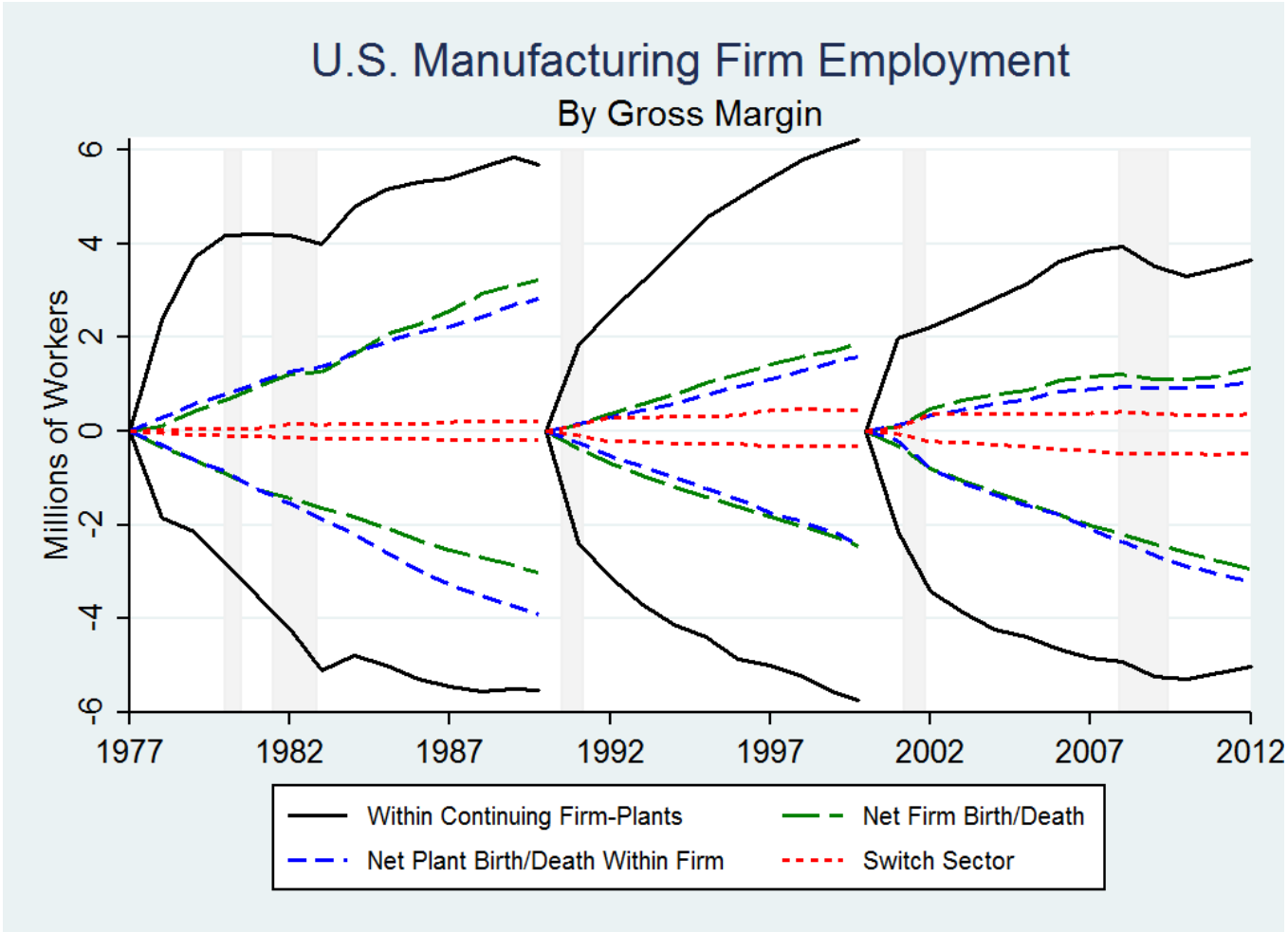
	(0.059)	(0.046)	(0.06)	(0.05)
$\Delta ChinaImpPen^{t:t+5}_{pi}$	0.721***	0.09	-0.036	0.204***
	(0.121)	(0.084)	(0.13)	(0.06)
Initial log of firm emp	Yes	Yes	Yes	Yes
Fixed Effects	Firm and Year		Industry and Year	

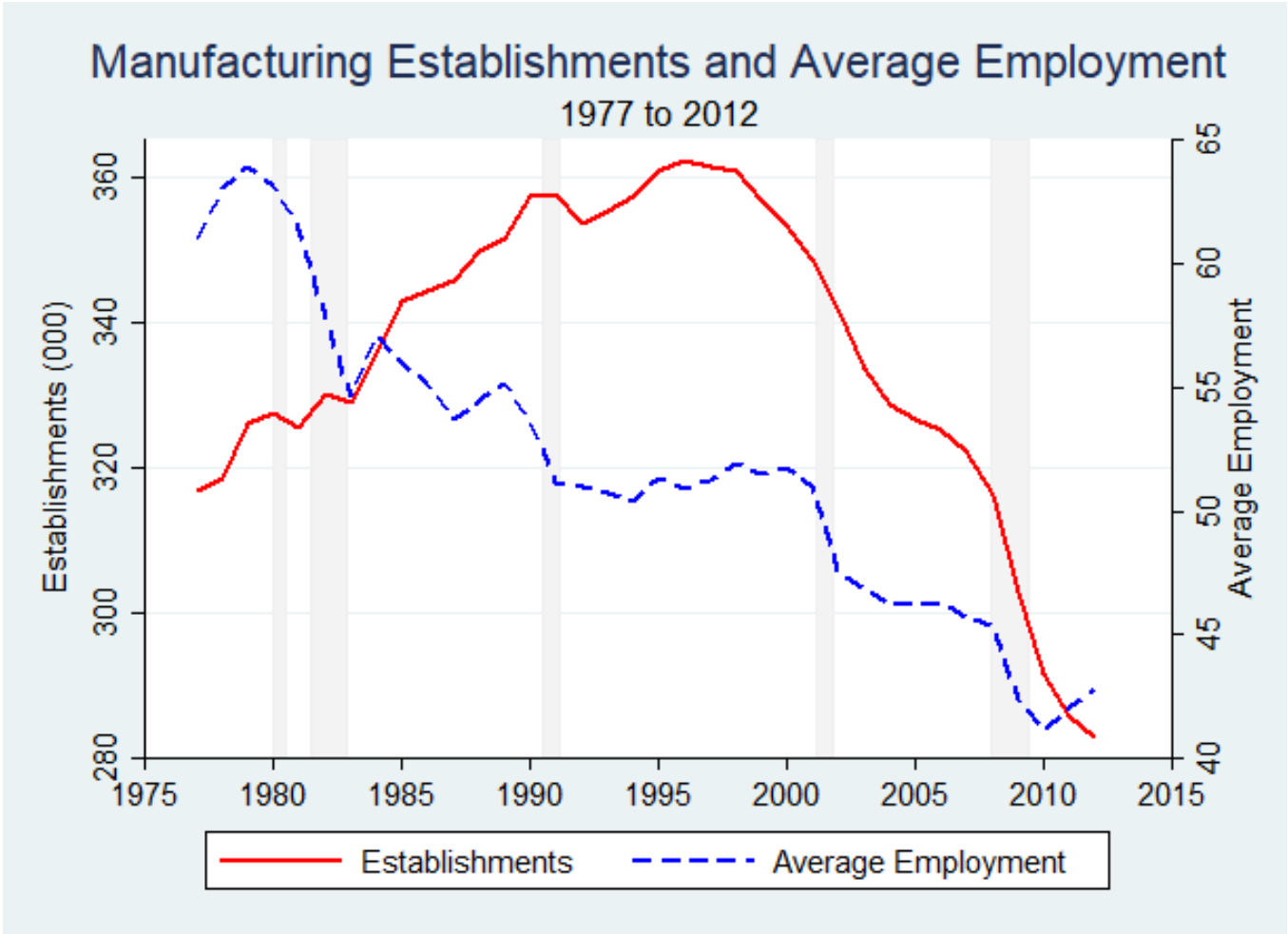
Notes: Each cell is a separate regression. * p<0.10, ** p<0.05, *** p<0.01
Standard errors for regressions with ind import penetration clustered at the ind level.

Net margins mask significant churn at continuers



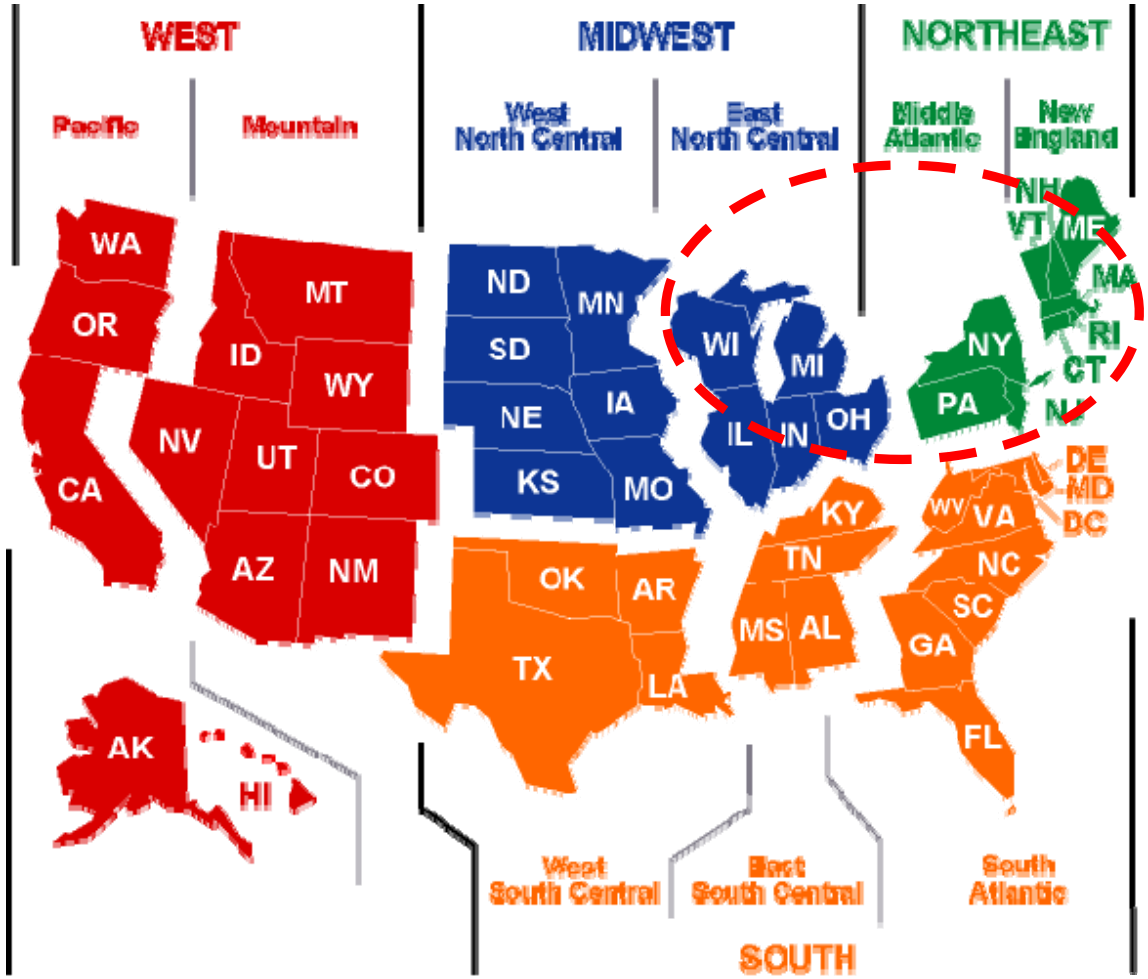
- Continuing firm-plants churn significantly more
- Decrease in churn and disproportionate increase in deaths
- Increase in switching over decades

Average plant size has been falling throughout

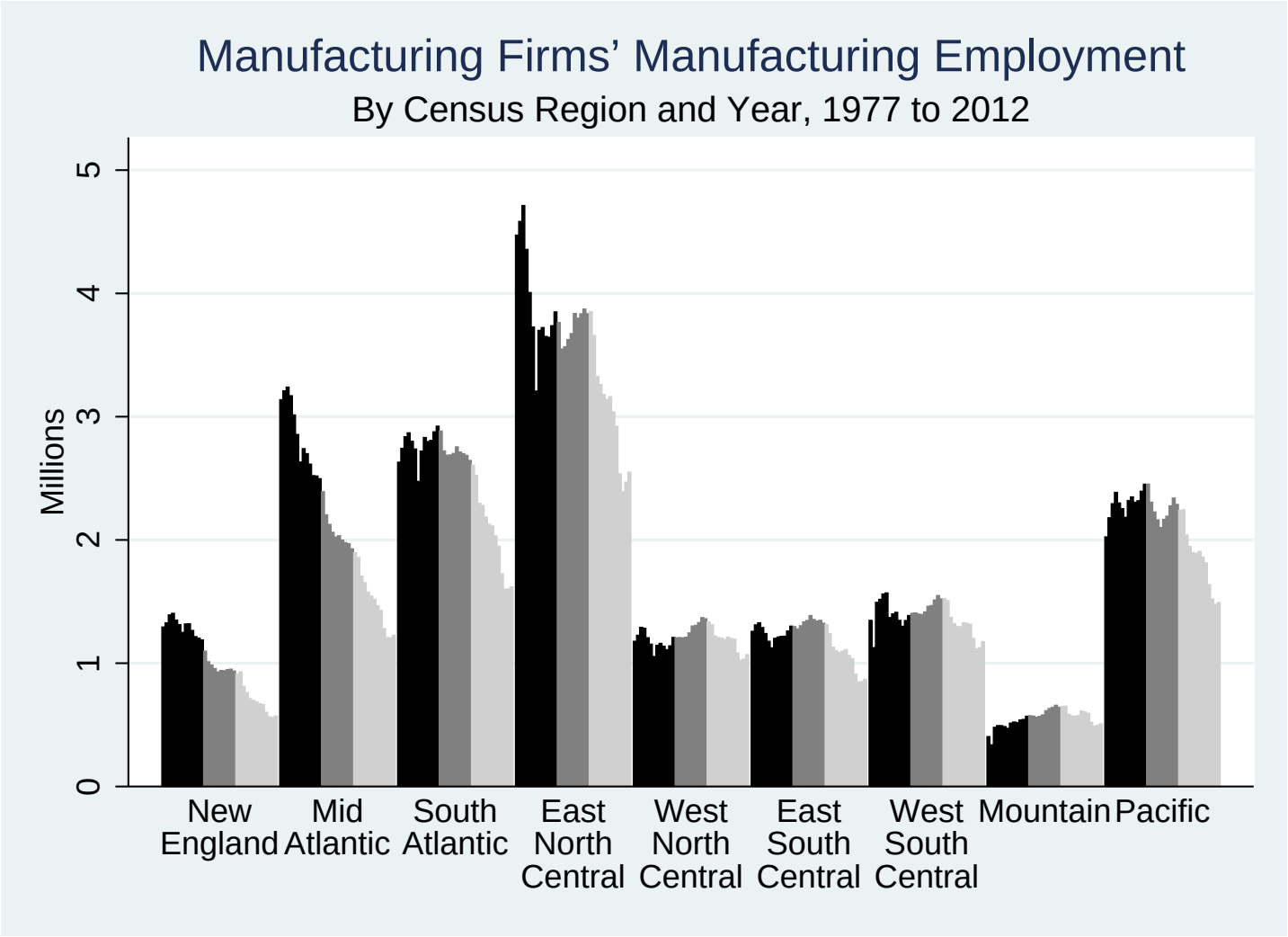


- Average plant size falls 29% from 1977-2012
- Number of plants starts to decline in 1997
- Number of plant births starts to decline in 1995

We examine firm margins by 9 Census regions



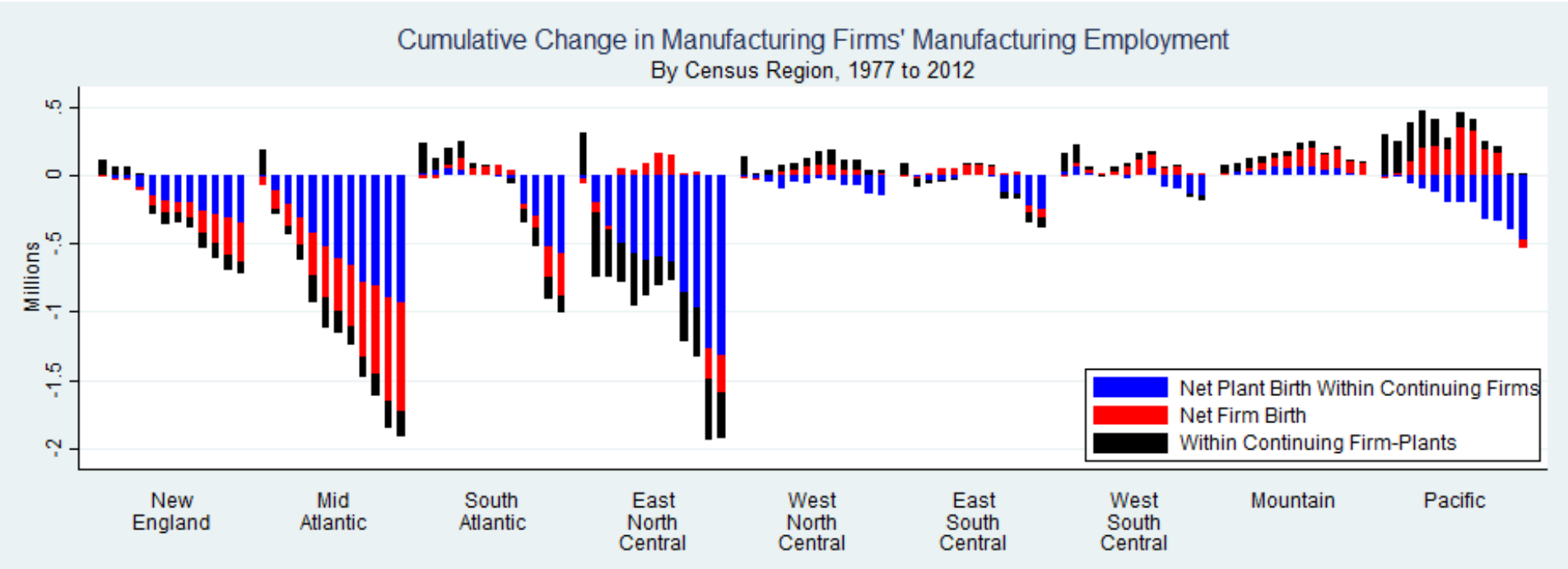
Manufacturing employment differs across these regions



- NE and MA declining throughout
- Many regions grow in 1990s–all decline in 2000s

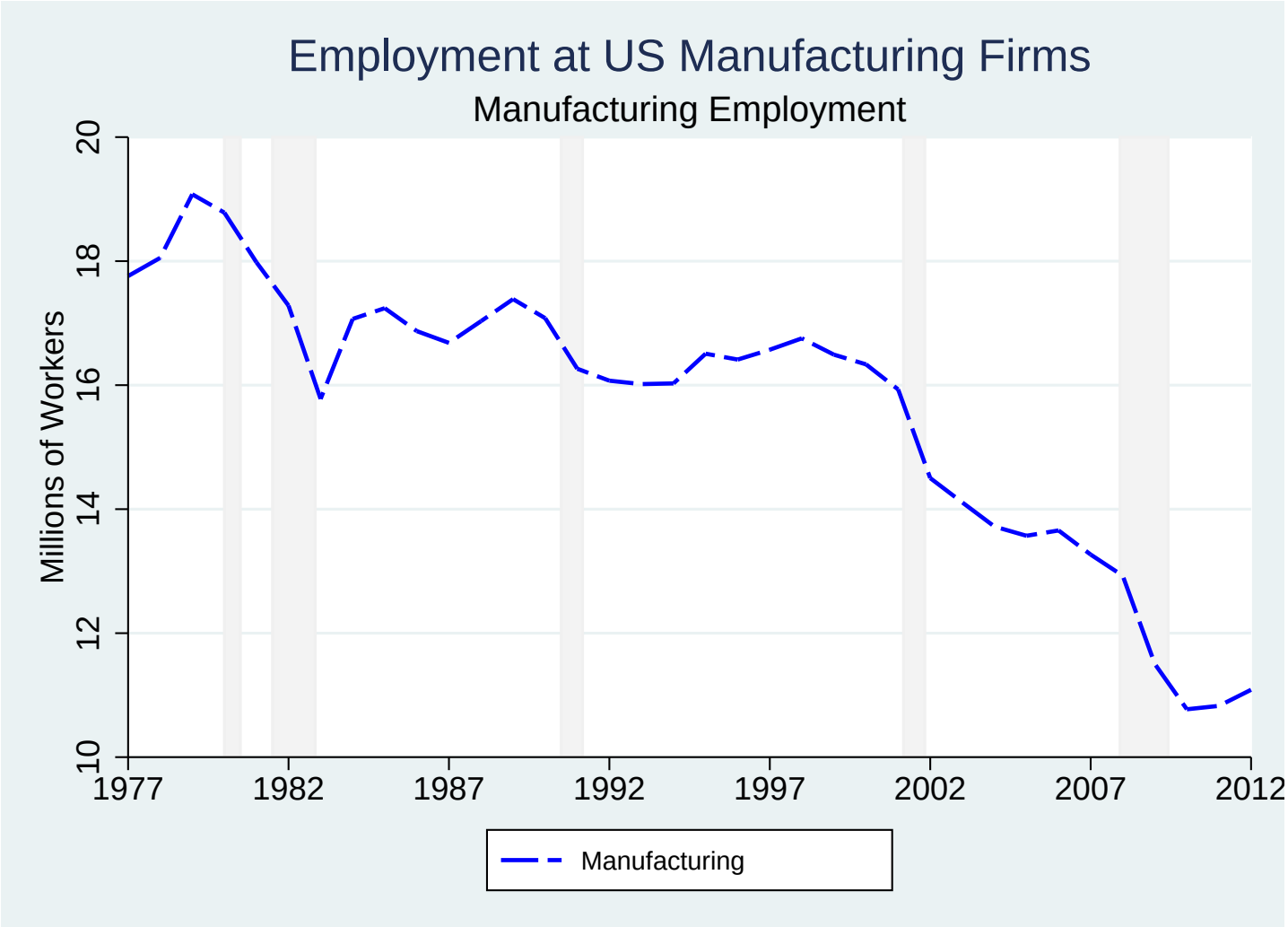
▸ Population

Manufacturing employment margins differ across regions



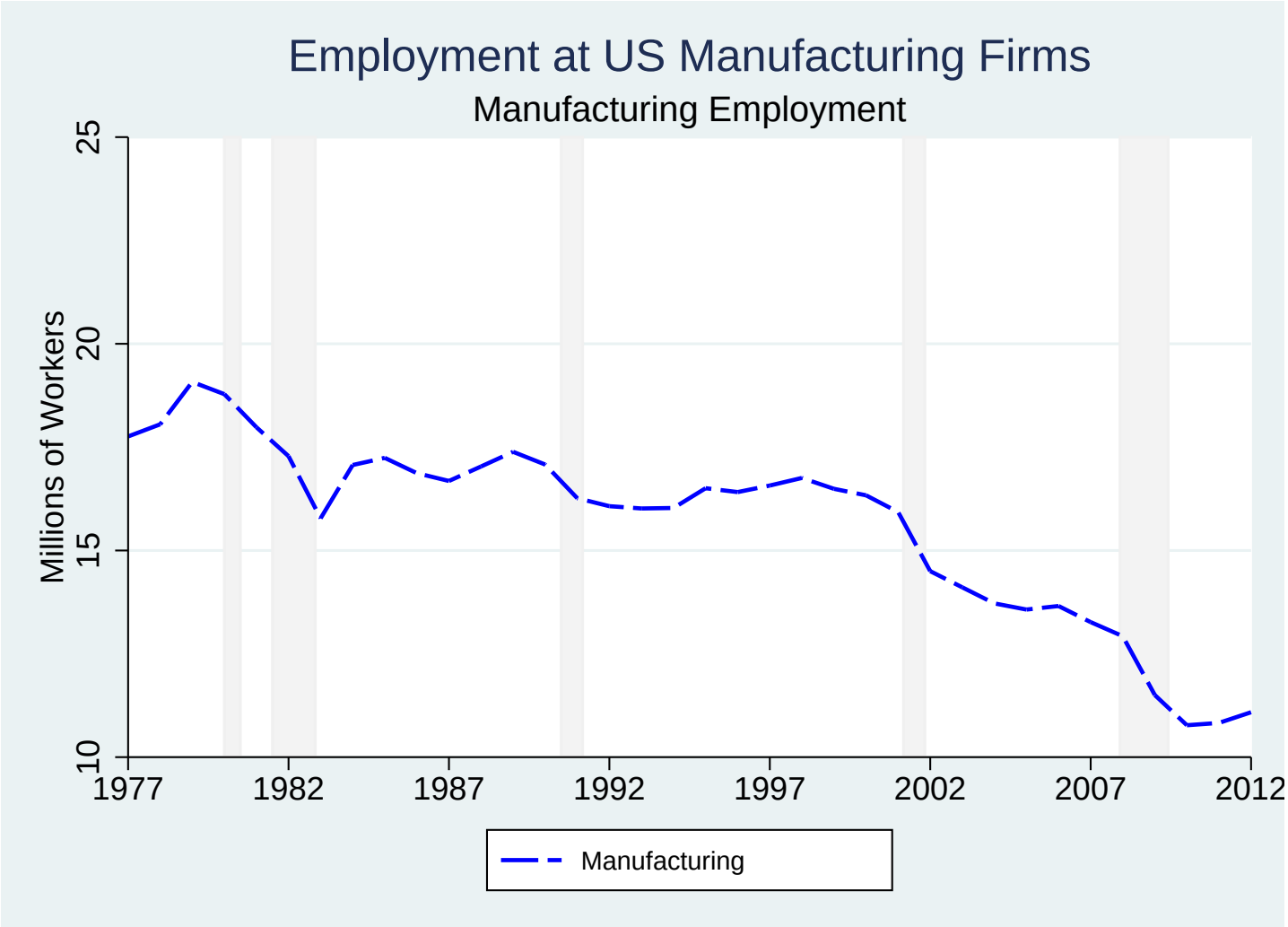
- Majority of emp loss from firm death in NE and Mid-Atlantic
- Mountain and Pacific have net emp gains from firm births

Manufacturing firms have non-manufacturing employment



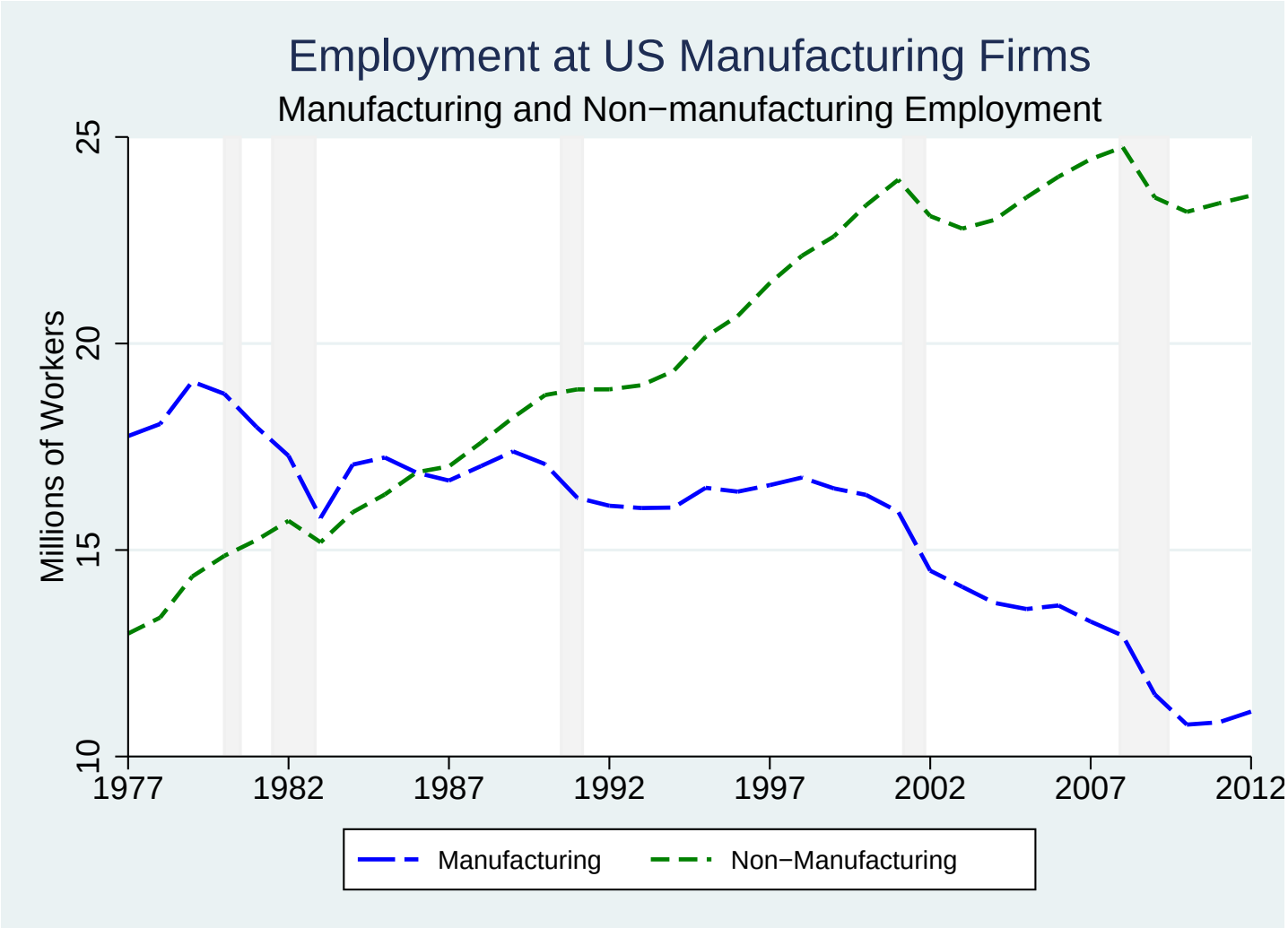
- Manuf firm definition: firm with 1+ manuf estab in 1+ years

Manufacturing firms have non-manufacturing employment



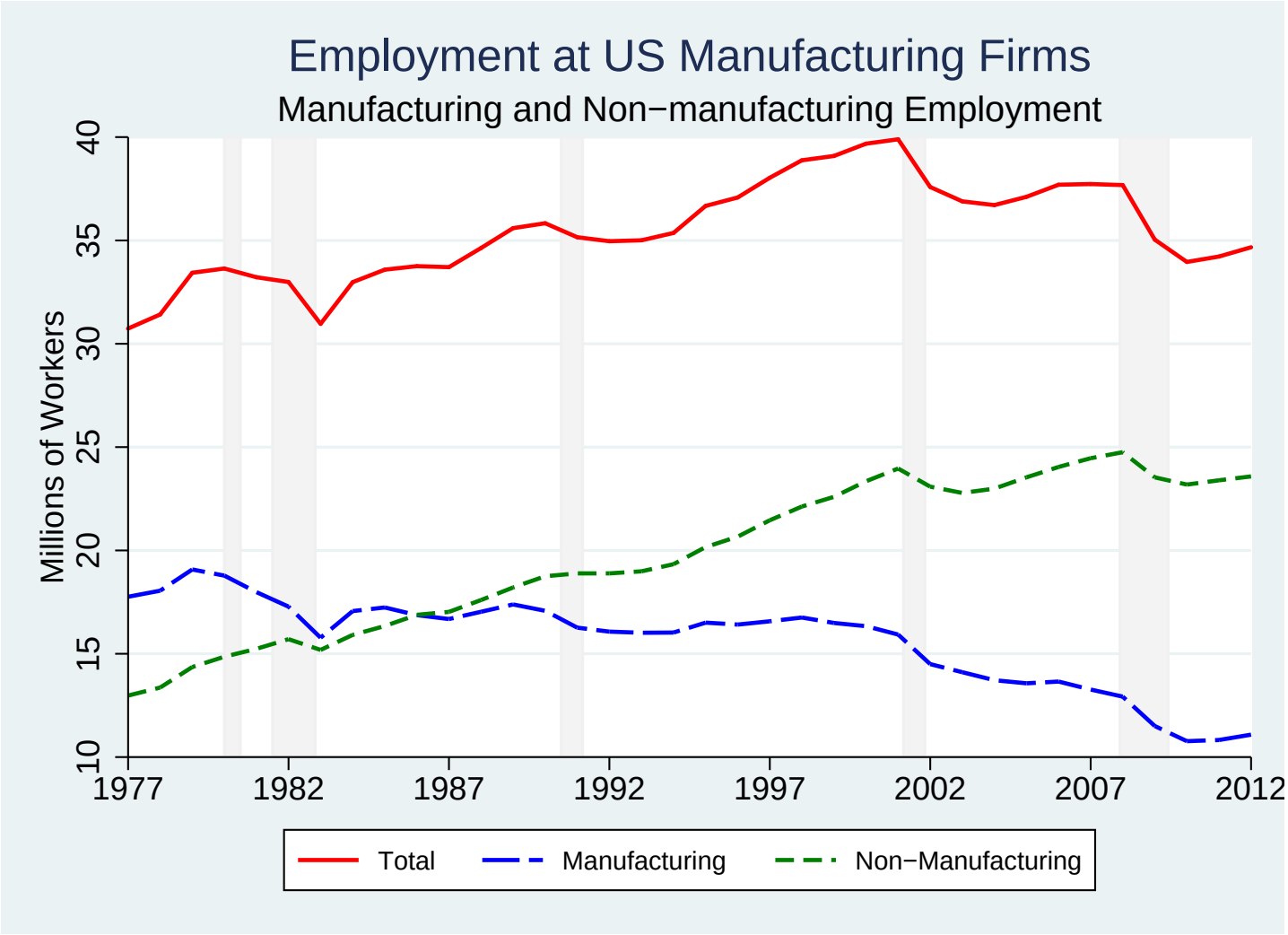
- Manufacturing employment falls by 6.7 M

Manufacturing firms have non-manufacturing employment



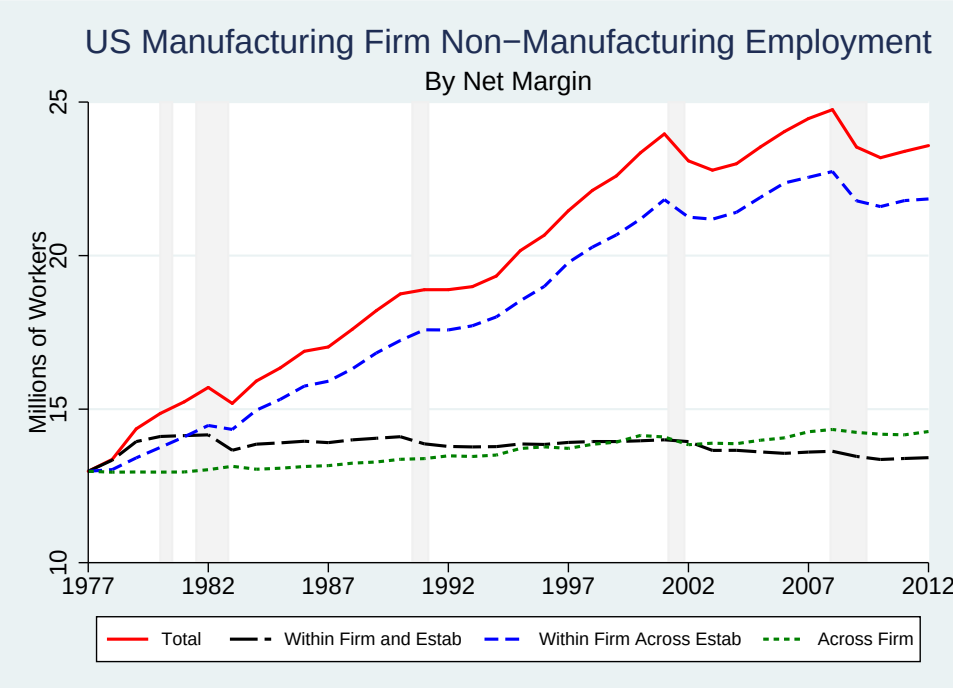
- Manufacturing employment falls by 6.7 M
- Non-manufacturing employment rises by 10.6 M

Manufacturing firms have non-manufacturing employment

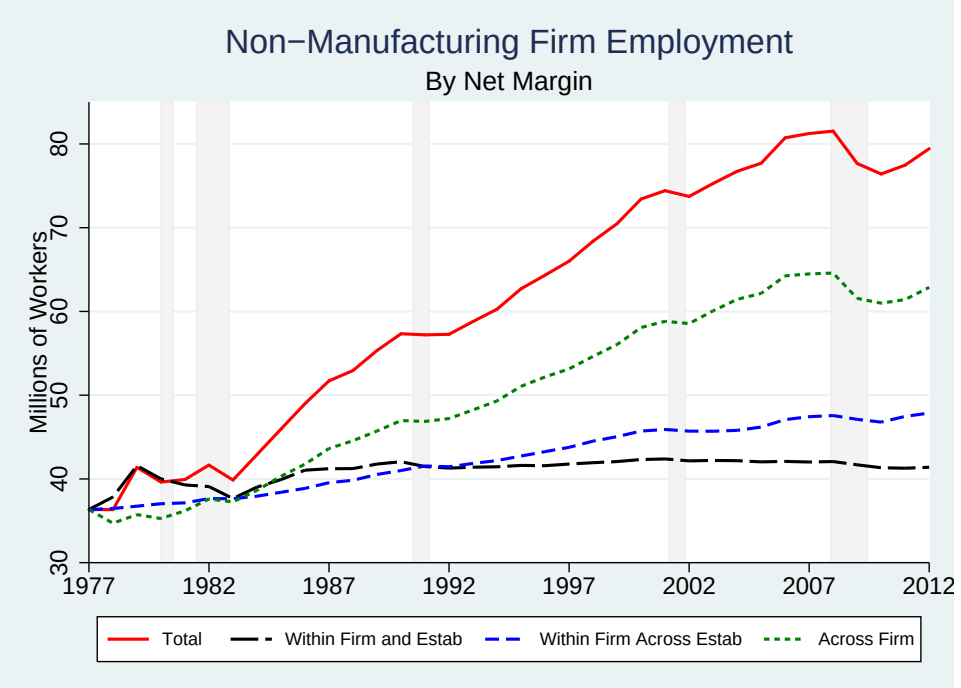


- Manufacturing employment falls by 6.7 M
- Non-manufacturing employment rises by 10.6 M
- Total employment rises by 3.9 M (but falling in 2000s)

Manufacturing firms create net employment at new plants



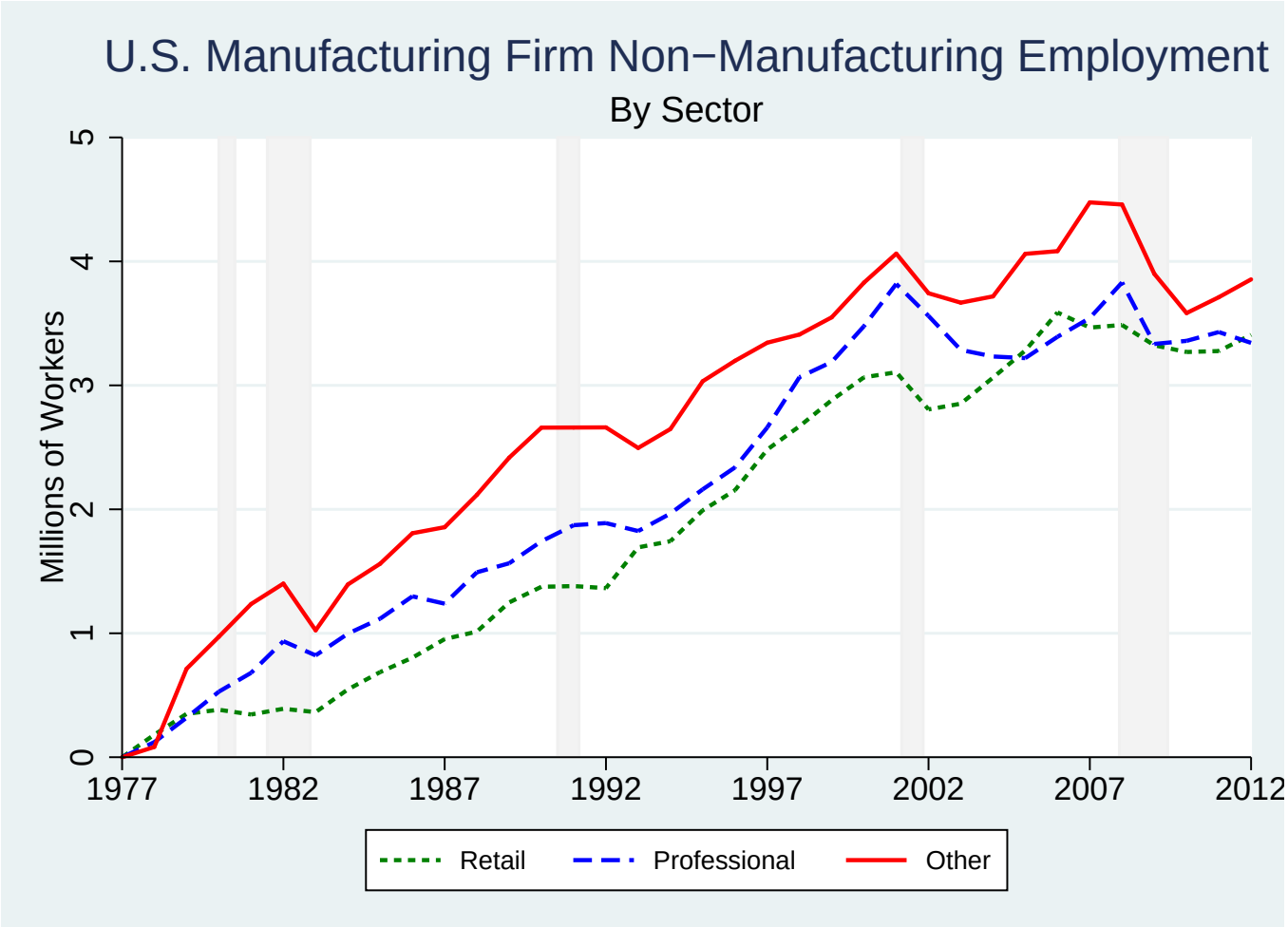
(a) Manufacturing firms



(b) Non-manufacturing firms

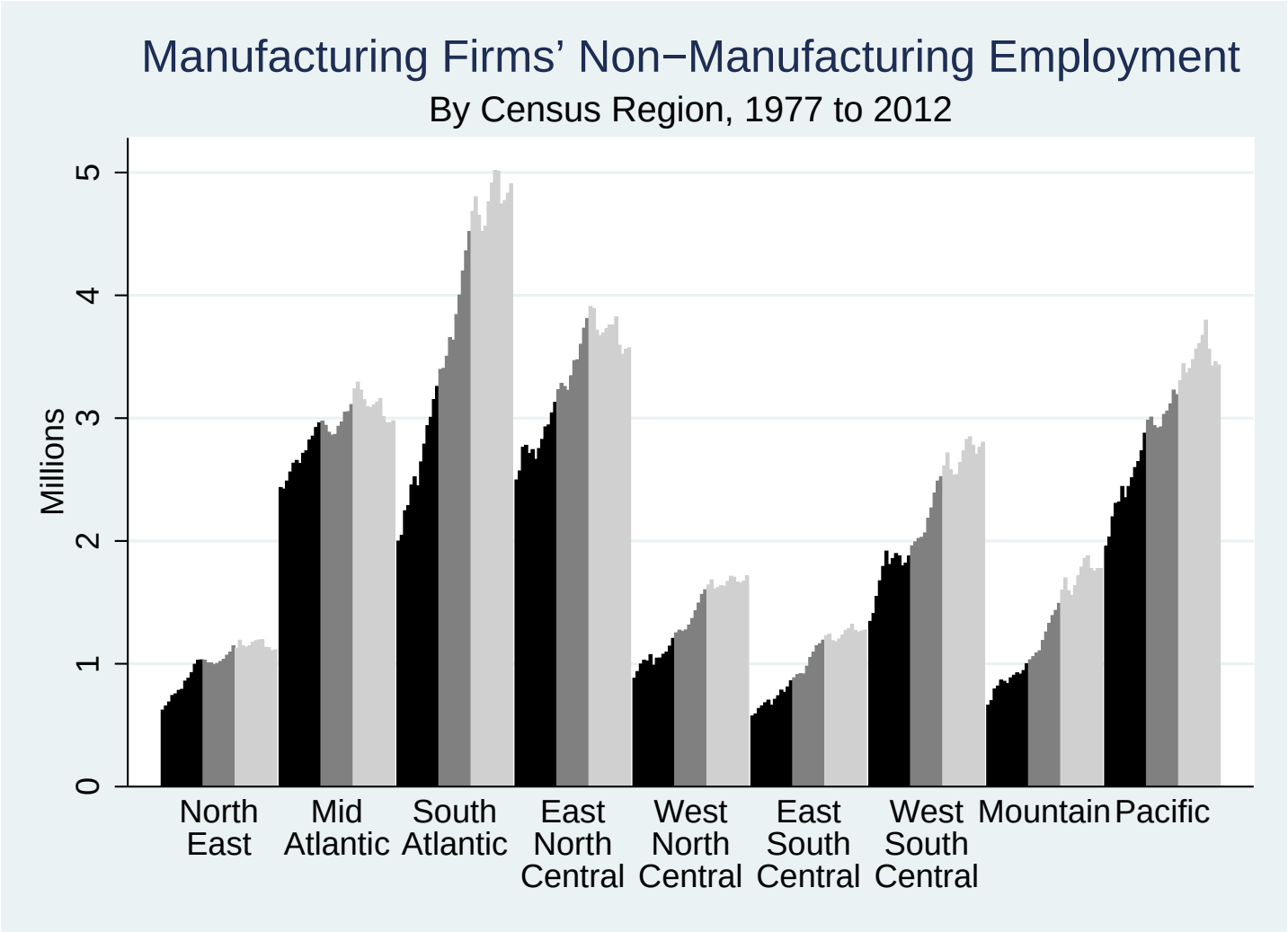
- At manuf firms, 80% of growth within firm, across estabs
- At non-manuf firms, growth driven by new firms

Retail and professional services growth equally important



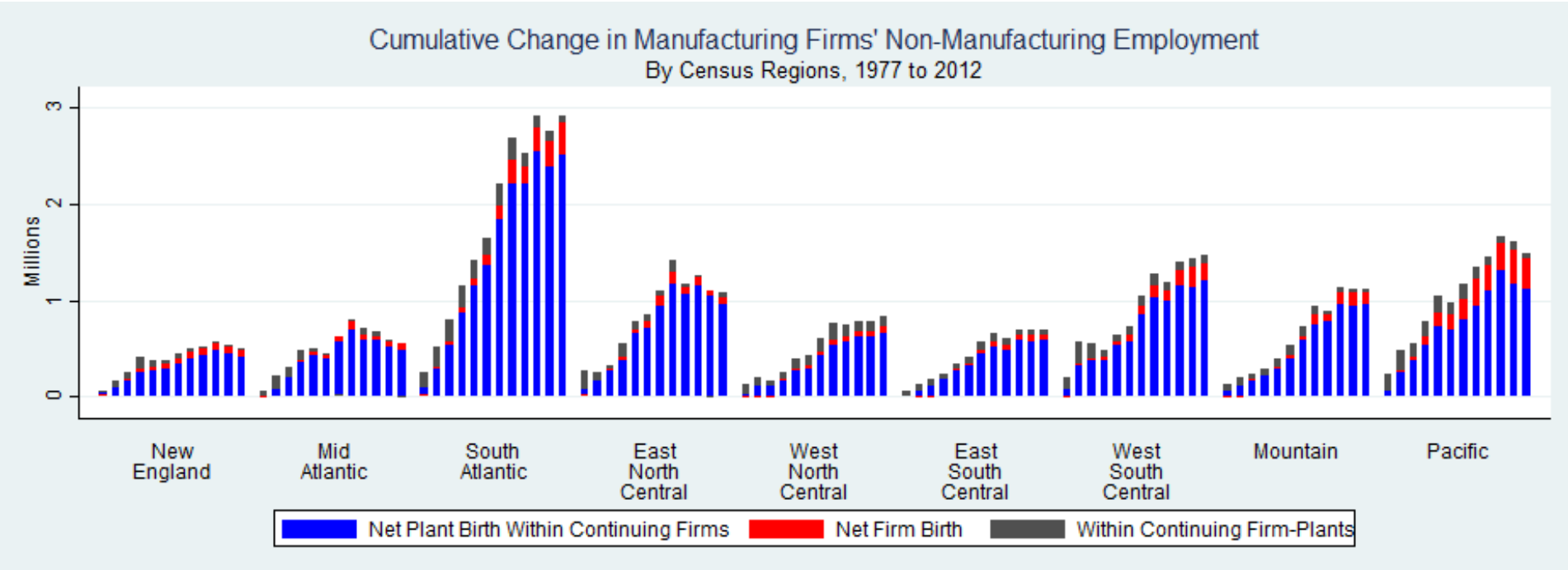
- About 1/3 of growth accounted by each of these categories
- All types recover after 2001 recession, in contrast to manuf emp

Non-manufacturing employment also differs across regions



- Growth across regions in 1980s and 1990s
- Growth in 2000s in several regions

Non-manufacturing employment margins differ across regions

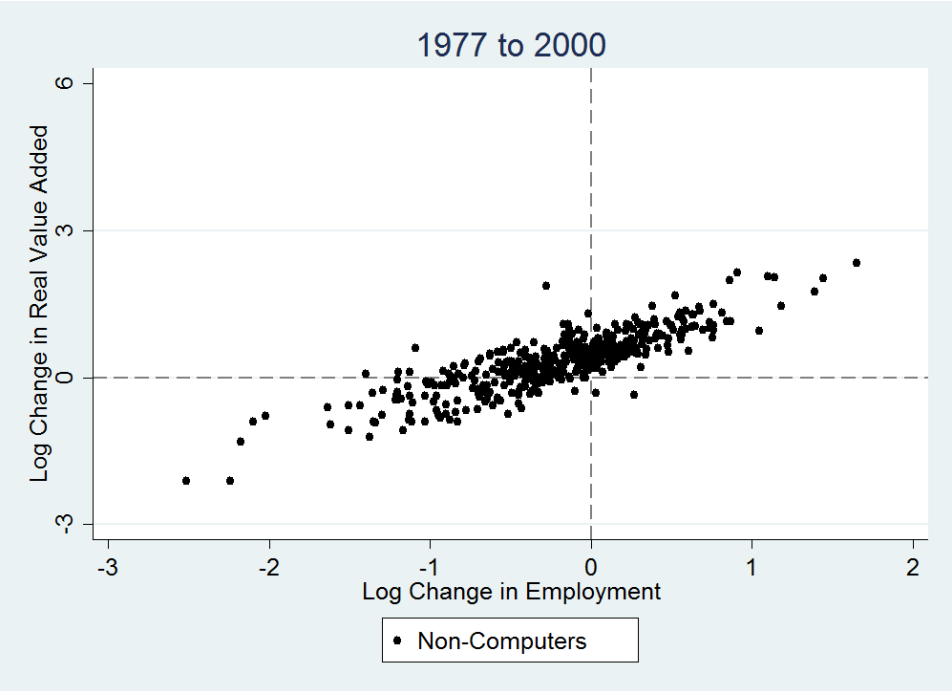


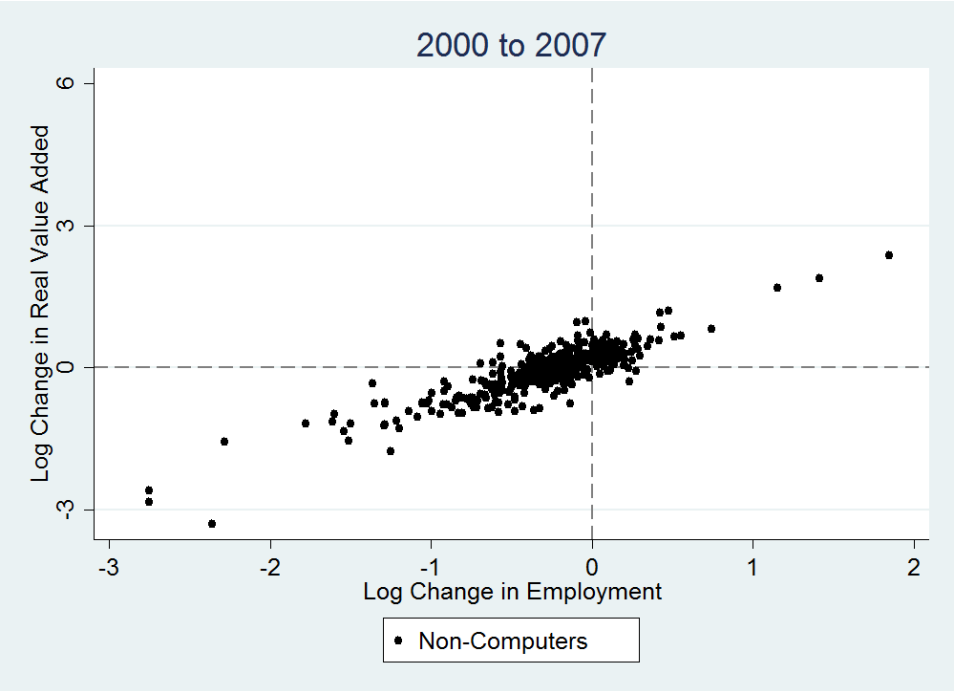
- Net firm birth emp growth concentrated in a few regions
- Net plant birth within continuers dominates margins

Conclusion

- Manufacturing employment is declining, but real output is not
  - Most of the decline is within firm
  - These firms are growing in other (potentially complementary) sectors
- Trade and technology highly interrelated
  - Adopters bigger and more productive
  - Tech and trade adoption premia decline over time
  - Tech and trade relate to survival and growth
- Potential heterogeneity in terms of trade and technology effects
  - Non-traders and non-adopters face increased competition
  - Import competition and foreign sourcing/offshoring not the same

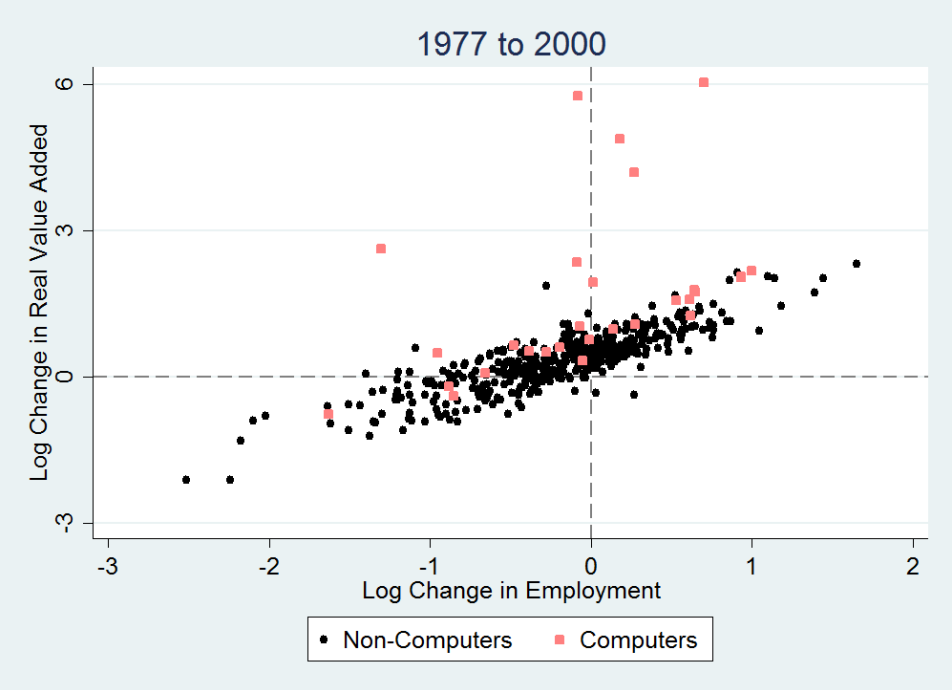
Employment and output diverge within NAICS 6 industries

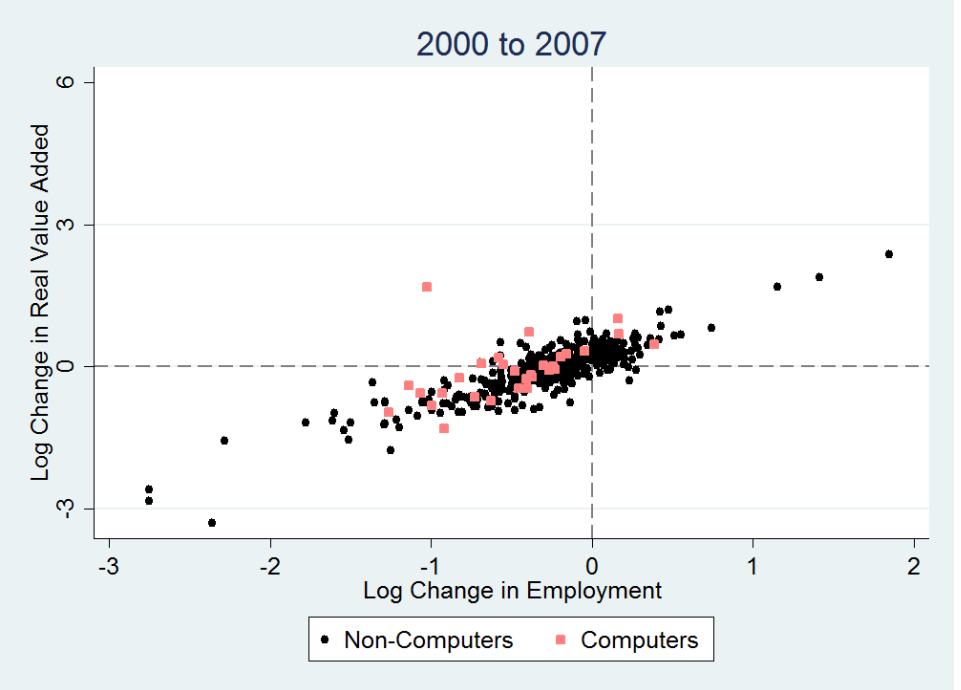




- Outside computers, log changes in emp and RVA correlated
- Outside computers, in 2000s
  - Fewer industries w/emp growth
  - Fewer industries with divergence b/w emp and RVA

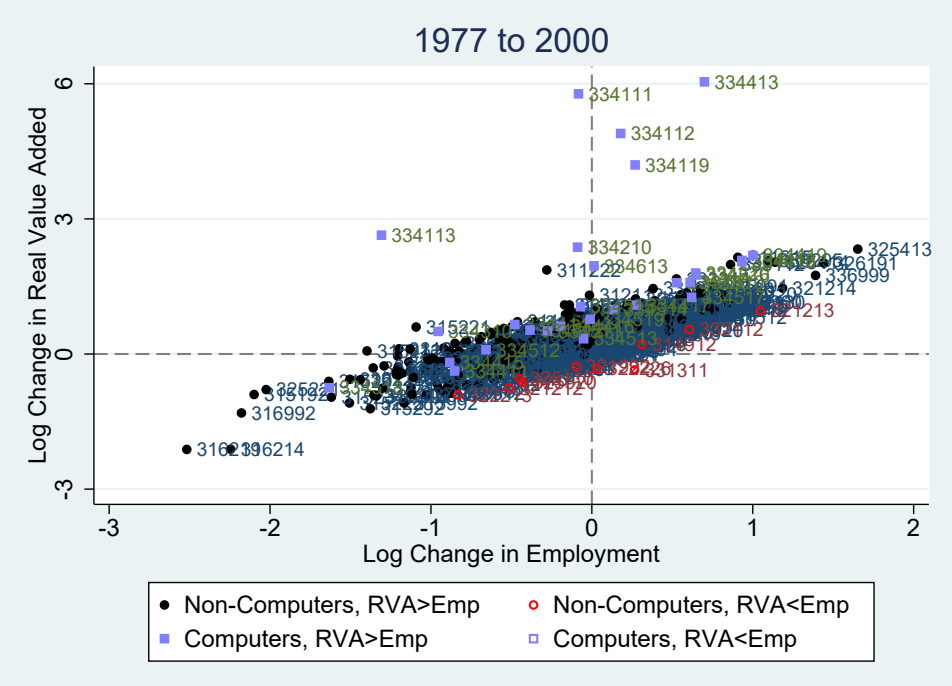
Employment and output diverge within NAICS 6 industries

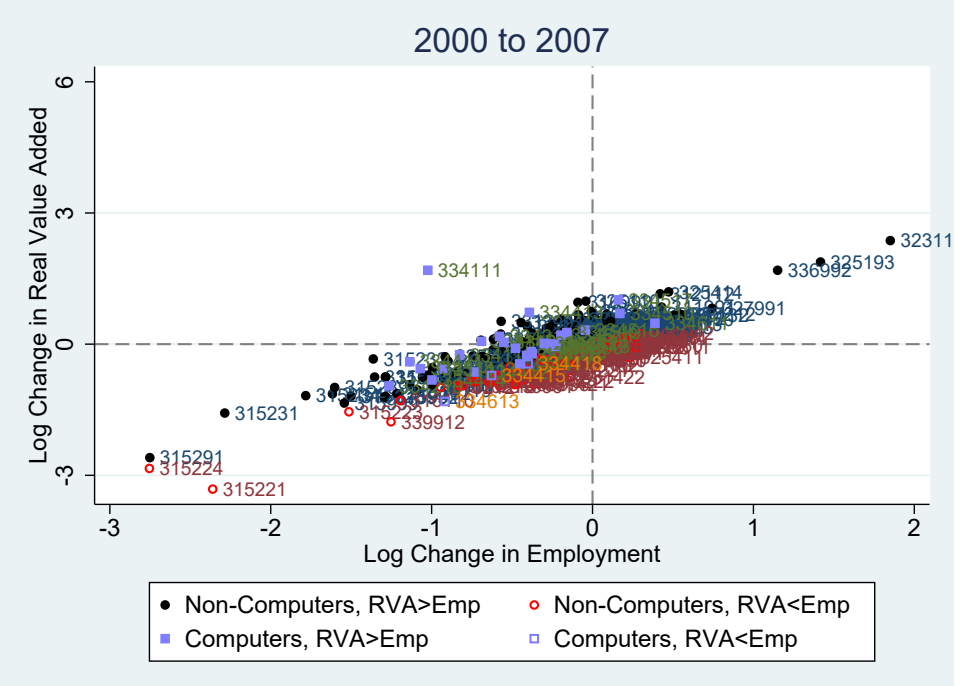




- Higher share of Computer inds with RVA growth pre 2000
- Fewer Computer inds with emp growth in 2000s
- Higher share of Computer inds with divergence b/w emp and RVA

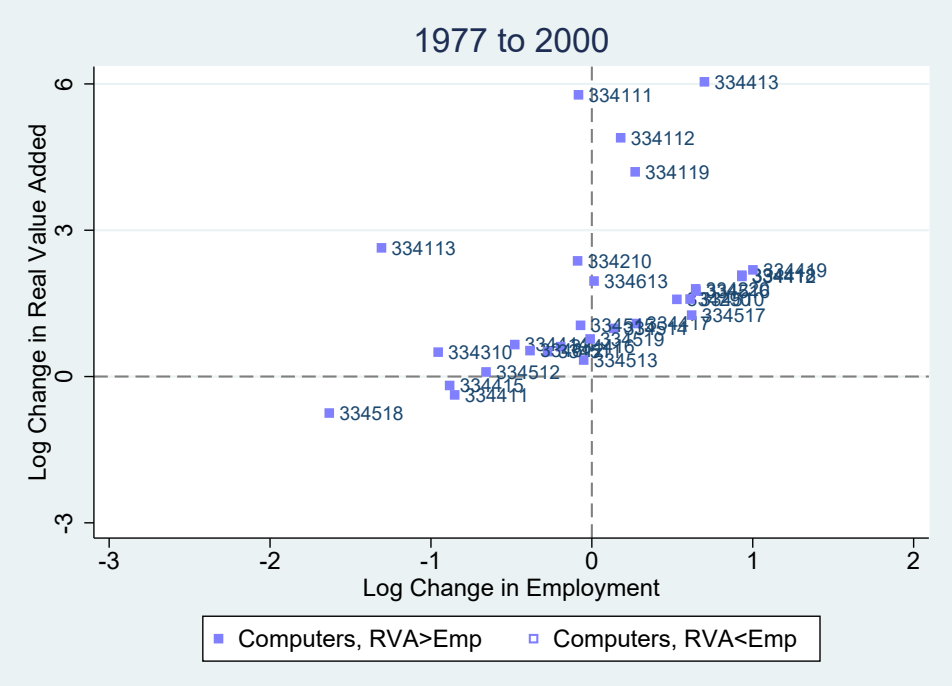
Employment and output diverge within NAICS 6 industries

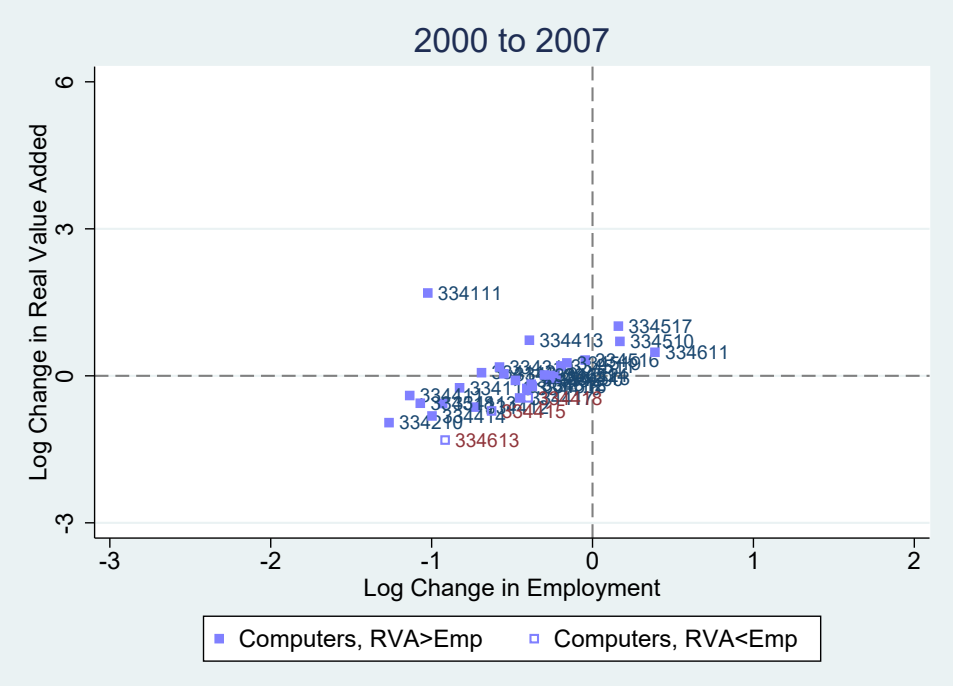




- 334113 is Computer Terminal Manufacturing
- 334111 is Electronic Computer Manufacturing
- 334413 is Semiconductor and Related Device Manufacturing

Just Computers





- 334113 is Computer Terminal Manufacturing
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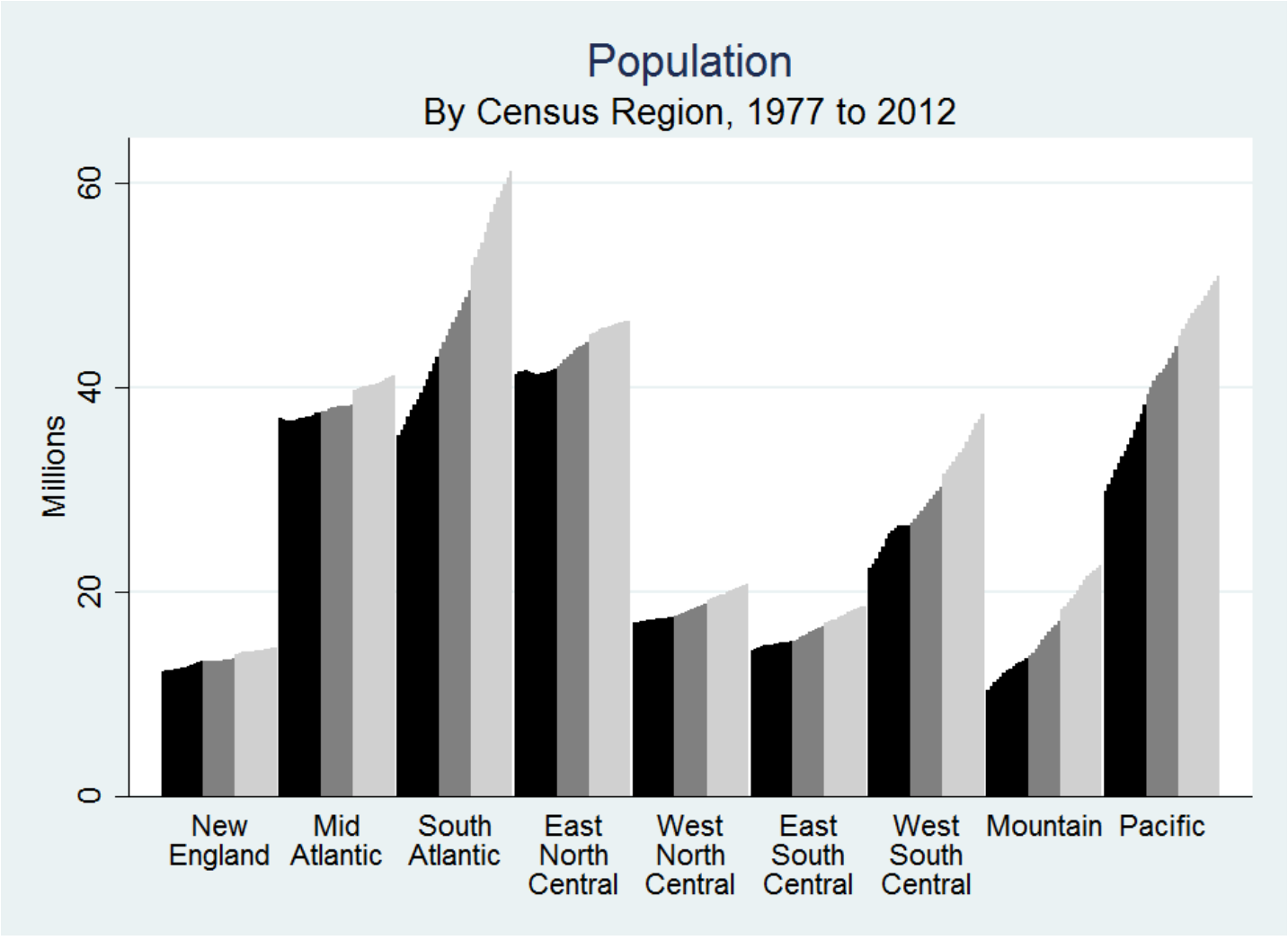
Population across these regions



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