Financial Integration through Production Networks

Indraneel Chakraborty Saketh Chityala Apoorva Javadekar Rodney Ramcharan

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Motivation

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- We know that improved access to bank credit allows plants to expand production.
- But how do plants distribute this bank liquidity through the supply chain? Multiple possibilities:
  - Firms could offer trade credit to downstream firms.
  - Direction of trade credit depends on relative bargaining power of firms in the supply chain: Credit may flow from firms with limited access to bank credit to less constrained firms (Murfin and Njoroge, 2014; Giannetti et al., 2021).
  - Firms may produce more reducing output prices, changing production decisions through the supply chains (Acemoglu et al., 2012).
- Evidence in the literature is from temporary negative shocks during crises.
- Recent work by Adelino, Ferreira, Giannetti, and Pires (RFS, 2022) on Trade Credit Transmission due to ECB's Corporate Sector Purchase Program.
- We investigate how firms respond to persistent increase in the availability of bank liquidity.

Identification Challenges

- Difficult to identify credibly whether and how plants might distribute bank liquidity through the supply chain.
  - plants in a network are similar and subject to common shocks.

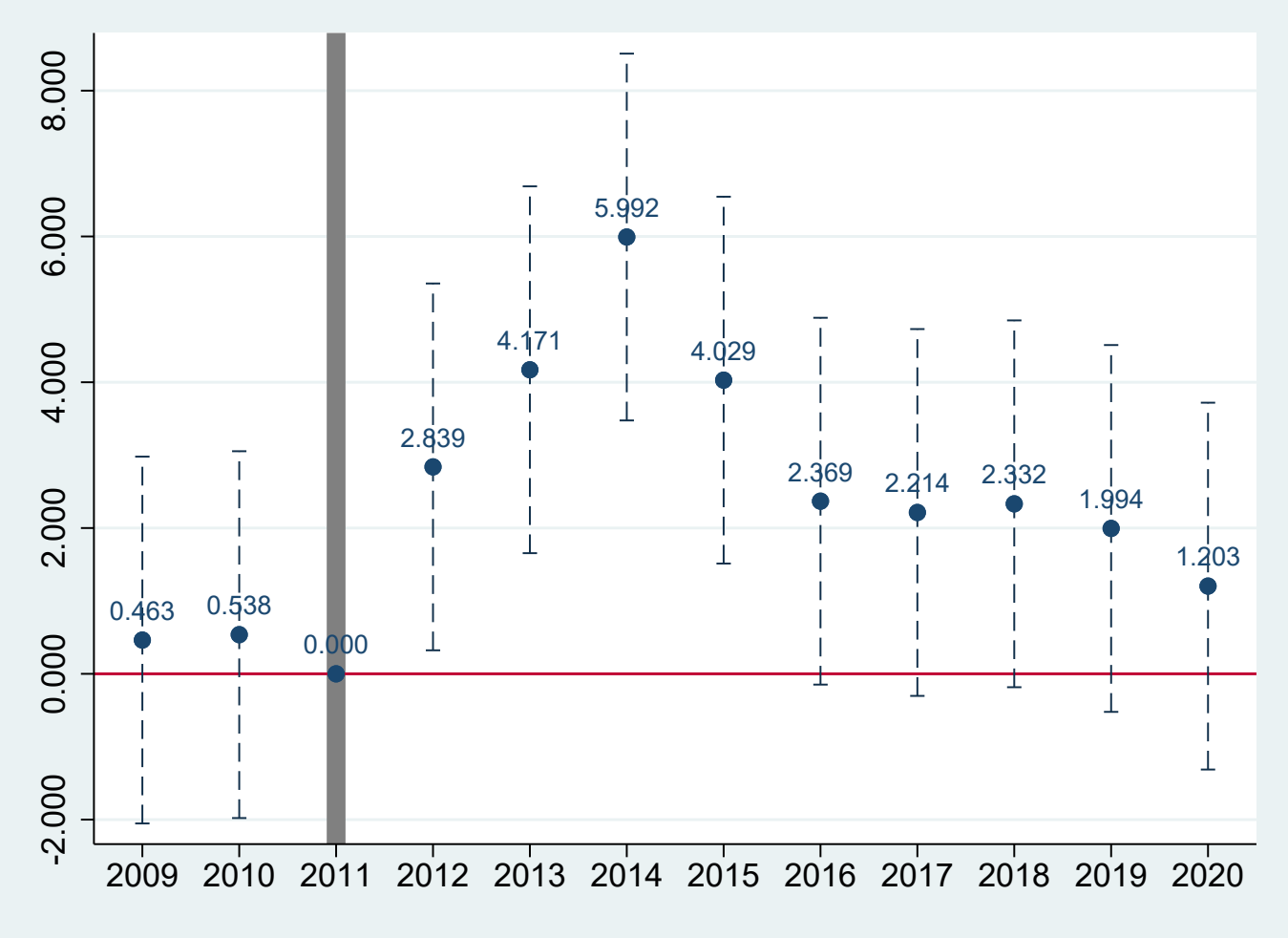
Our Approach

- We use a change in Indian branching regulation in 2011 that affected supply of banking services within very narrow geographic areas.
- Combine this with plant-level data that identify the input-output matrix or production network of each plant.

Regulation: July 2011, “At least 1:1 rule”

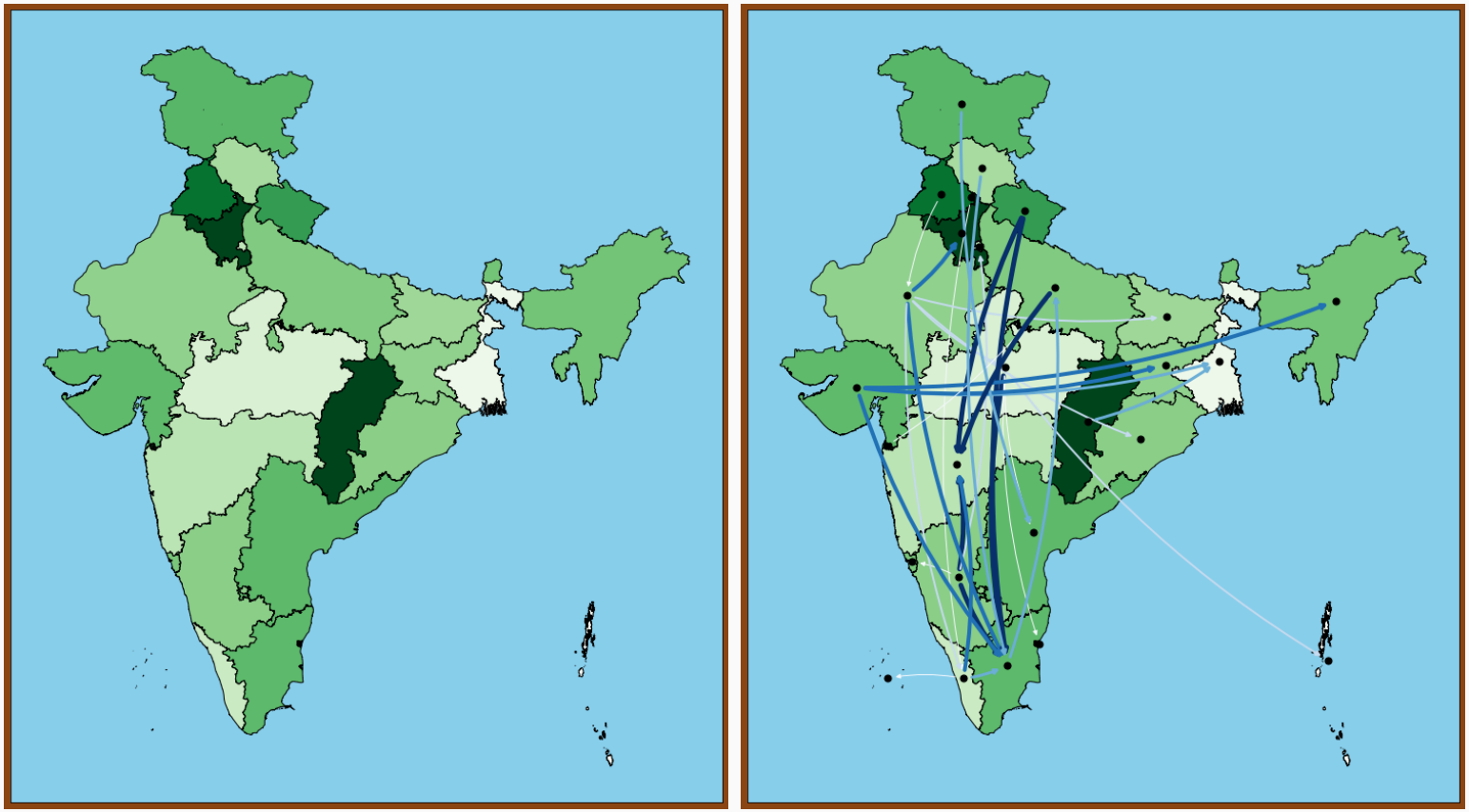
- Banks must open at least equal number of branches in smaller cities as tier 1 or 2 cities.
- Thus, districts with tier 3 cities became more exposed to branch competition after 2011.

Bank Entry due to RBI “1:1” policy



The figure reports the additional entry of banks (number of branches) in districts with tier 3 cities after the Reserve Bank of India adopted the 1:1 Branch Policy (Equation 2 in text).

Trade Credit Growth



Bank branch expansion (left) and trade credit growth with source/destination (right).

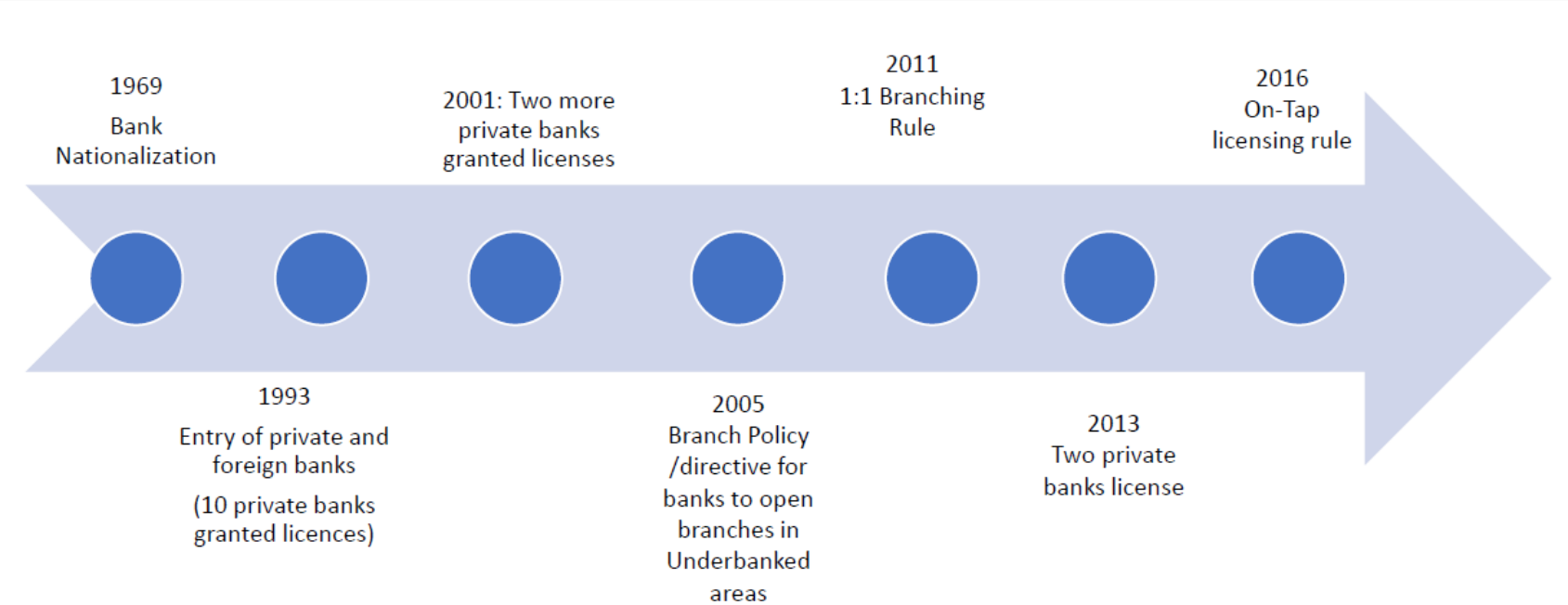
Main Results

- Direct exposure to the spatial banking shock:
  - Significantly affects both real and financial outcomes at directly exposed plants.
  - Exposed plants redistribute liquidity through their production network, increasing short-term financing to other firms in the production network.
- We use the input-output relationships for each plant to understand how supply linkages propagate the granular banking shocks throughout the economy.
  - A parsimonious model to estimate the trade credit multiplier in India in our sample period.
- Directed Technical Change in presence of Labor Market Rigidity.
  - We investigate who extracts the surplus created by additional credit supply (managers extract much more than workers).
- We conclude that labor reforms alongside banking reforms will help ensure that workers benefit further from credit supply.

Outline

Background and Data

Bank Entry due to RBI “1:1” policy



The figure provides a timeline of policy actions taken by the Reserve Bank of India regarding bank entry.

Data Sources

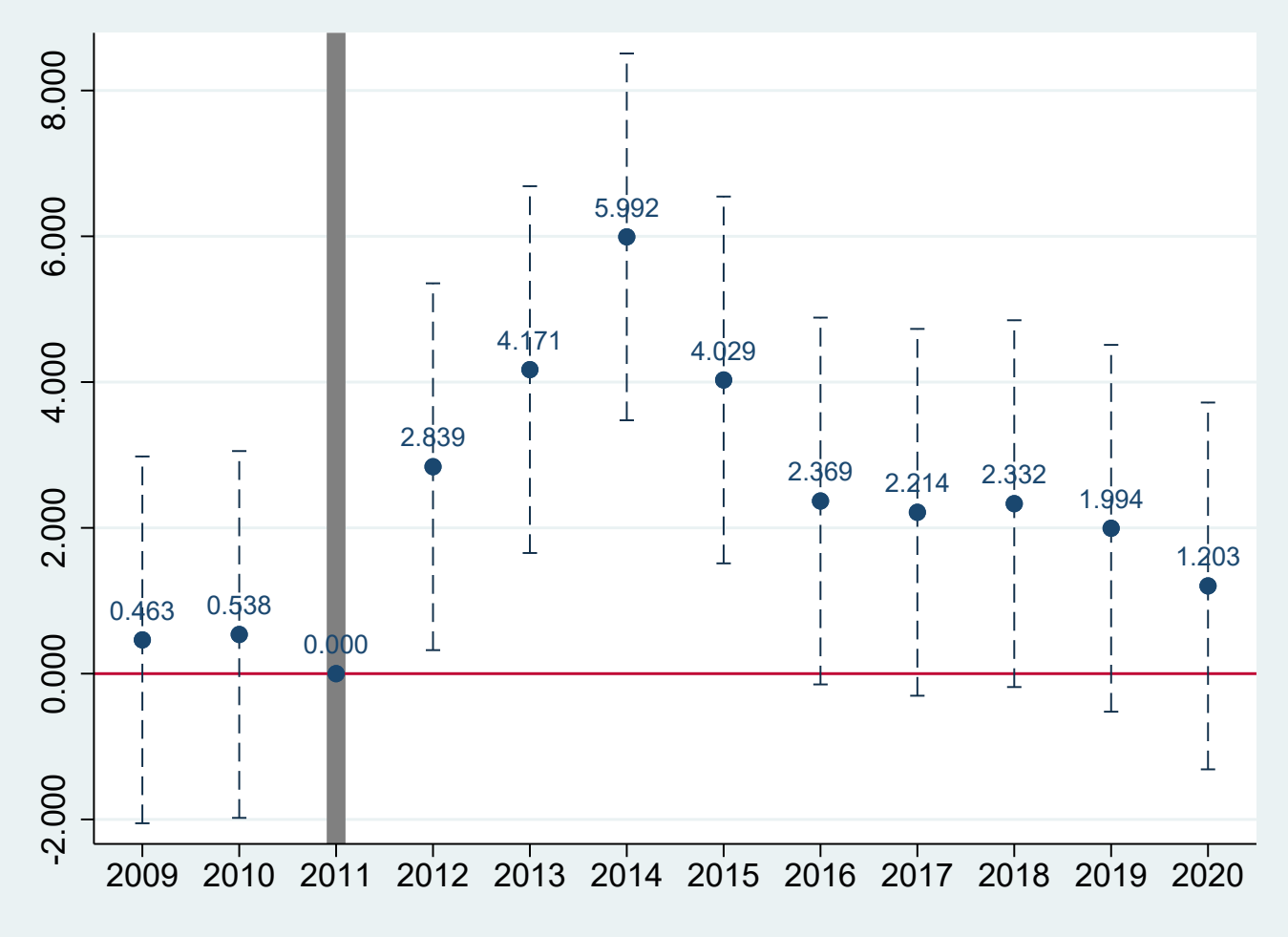
- Annual Survey of Industries (ASI) database: plant-level financial and productivity variables.
- Reserve Bank of India's (RBI) Basic Statistical Returns (BSR): aggregate annual banking deposits and credit data at the district-level. The returns also divide the deposits and credit data by the type of banks - namely public sector and private banks.
- Annual data since 2005 on newly opened branches within each district, divided by the type of bank.

Identification Through Regulation

The 2011 Rule

- To foster financial inclusion among the historically underbanked population.
- Banks had to follow an “at least 1:1 rule” in their branch location decisions after 2011: must open at least as many branches in tier 3+ districts as top tier districts.
    - Tier 1 cities have a population above 100,000
    - Tier 2 cities have 99,999–50,000 people
    - Tier 3 cities have 49,999–20,000 people
    - Tier 4: 19,999–10,000
    - Tier 5: 9,999–5,000 and tier 6: less than 5,000 people.

Bank Entry due to RBI “1:1” policy



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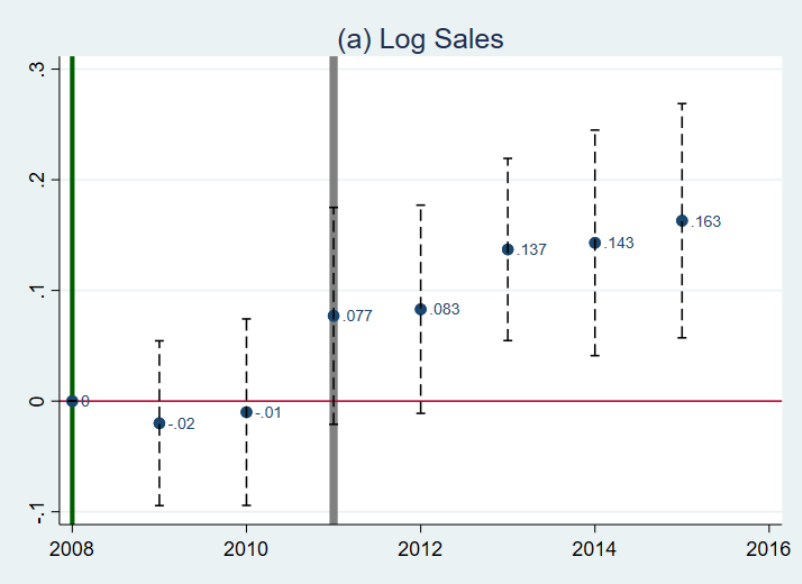
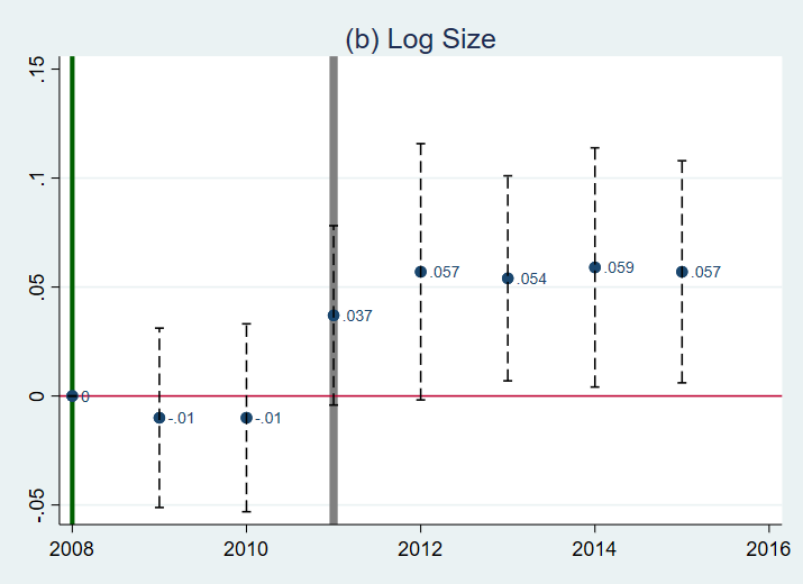
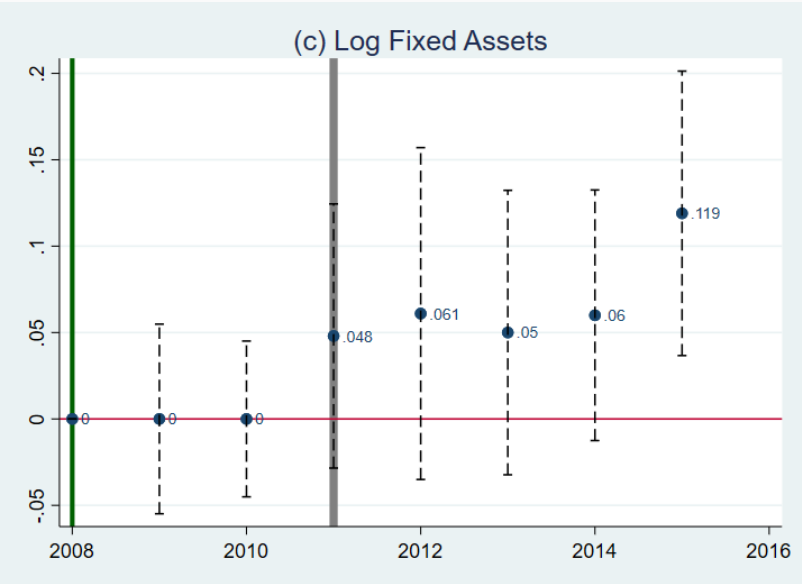
⏩ Bank Entry Regressions

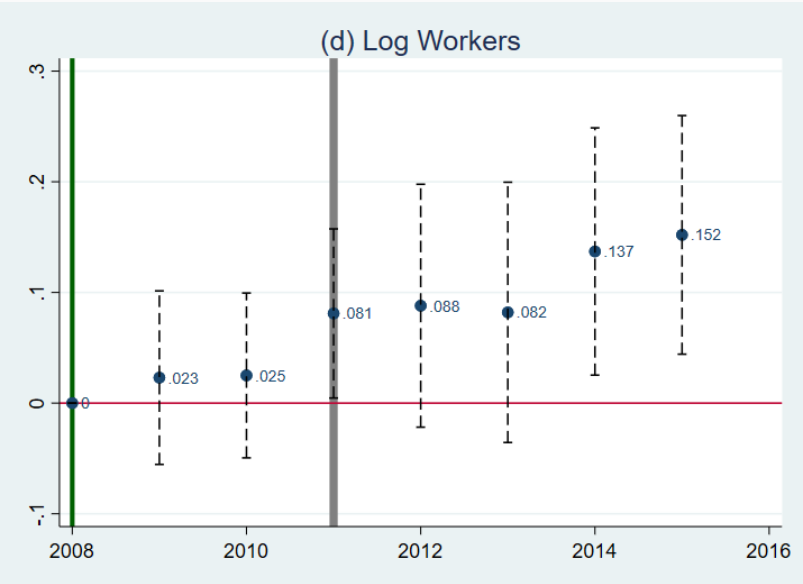
Direct Impact of Branching Expansion

Yearly Effects of Bank-Entry on Plant Outcomes









Bank Entry and Real Plant Outcomes

Panel A: Baseline Results

	Log Sales (1)	Log Plant Size (2)	Log Investment (3)	Log Employment (4)	Log TFP (5)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	0.1081***	0.0628***	0.0745***	0.0415***	0.0376***
	(0.0217)	(0.0166)	(0.0268)	(0.0147)	(0.0144)
Observations	157,420	172,700	172,814	172,644	157,467
Adjusted R^2	0.9287	0.9609	0.9328	0.9302	0.7239

Panel B: Larger districts

	Log Sales (1)	Log Plant Size (2)	Log Investment (3)	Log Employment (4)	Log TFP (5)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	0.1233***	0.0669***	0.0837***	0.0432***	0.0468***
	(0.0229)	(0.0182)	(0.0291)	(0.0164)	(0.0165)
Observations	145,742	160,115	160,220	160,100	145,751
Adjusted R^2	0.9276	0.9602	0.9307	0.9296	0.6971
Plant FE	Y	Y	Y	Y	Y
Industry$\times$Year FE	Y	Y	Y	Y	Y
Pre-Size$\times$Post FE	Y	Y	Y	Y	Y
Pre-Age$\times$Post FE	Y	Y	Y	Y	Y

⏩ Population Trends

⏩ Matching Results

Bank Entry and Labor Market Outcomes

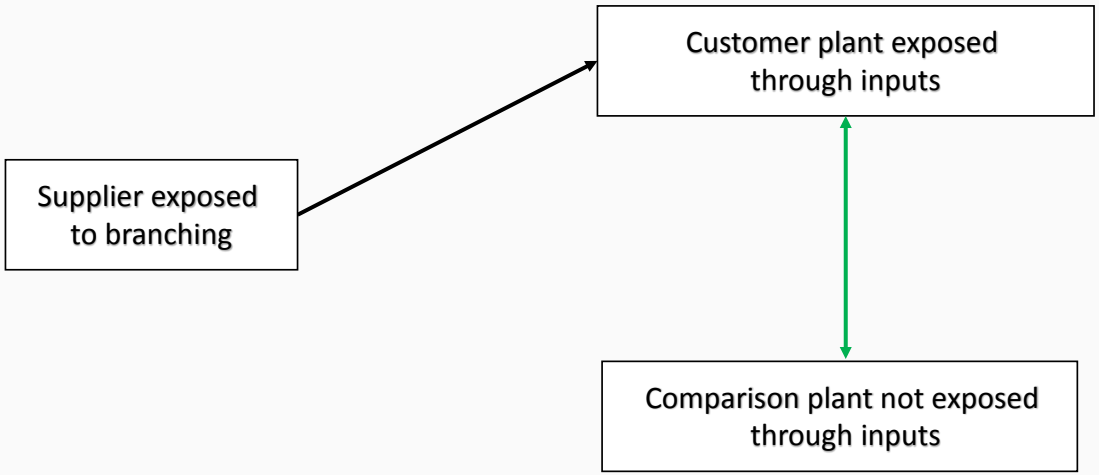
	Log Managers (1)	Log Workers (2)	Output Per Worker (3)	Wages Per Employee (4)	Wages Per Manager (5)	Wages Per Worker (6)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	0.0313	0.0391**	0.0602***	0.0351***	0.0286	0.0317***
	(0.0249)	(0.0162)	(0.0179)	(0.0099)	(0.0277)	(0.0118)
Plant FE	Y	Y	Y	Y	Y	Y
Industry$\times$Year FE	Y	Y	Y	Y	Y	Y
Pre-Size$\times$Post FE	Y	Y	Y	Y	Y	Y
Pre-Age$\times$Post FE	Y	Y	Y	Y	Y	Y
Observations	158,932	171,807	143,352	172,539	158,434	171,731
Adjusted R^2	0.8635	0.9195	0.8149	0.8324	0.7583	0.7856

Bank Entry and Financial Outcomes

	Cash / Assets (1)	Cash / Current Liabilities. (2)	Log Bank-Debt (3)	Log A/C Receivable (4)	A/C Receivable / Sales (5)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	-0.0071**	-0.0956**	0.0664**	0.1056***	-0.0074
	(0.0030)	(0.0439)	(0.0261)	(0.0244)	(0.0064)
$\mathbb{1}$(High Profitability)					-0.0676***
					(0.0152)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(High Profitability)					0.0348**
					(0.0158)
$\mathbb{1}$(Post) $\times$ $\mathbb{1}$(High Profitability)					0.0255***
					(0.0082)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post) $\times$ $\mathbb{1}$(High Profitability)					-0.0263***
					(0.0092)
Plant FE	Y	Y	Y	Y	Y
Industry$\times$Year FE	Y	Y	Y	Y	Y
Pre-Size$\times$Post FE	Y	Y	Y	Y	Y
Pre-Age$\times$Post FE	Y	Y	Y	Y	Y
Observations	172,700	163,756	144,076	160,116	157,382
Adjusted R^2	0.4956	0.5562	0.8367	0.8457	0.5679

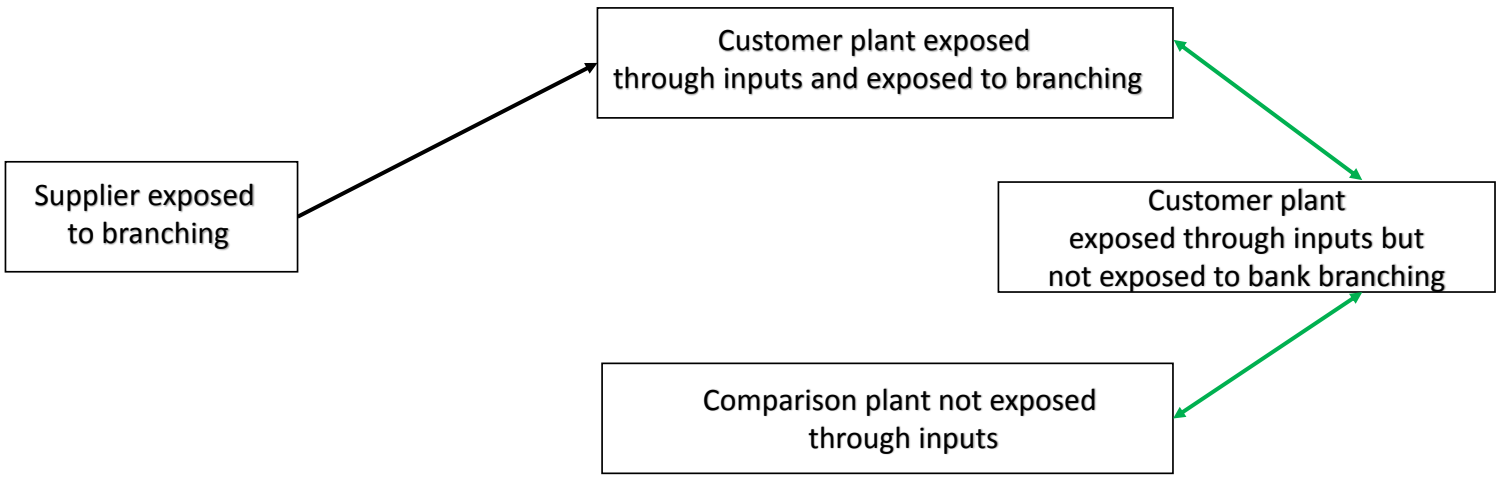
Spillover Effects

Identification: Conceptual



Comparison of plants exposed to treatment through inputs vs. plants not exposed to treatment through inputs

Identification: Conceptual (contd.)



Comparison of plants exposed to treatment through inputs + not exposed to bank branch expansion with the rest

Bank Entry and Spillover of Financial Outcomes

	Payables/ Assets (1)	Payables/ Debt (2)	Payables/ Assets (3)	Payables/ Debt (4)	Payables/ Assets (5)	Payables/ Debt (6)
$\mathbb{1}$(Post)×	0.0807**	0.1134**	0.0341	0.0442	-0.0158	0.0008
Input Exposure to Treatment	(0.0402)	(0.0518)	(0.0449)	(0.0661)	(0.0515)	(0.0767)
$\mathbb{1}$(Post)×			-0.0335***	-0.0448***	-0.0369***	-0.0467**
$\mathbb{1}$(Low Plant Treatment Intensity)			(0.0126)	(0.0163)	(0.0124)	(0.0182)
$\mathbb{1}$(Post)×			0.1199*	0.1749**	0.1413**	0.1867**
Input Exposure to Treatment ×			(0.0623)	(0.0777)	(0.0611)	(0.0879)
$\mathbb{1}$(Low Plant Treatment Intensity)						
Change in input prices					0.0007	-0.0001
					(0.0008)	(0.0012)
Industry×Year FE	Y	Y	Y	Y	Y	Y
Pre-Size×Post FE	Y	Y	Y	Y	Y	Y
Pre-Age×Post FE	Y	Y	Y	Y	Y	Y
Observations	165,540	161,685	165,540	161,685	139,681	136,990
Adj. R-sq	0.5737	0.6385	0.5739	0.6386	0.5773	0.6454

Bank Entry and Spillover of Financial Outcomes: Competition Channel

	Log Payables	Payables/ Assets	Payables/ Debt
	(1)	(2)	(3)
𝟙(Post)×	-0.1218	0.0291	0.0187
Input Exposure to Treatment	(0.3772)	(0.0517)	(0.0742)
𝟙(Post)×	-0.2690**	-0.0196	-0.0413*
Low Supplier Competition	(0.1177)	(0.0151)	(0.0213)
𝟙(Post)×	1.3952**	0.1234*	0.2295**
Input Exposure to Treatment×	(0.5559)	(0.0723)	(0.1054)
Low Supplier Competition			
Industry×Year FE	Y	Y	Y
Pre-Size×Post FE	Y	Y	Y
Pre-Age×Post FE	Y	Y	Y
Observations	154,987	165,540	161,685
Adj R-sq	0.8478	0.5737	0.6385

Bank Entry and Spillover of Real Outcomes

	Baseline			Low Plant Treatment Intensity		
	Log Sales	Log Employment	Log TFP	Log Sales	Log Employment	Log TFP
	(1)	(2)	(3)	(4)	(5)	(6)
$\mathbb{1}$(Post)×	0.7143***	0.4257***	0.4860***	1.0703***	0.5592***	0.6088***
Input Exposure to Treatment	(0.2116)	(0.1470)	(0.1352)	(0.3496)	(0.1929)	(0.2151)
Plant FE	Y	Y	Y	Y	Y	Y
Industry×Year FE	Y	Y	Y	Y	Y	Y
Pre-Size×Post FE	Y	Y	Y	Y	Y	Y
Pre-Age×Post FE	Y	Y	Y	Y	Y	Y
Observations	157,721	165,407	157,738	51,050	54,578	51,074
Adjusted R^2	0.9289	0.9314	0.7225	0.9269	0.9364	0.7266

Estimation of Credit Network Multiplier

Producer firm's profit maximization problem is thus as follows:

$$\max_{c,y} p.y - r(K + c), \tag{1}$$

where p is the product price, and where demand y is spurred by credit c offered by the firm in question as follows:

$$y = a - b_p p + b_c c^{\theta}. \tag{2}$$

where b_p and b_c denote the sensitivity of demand to the price and the trade-credit extended. The first order condition for c yields optimal credit c^* for a given level of capital K:

$$c^* = \left(\frac{b_c \theta}{r b_p} \cdot y \right)^{\frac{1}{1-\theta}}, \tag{3}$$

Optimal Trade Credit

We take logarithms to obtain an equation that can be easily estimated: the relation between quantity y or capital K and credit supply c^* is given by:

$$\ln c^* = \frac{\alpha}{1-\theta} \ln K + \frac{1}{1-\theta} \ln \frac{A\theta b_c}{r b_p} \tag{4}$$

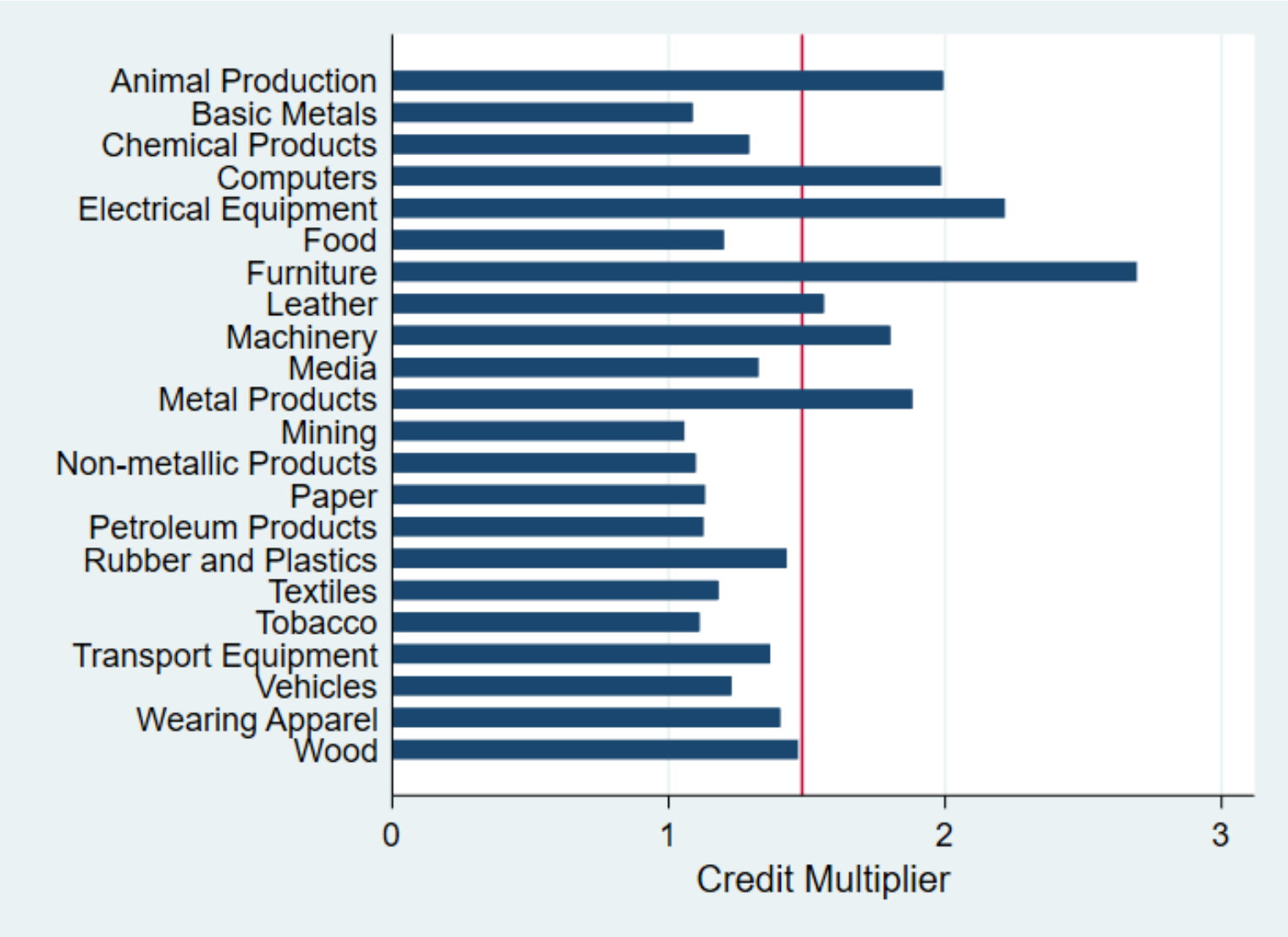
Differentiating the relation above, we get a relation between marginal credit supply and marginal capital investment:

$$dc = \frac{\alpha}{1-\theta} \frac{c}{K} dK \tag{5}$$

Under the assumption that the trade credit transmits down the supply chain, we obtain an expression for the trade credit multiplier, i.e., the amount of credit created in the production network for unit amount of credit provided by a bank:

$$\text{Credit Multiplier} = 1 + \frac{\alpha}{1-\theta} \frac{c}{K} \tag{6}$$

Trade Credit Multiplier



Labor Market Rigidility and Credit Utilization

The rule of 100

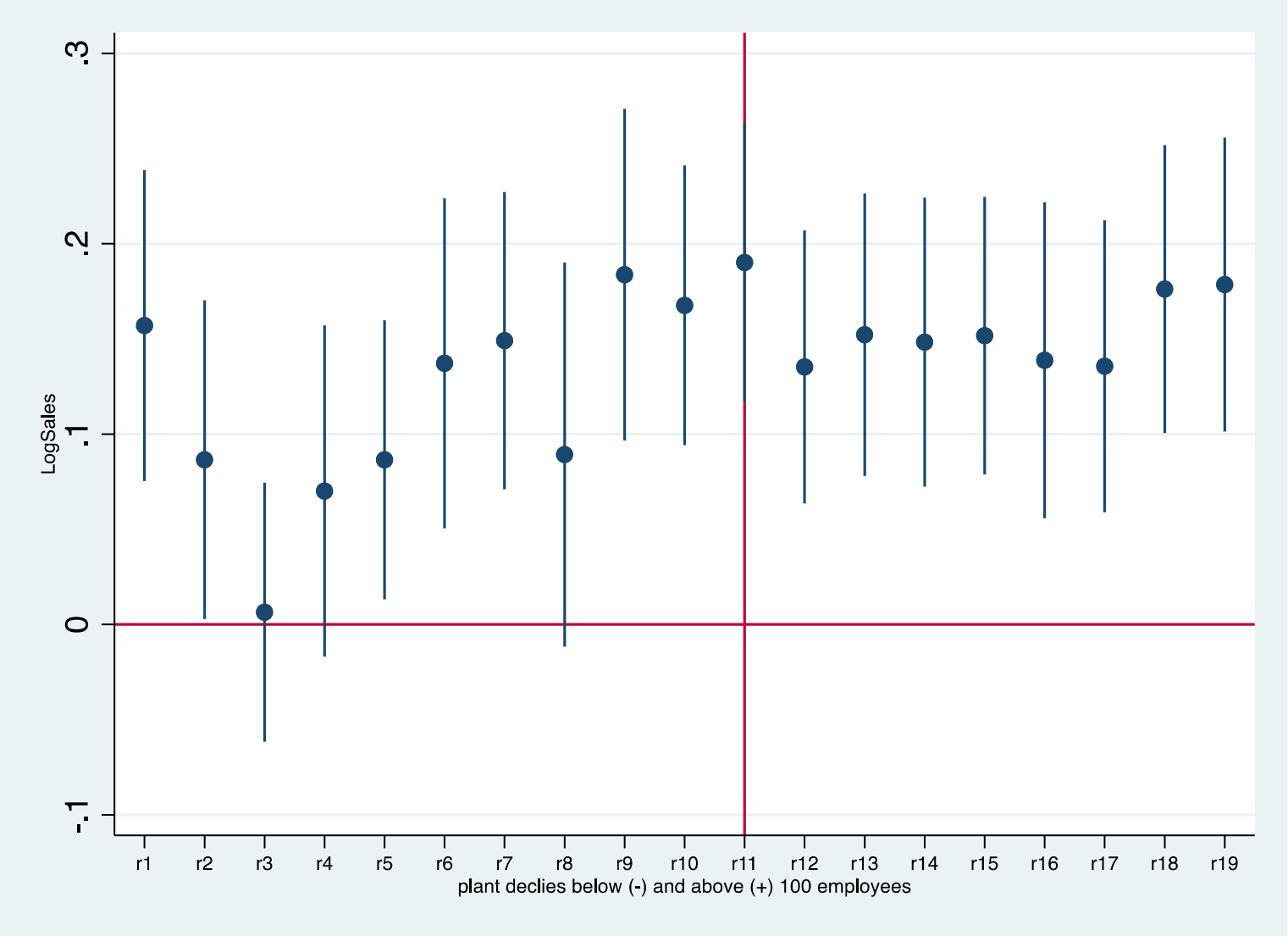
An employer is required to:

- Notify government.
- Workmen shall be entitled to one month notice/compensation in lieu of notice.
- 15 day compensation for each year of service completed for employees in service for more than 240 days.

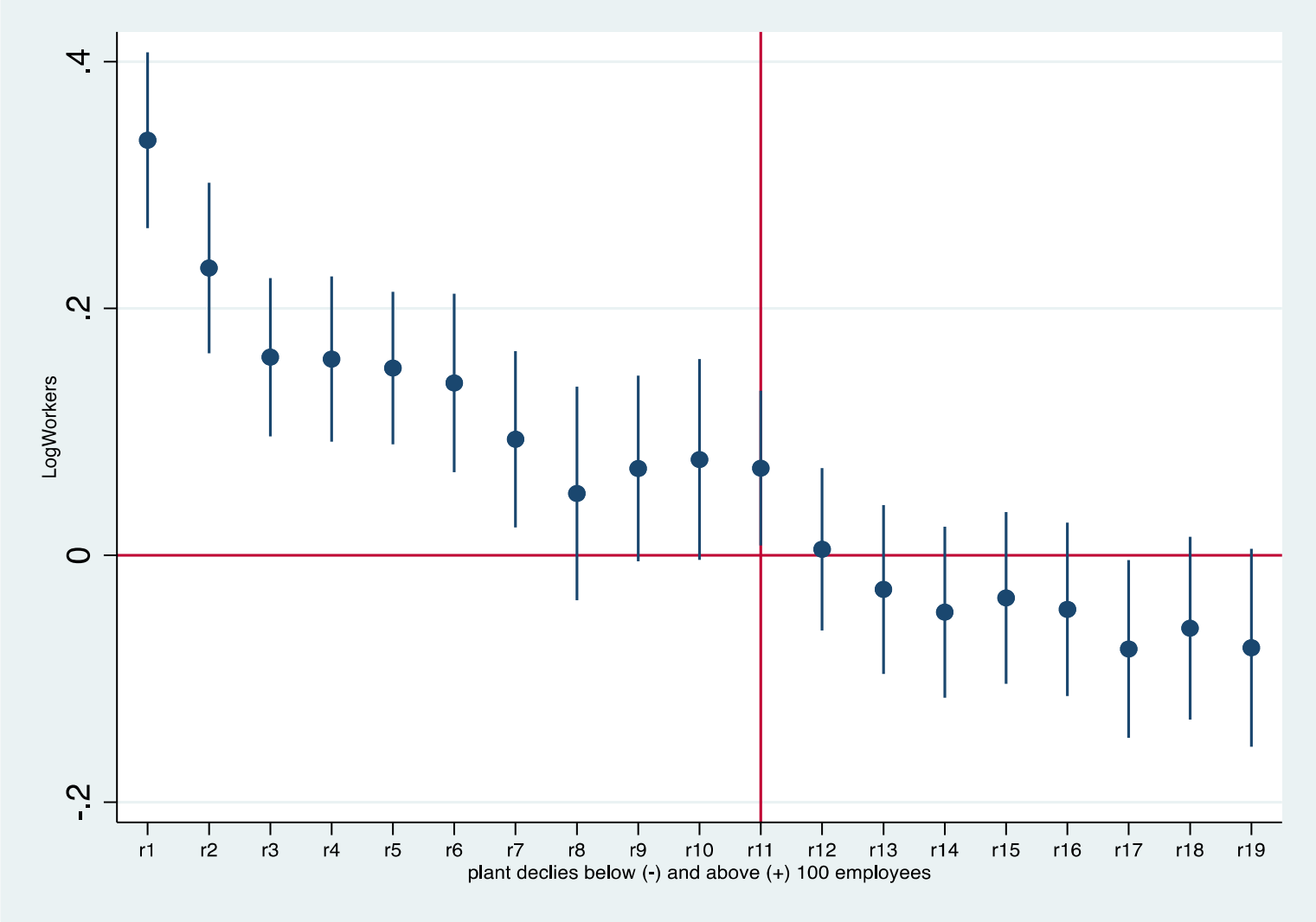
An employer with more than 100 workmen is required to:

- Obtain permission of government for dismissing workmen.
- Workmen shall be entitled to three months notice/compensation in lieu of notice.

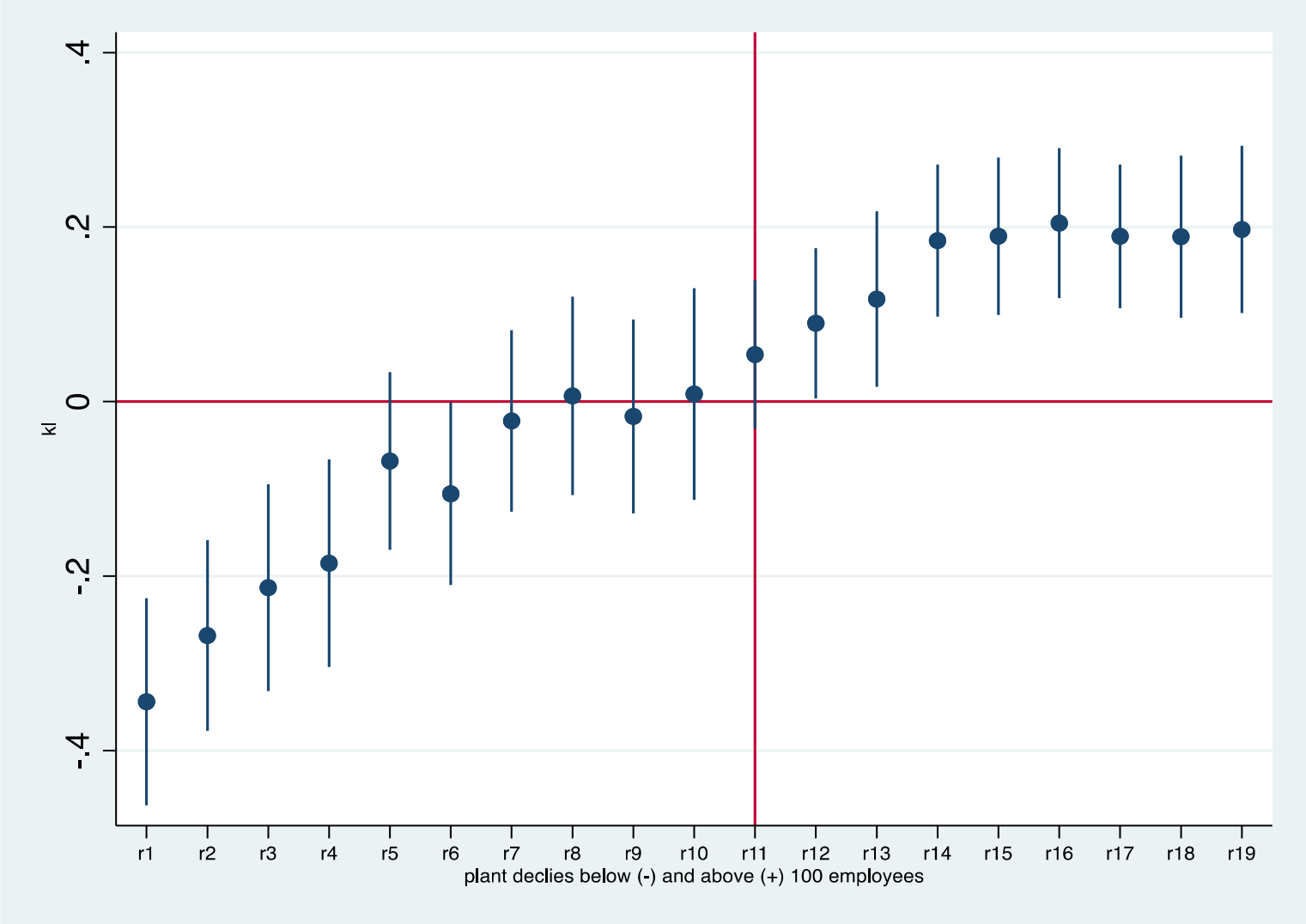
Sales by employee count



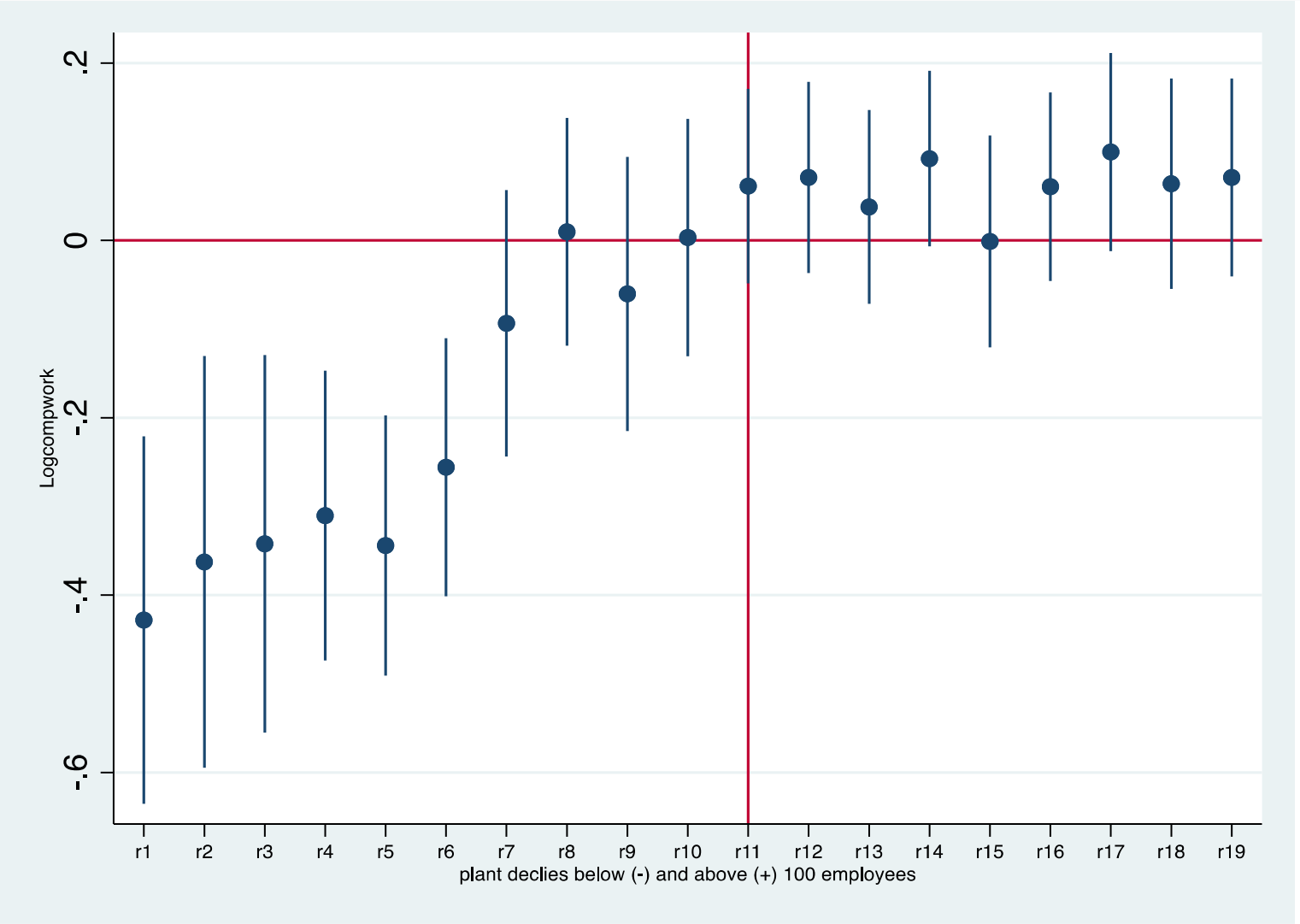
Workmen employment past the 100 count



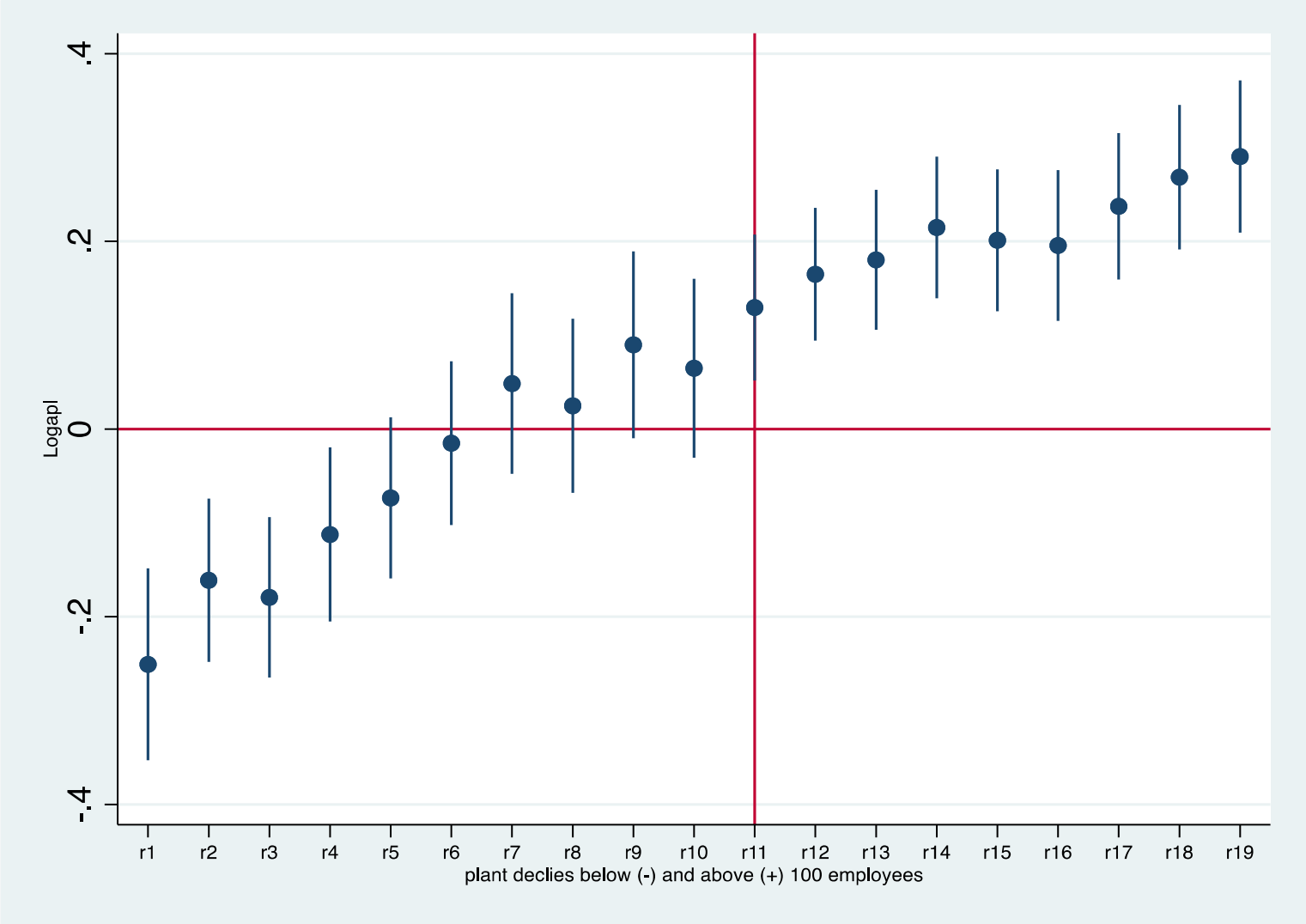
Capital Labor Ratio by employee count



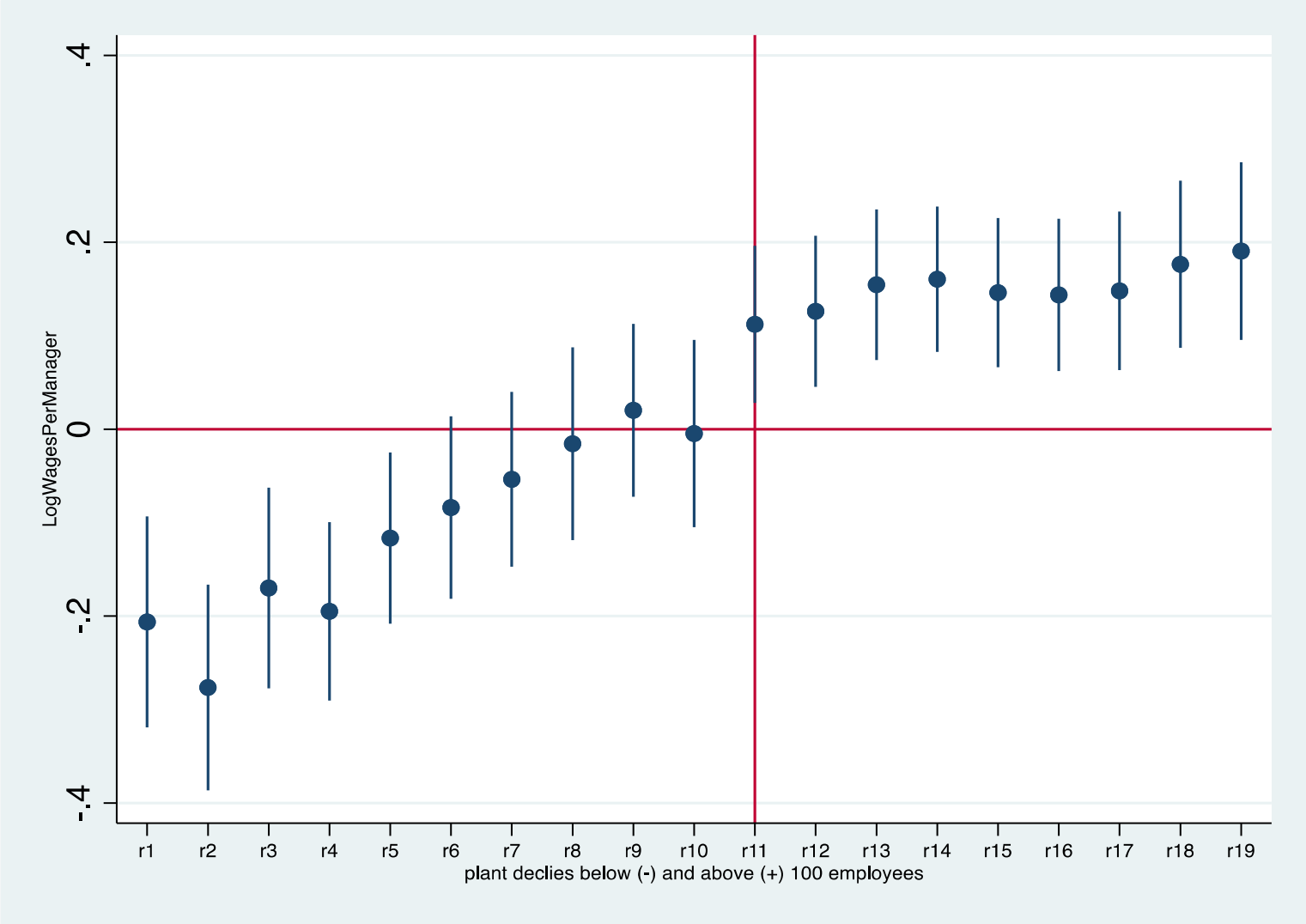
Investment in computers



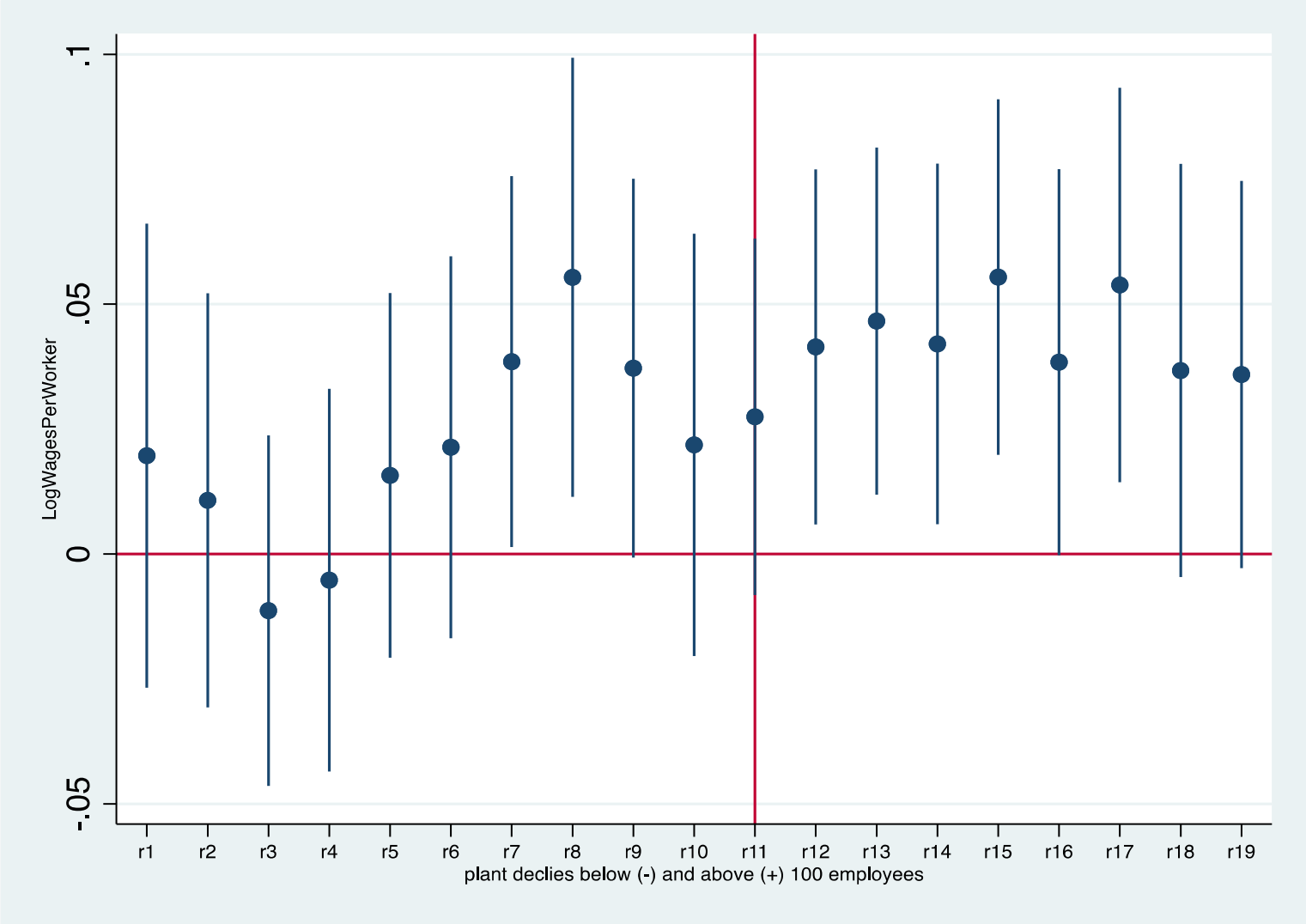
Average Productivity of Labor



Who benefits from the surplus? Managers?



Who benefits from the surplus? Workmen?



We request your feedback

- Results on trade credit.
  - Your thoughts and questions.

- Results on Directed Technical Change
  - Your thoughts and questions.

Conclusion

- Direct exposure to the spatial banking shock:
  - Significantly affects both real and financial outcomes at directly exposed plants.
  - Exposed plants redistribute liquidity through their production network, increasing short-term financing to other firms in the production network.
- We use the input-output relationships for each plant to understand how supply linkages propagate the granular banking shocks throughout the economy.
  - A parsimonious model to estimate the trade credit multiplier in India in our sample period.
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Appendix

The Impact of the RBI's 1:1 Branching Expansion on Bank Entry

	District New Branches			District Share of New Branches		
	All banks (1)	Private (2)	PSB (3)	All banks (4)	Private (5)	PSB (6)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	3.8921***	1.1183***	2.7241***	0.0693**	0.1141**	0.0550**
	(0.8662)	(0.4248)	(0.6295)	(0.0297)	(0.0522)	(0.0244)
Year FE	Y	Y	Y	Y	Y	Y
District FE	Y	Y	Y	Y	Y	Y
Observations	3,208	3,208	3,200	3,208	3,208	3,200
Adjusted R^2	0.8644	0.7532	0.8196	0.8441	0.7622	0.8014

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Back

Bank Entry and Real Plant Outcomes (additional)

	Panel C: Population trends				
	Log Sales (1)	Log Plant Size (2)	Log Investment (3)	Log Employment (4)	Log TFP (5)
$\mathbb{1}$(Has Tier 3) × $\mathbb{1}$(Post)	0.1121***	0.0533***	0.0702**	0.0630***	0.0332**
	(0.0216)	(0.0197)	(0.0310)	(0.0155)	(0.0163)
Observations	157,420	172,700	172,814	172,644	157,444
Adjusted R^2	0.9285	0.9608	0.9328	0.9298	0.6963
Plant FE	Y	Y	Y	Y	Y
Industry×Year FE	Y	Y	Y	Y	Y
Pre-Size×Post FE	Y	Y	Y	Y	Y
Pre-Age×Post FE	Y	Y	Y	Y	Y
Population × Post	Y	Y	Y	Y	Y

Back

Bank Entry and Real Plant Outcomes: Matching Estimation

	Log Sales (1)	Log Plant Size (2)	Log Investment (3)	Log Employment (4)	Log TFP (5)
$\mathbb{1}$(Has Tier 3) $\times$ $\mathbb{1}$(Post)	0.2541***	0.1123***	0.2403***	0.0593*	0.1449**
	(0.0722)	(0.0367)	(0.0445)	(0.0325)	(0.0676)
Observations	16,501	17,496	17,499	17,466	16,526
Adjusted R^2	0.9248	0.9685	0.9432	0.9334	0.7218
Plant FE	Y	Y	Y	Y	Y
Industry$\times$Year FE	Y	Y	Y	Y	Y
Pre-Size$\times$Post FE	Y	Y	Y	Y	Y
Pre-Age$\times$Post FE	Y	Y	Y	Y	Y

⏩ Back