Using Payroll Tax Variation to Unpack the Black Box of Firm-Level Production

Youssef Benzarti (UCSB and NBER)
Jarkko Harju (VATT and CESifo)

Teaching Slides

Motivation

- Payroll taxes represent on average **9% of GDP** and raise **26% of revenue** in OECD countries.
- Payroll tax **rates** can be very large
  - In France almost 40%
  - OECD average higher than 20%
- Understanding the **distortion** they impose on the economy is important given their magnitude
- Yet **limited research** on payroll taxes:
  - 8,695 articles in Proquest on payroll taxes versus 152,523 for income taxes

This Paper

- Common wisdom: payroll tax incidence **borne by workers**
  - $\Rightarrow$ Cost of labor is **undistorted** by payroll taxes
  - $\Rightarrow$ Unlikely to impose distortions on production
- Recent evidence questions this common wisdom (Saez et al (2012) and Saez et al (2019))
- Who bears the incidence of payroll taxes?
  - Employees or employers?
- Do payroll taxes **distort production**?
  - What is the **magnitude** of the distortion?
  - Do they **bias** production towards certain factors?

Our Data

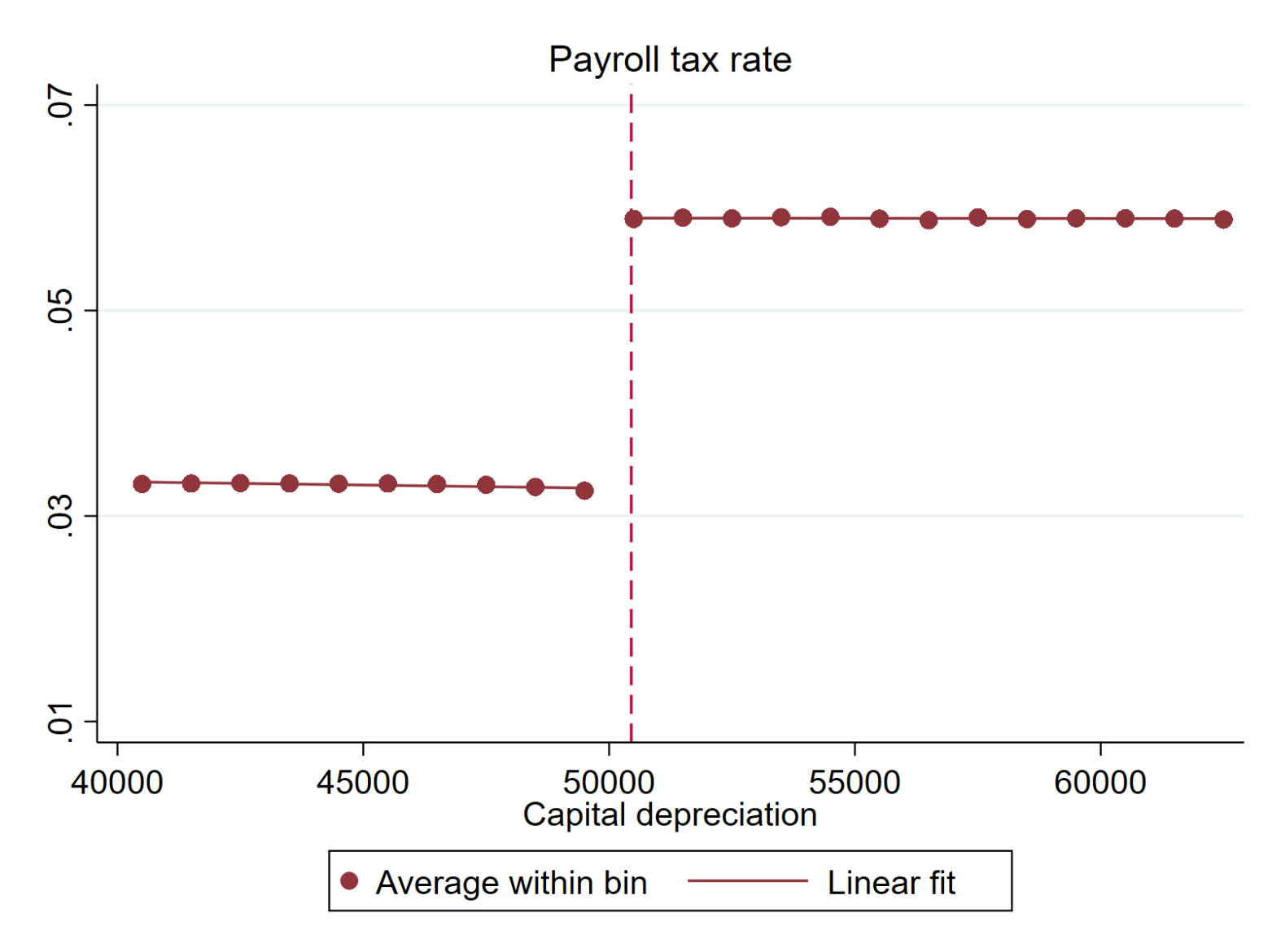
1. **Universe of Finnish firms**: both accounting and tax statements.
   - Accounting outcomes are systematically **audited by third party**, so less subject to evasion.
   - In our data, over 90% firms accounting is audited.
2. Linked to employee data: **tax returns** linked to comprehensive **employer level survey**
   - Earnings (annual and hourly)
   - Demographics
   - Job descriptions and tasks
   - Unionization status

descriptive stats

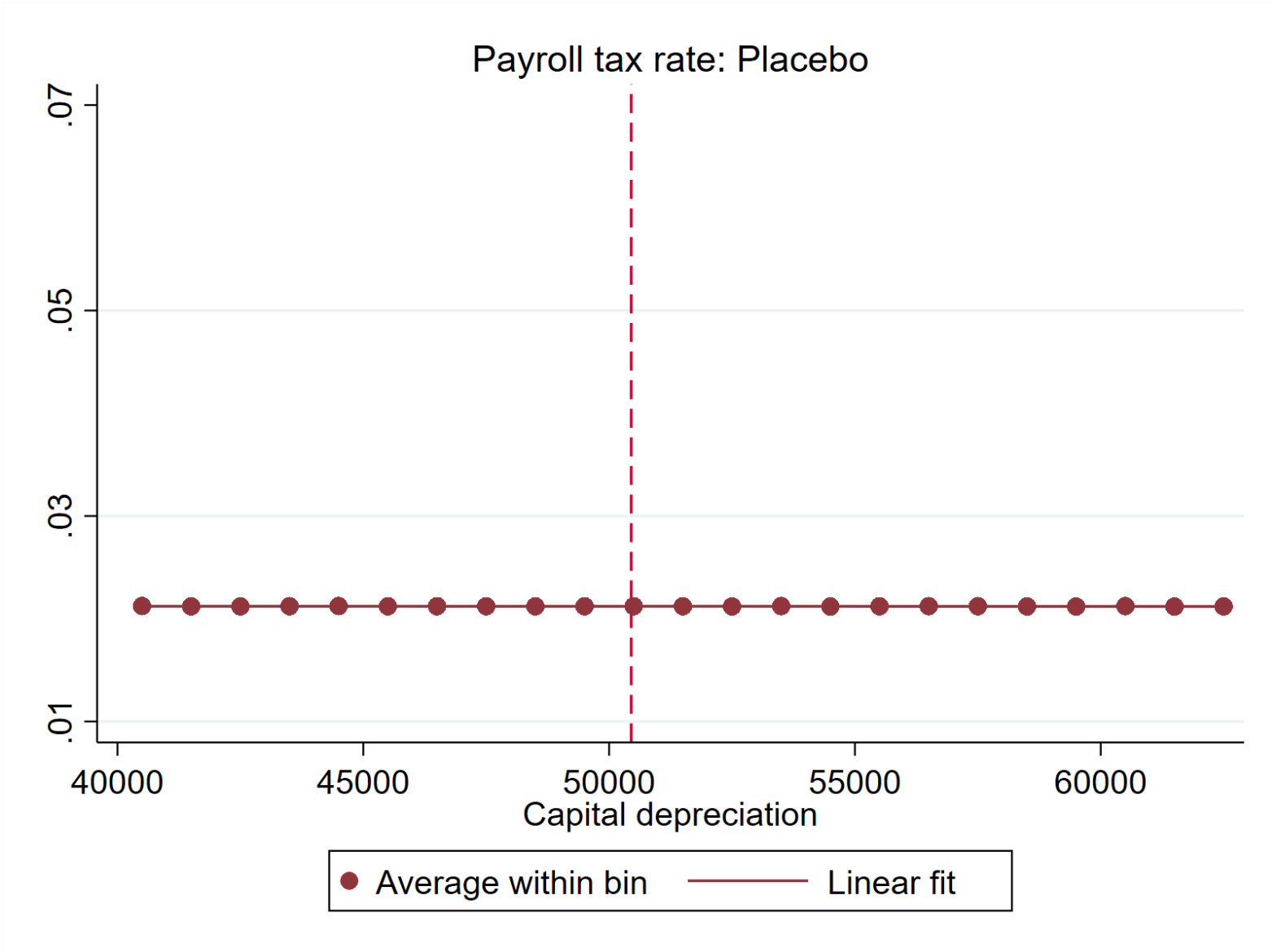
Our Exogenous Variation

- Employer portion of payroll taxes **increases discontinuously** for firms with more than 50,500 euros of **capital depreciations**
  - Importantly, employees' tax rates or benefits are not affected
- This regulation was **repealed in 2010**
- Firm level variation in payroll tax rates
  - All workers affected $\Rightarrow$ avoid issues of pay inequality.
    - Previous literature has mostly looked at within firm variation in payroll tax rates caused by age discontinuities
  - On average equivalent to 5% of profits.

Payroll Tax Rate Prior to 2010



Payroll Tax Rate After 2010



A Simple Test of Incidence

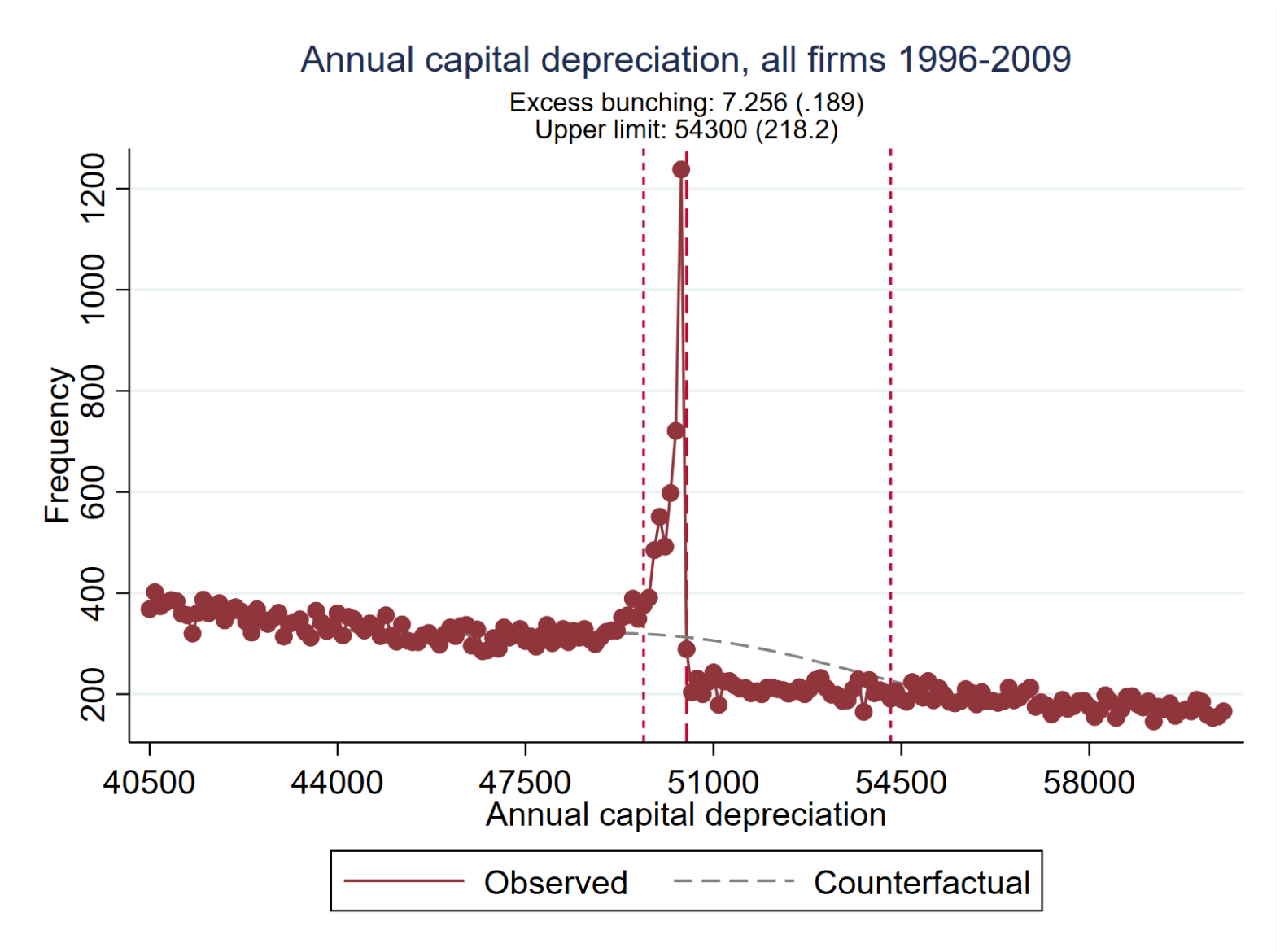
- If firms bunch at the threshold, this would suggest that employers bear at least some of the incidence of payroll taxes
- Excess mass at the depreciation threshold can be decomposed as:

$$\frac{d\delta}{d\tau} = \frac{d\delta}{dK}\frac{dK}{dw}\frac{dw}{d\tau}$$

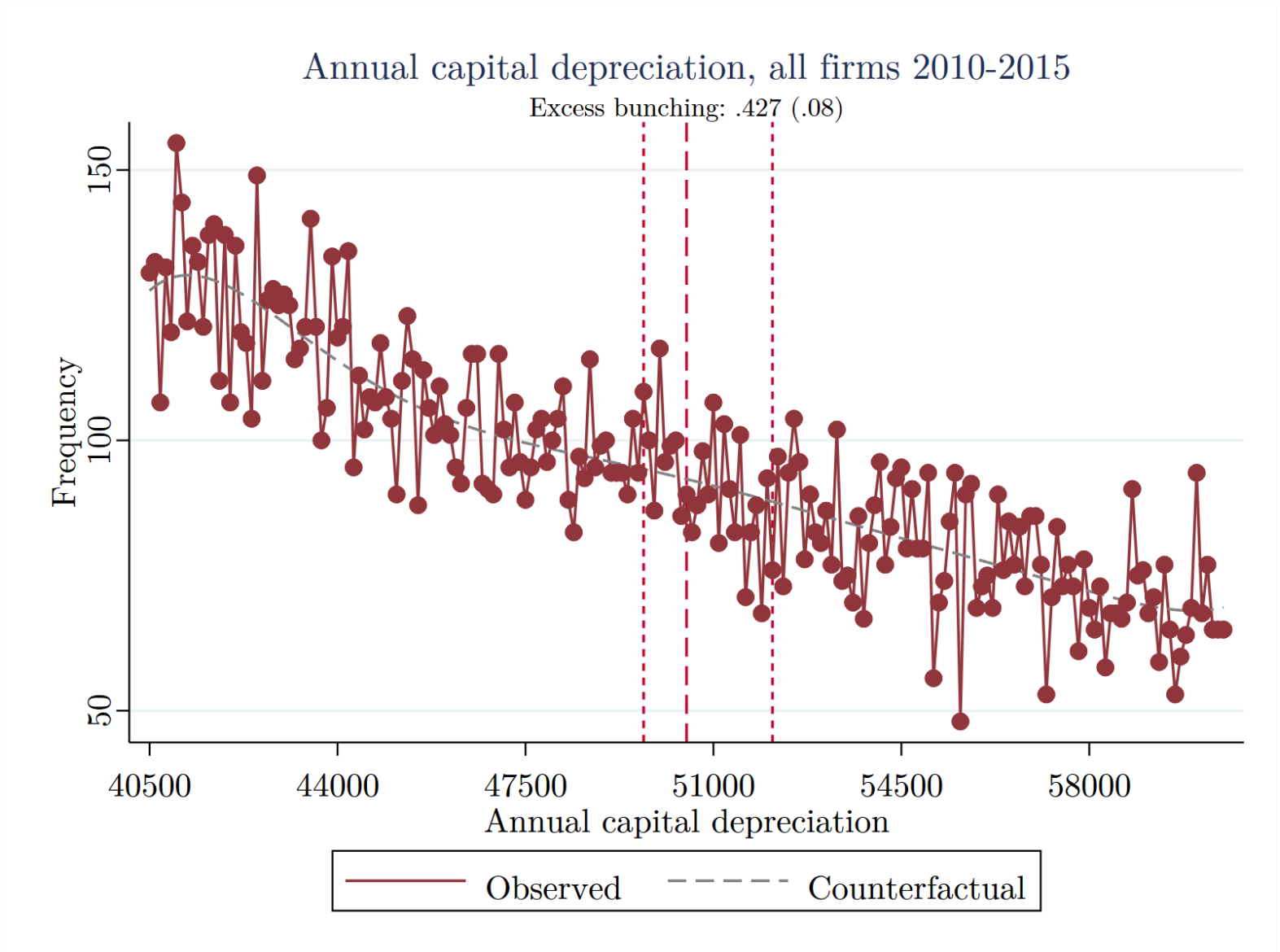
- where δ is depreciation, τ is the payroll tax rate, K is capital and w is the wage rate inclusive of employer payroll taxes
- If incidence is fully borne by workers, then $\frac{dw}{d\tau} = 0$

$\Rightarrow$ If workers bear full incidence then we expect **no bunching**

Distribution Around Cutoff



Placebo


Annual capital depreciation, all firms 2010-2015
Excess bunching: .427 (.08)
Frequency
150
100
50
40500
44000
47500
51000
54500
58000
Annual capital depreciation
Observed
Counterfactual

Firms Respond to Payroll Tax

- Firms bear some of the incidence of payroll taxes
- Next further investigate:
  1. Incidence
  2. Production distortion

persistence rates

real vs evasion

bunching heterogeneity

Donut Hole RD

Donut hole RD allows us to move beyond effect on **capital** only

$$log(y_i) = \alpha + \beta_1 \cdot (depr_i - d) + \beta_2 * Above_i + \beta_3 * Above_i * (depr_i - d) + \epsilon_i$$

- y_i is the outcome of interest for firm i
- d is the depreciation threshold
- *depr* is the level of capital depreciations
- *Above* is a dummy for above the depreciation threshold
- ϵ_i is the error term calculated using Calonico et al. (2014)

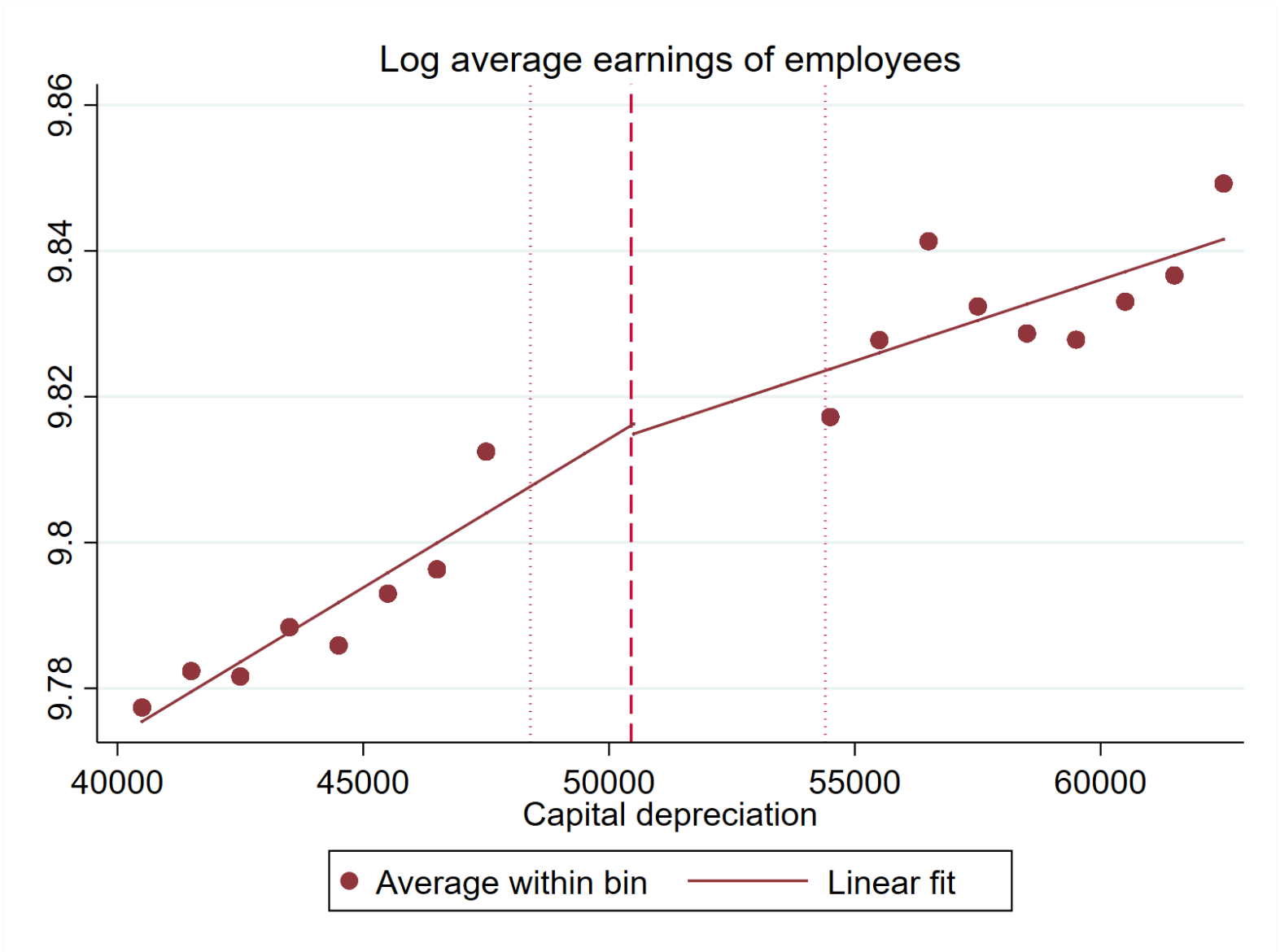
$\Rightarrow \beta_3$ is the main coefficient of interest showing the magnitude of the change at the discontinuity

Outline

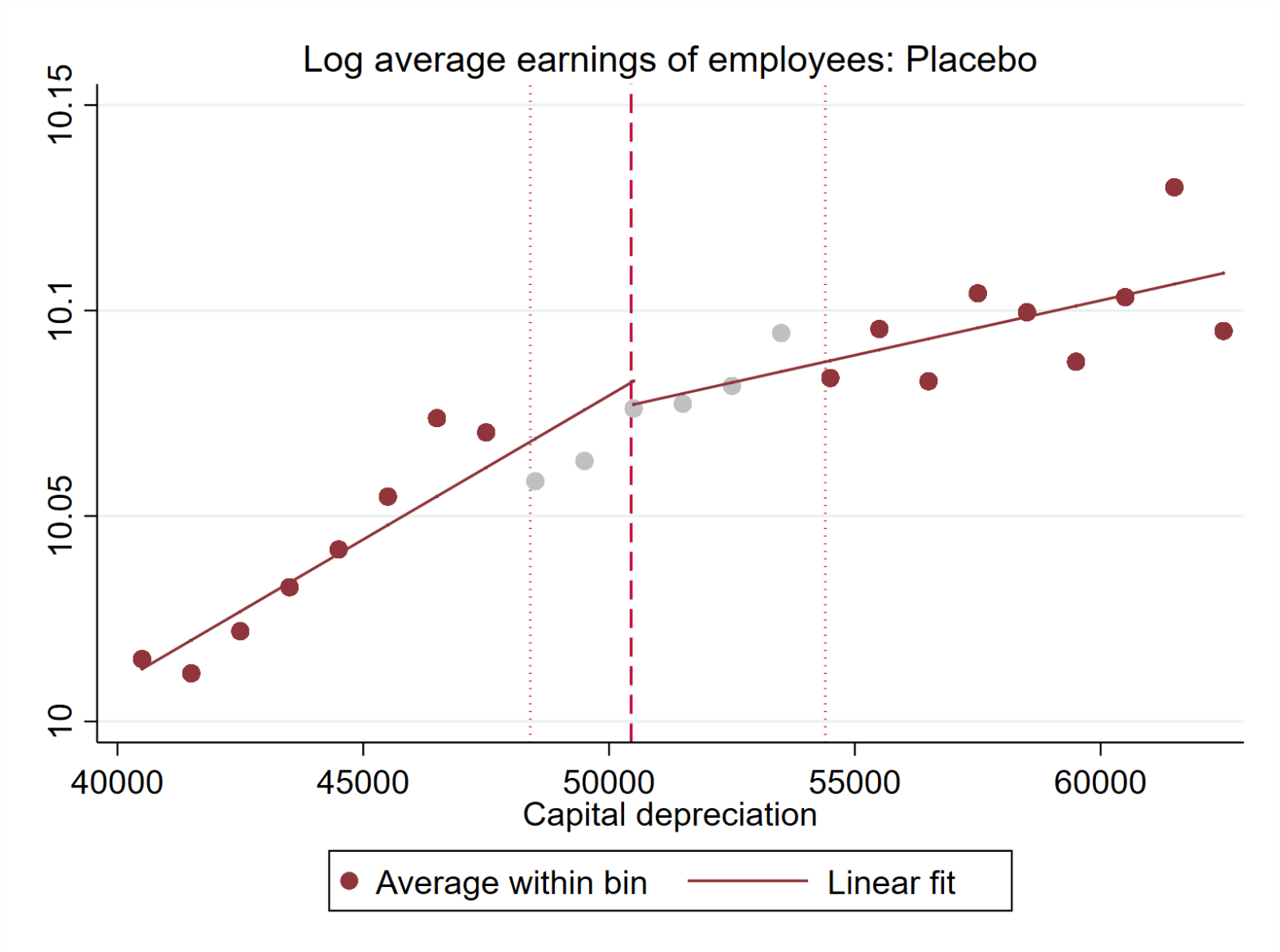
Predictions

1. If workers bear the burden of payroll taxes, then we should expect to see a decrease in average employee-level earnings above the threshold.
2. Instead, if firms bear the burden of payroll taxes, then we should expect to see no discontinuity in wages at the threshold.

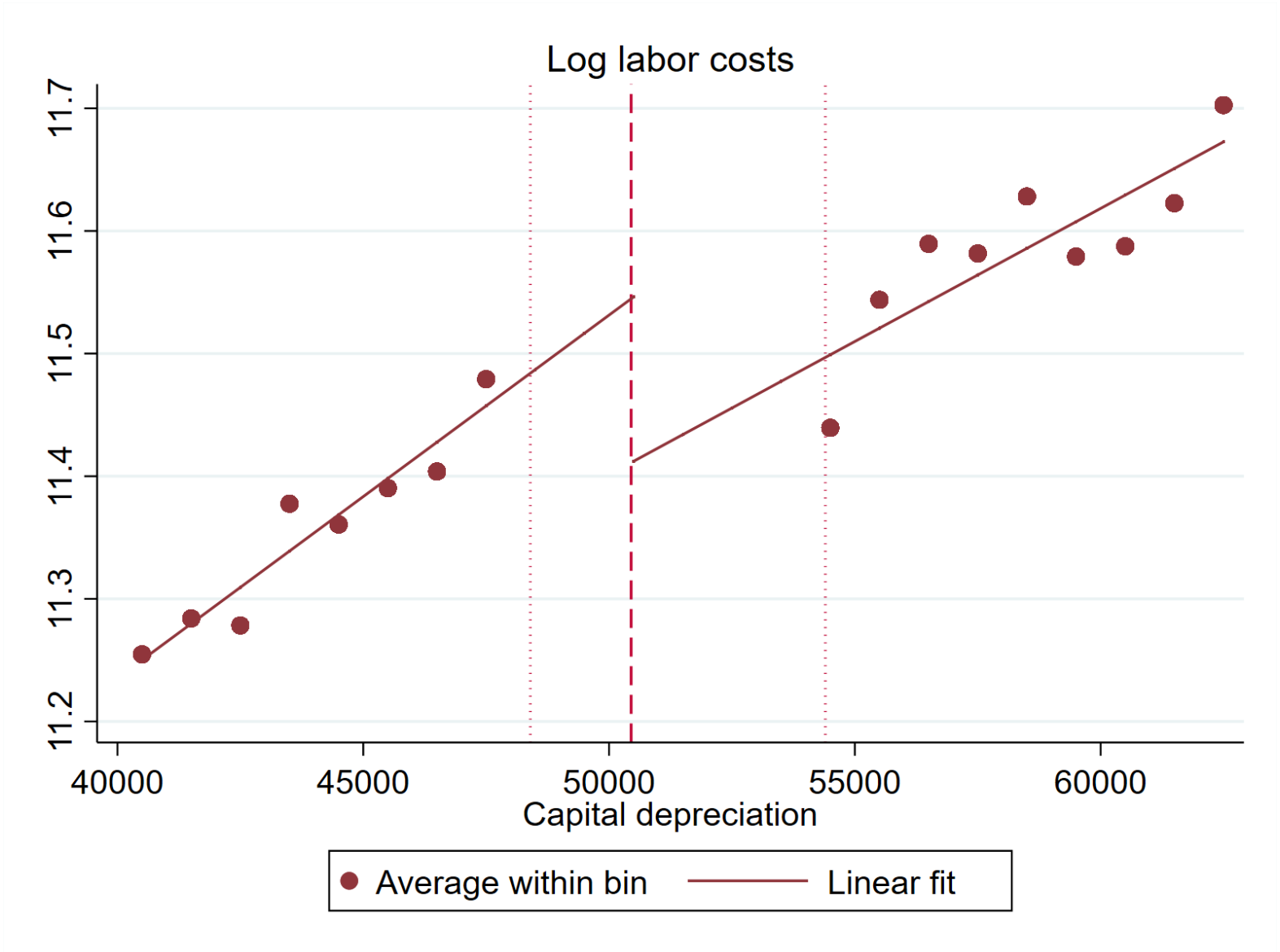
Earnings


Log average earnings of employees
9.78
9.8
9.82
9.84
9.86
40000
45000
50000
55000
60000
Capital depreciation
Average within bin
Linear fit

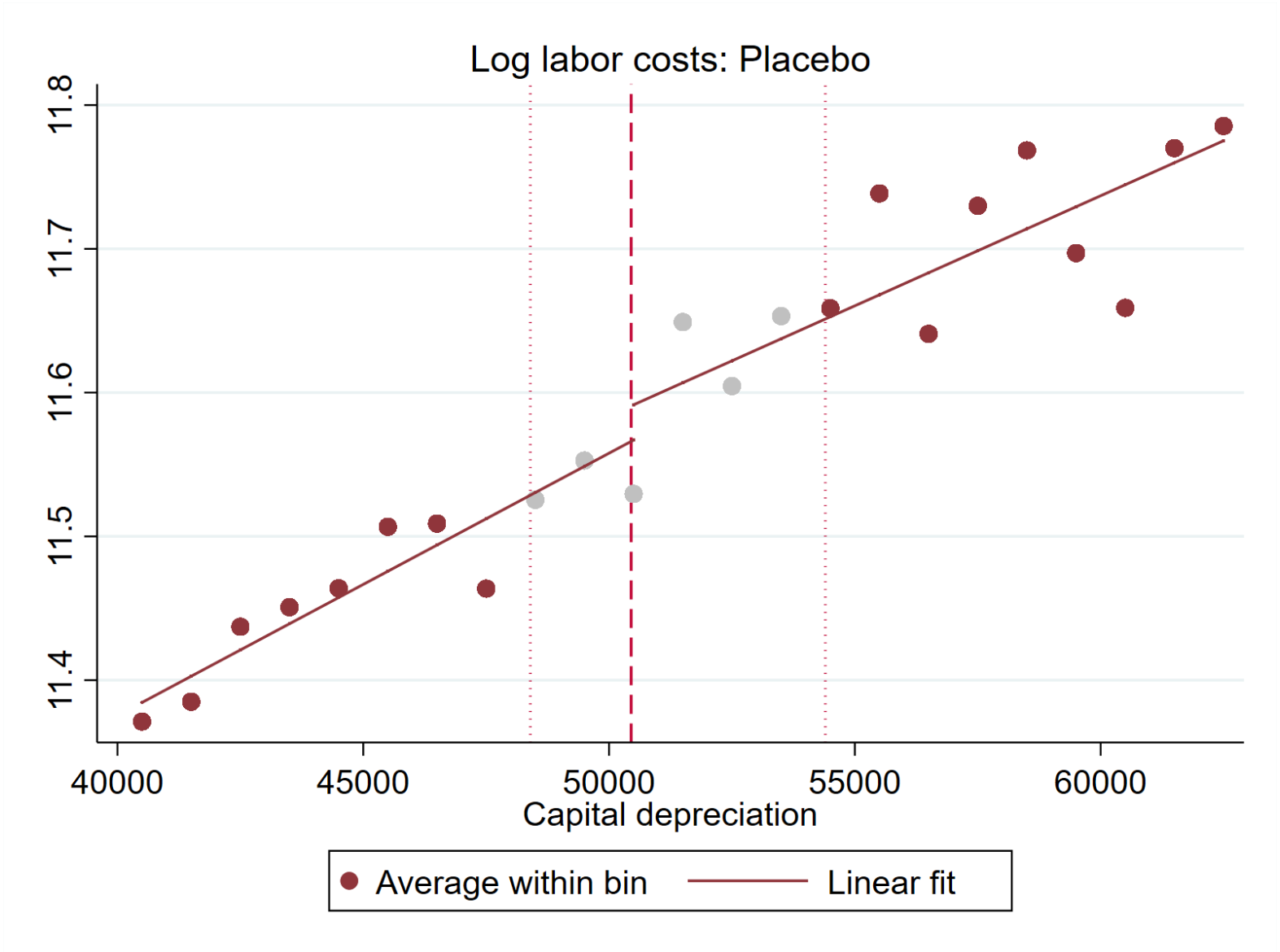
Earnings – Placebo



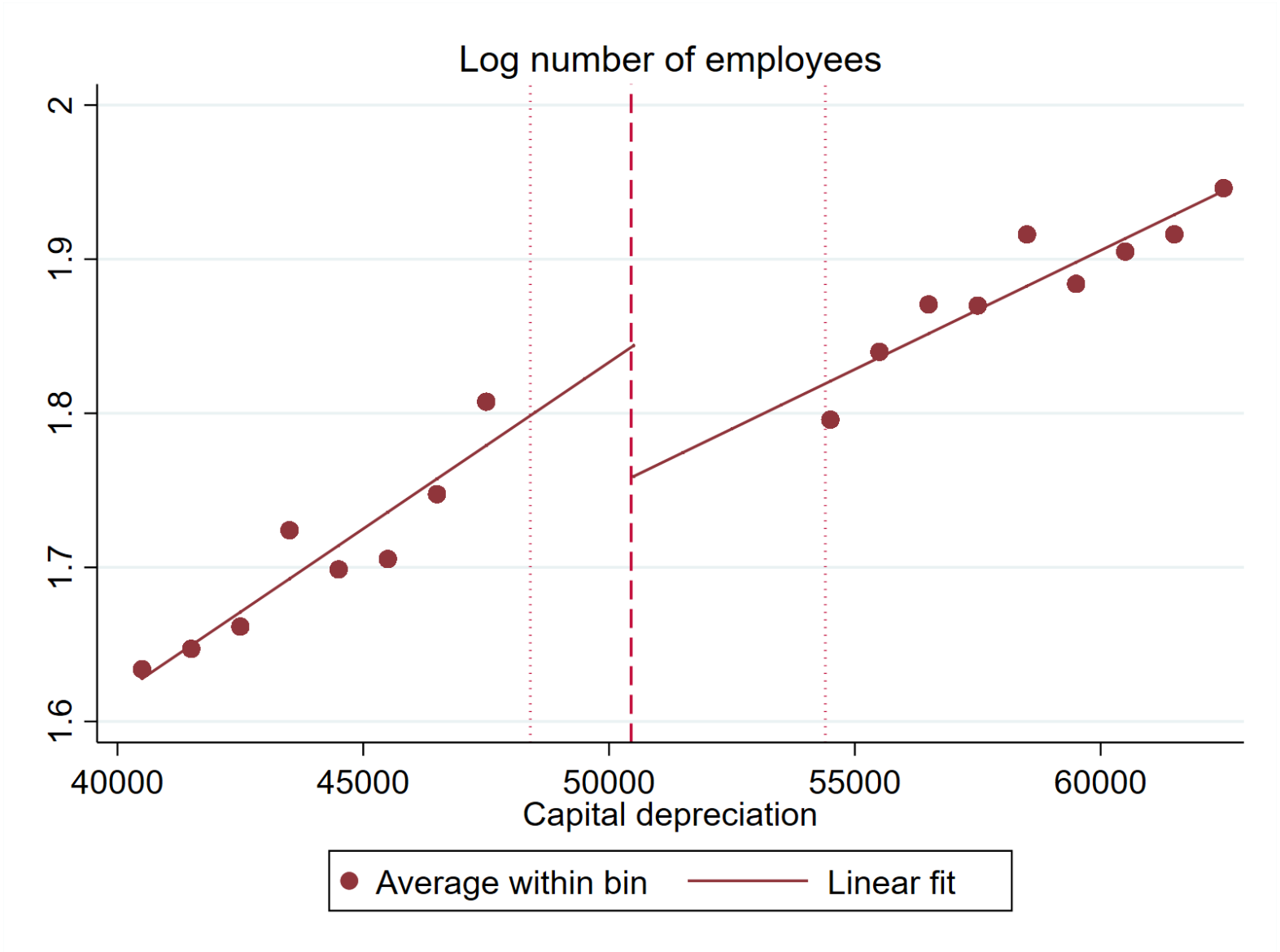
Net of Payroll Tax Labor Costs



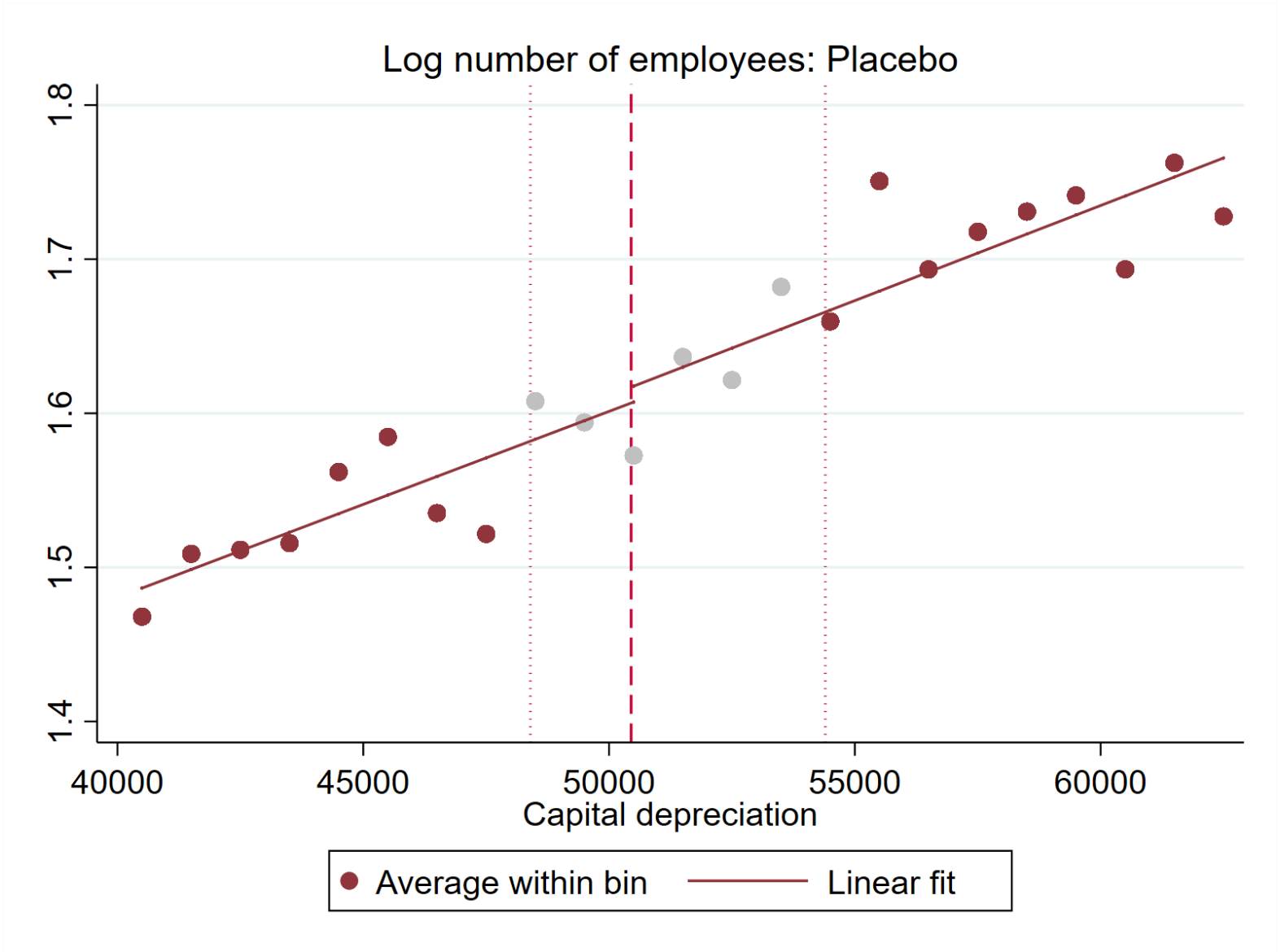
Net of Payroll Tax Labor Costs – Placebo



Number of Employees



Number of Employees – Placebo



Regression Estimates

Outcomes (logs)	Earnings	Labor Costs	No. Employees
		Treatment	
RD Estimate	-0.005	-0.177***	-0.091***
	(0.009)	(0.042)	(0.029)
Bandwidth	10,421	16,895	17,976
N above	12,369	21,778	22,757
N below	27,401	58,259	61,859
Control mean	9.824	11.55	2.151
		Placebo	
RD Estimate	-0.010	0.077	0.035
	(0.024)	(0.063)	(0.038)
Bandwidth	11,260	14,145	18,098
N above	7,269	9,786	12,701
N below	15,402	21,100	29,647
Control mean	10.08	11.56	1.863

RD estimates over time

RD estimates by industries

Labor

1. No effect on earnings
   $\Rightarrow$ Consistent with bunching evidence that firms bear some of the payroll tax incidence
2. Firms adjust by reducing number of workers
3. Next: what workers/jobs get affected the most?

Outline

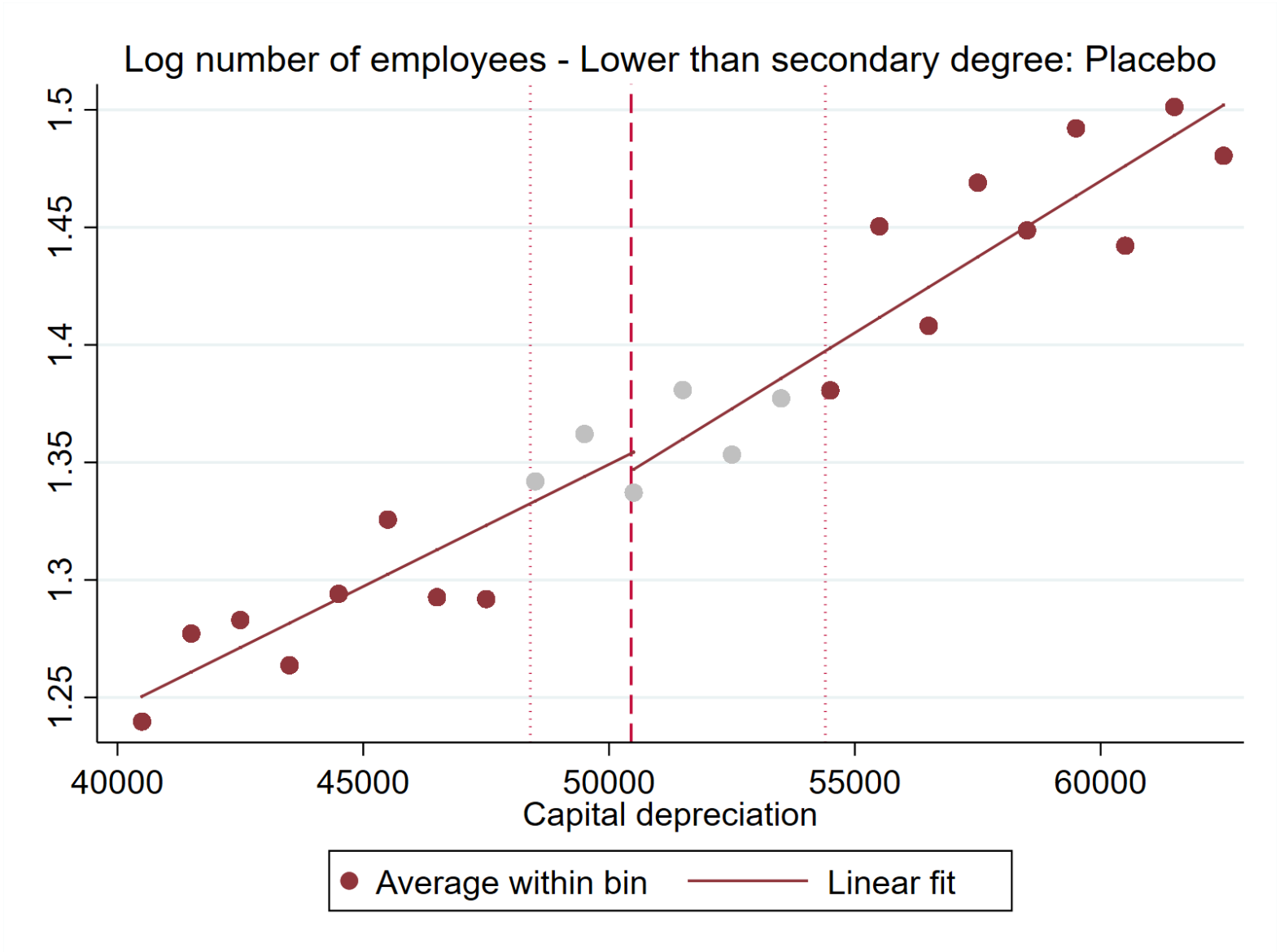
Skill

Classify workers by their **educational attainment**:

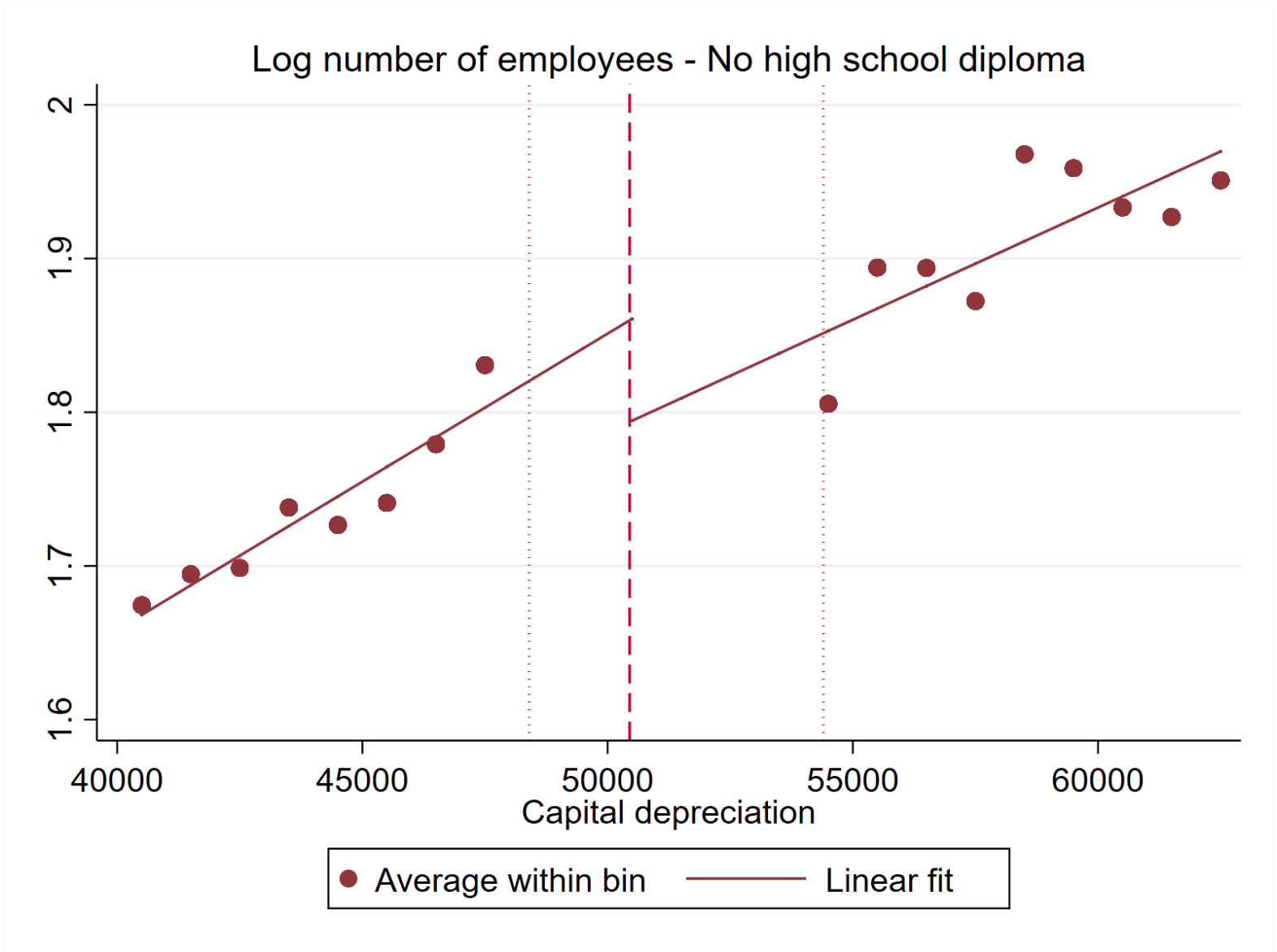
1. Secondary degree (includes bachelor, masters and doctorate) vs no secondary degree.
2. High school terminal exam vs not.

Low Skilled: Less Than Secondary Degree

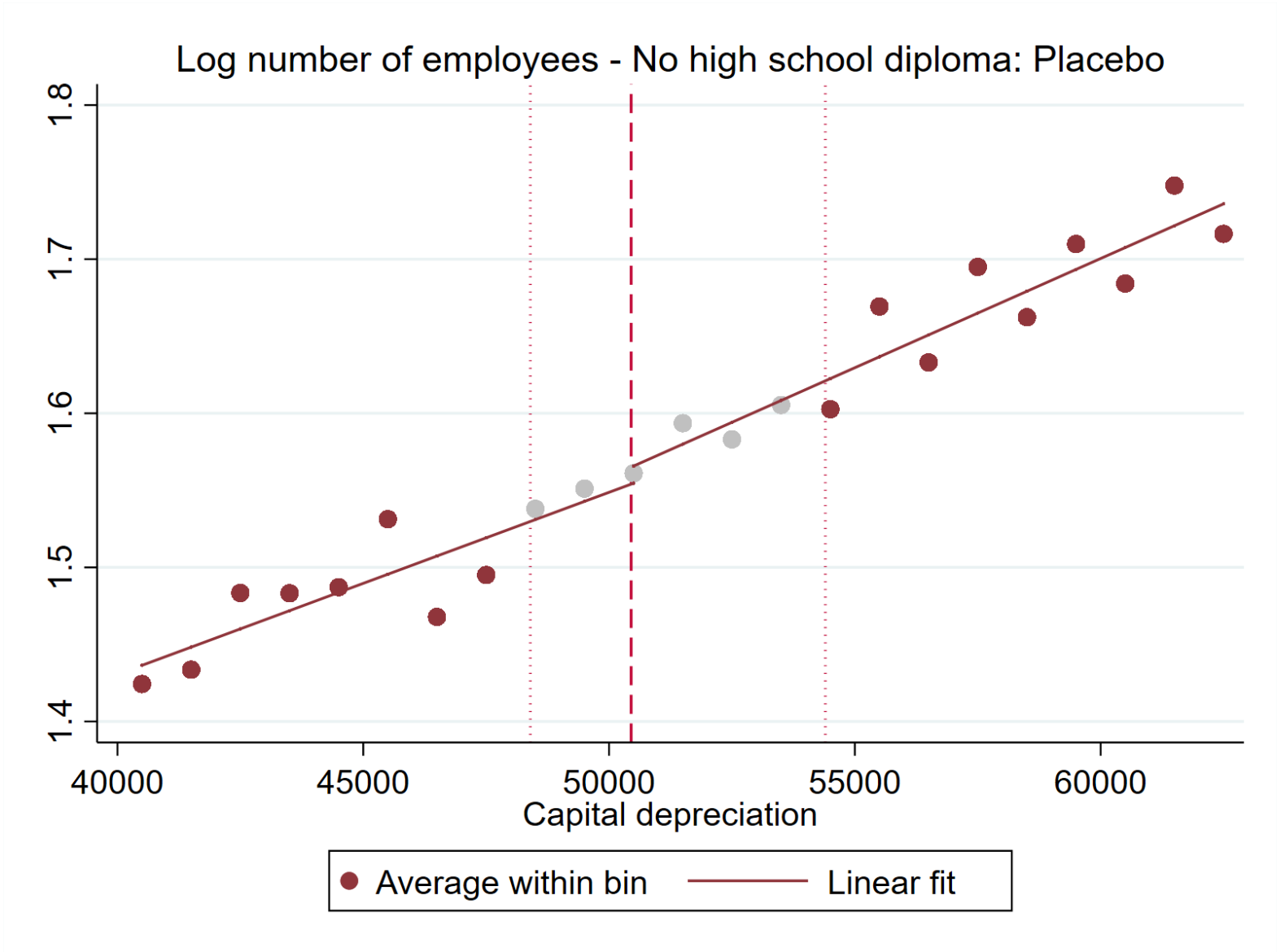
Low Skilled: Less Than Secondary Degree – Placebo



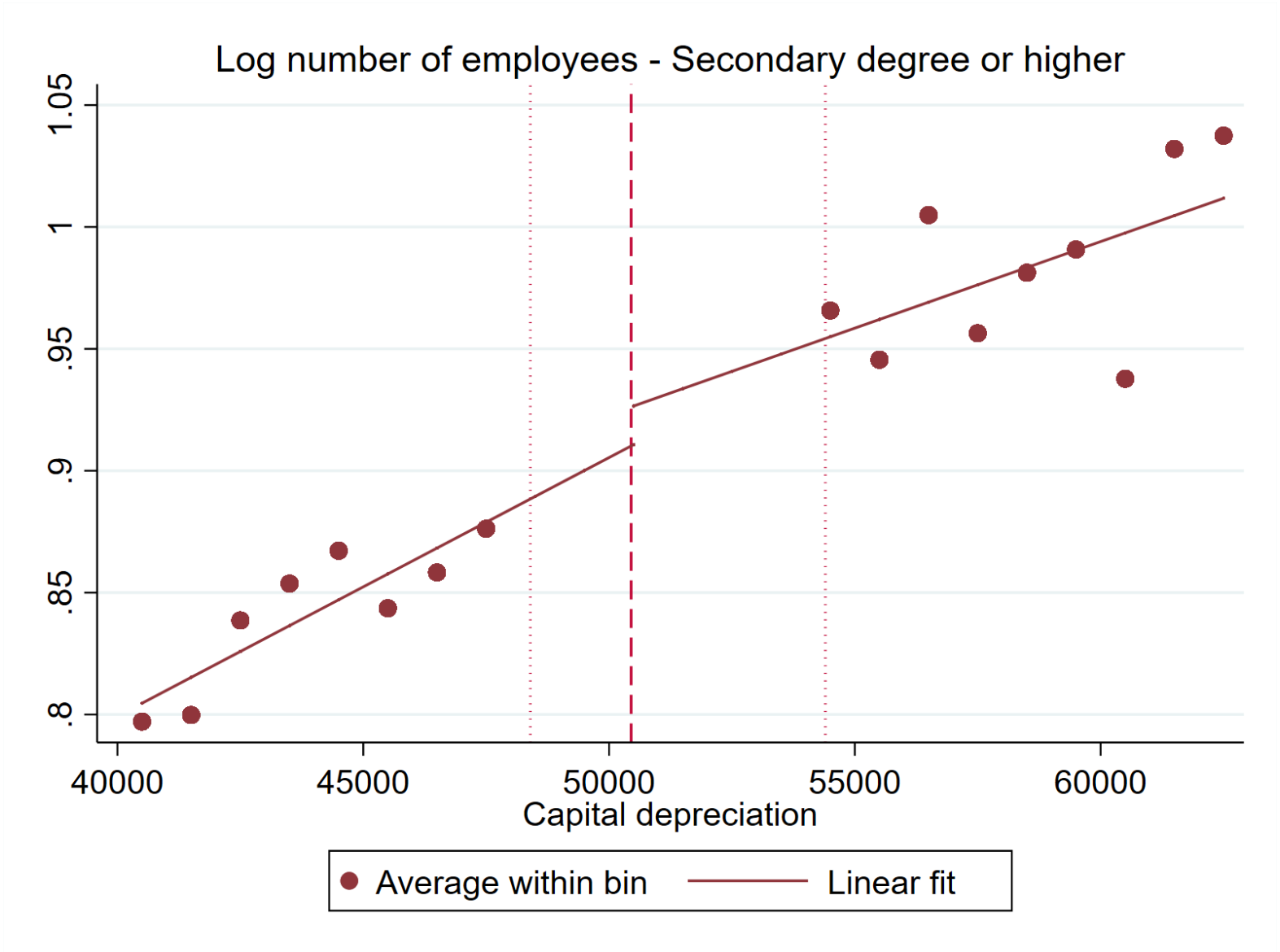
Low Skilled: Less Than High School Degree



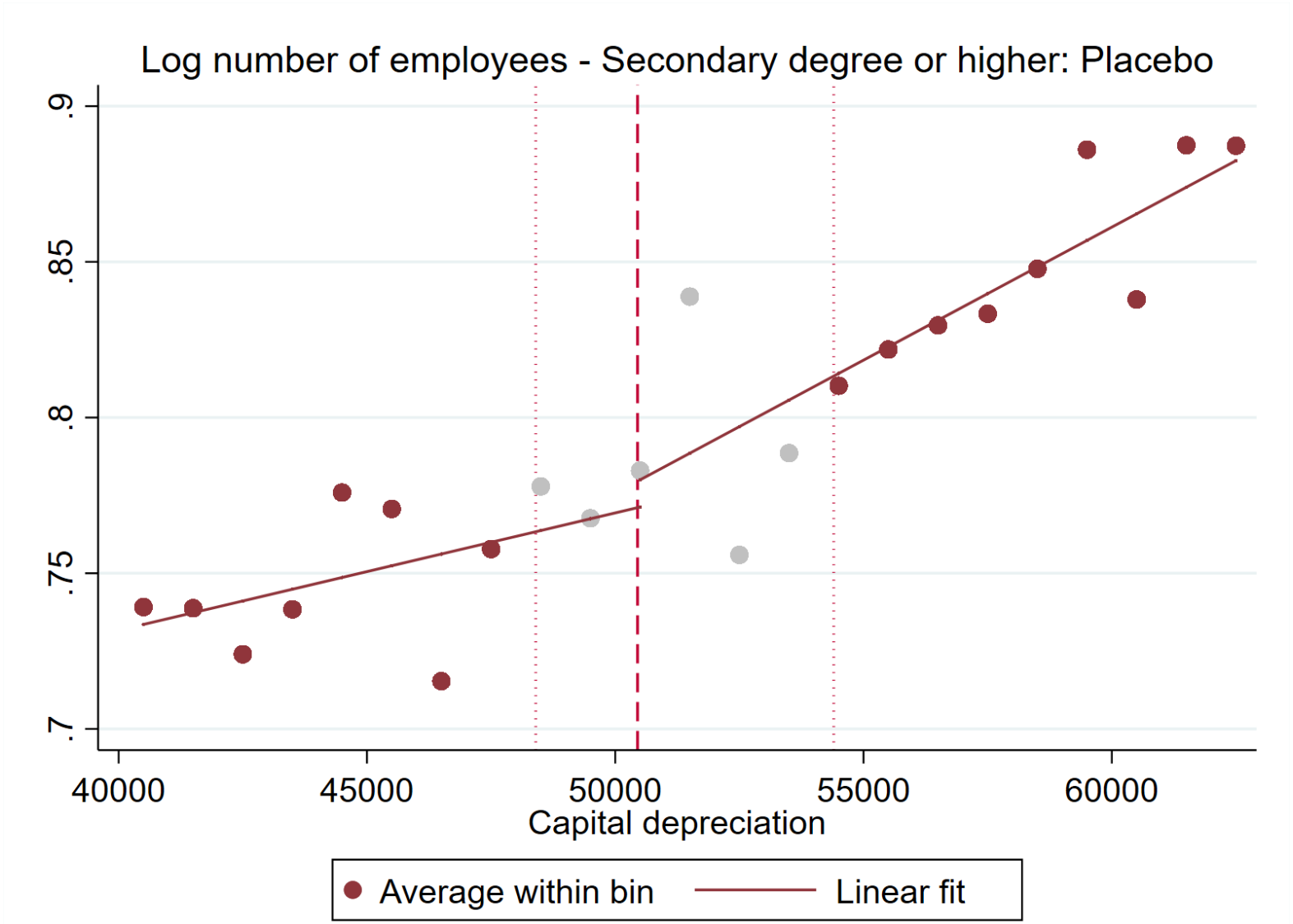
Low Skilled: Less Than High School Degree – Placebo



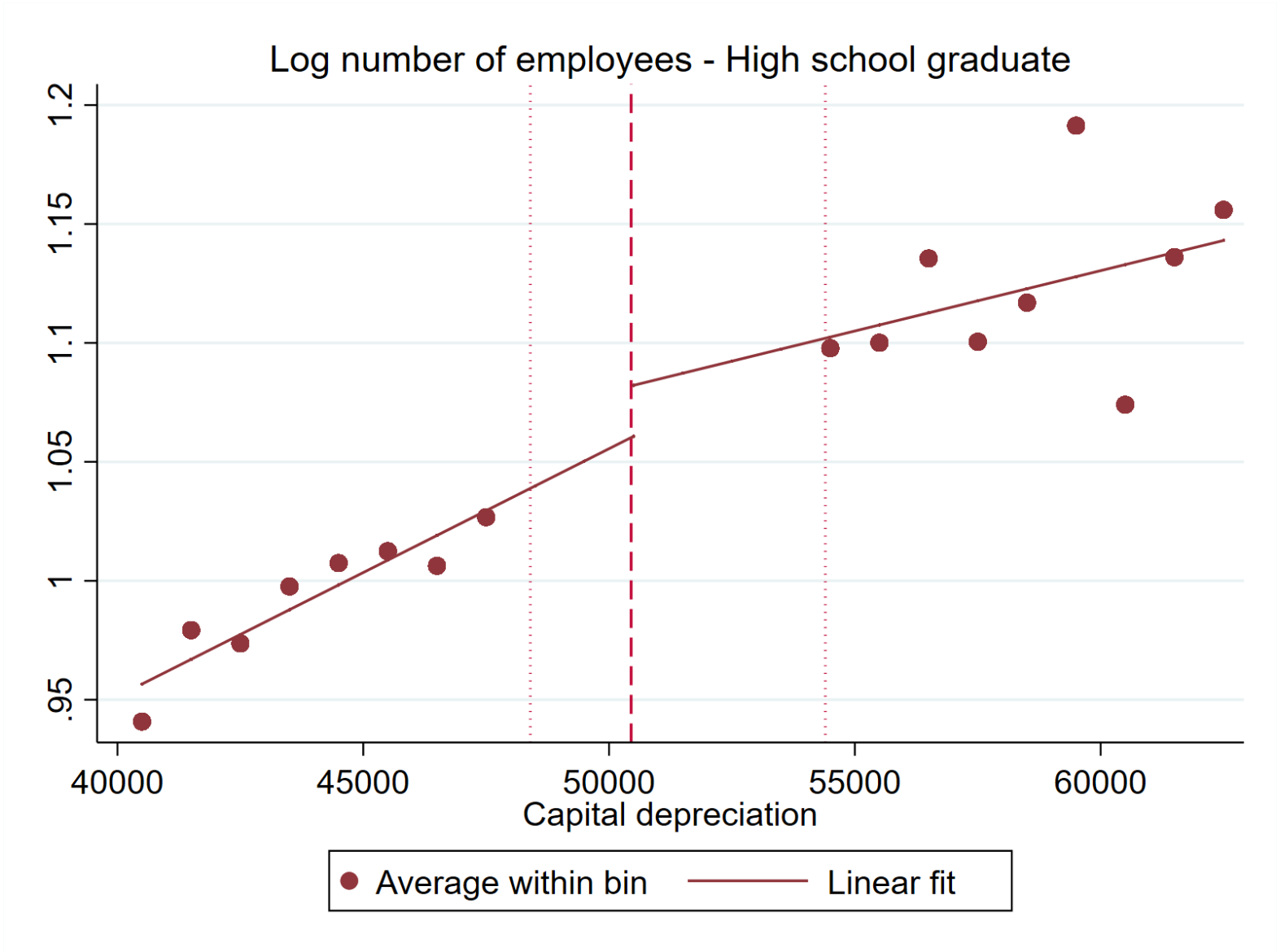
High Skilled: Secondary Degree or More



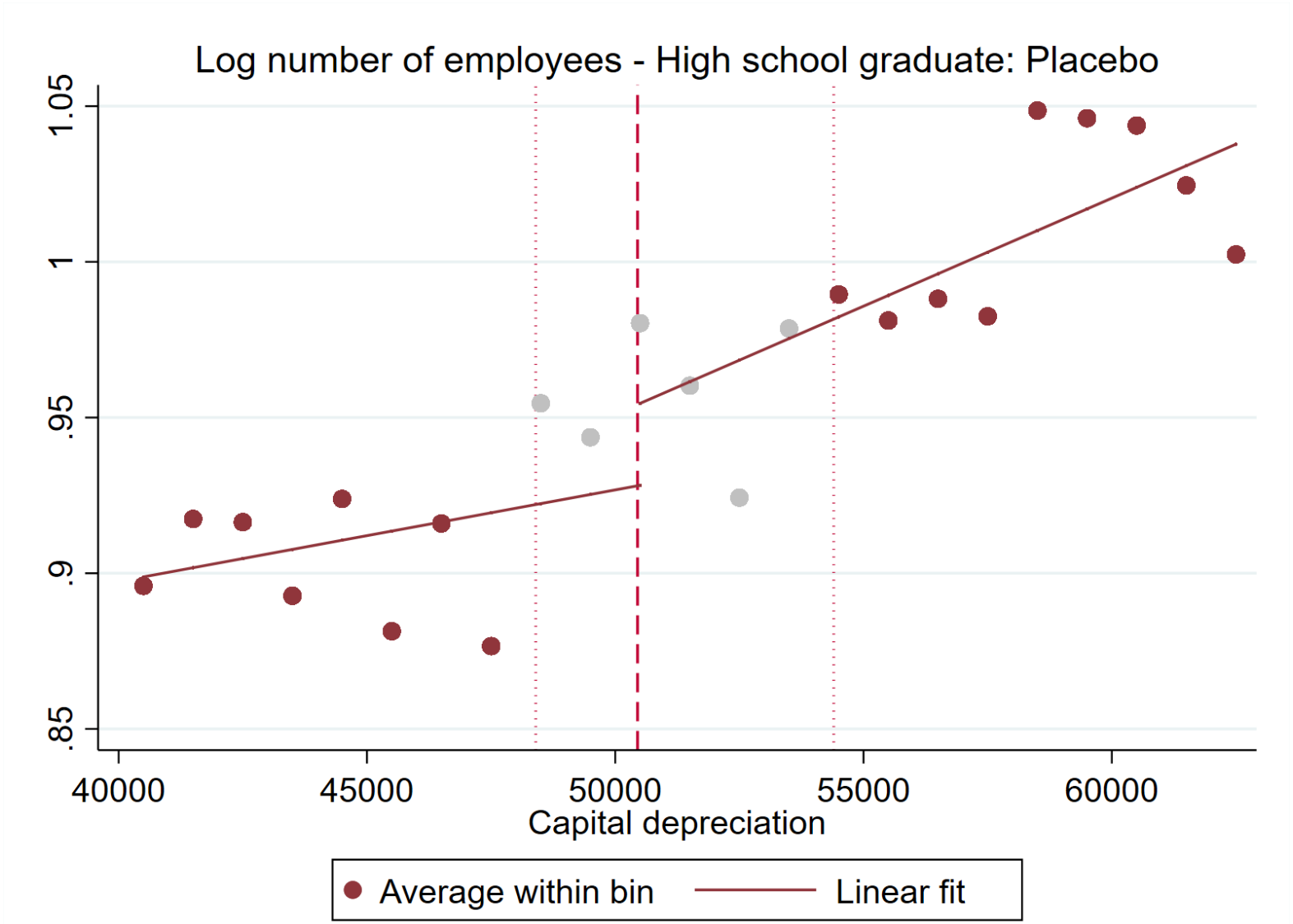
High Skilled: Secondary Degree or More – Placebo



High Skilled: High School Degree or More



High Skilled: High School Degree or More – Placebo



Effect on Workers by Skill Level

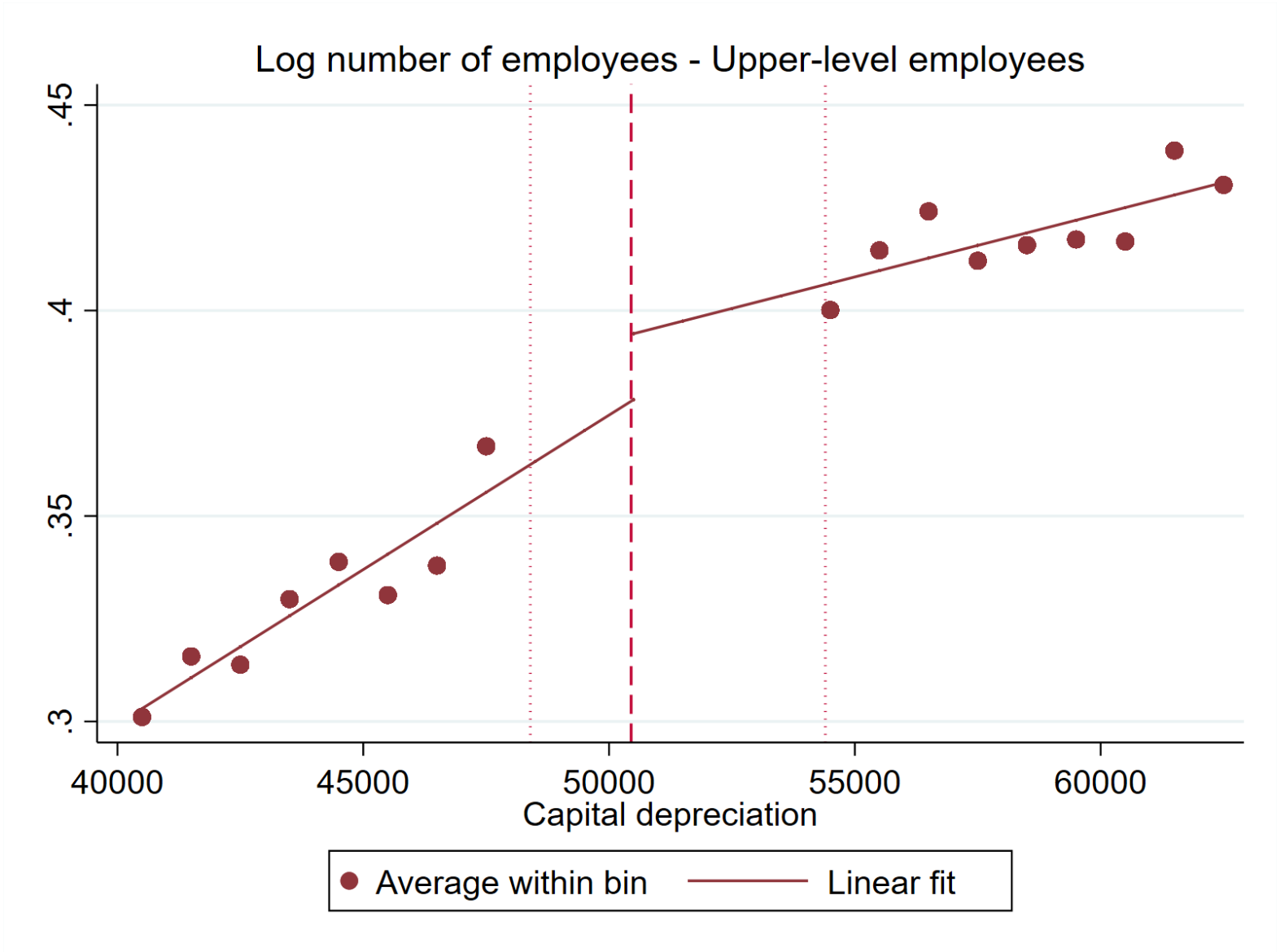
Log No. Employees	High School	No High School	Secondary or Higher	Lower than Secondary
		Treatment		
RD Estimate	0.046	-0.224***	0.055	-0.170***
	(0.056)	(0.065)	(0.049)	(0.061)
Bandwidth	11,527	8,107	12,163	8,595
N above	8,469	7,593	8,703	8,025
N below	18,292	18,361	18,597	18,757
Control mean	1.050	1.872	0.890	1.536
		Placebo		
RD Estimate	-0.083	0.008	-0.076	-0.037
	(0.150)	(0.053)	(0.113)	(0.061)
Bandwidth	6,830	11,584	7,555	10,490
N above	2,319	7,776	2,598	6,630
N below	4,555	15,326	4,766	12,652
Control mean	0.952	1.541	0.779	1.346

Outline

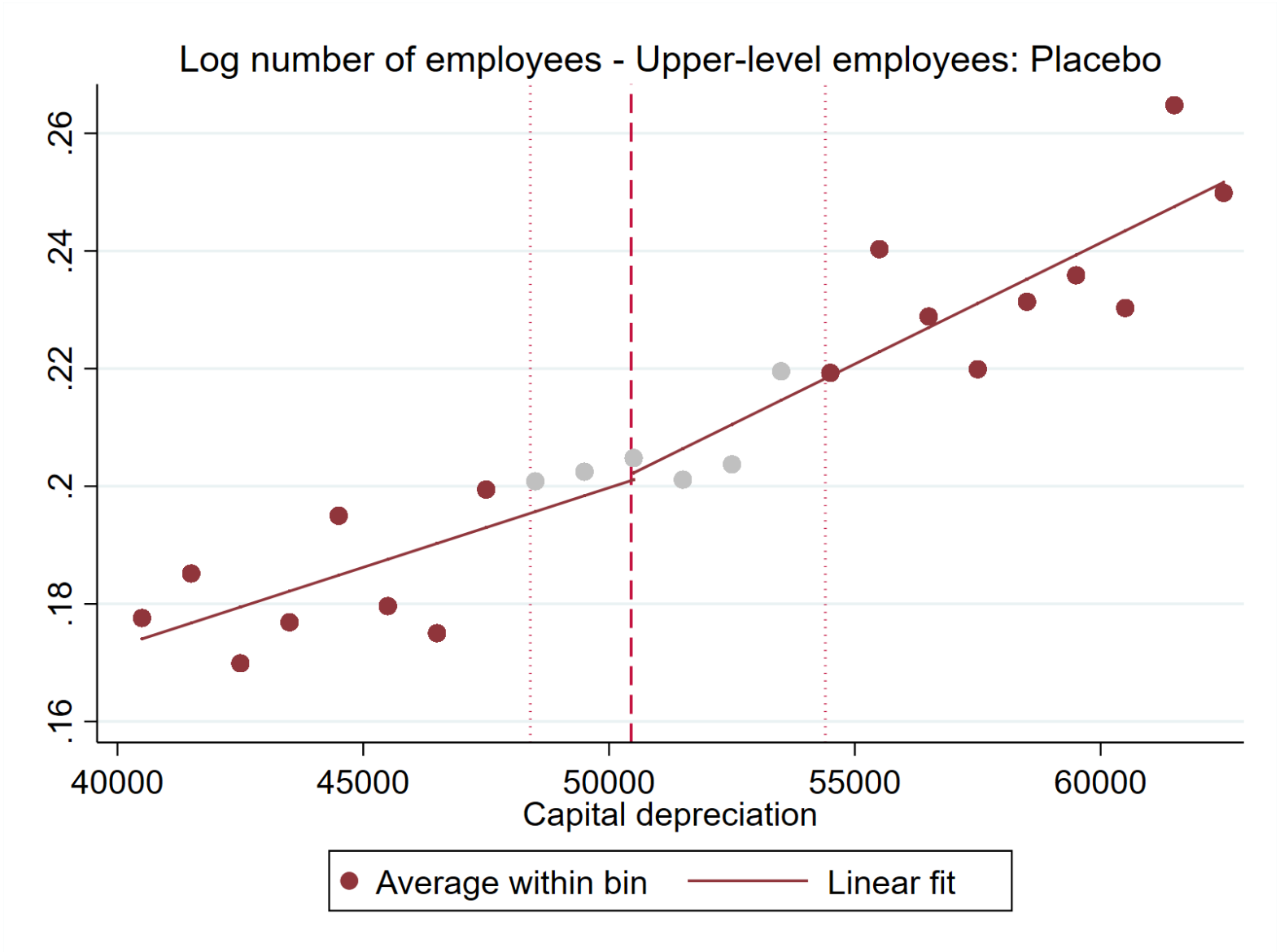
Routine Classification

1. Upper Level employees:
   - Senior officials and upper management
   - Senior officials and employees in research and planning
   - Senior officials and employees in education and training
   - Other senior officials and employees
2. Non-routine, non-manual, lower level employees:
   - Supervisors
   - Clerical and sales workers, independent work
   - Other lower-level employees
3. Routine and manual workers:
   - Clerical and sales workers, routine work
   - Workers in agriculture, forestry and commercial fishing
   - Manufacturing workers
   - Other production workers
   - Distribution and service workers

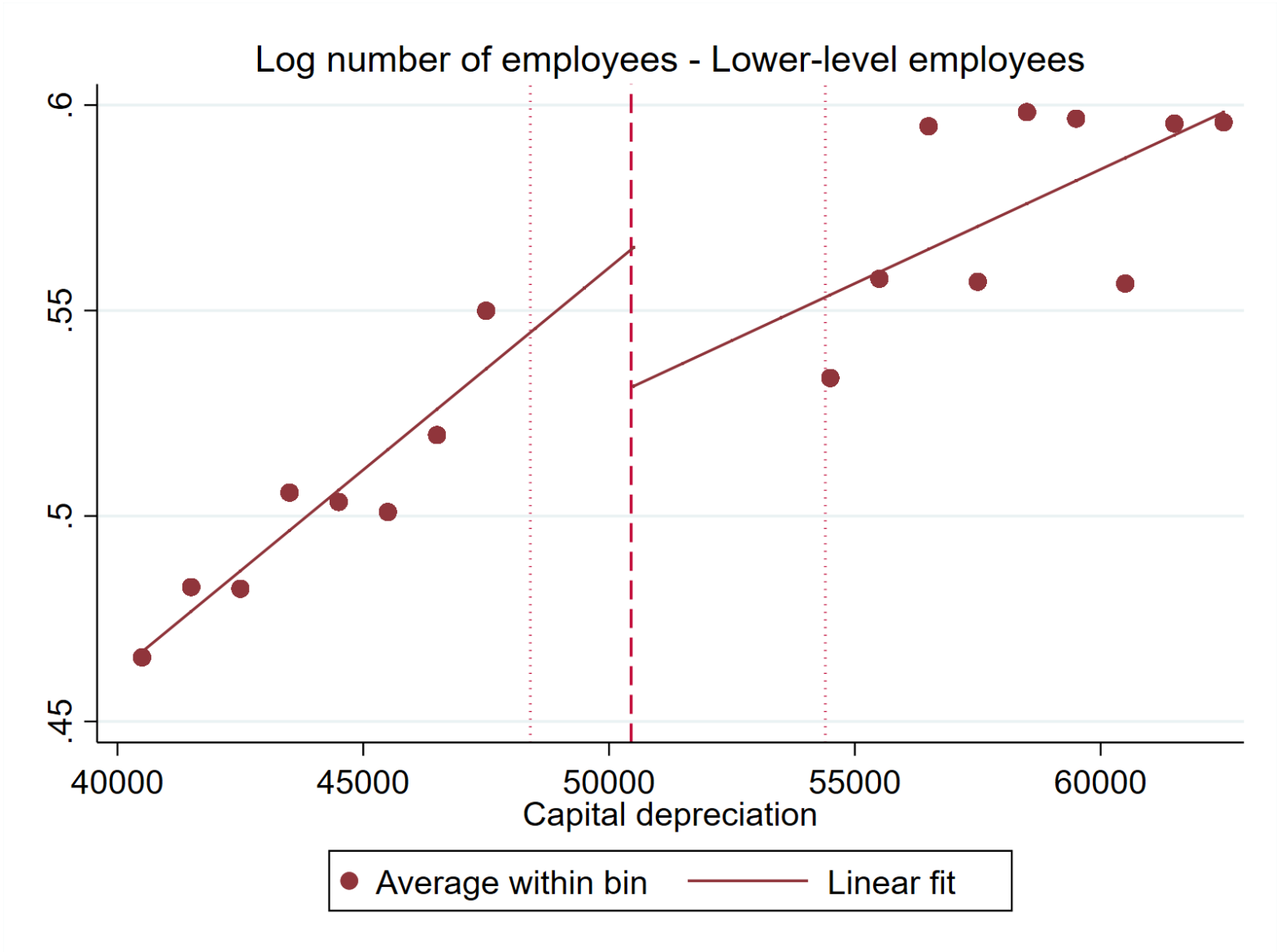
Upper Level Employees



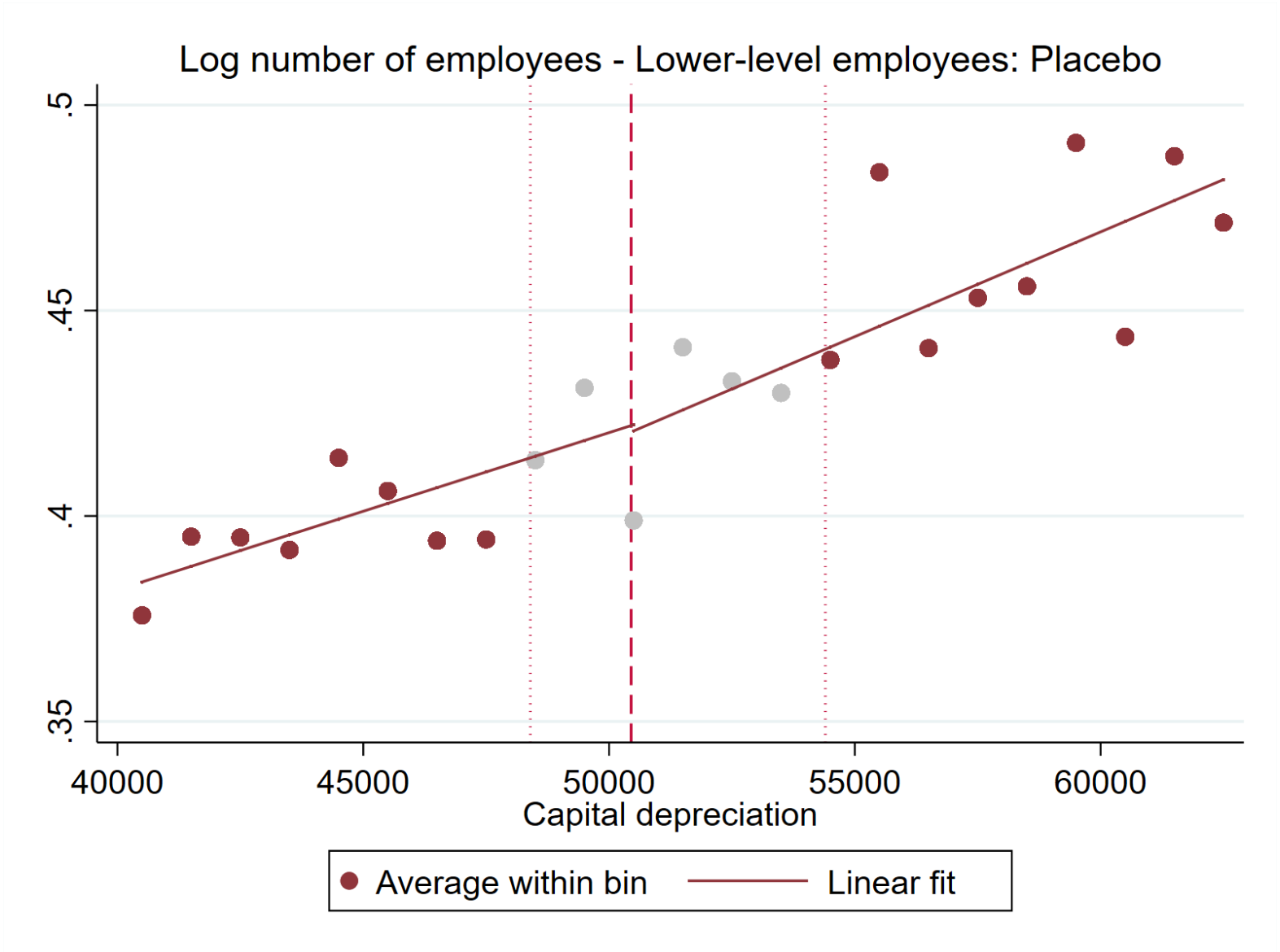
Upper Level Employees – Placebo



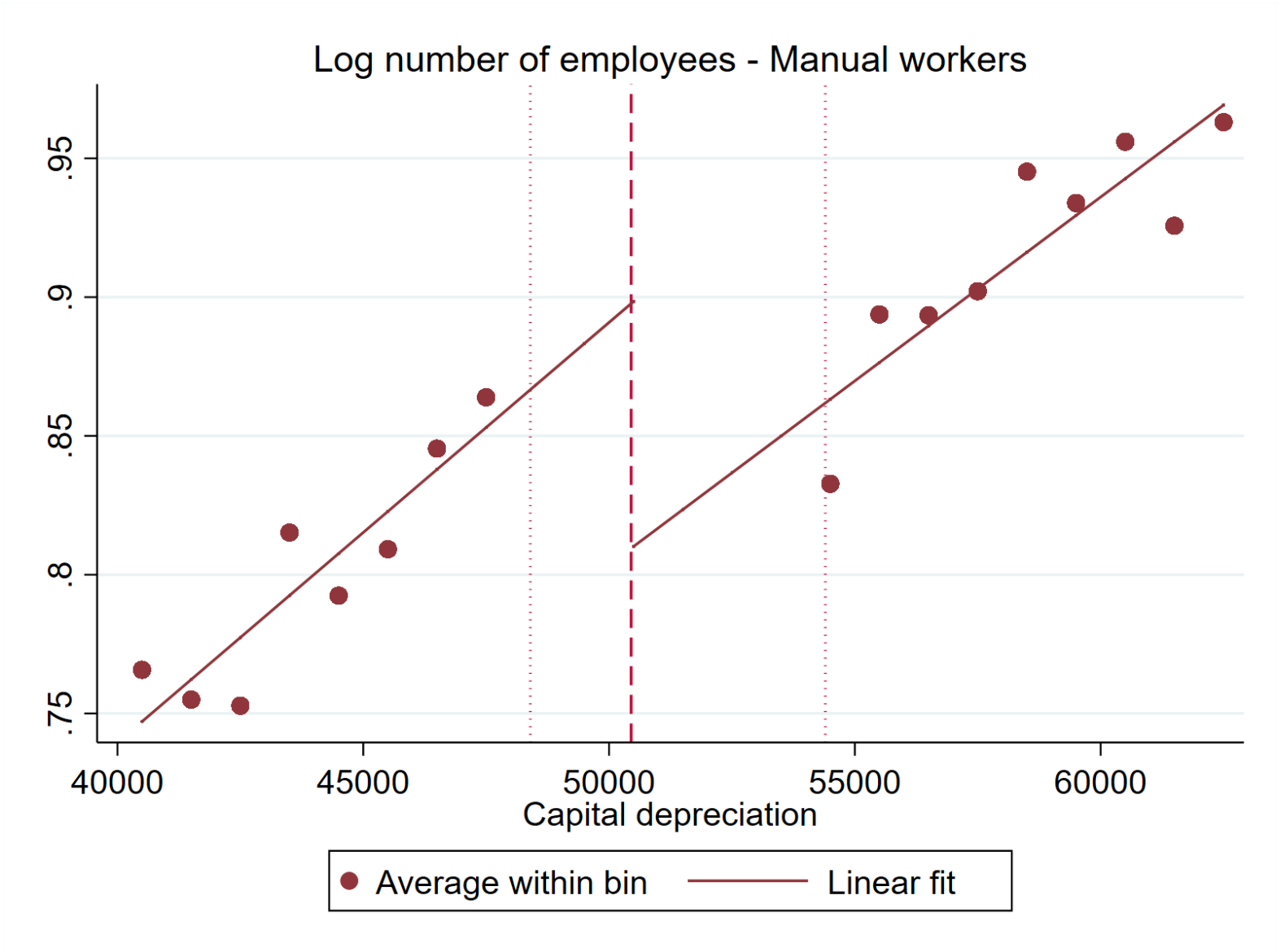
Non-Routine, Non-Manual, Lower Level Employees



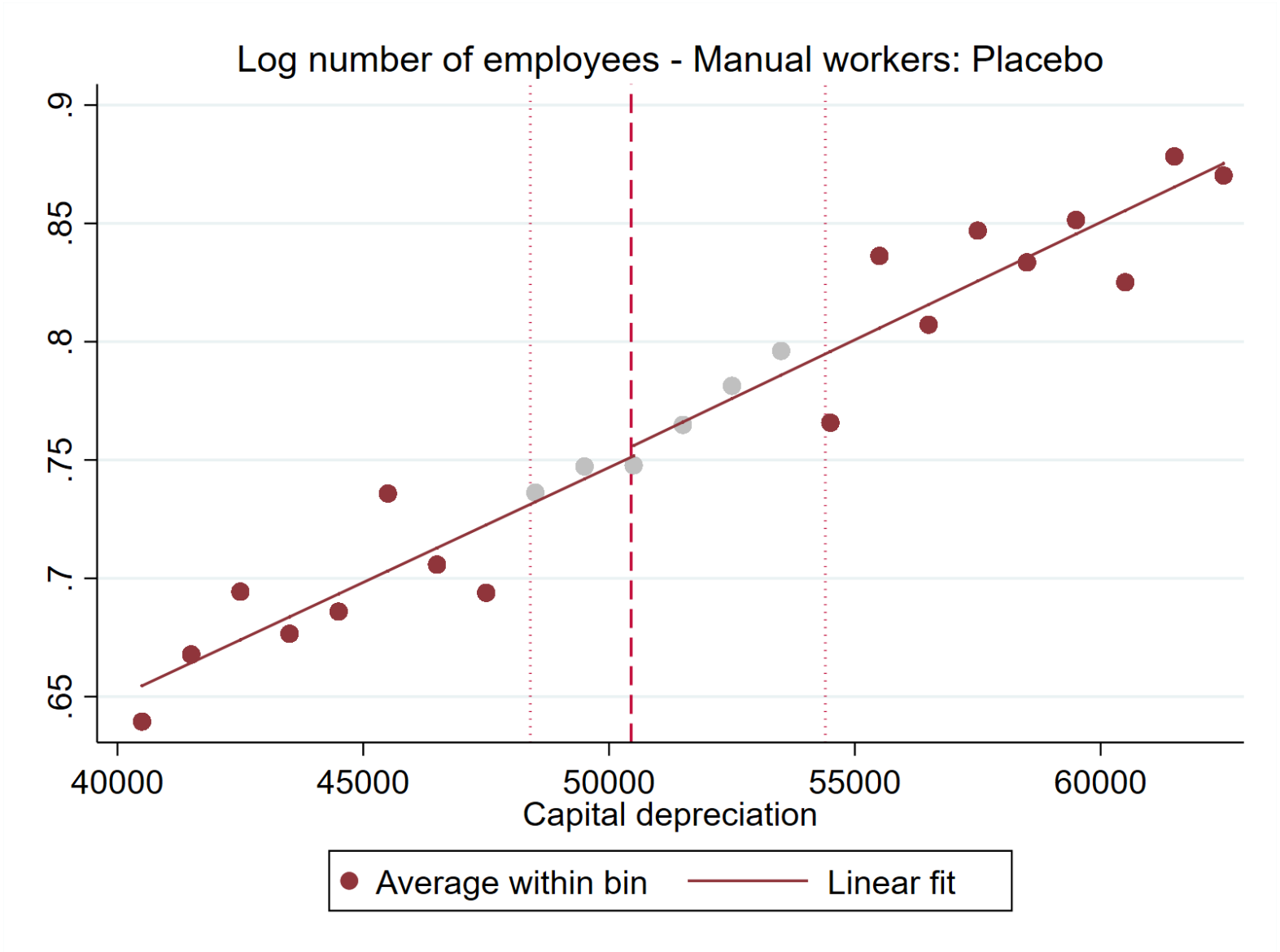
Non-Routine, Non-Manual, Lower Level Employees – Placebo



Routine and Manual Employees



Routine and Manual Employees – Placebo

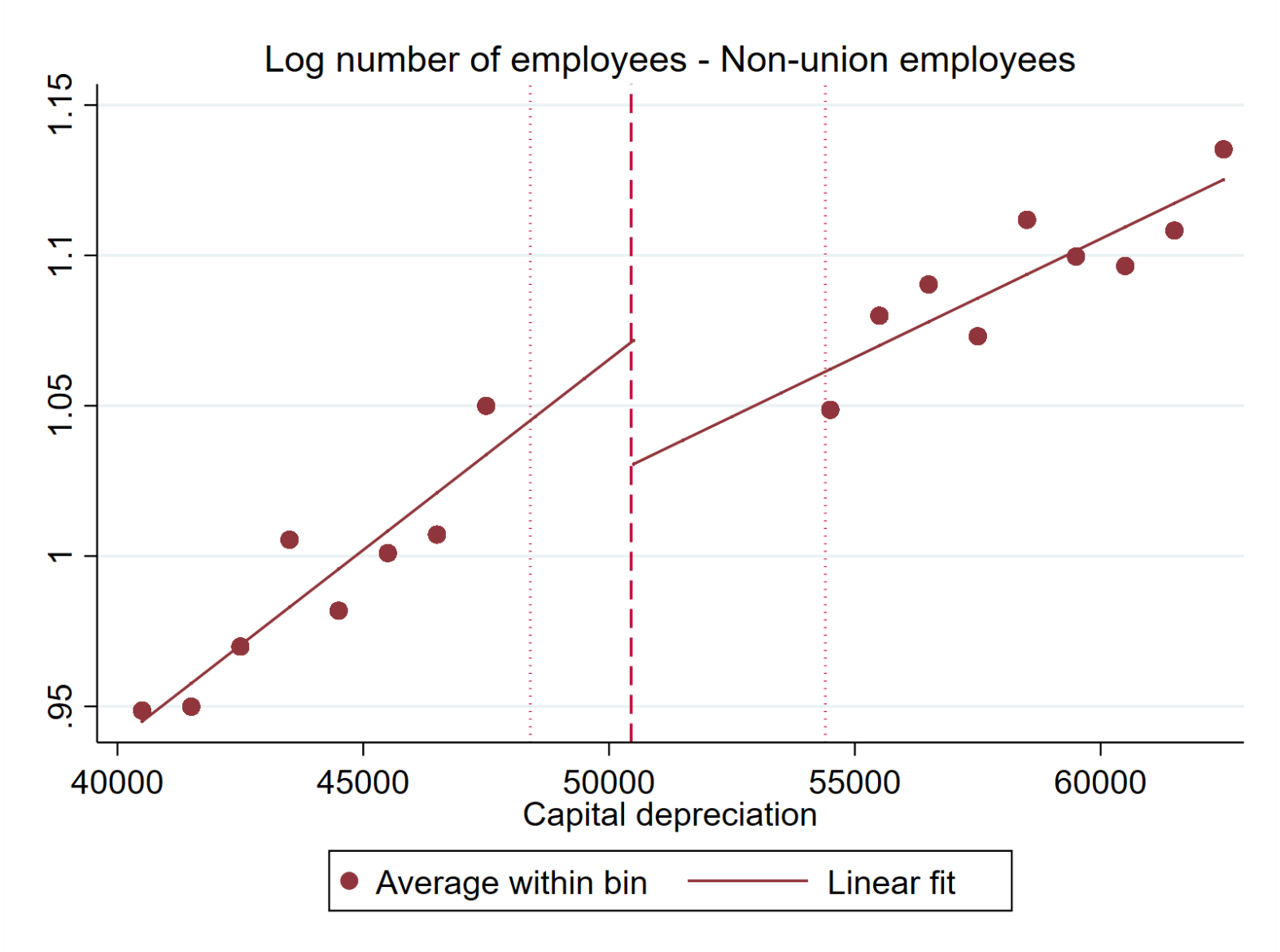


Effect on Workers by Type of Work

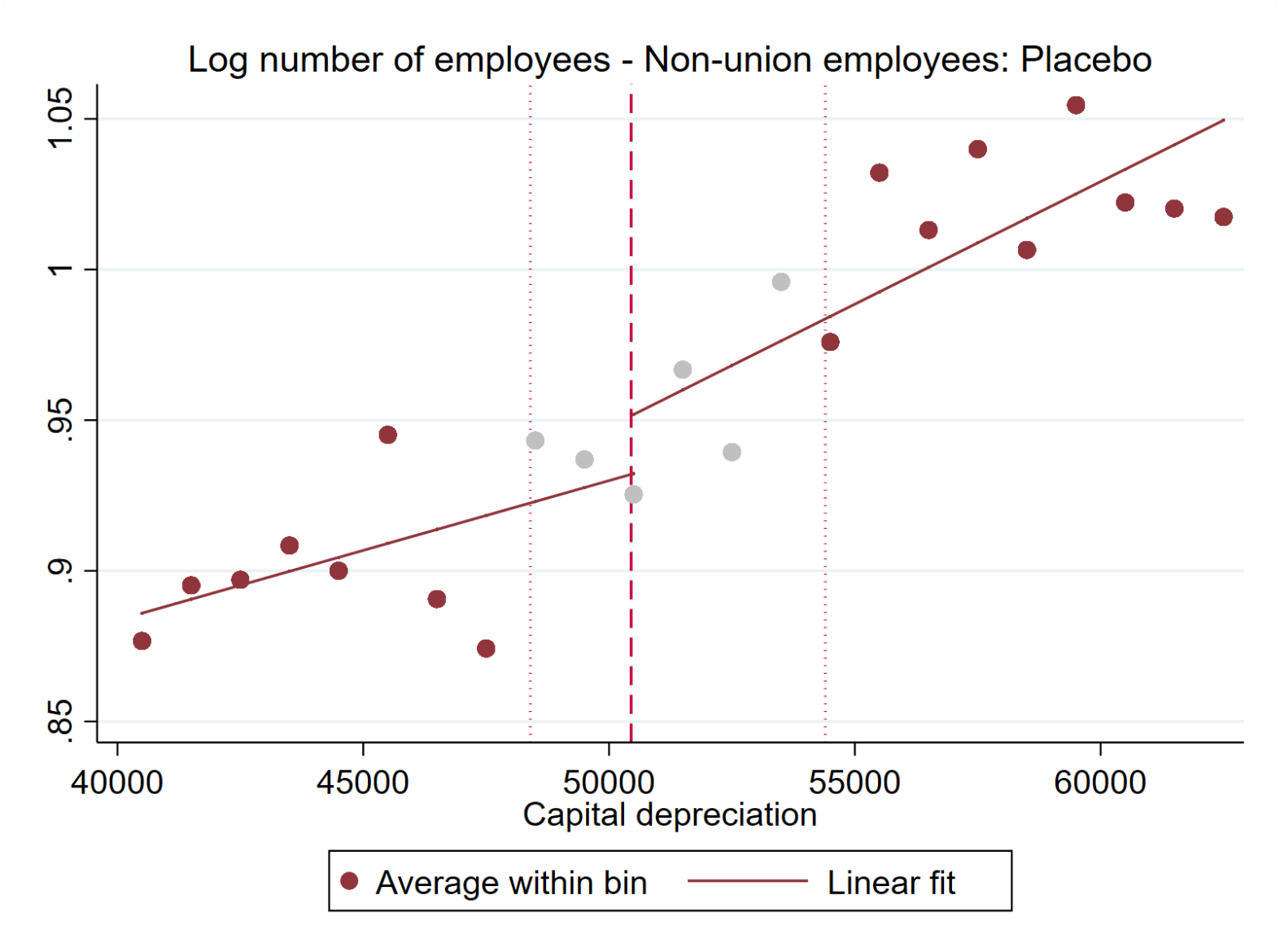
Log No. Employees	Upper-level workers	Lower-level workers	Manual workers
		Treatment	
RD Estimate	0.056*	-0.077*	-0.211***
	(0.029)	(0.042)	(0.049)
Bandwidth	14,640	11,379	10,222
N above	19,586	14,375	12,426
N below	47,838	33,789	29,219
Control mean	0.454	0.666	0.994
		Placebo	
RD Estimate	0.030	0.021	-0.006
	(0.043)	(0.051)	(0.051)
Bandwidth	10,411	11,718	12,536
N above	7,724	8,966	9,707
N below	15,250	18,003	19,788
Control mean	0.274	0.504	0.807

Outline

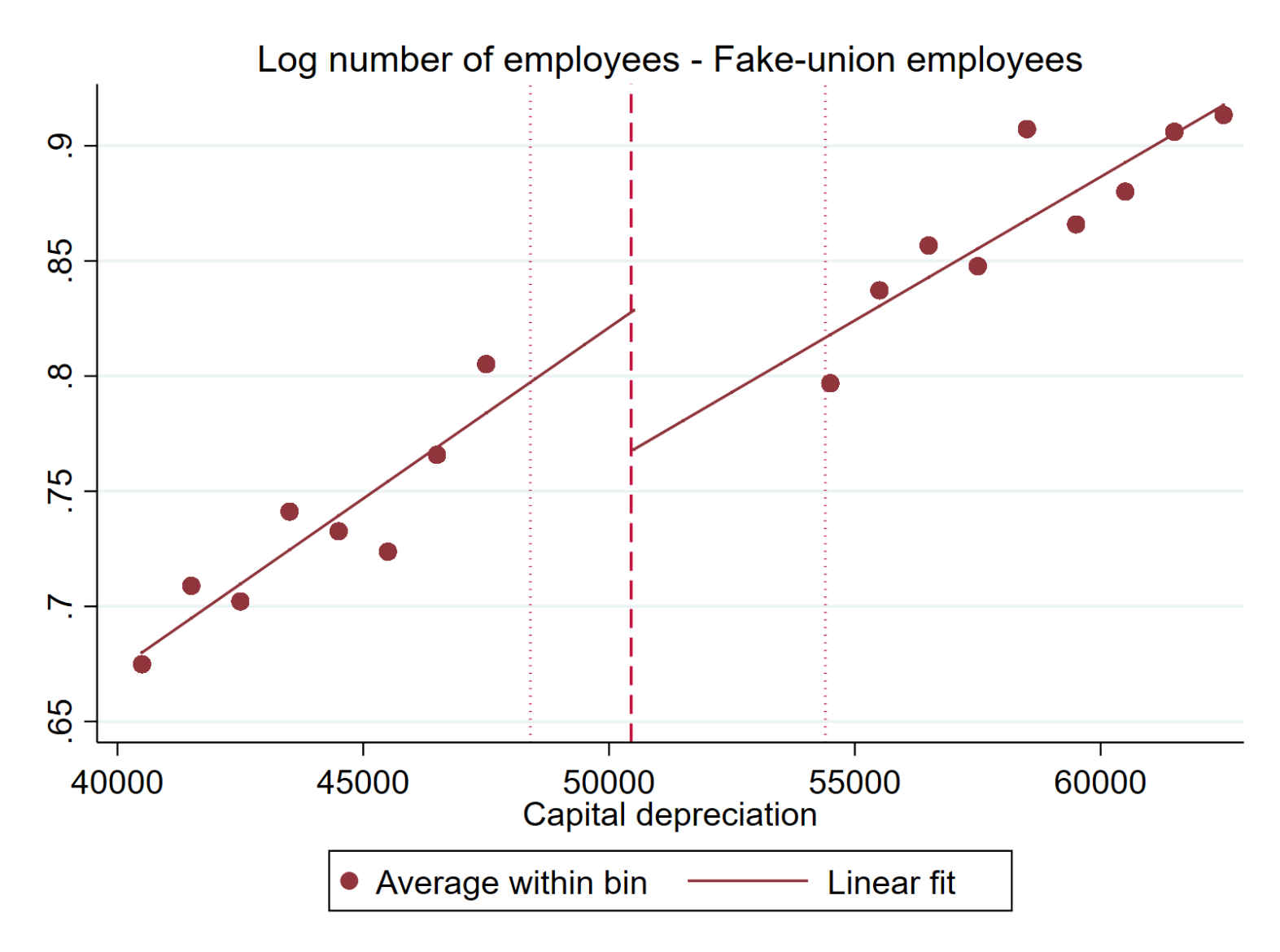
Non-Unionized Employees



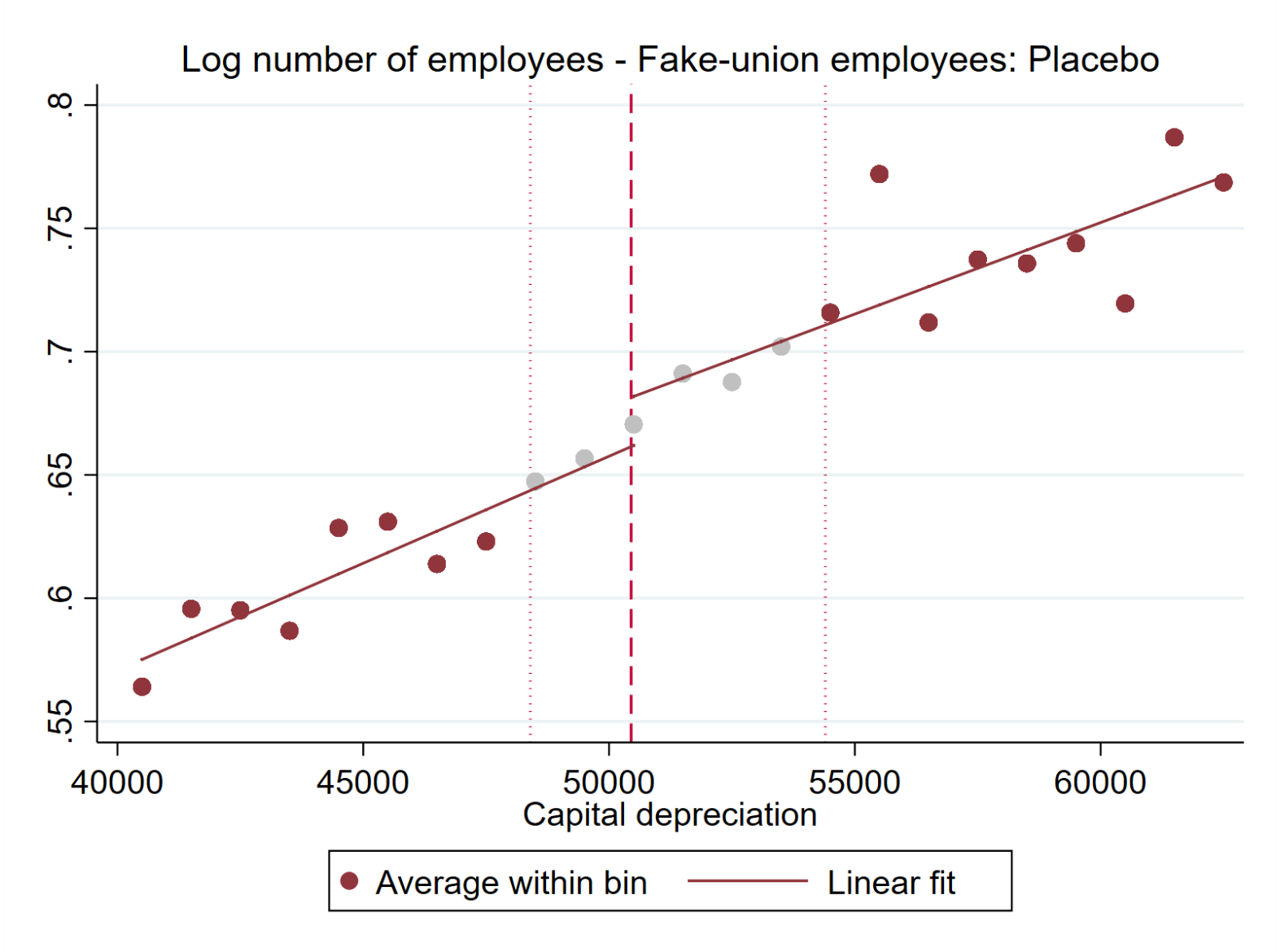
Non-Unionized Employees – Placebo



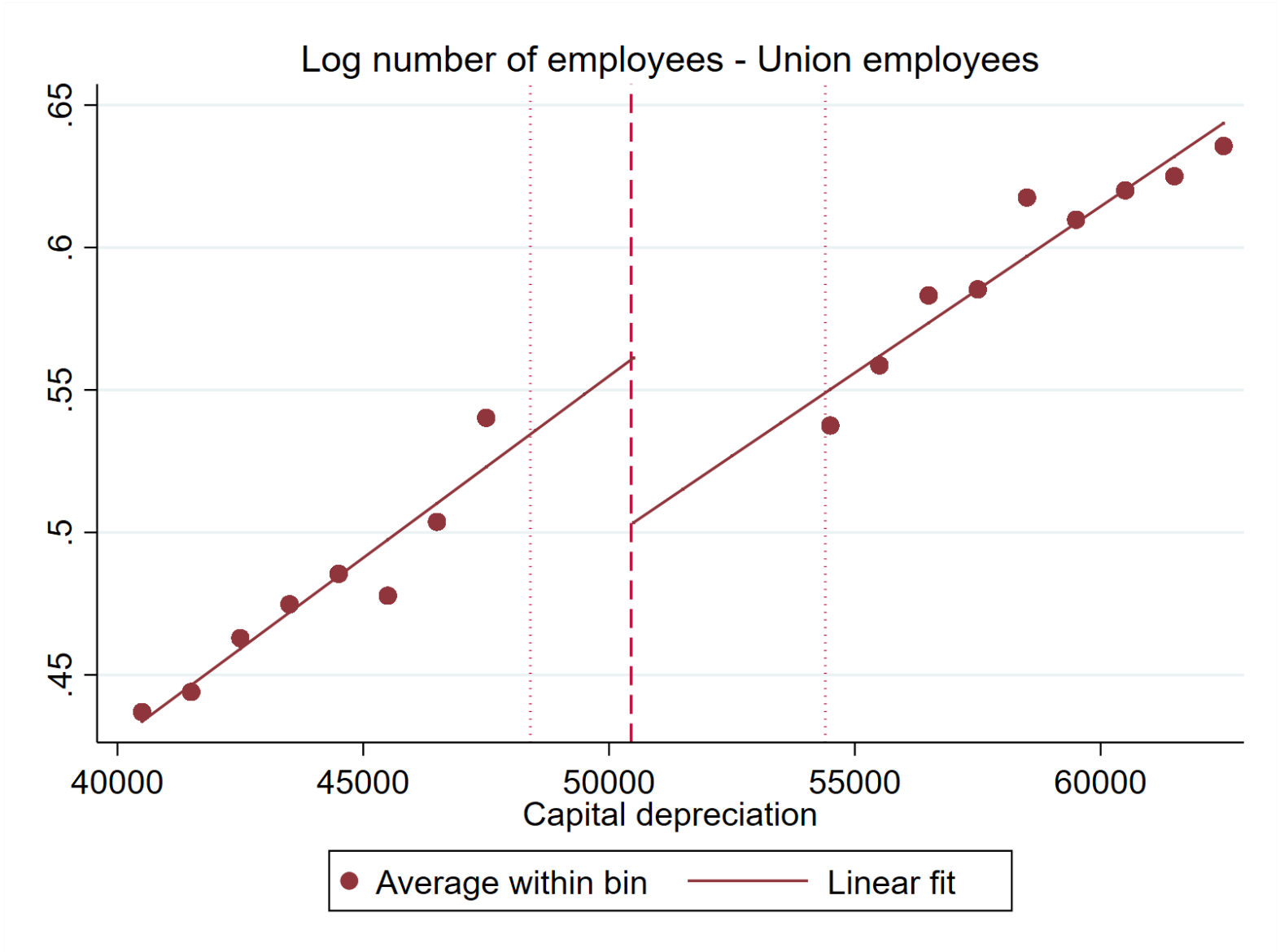
Fake Union Employees



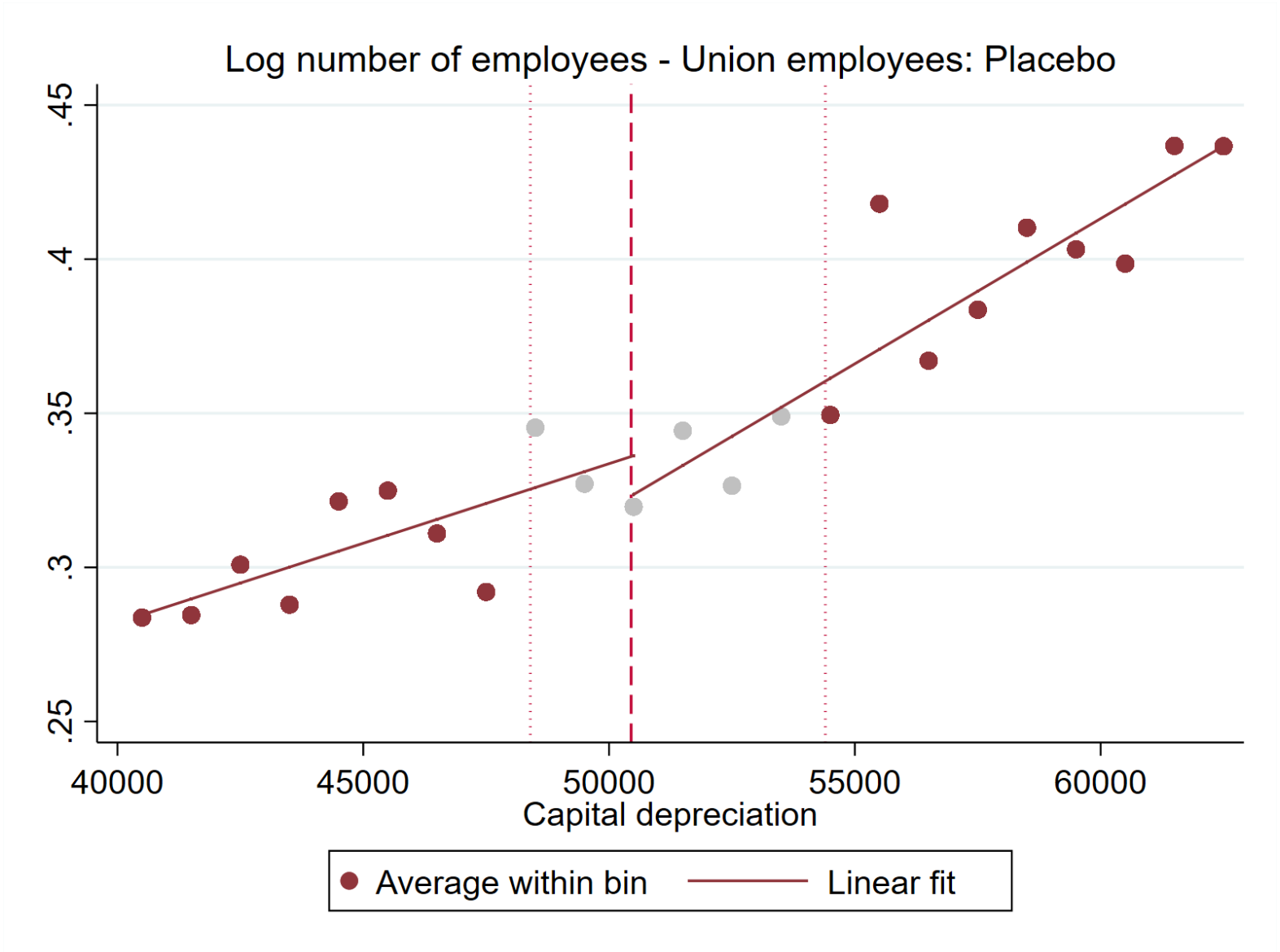
Fake Union Employees – Placebo



Unionized Employees



Unionized Employees – Placebo

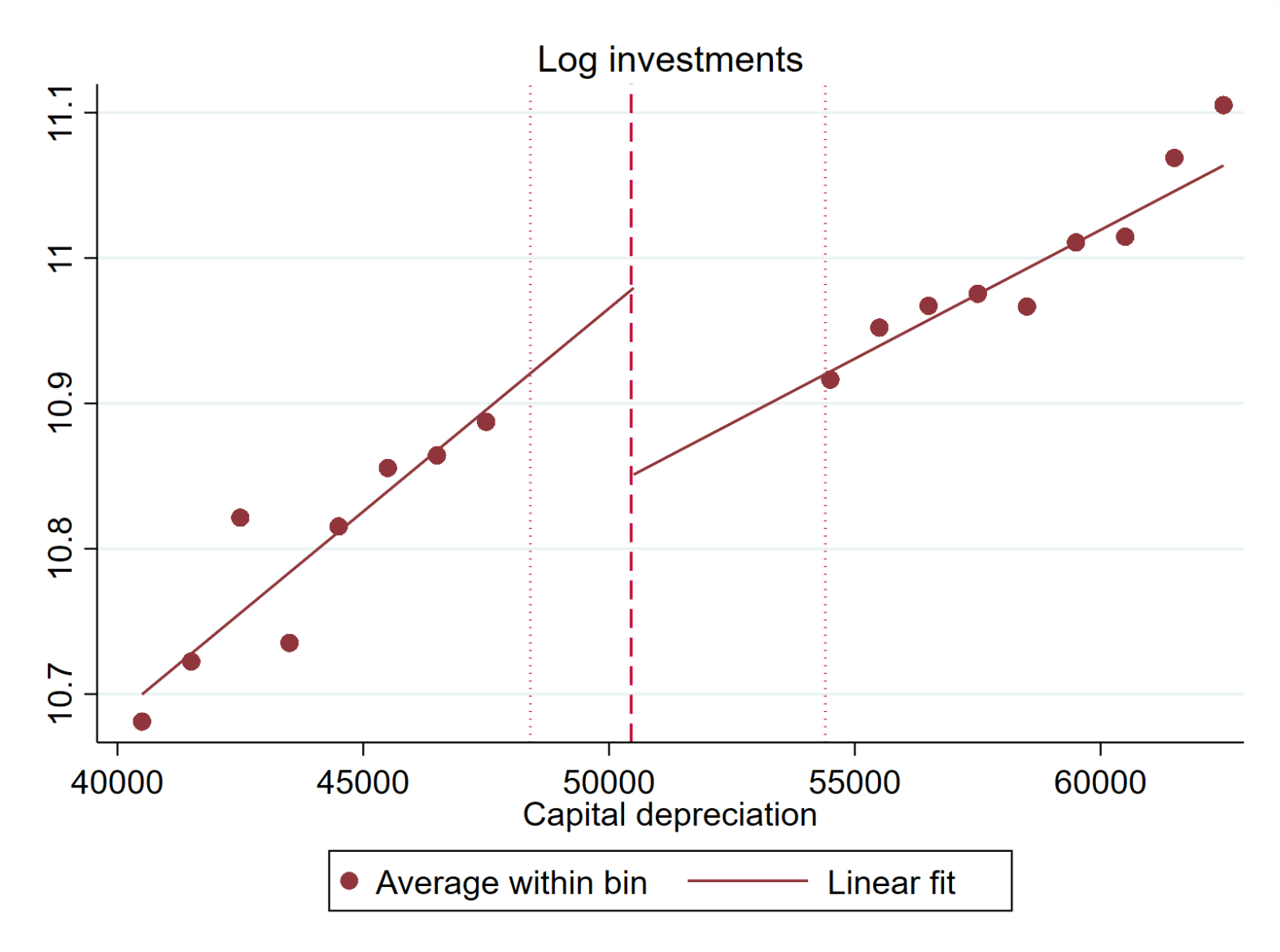


Estimates by Unionization Status

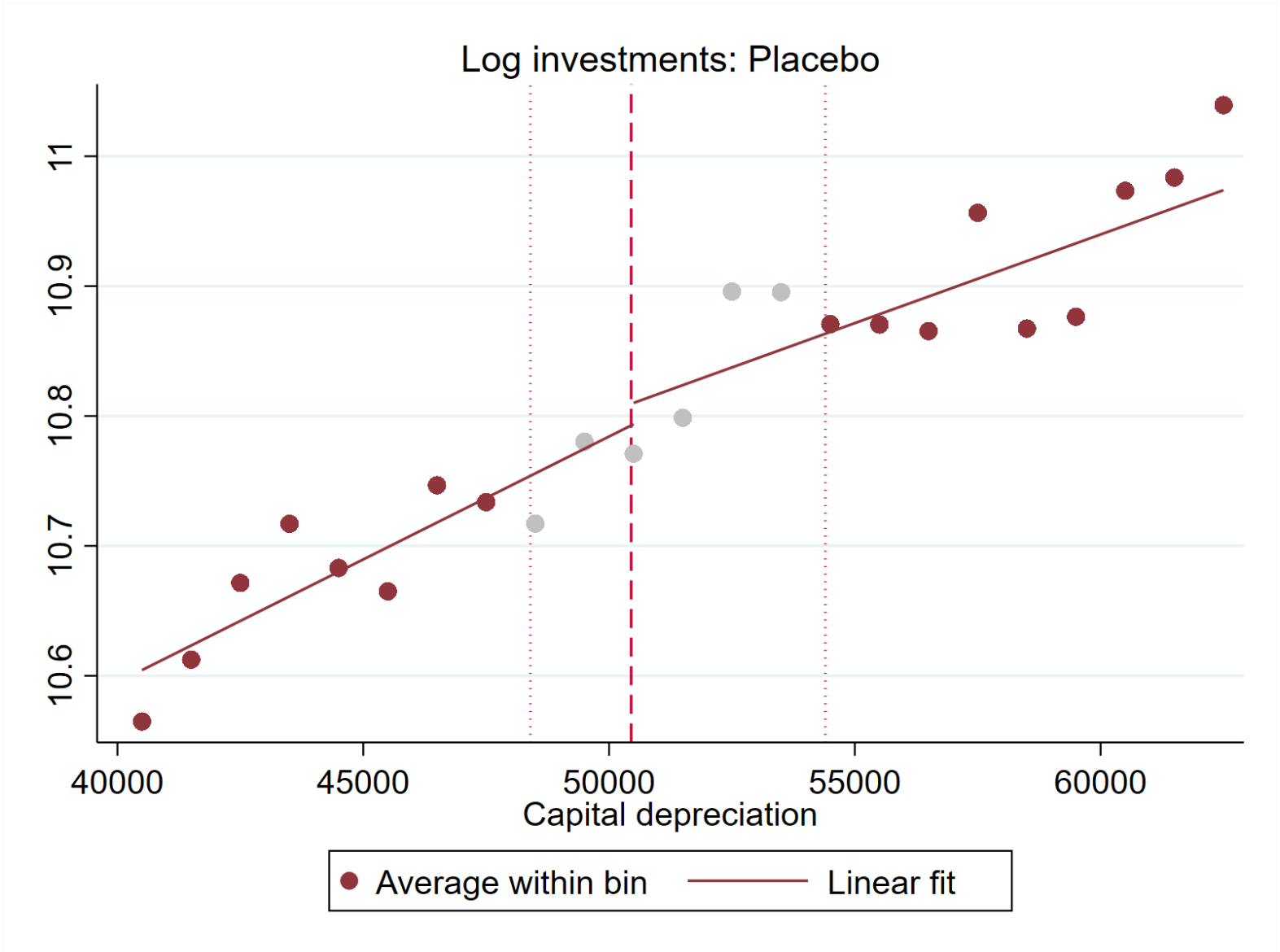
Outcomes	Share of union employees	No. not union employees	No. fake union employees	No. union employees
		Treatment		
RD Estimate	-0.015	-0.061*	-0.153***	-0.148***
	(0.015)	(0.036)	(0.054)	(0.050)
Bandwidth	9,269	14,147	9,175	9,162
N above	8,825	18,821	10,635	10,613
N below	20,048	45,534	25,235	25,185
Control mean	0.579	1.152	0.907	0.659
		Placebo		
RD Estimate	0.003	0.048	0.082	0.010
	(0.016)	(0.049)	(0.051)	(0.040)
Bandwidth	11,087	12,338	11,390	12,364
N above	6,677	9,532	8,652	9,554
N below	12,354	19,337	17,309	19,387
Control mean	0.554	0.985	0.710	0.393

Outline

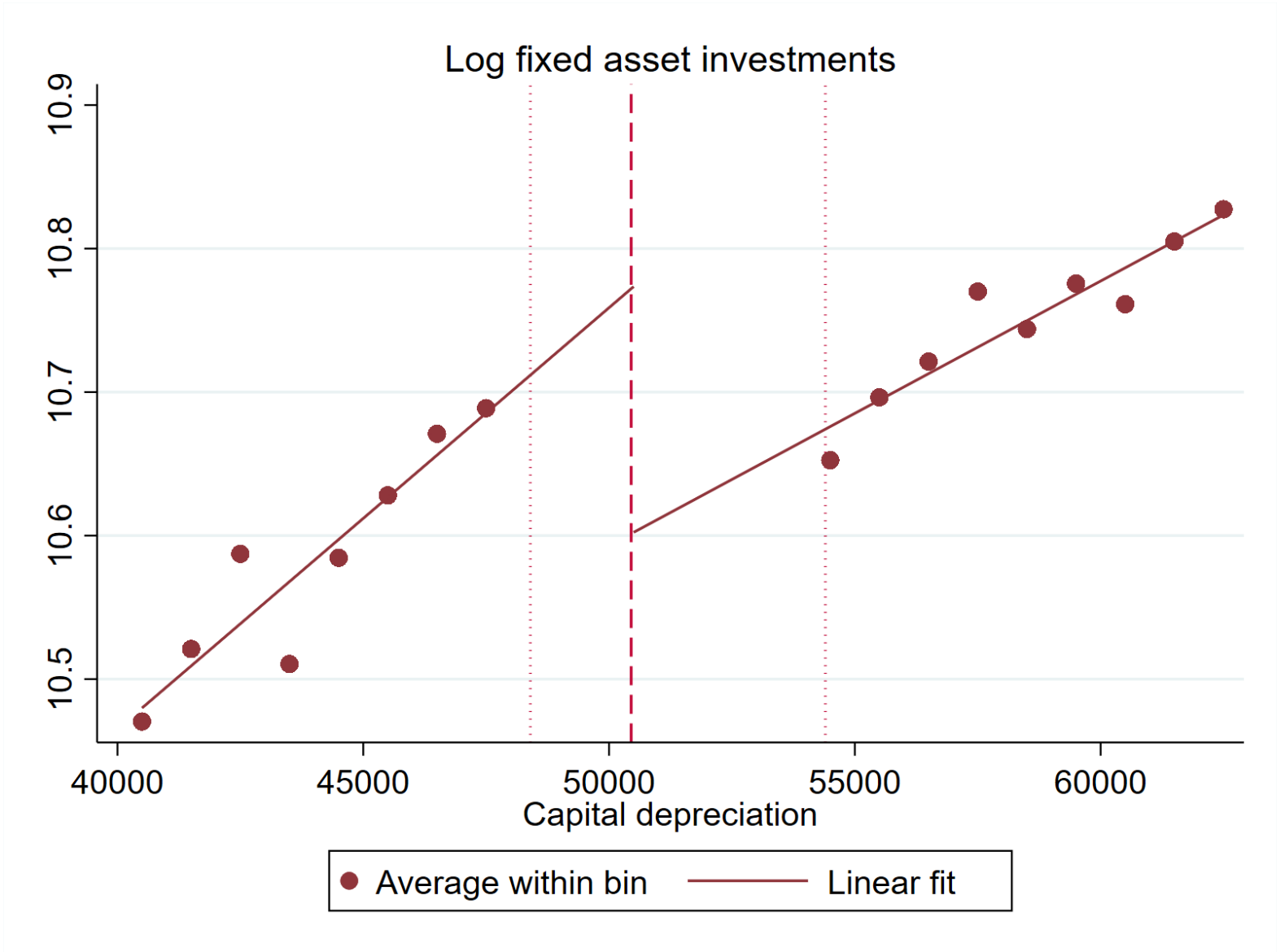
Investment


Log investments
11.1
11
10.9
10.8
10.7
40000
45000
50000
55000
60000
Capital depreciation
Average within bin
Linear fit

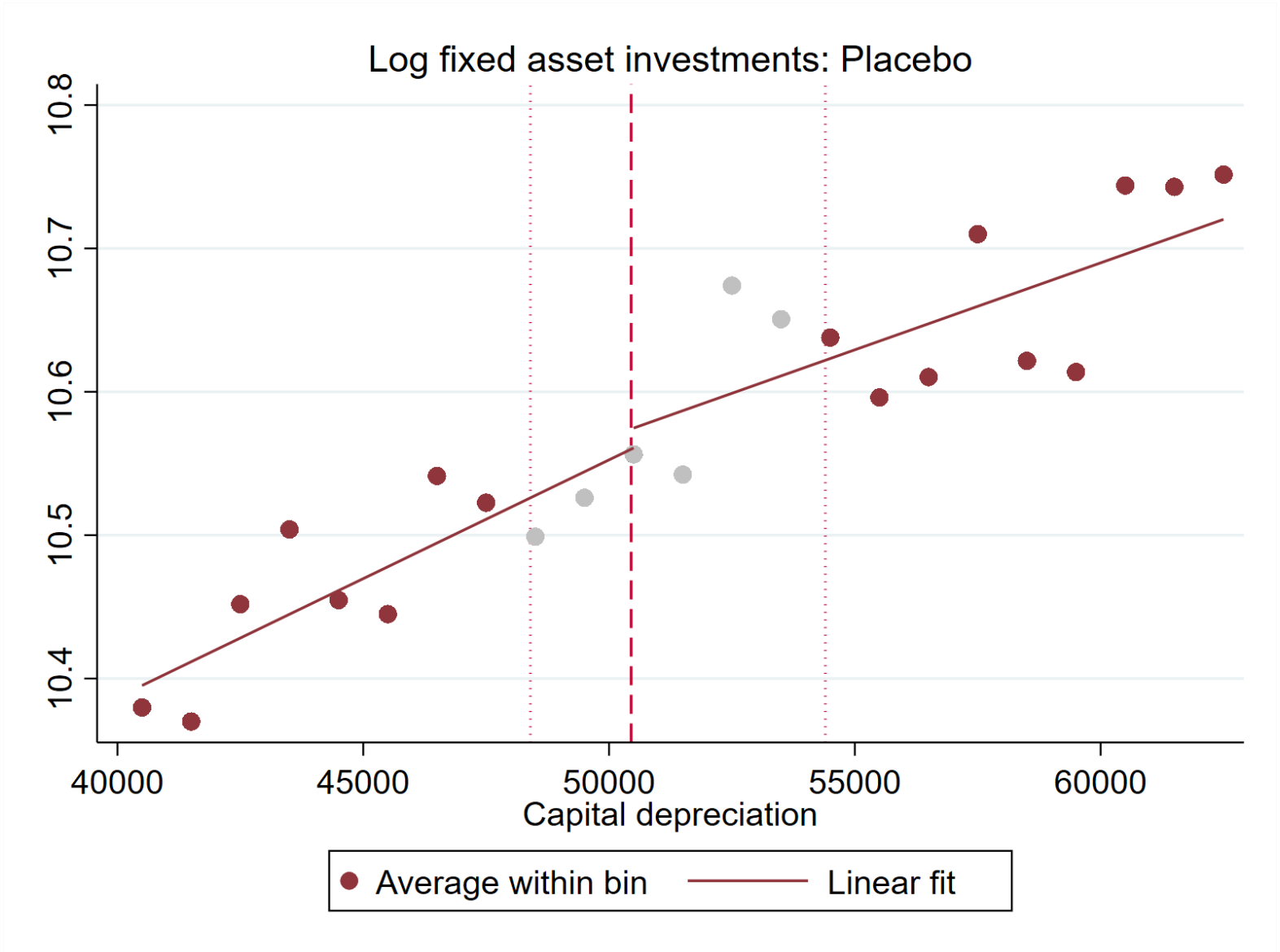
Investment – Placebo



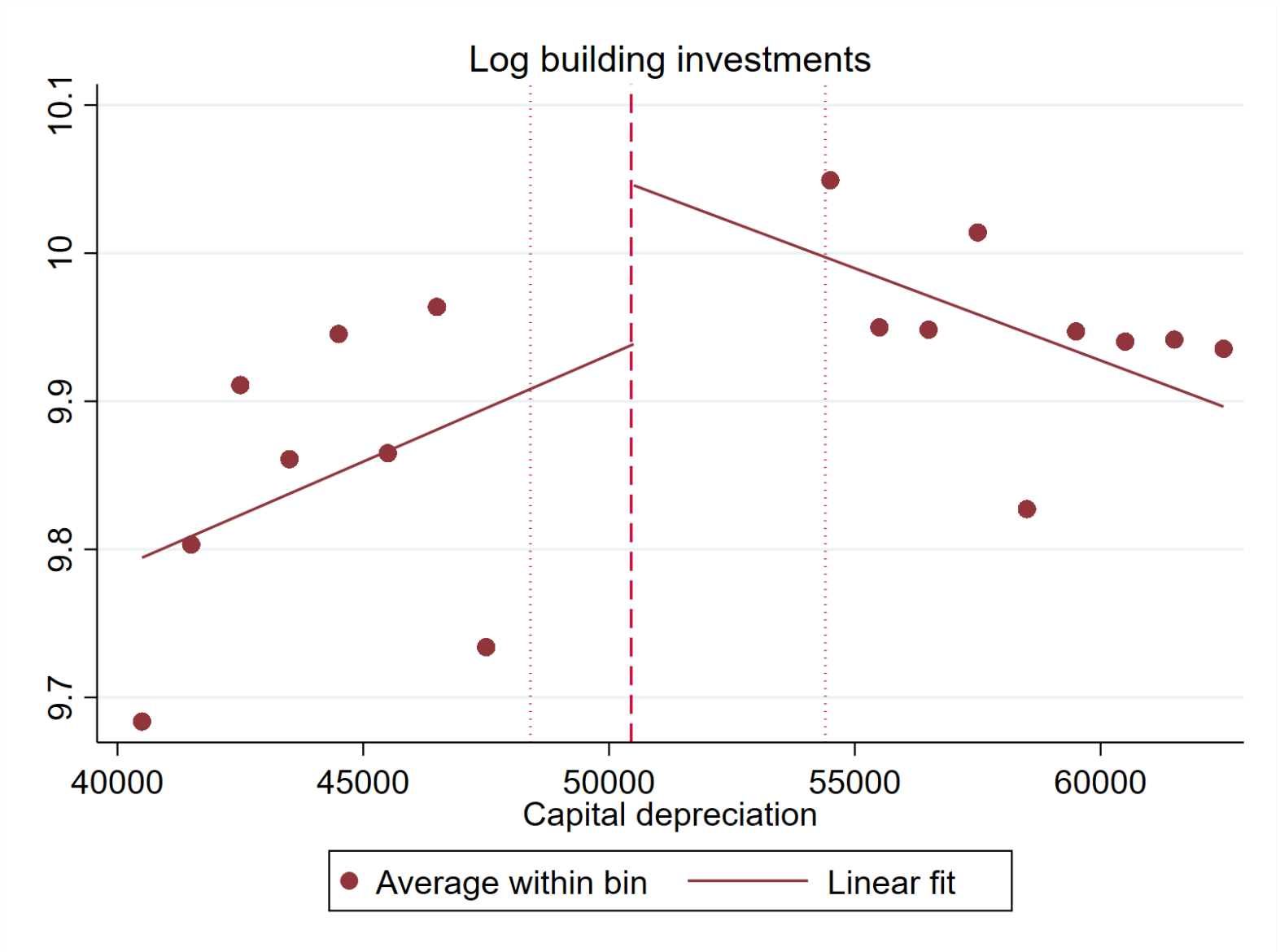
Fixed Assets



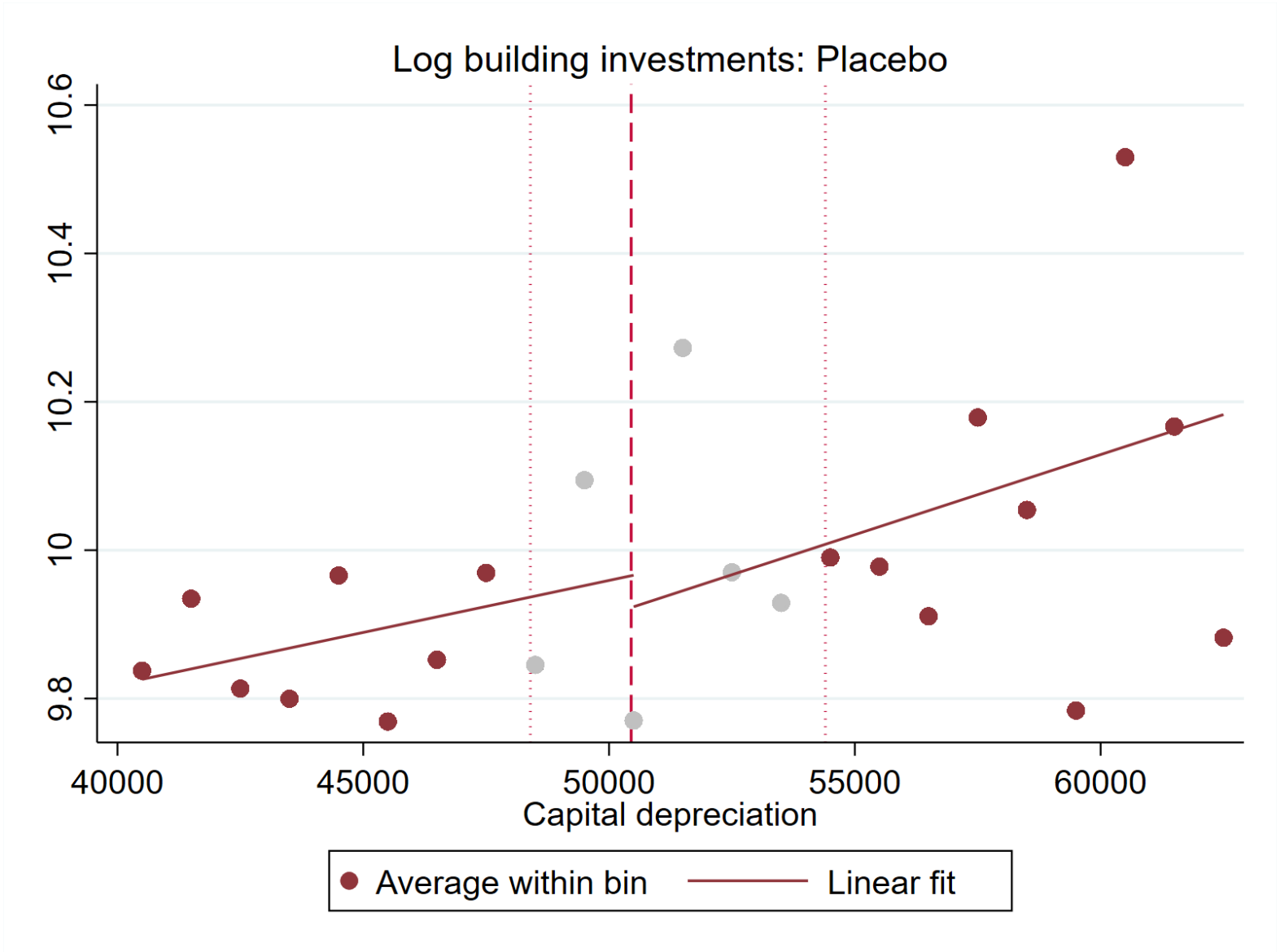
Fixed Assets – Placebo



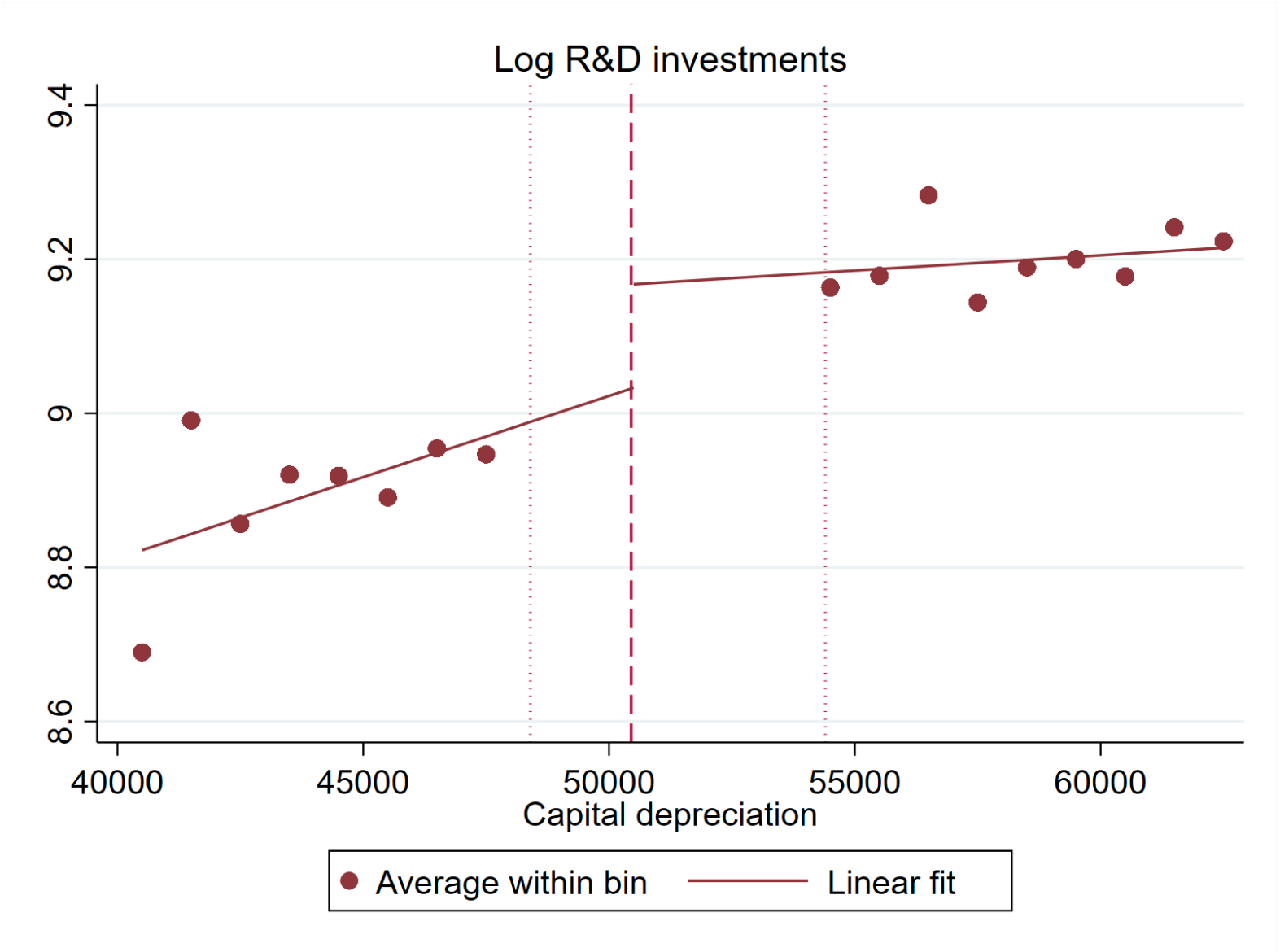
Buildings


Log building investments
10.1
10
9.9
9.8
9.7
40000
45000
50000
55000
60000
Capital depreciation
Average within bin
Linear fit

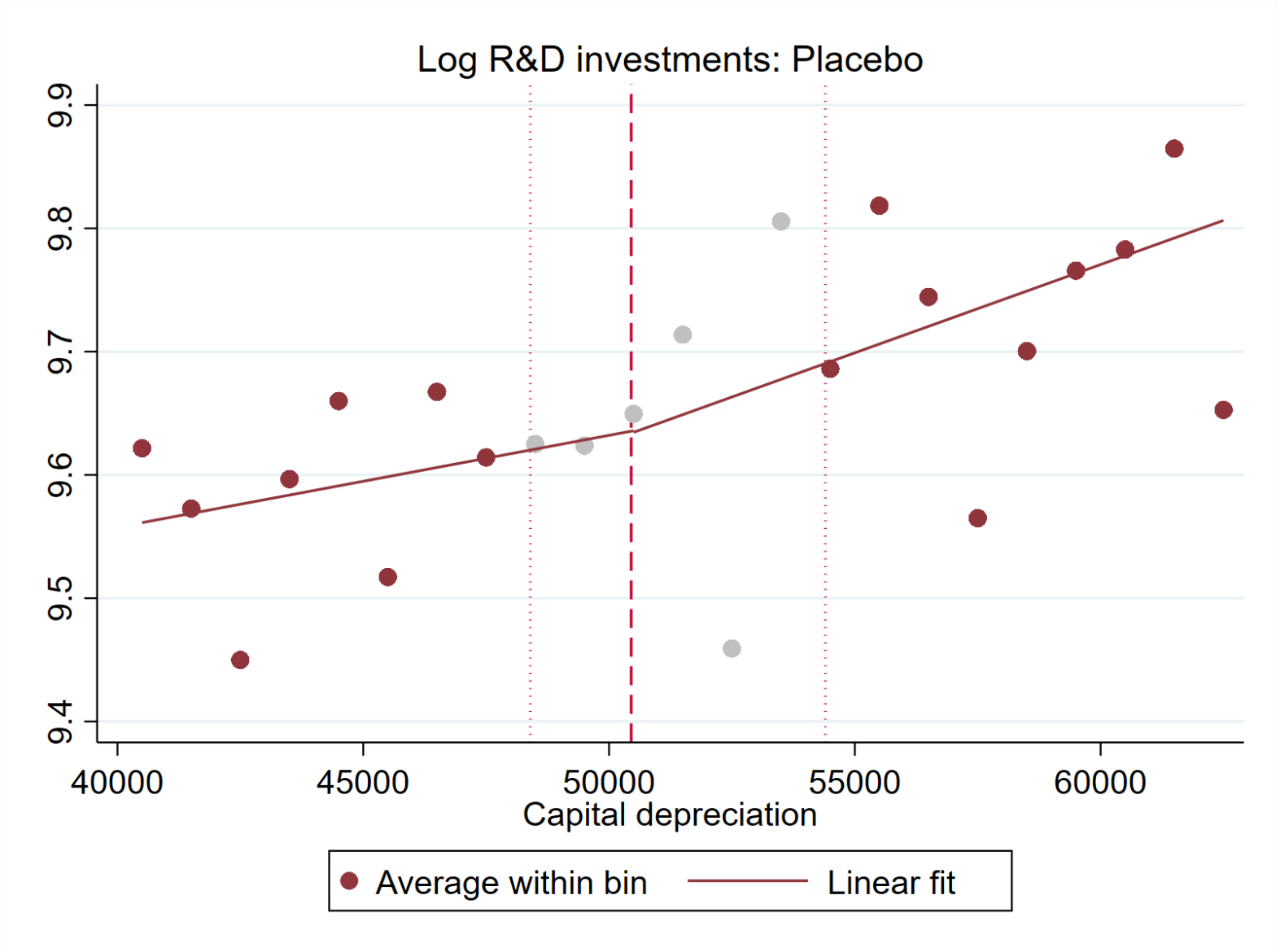
Buildings – Placebo



Research and Development



Research and Development – Placebo



Effect on Investment

Outcomes (logs)	Investment	Fixed assets	Buildings	R&D
		Treatment		
RD Estimate	-0.143***	-0.184***	0.120	0.244**
	(0.044)	(0.048)	(0.121)	(0.102)
Bandwidth	19,798	18,252	13,078	15,654
N above	24,254	21,586	7,345	9,900
N below	68,659	58,794	17,121	22,331
Control mean	10.98	10.76	9.871	8.957
		Placebo		
RD Estimate	0.052	0.016	0.127	0.158
	(0.066)	(0.068)	(0.150)	(0.165)
Bandwidth	16,472	16,478	14,387	12,874
N above	11,093	10,493	4,913	4,042
N below	25,002	23,623	9,947	7,737
Control mean	10.77	10.55	9.653	9.619

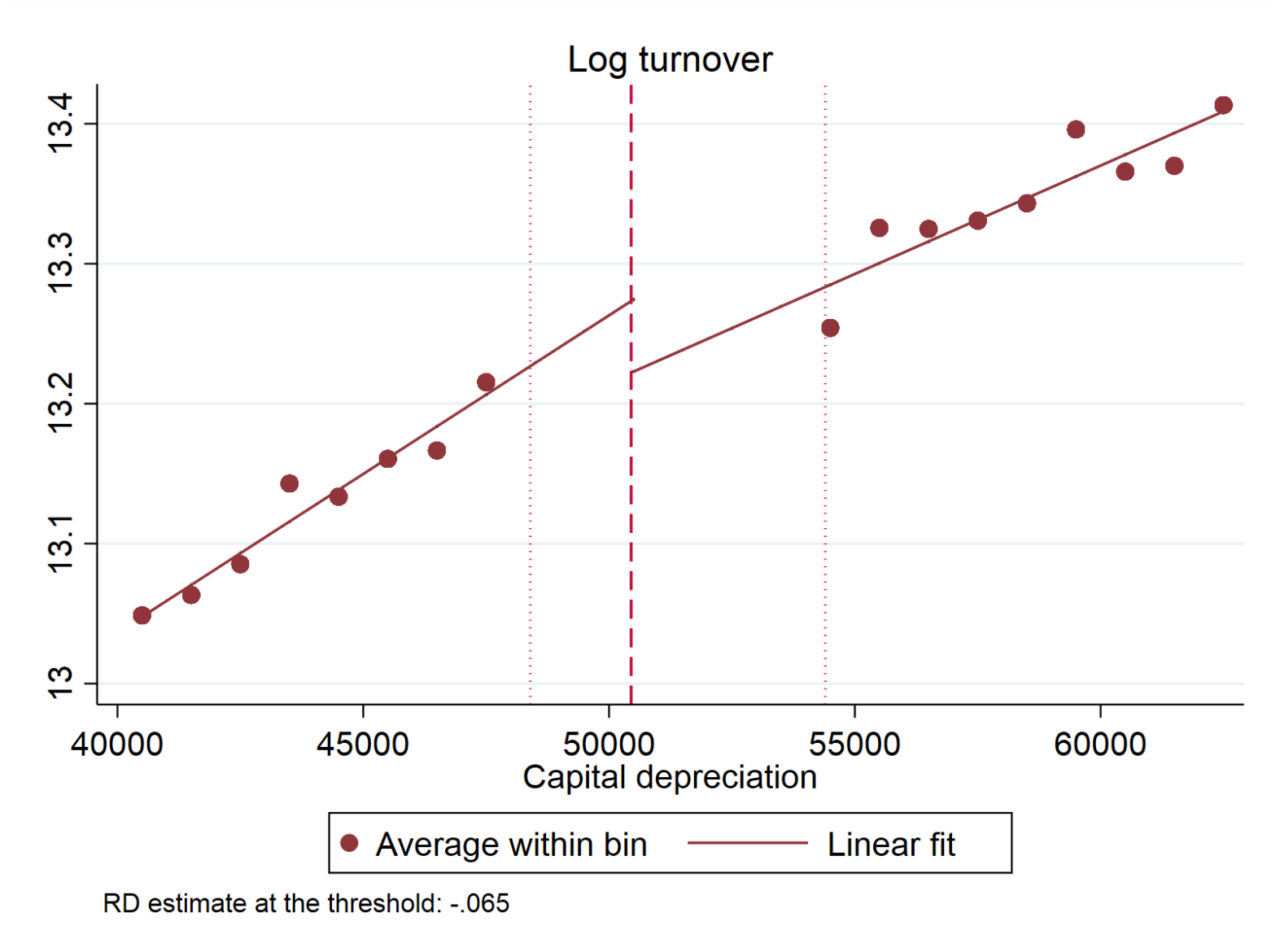
heterogeneity

So Far

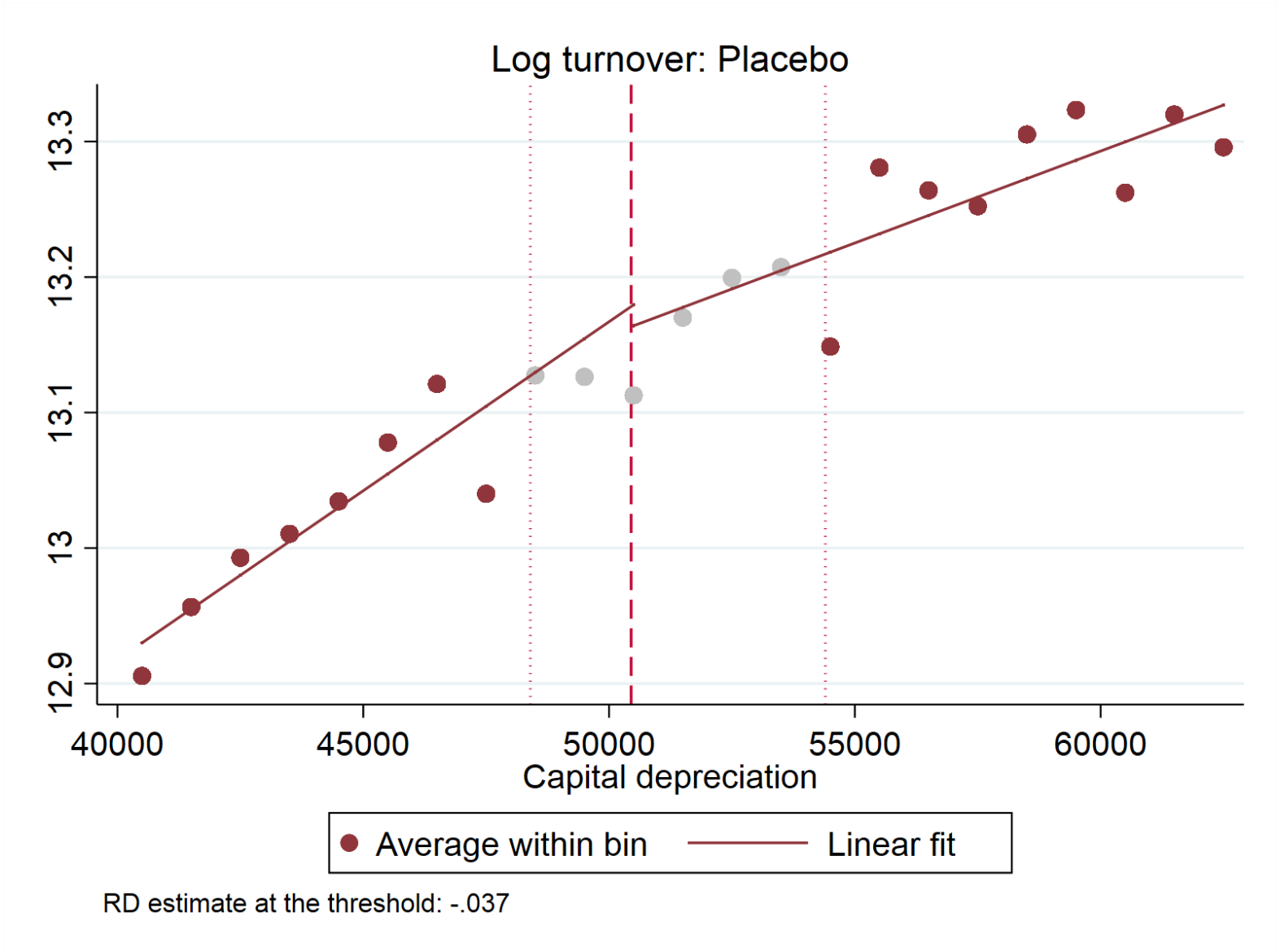
- **Low skilled and routine** workers are most affected by payroll tax increase
- We also observe a decrease in **investment**
- Does this cause production distortions?

Outline

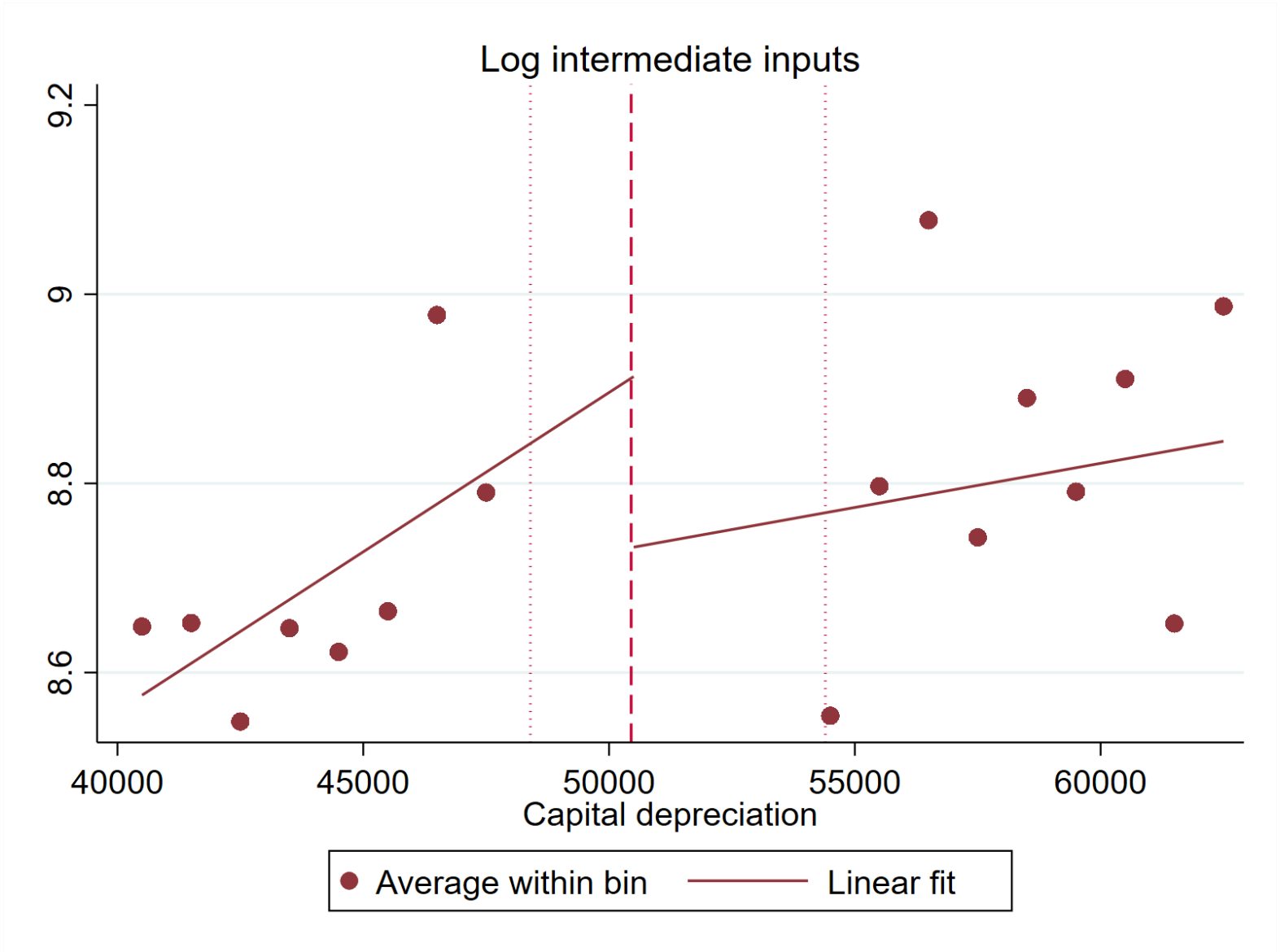
Effect on aggregate output



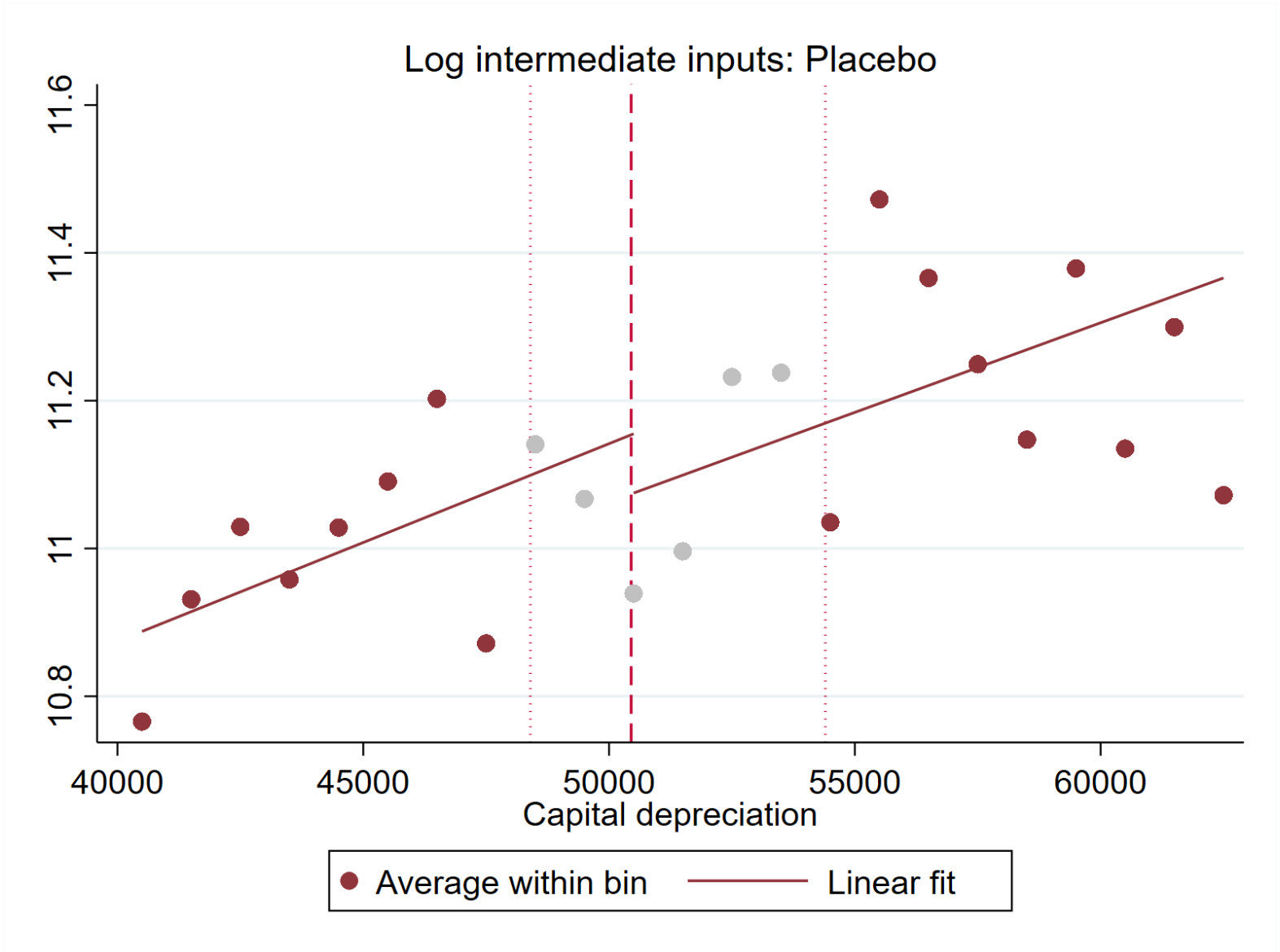
Effect on aggregate output – Placebo



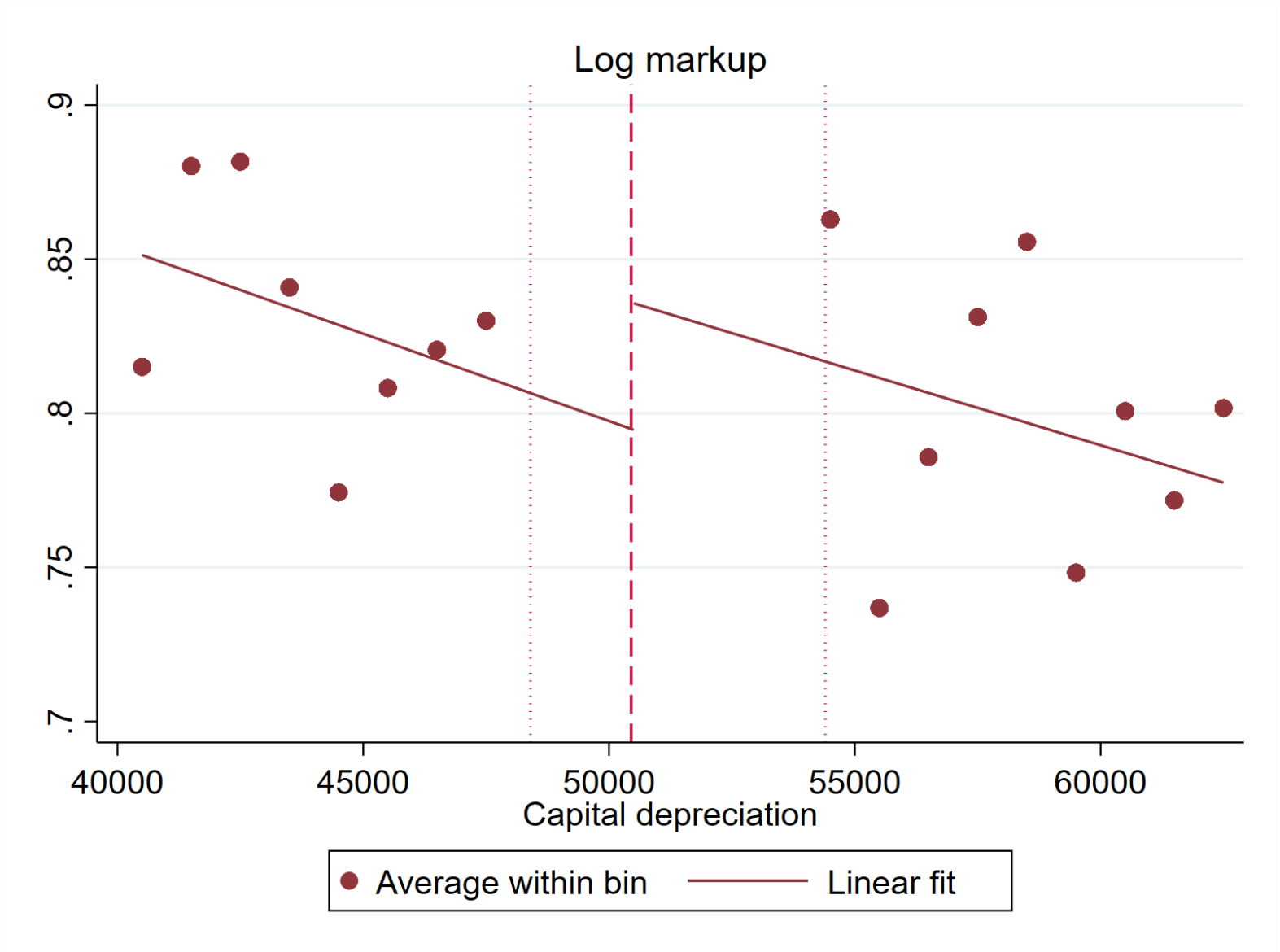
Effect on intermediate inputs



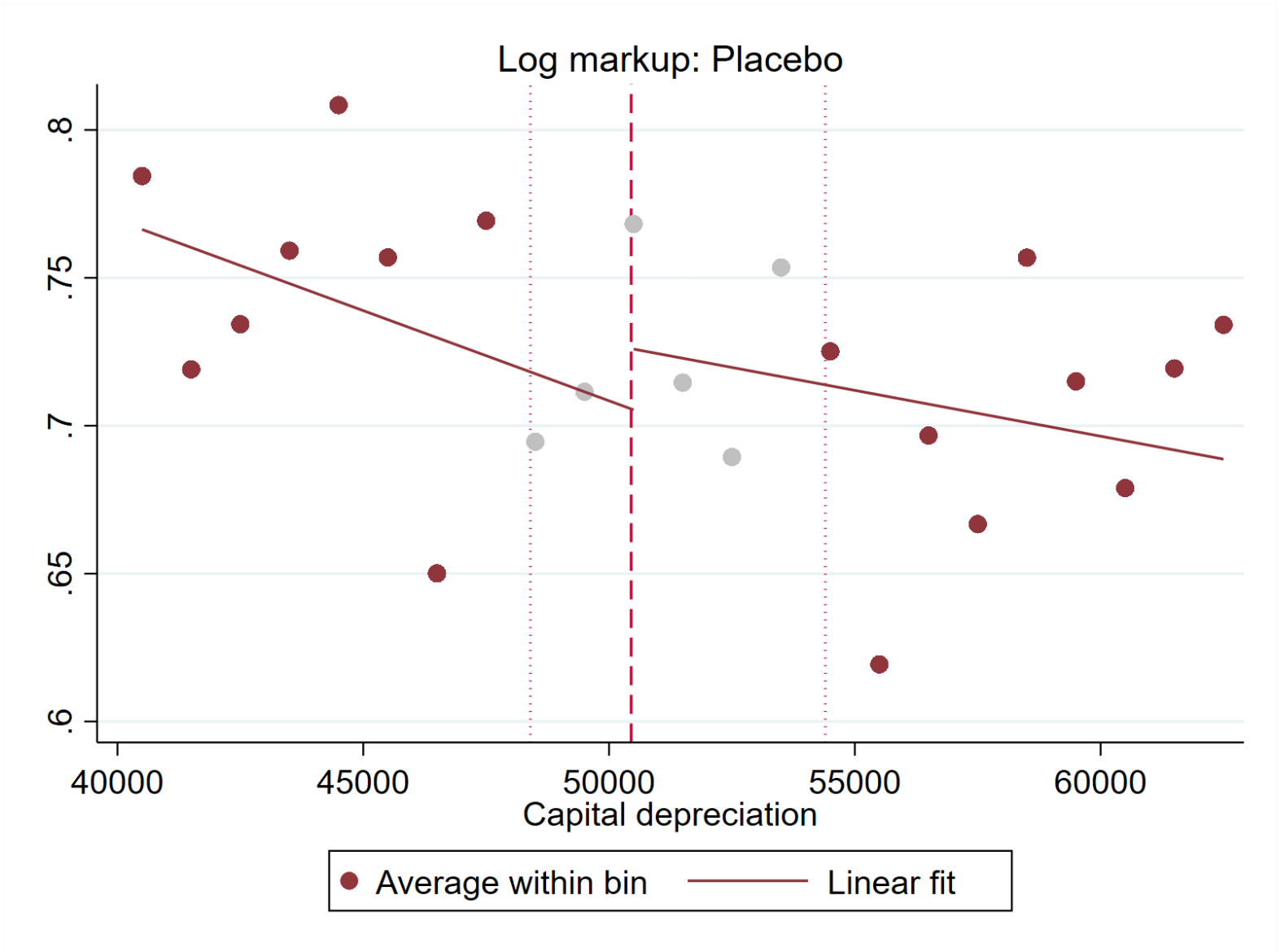
Effect on intermediate inputs – Placebo



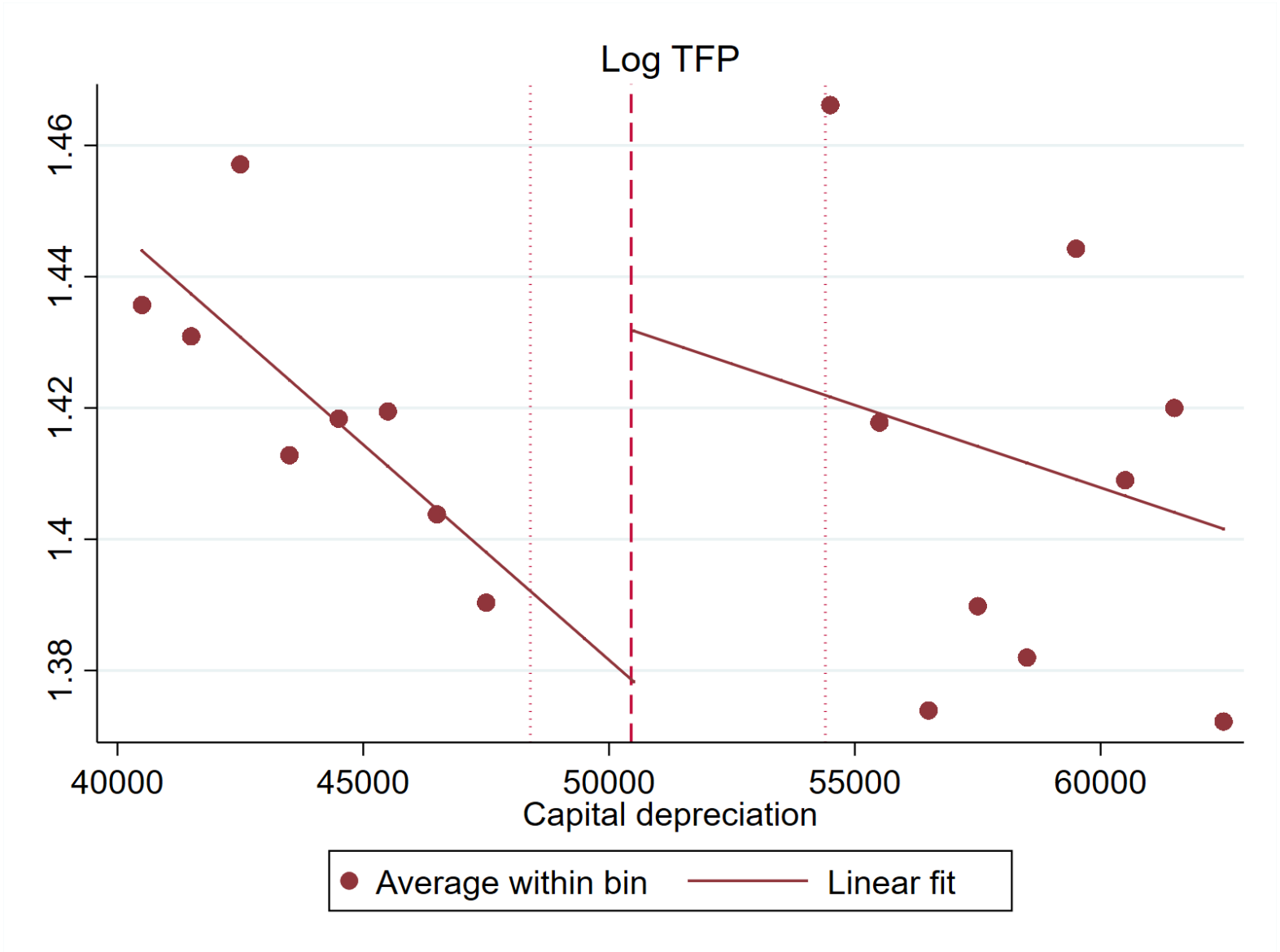
Effect on Markup



Effect on Markup – Placebo



Effect on Productivity



Output & Productivity Estimates

Outcomes (logs)	Sales	Inputs	Markup	TFP
		Treatment		
RD Estimate	-0.068**	-0.295**	0.015	0.129***
	(0.028)	(0.131)	(0.054)	(0.029)
Bandwidth	23,505	26,838	23,337	18,784
N above	30,785	35,186	22,570	24,039
N below	100,807	118,055	72,844	67,087
Control mean	13.35	11.81	0.859	1.387
		Placebo		
RD Estimate	-0.034	0.142	-0.008	-0.063
	(0.050)	(0.165)	(0.065)	(0.038)
Bandwidth	15,769	14,298	18,277	14,583
N above	12,069	10,954	13,135	10,046
N below	27,913	24,565	32,161	21,772
Control mean	13.21	11.20	0.746	1.234

Outline

Implications

- Wages are downward rigid
  - Wages do not decrease when payroll taxes increase
  - Is not due to fairness concerns and issues of pay inequality as argued in previous papers (Saez et al (2012) and Saez et al (2019))
  - Not due to labor unions either
  - Consistent with large labor literature that finds evidence of downward wage rigidity in very different contexts (Card (1990), ..., Kaur (2019))

Implications

- If taken at face value, our results imply that, at the micro level, labor and capital could be complements
  - In a CES framework, our findings suggest a micro capital-labor elasticity of zero since investment decreases when the price of labor increases at the firm level
  - We use the framework of Oberfield and Raval (2014) and get a macro capital-labor elasticity of 0.17.
  - Hard to rationalize falling labor shares with capital-labor elasticity of substitution greater than 1.
- Alternatively, labor and capital moving in the same direction could also be consistent with liquidity effects, but we cannot disentangle the two.

Conclusion

- Firms bear the incidence of payroll taxes
- Payroll taxes distort production:
  - ... by reducing both labor and capital
- Aggregate output affected.

Appendix Slides

Descriptive Statistics (Labor)

	Labor costs	No. employees Upper-level	No. employees Lower-level	No. employees Manual
Mean	144,251	3.6	4.5	5.1
Median	103,805	2	2	4
SD	135,712	4.7	5.9	5.1
N	118,100	57,492	68,933	81,102

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Descriptive Statistics (Capital)

	Investments Total	Investments Fixed assets	Investments Buildings	Investments R&D
Mean	91,925	67,778	16,547	18,085
Median	55,504	42,479	0	0
SD	283,806	161,965	214,377	75,777
N	118,610	118,610	118,610	118,610

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Descriptive Statistics (Misc.)

	Turnover	Value added	TFP	Markup
Mean	1,058,607	334,385	3.6	6.4
Median	478,231	230,456	2.4	1.1
SD	5,786,968	1,149,718	6.4	18.1
N	118,100	118,100	118,100	118,100

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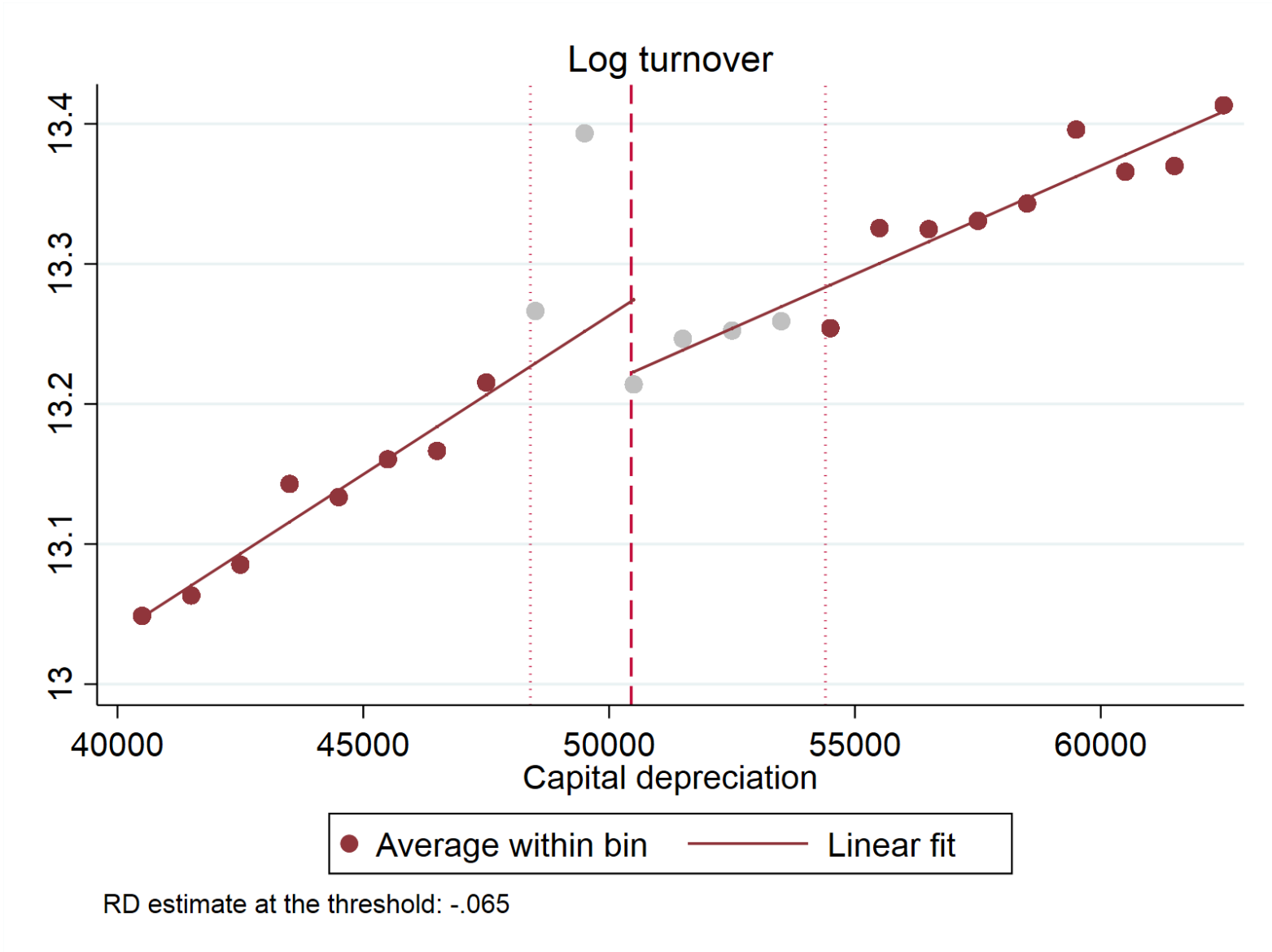
Turnover



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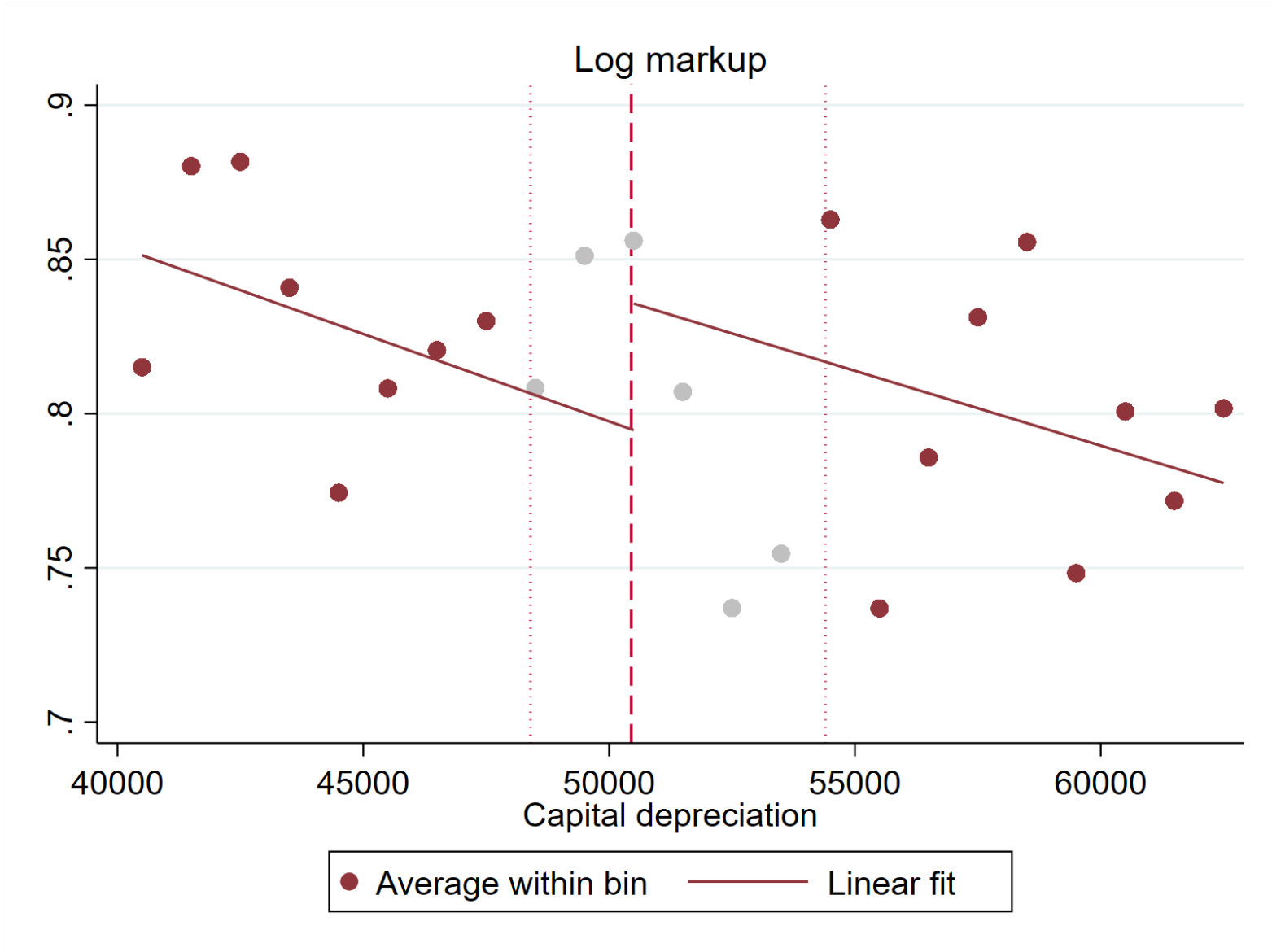
Effect on Markup



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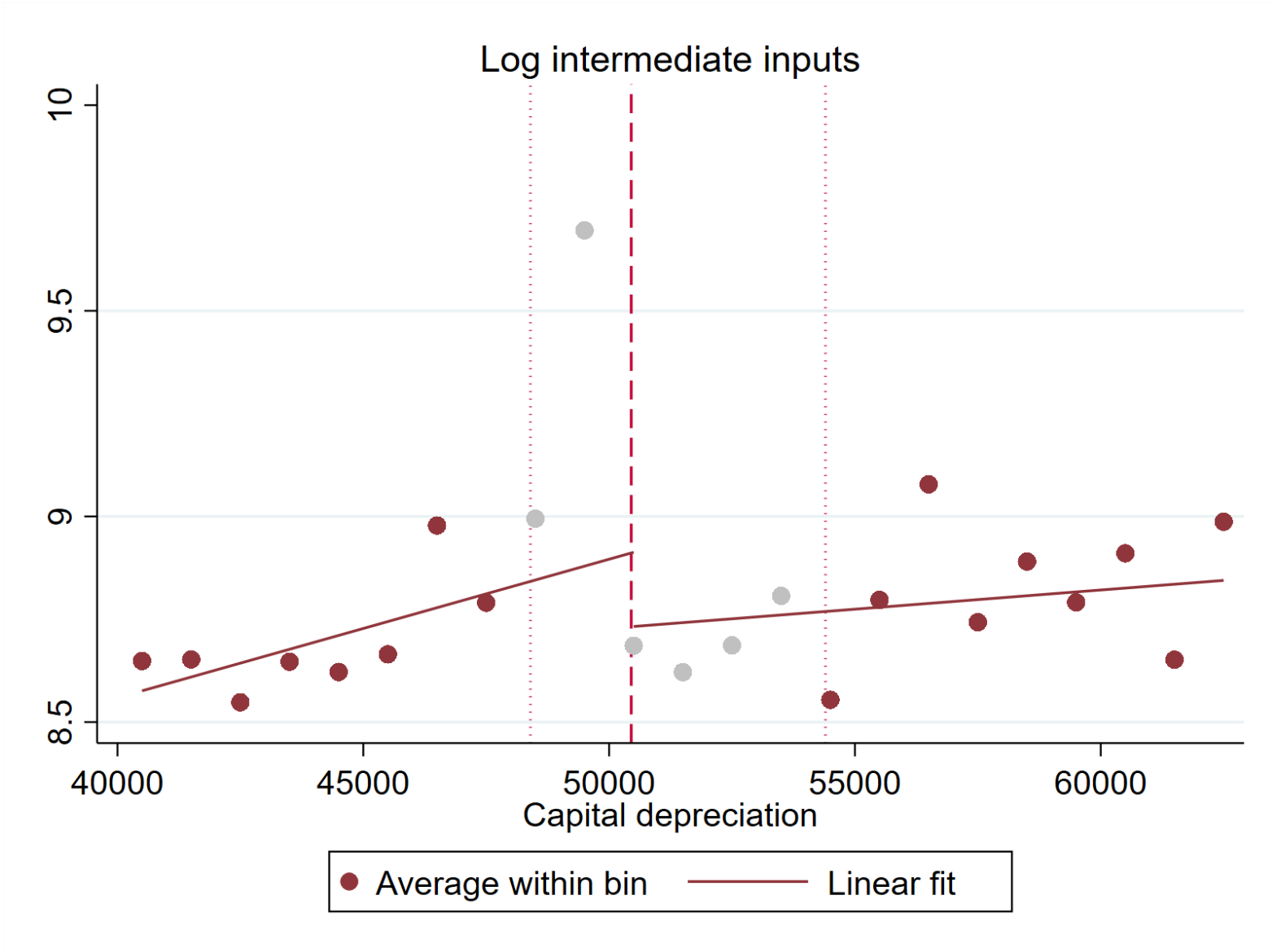
Effect on intermediate inputs



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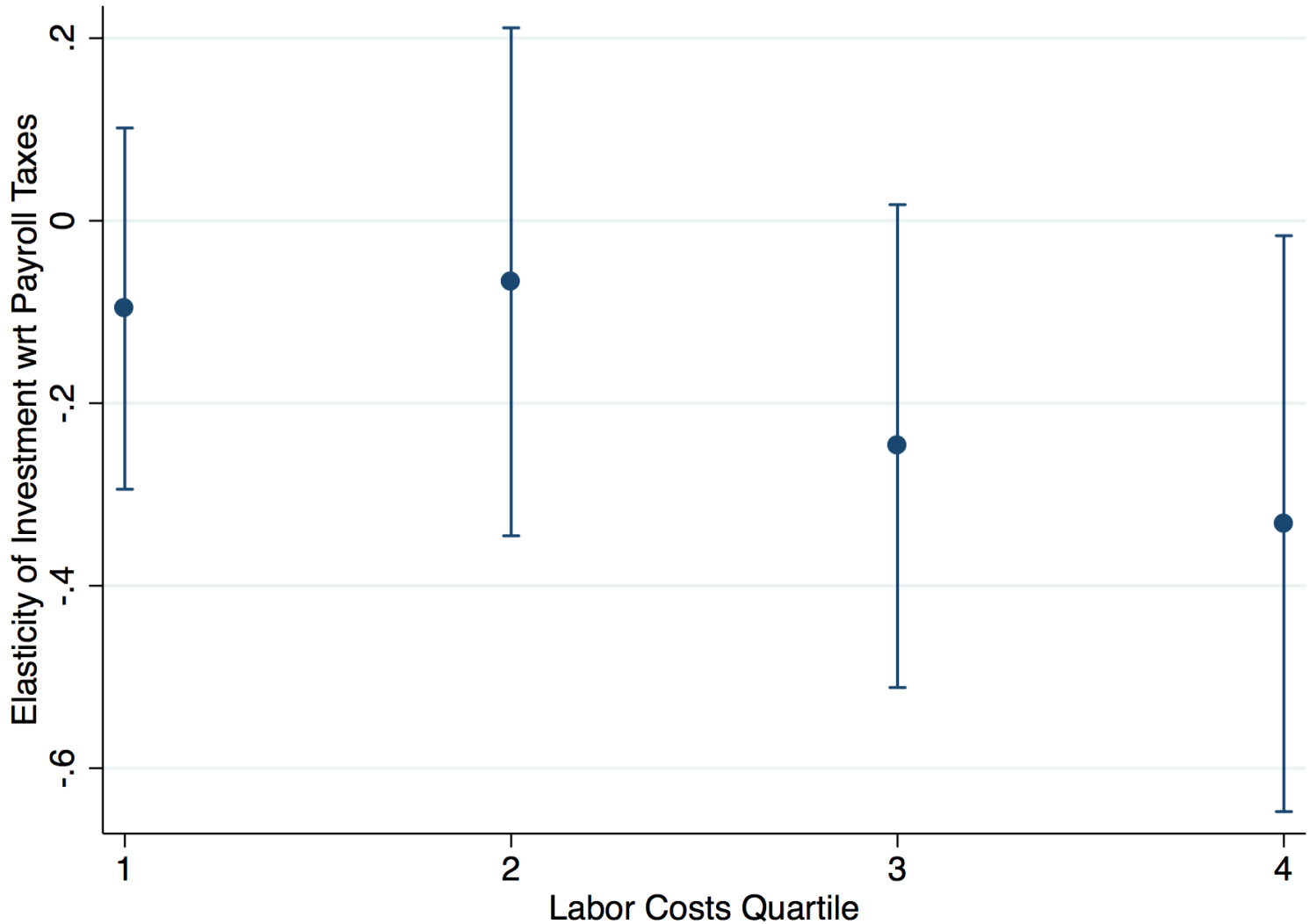
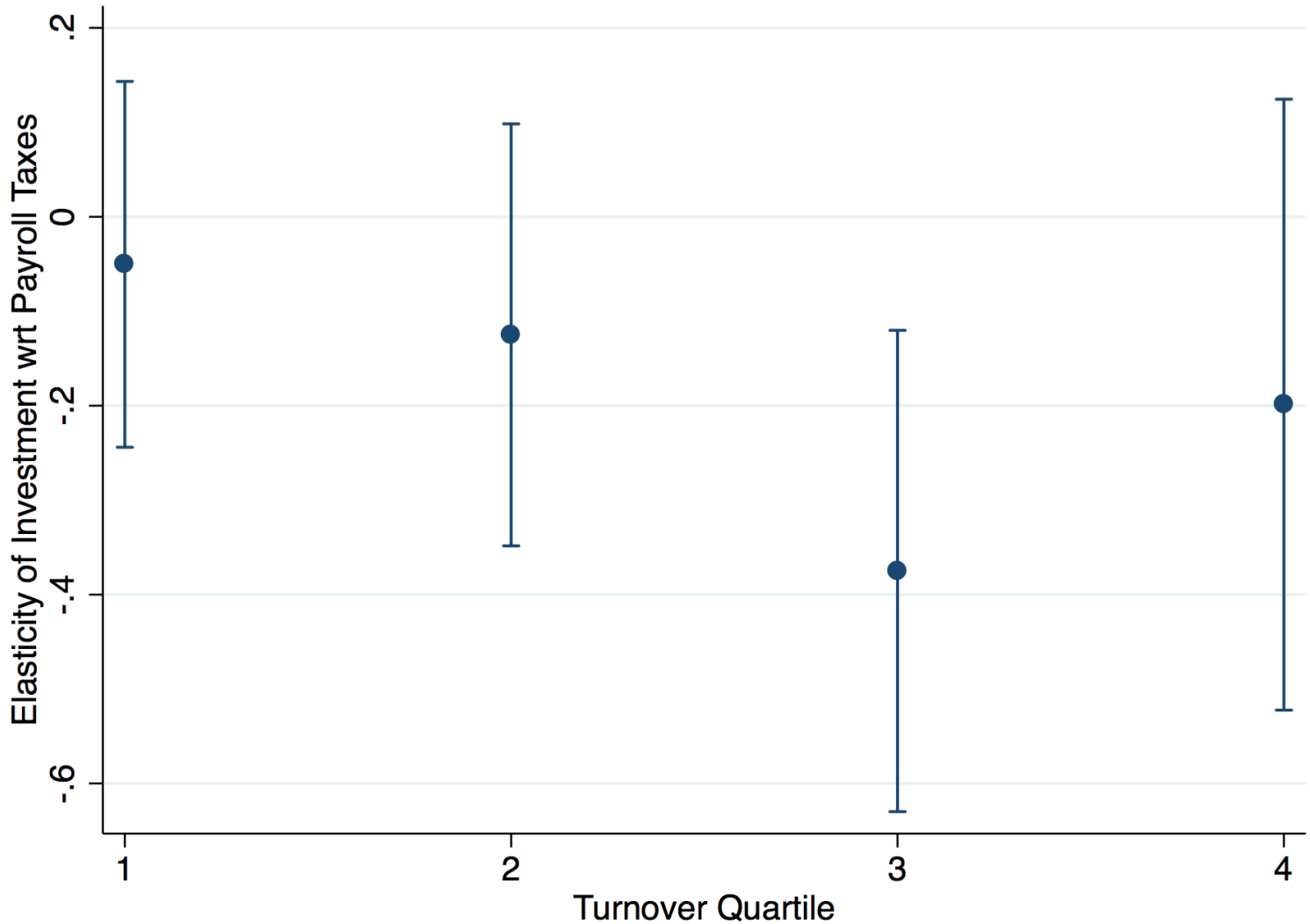
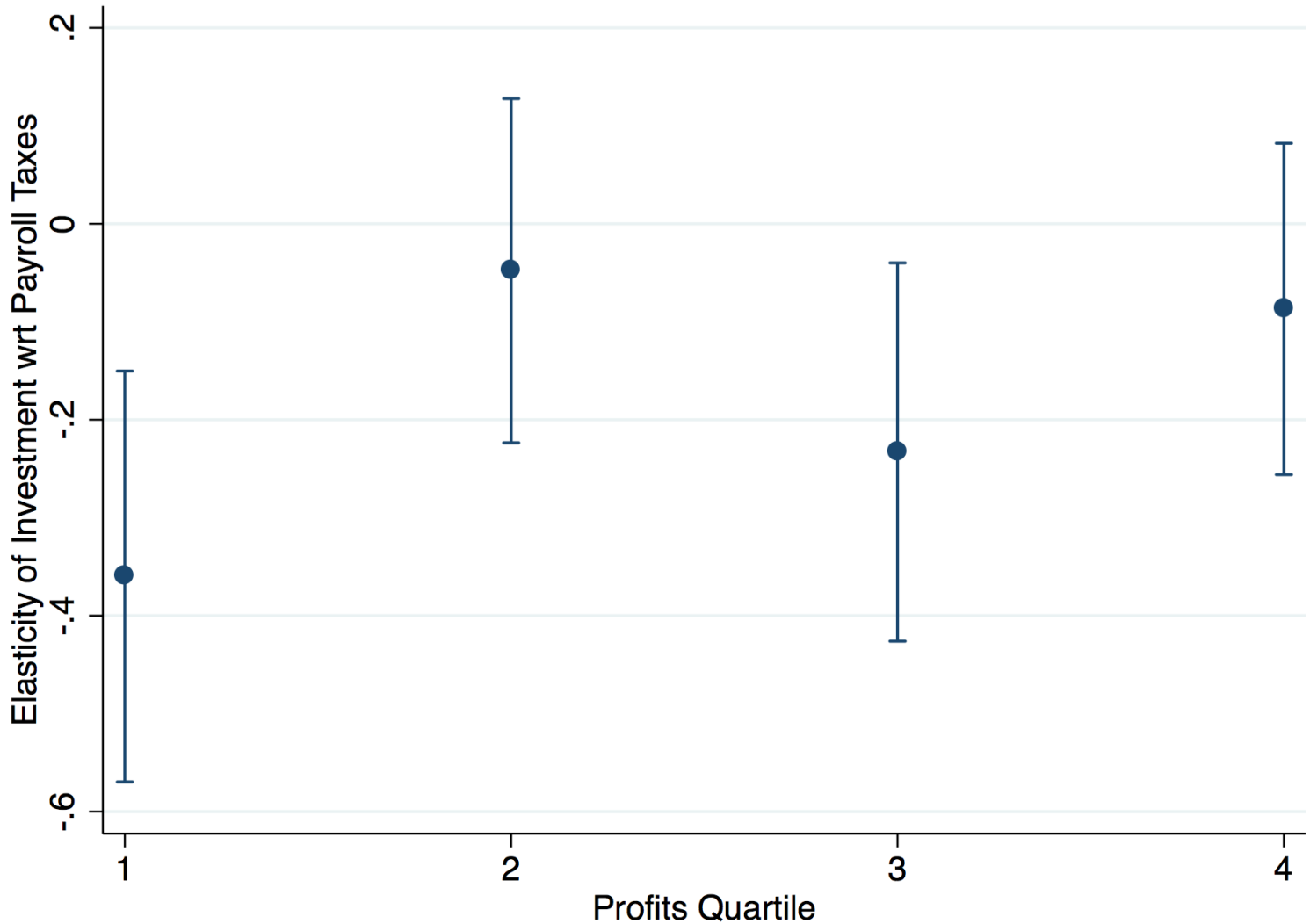
Investment Response by Total Labor Costs



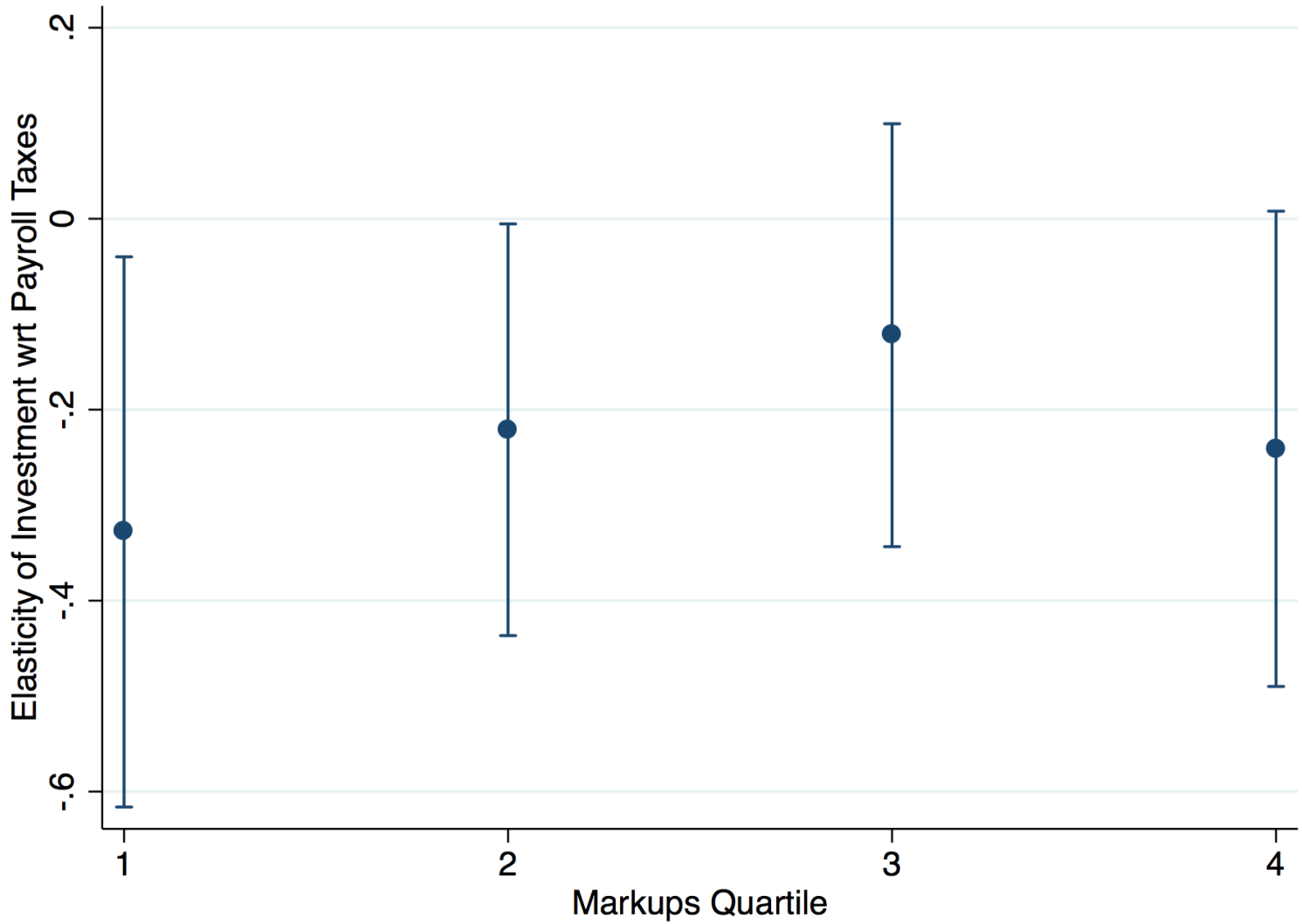
Investment Response by Turnover



Investment Response by Profits



Investment Response by Markups



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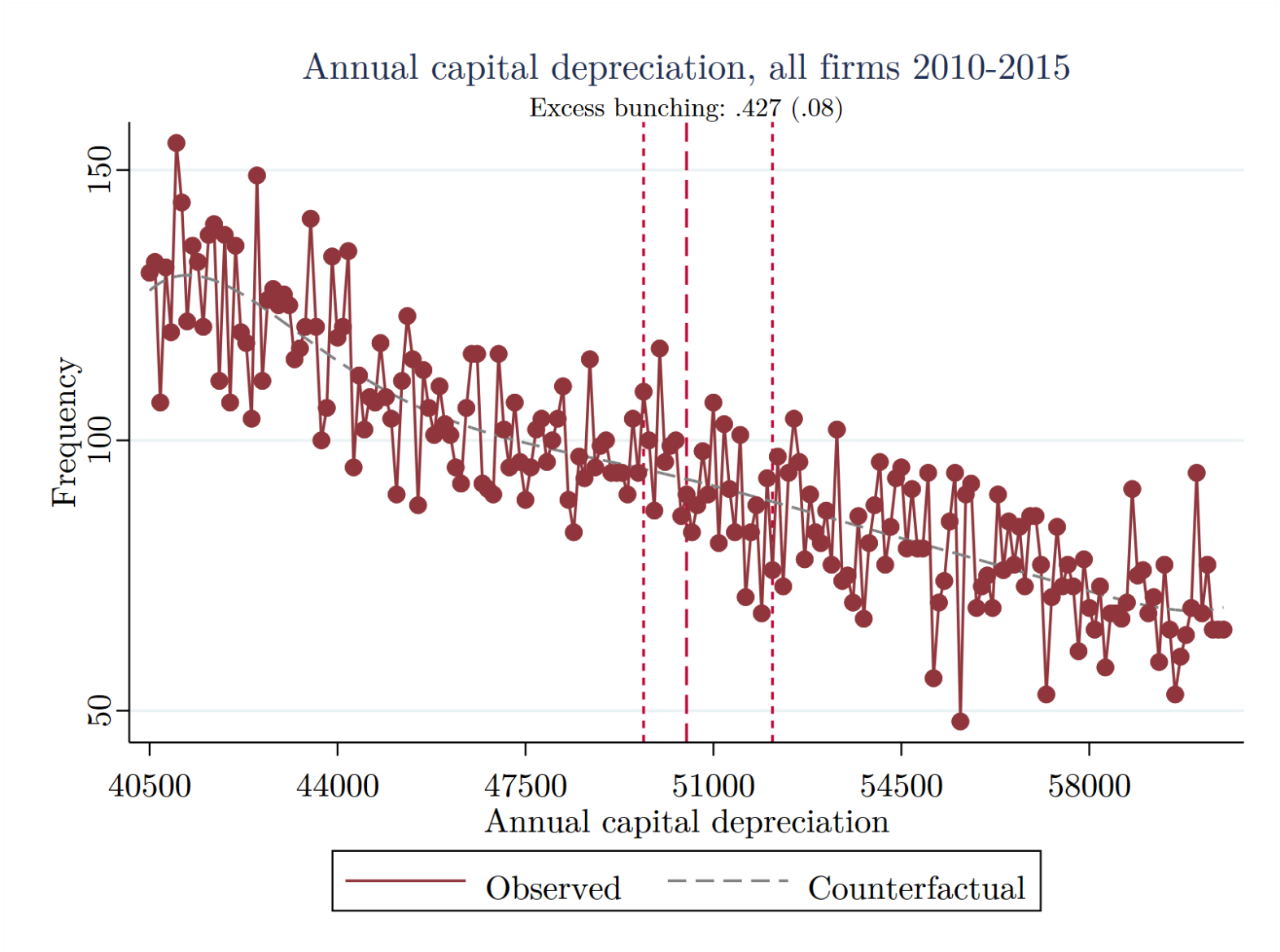
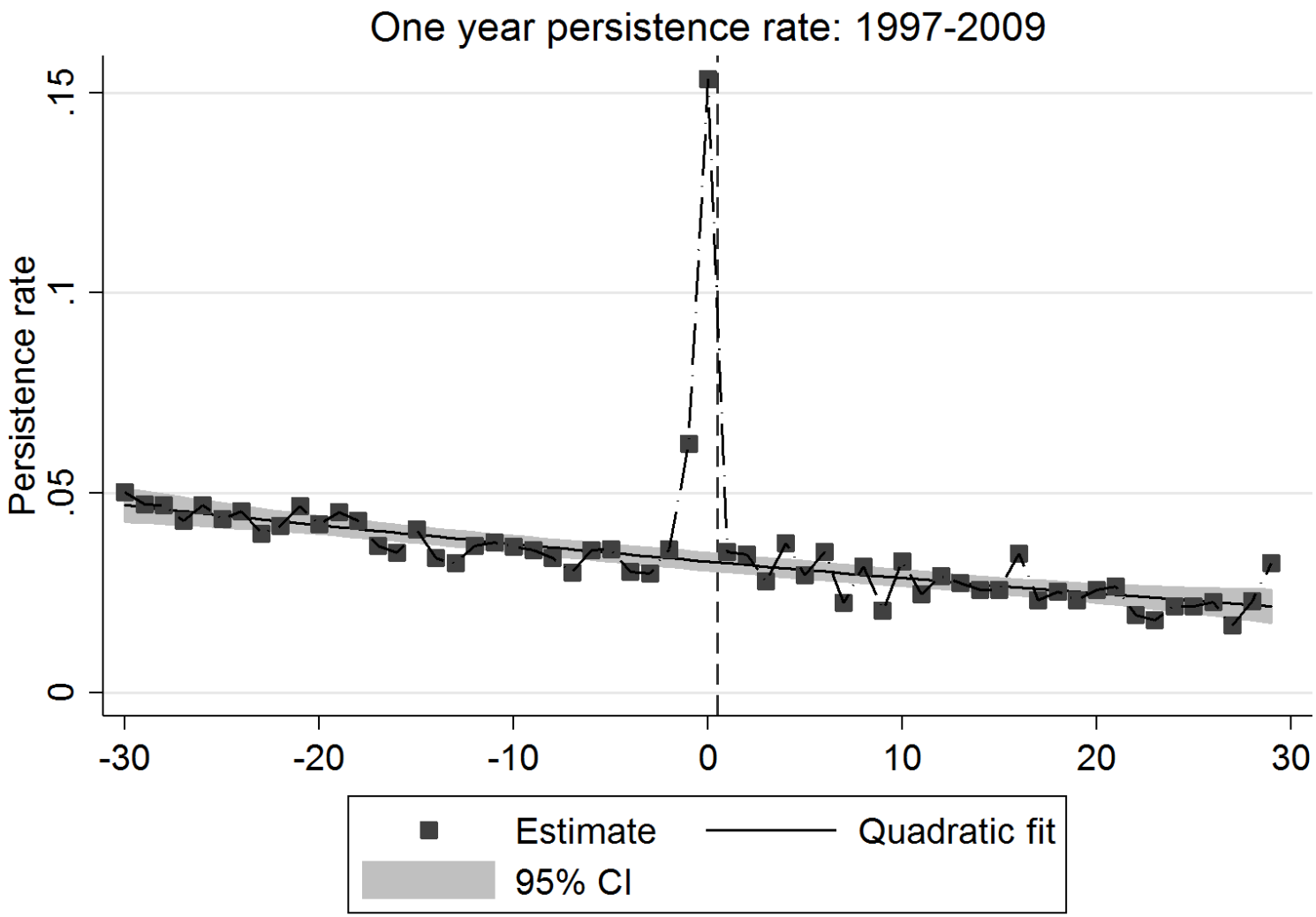
Placebo


Annual capital depreciation, all firms 2010-2015
Excess bunching: .427 (.08)
Frequency
150
100
50
40500
44000
47500
51000
54500
58000
Annual capital depreciation
Observed
Counterfactual

Persistence of bunching



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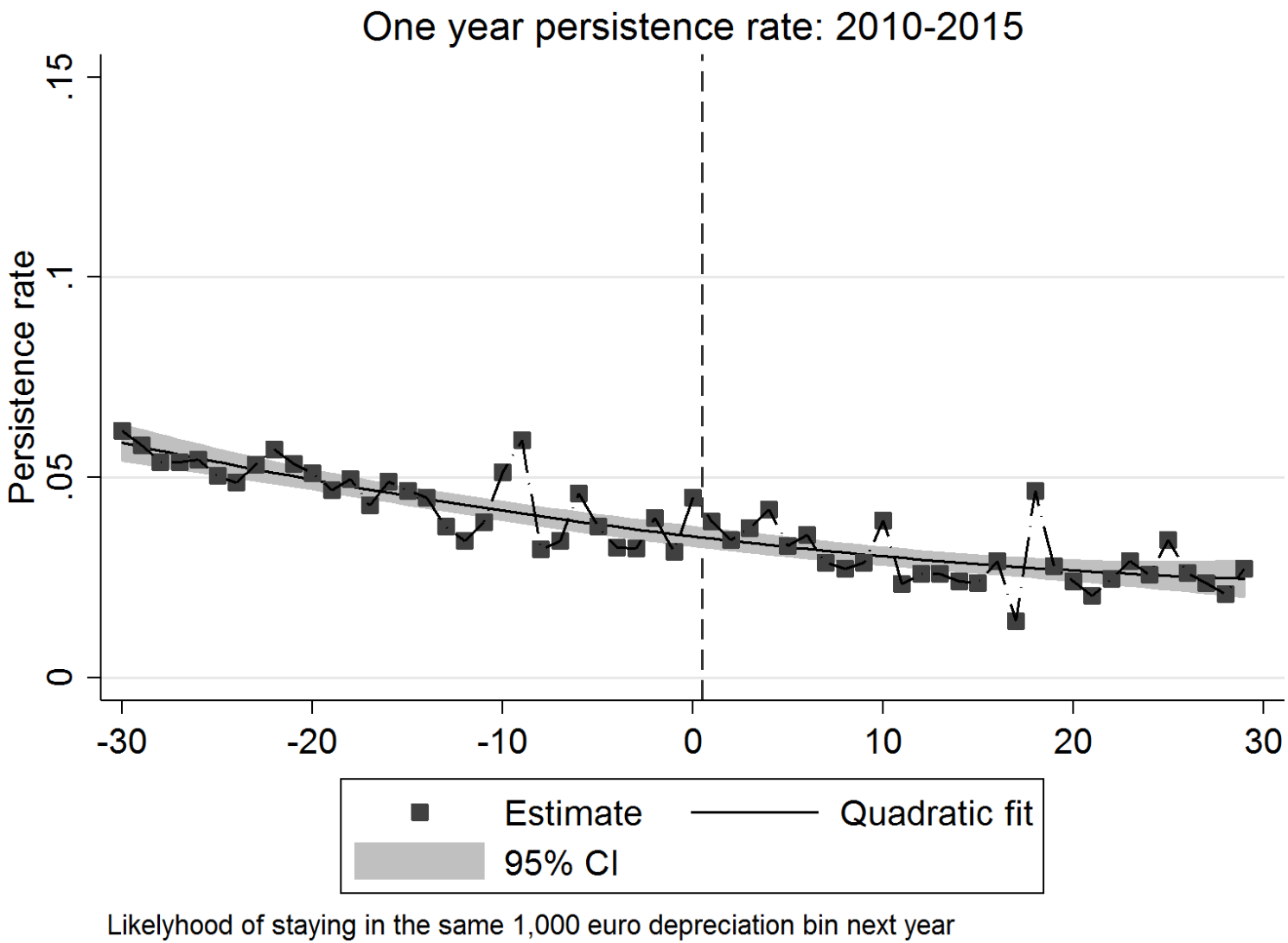
Persistence of bunching: Placebo



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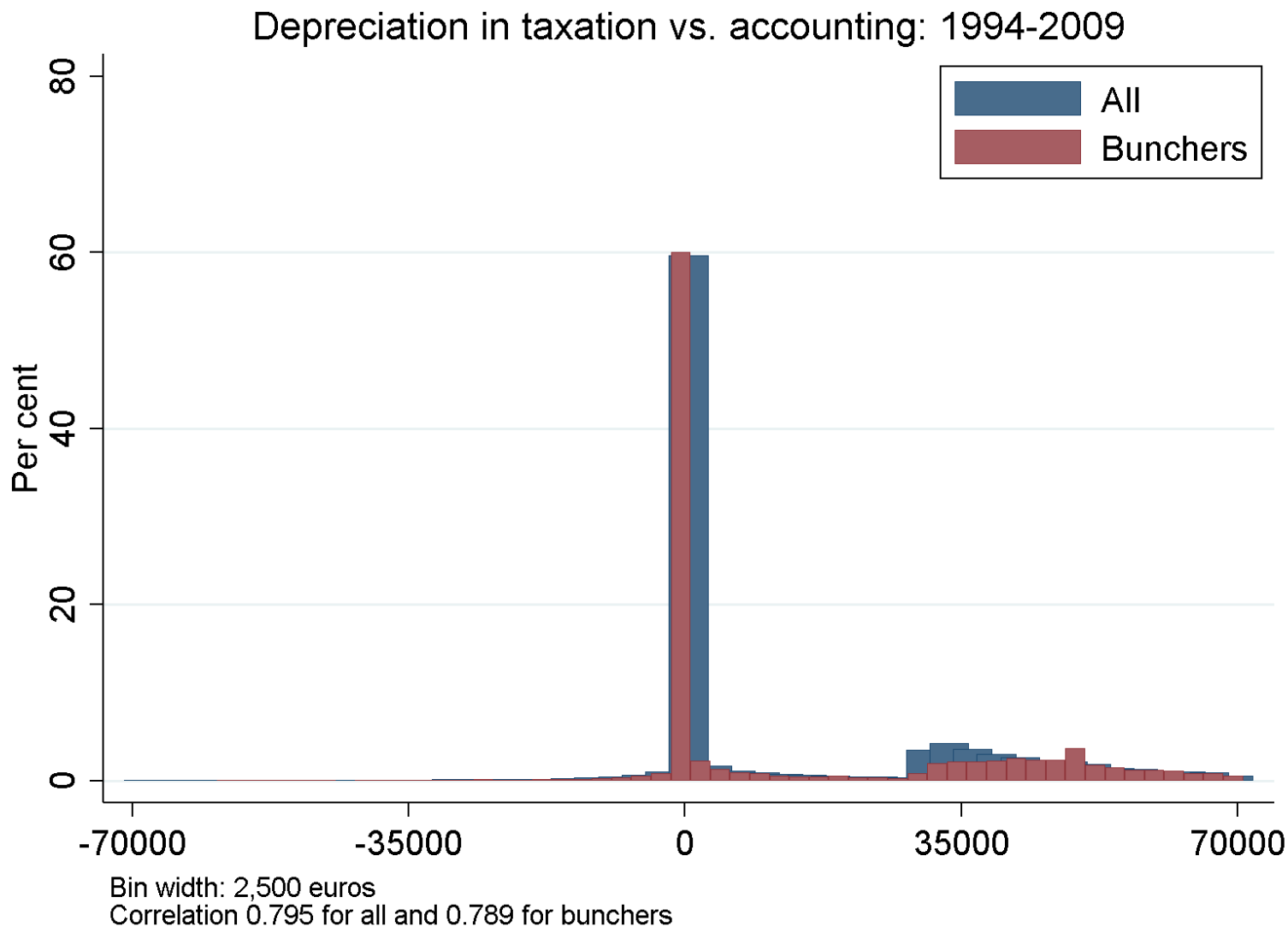
Accounting Vs Tax Depreciation



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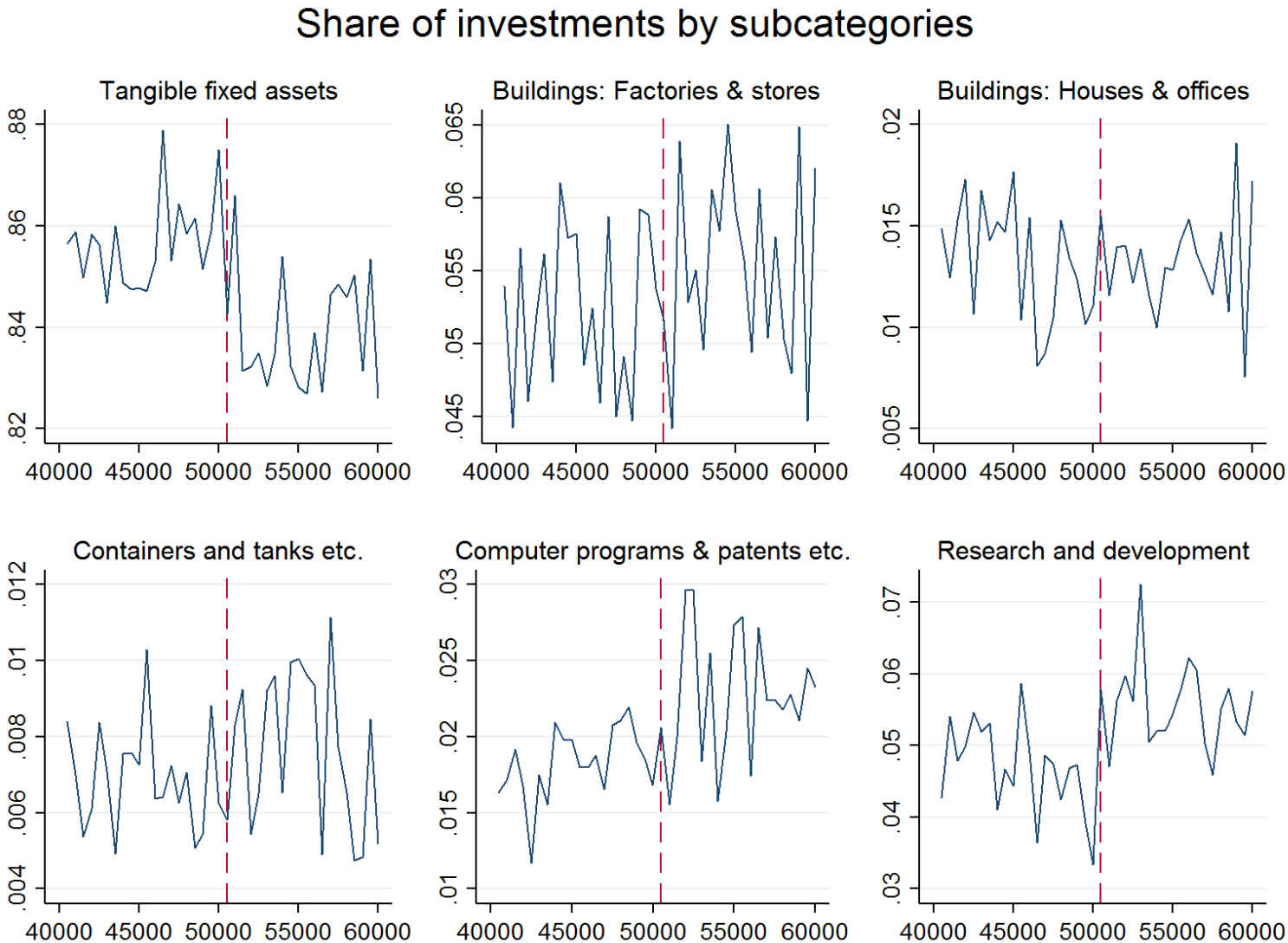
Investments by subcategories



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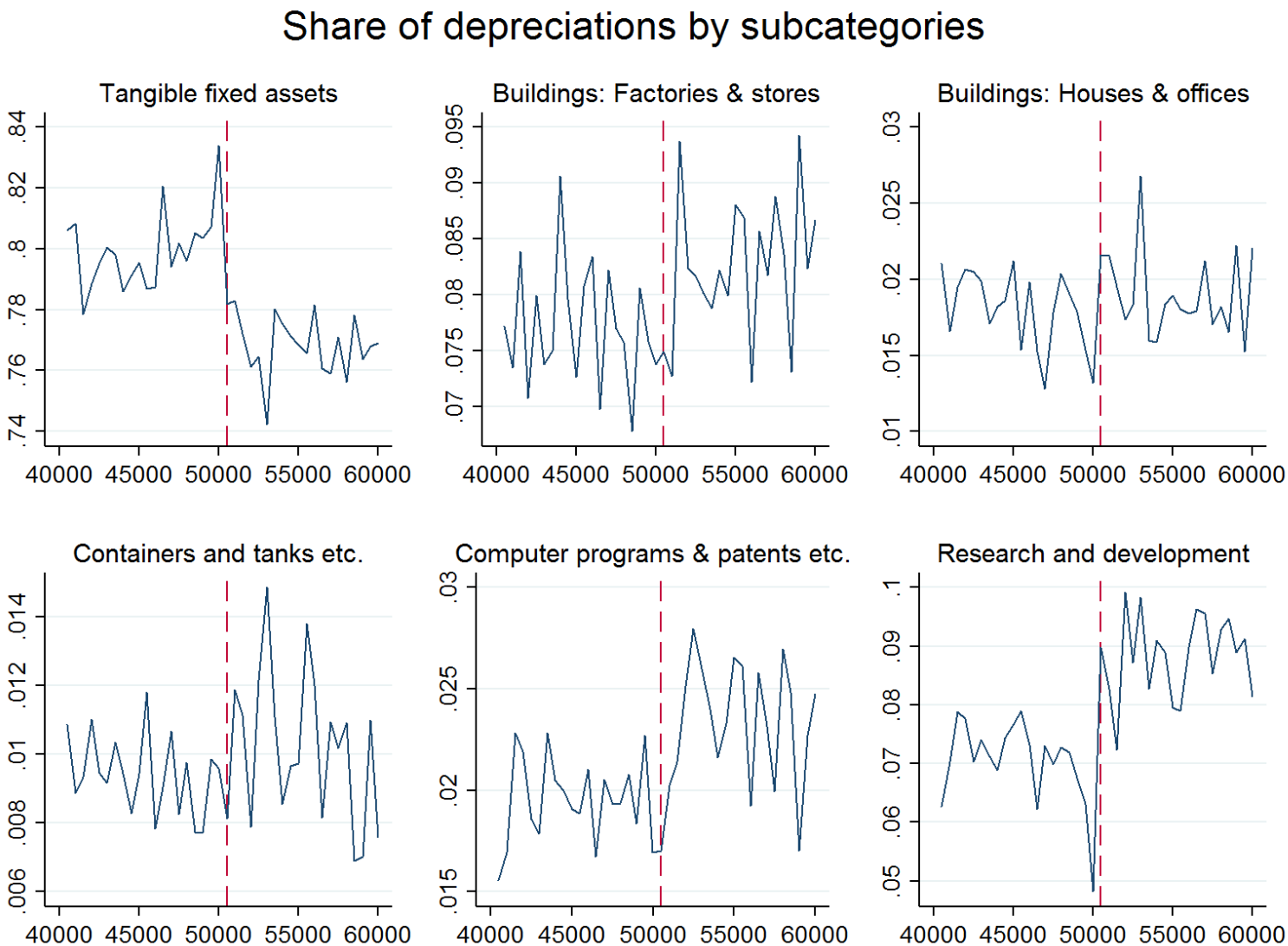
Depreciations by investment subcategories



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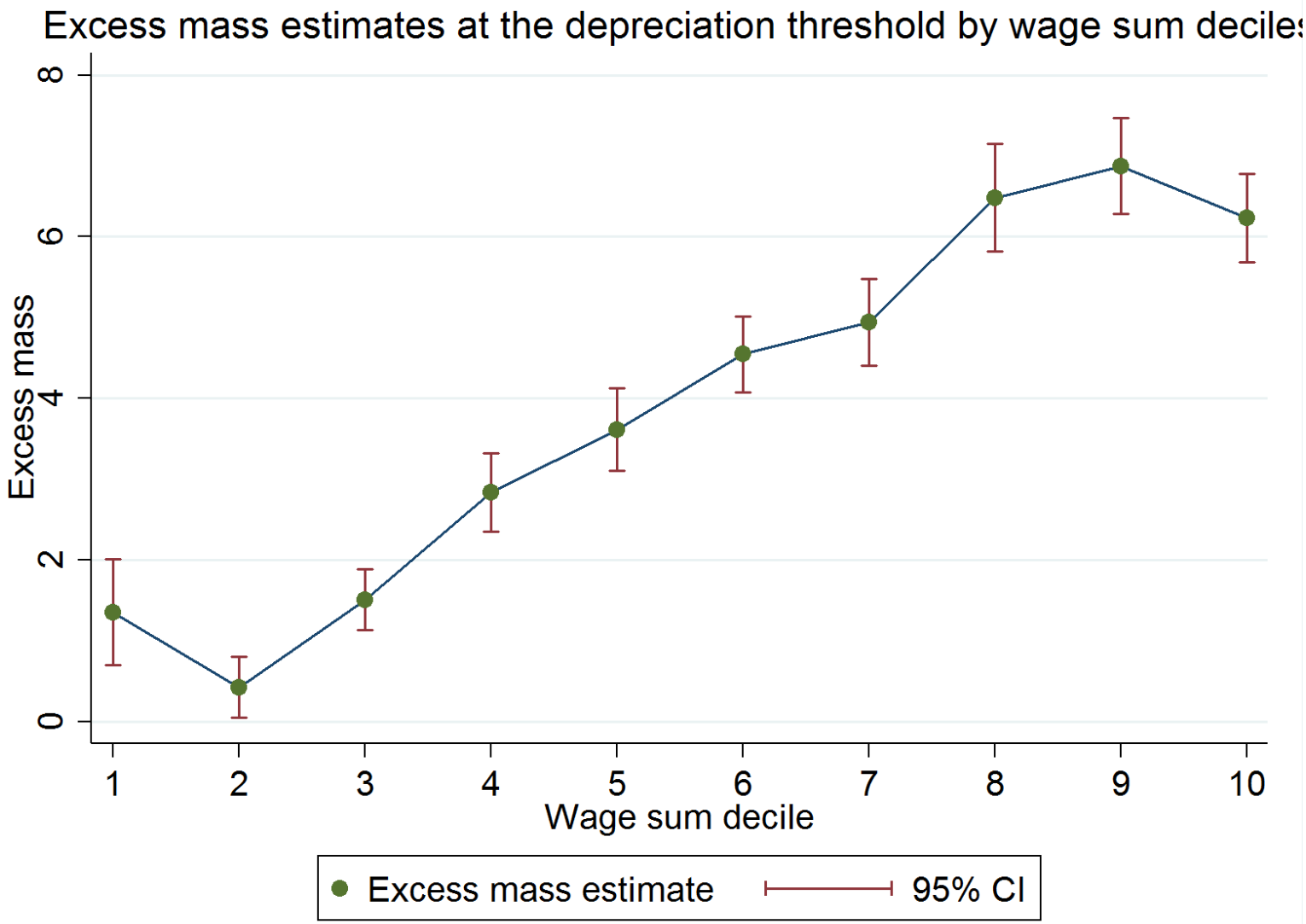
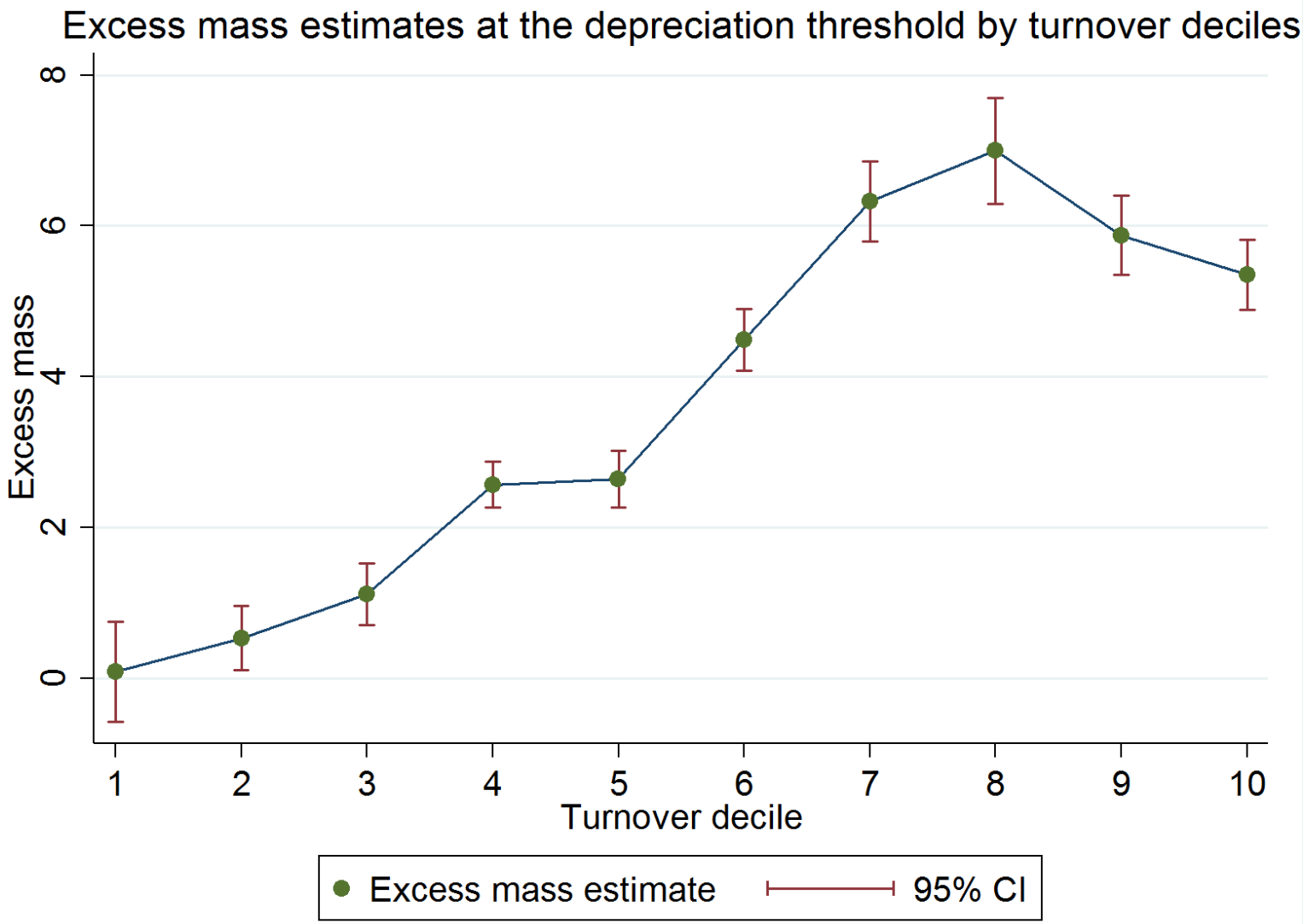
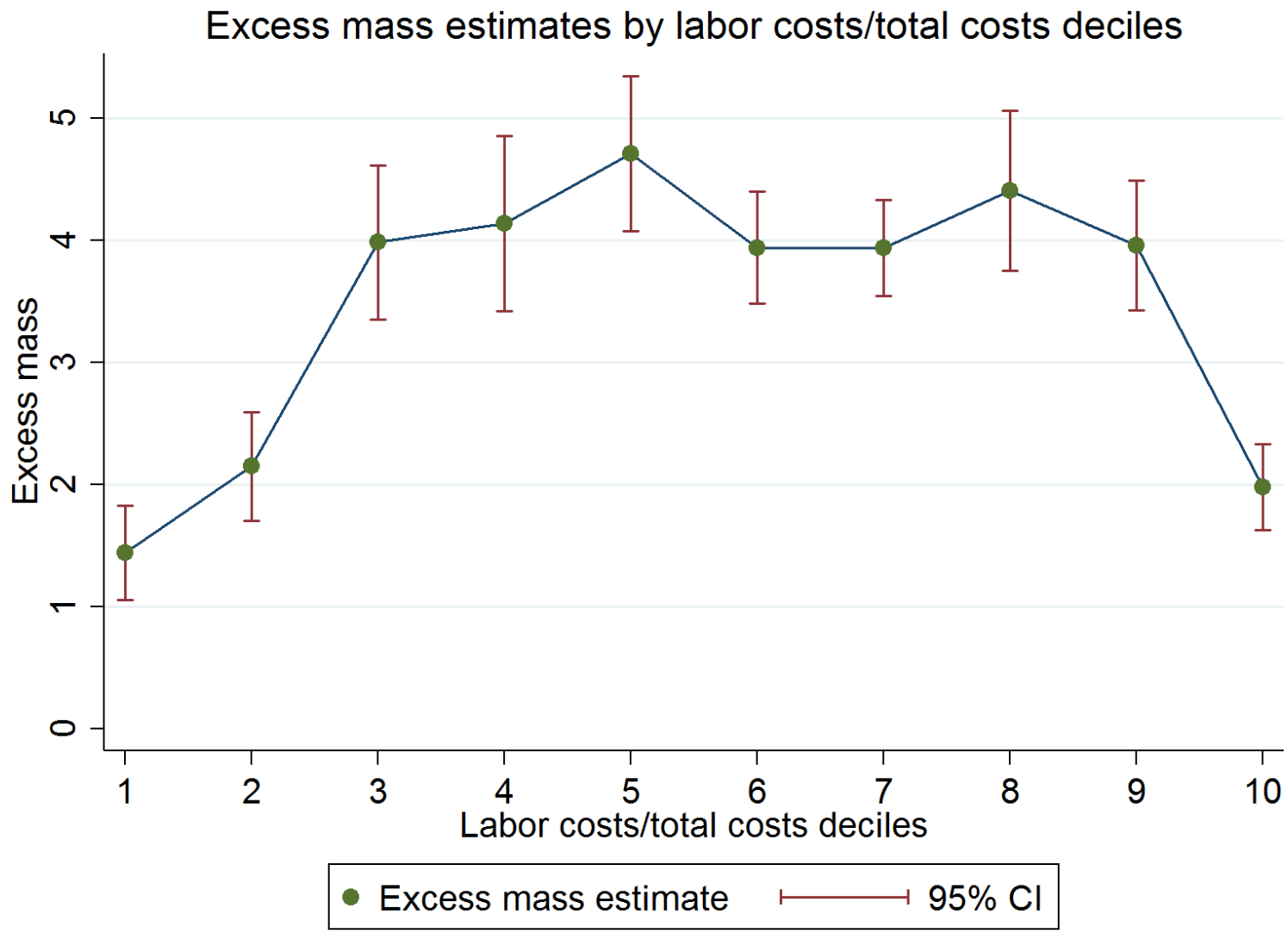
Bunching Response by Total Labor Costs



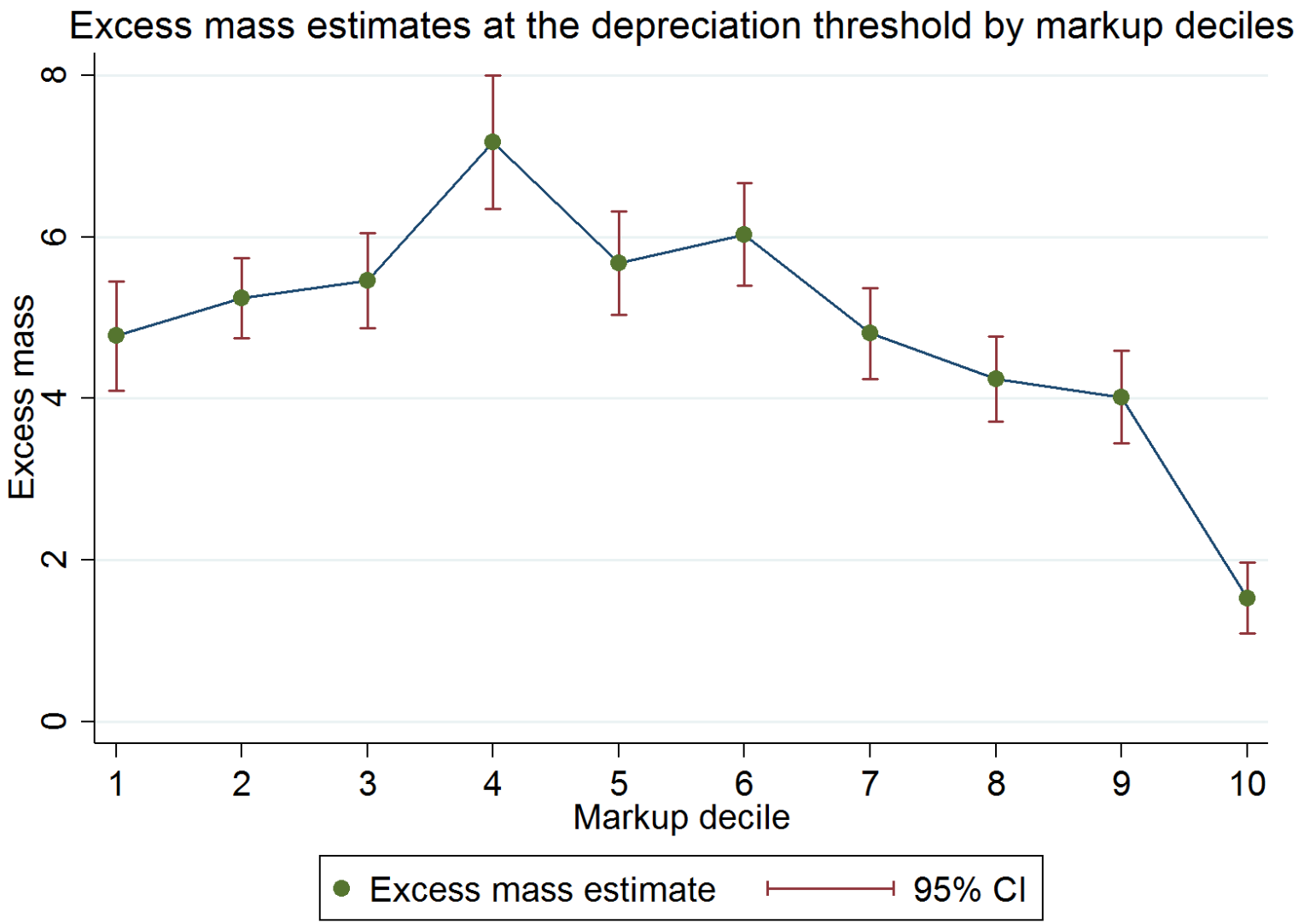
Bunching Response by Turnover



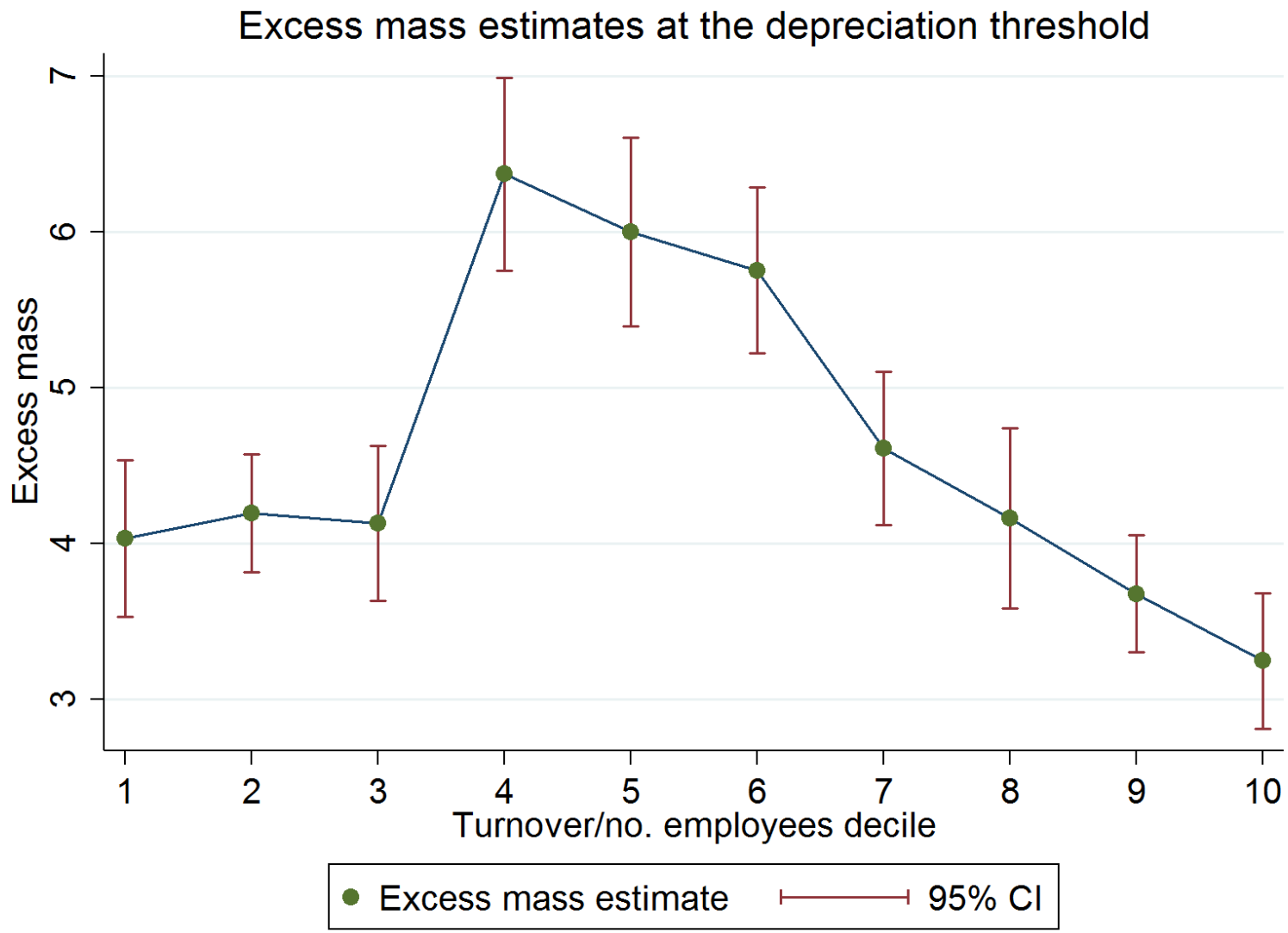
Bunching Response by Share of Labor Costs



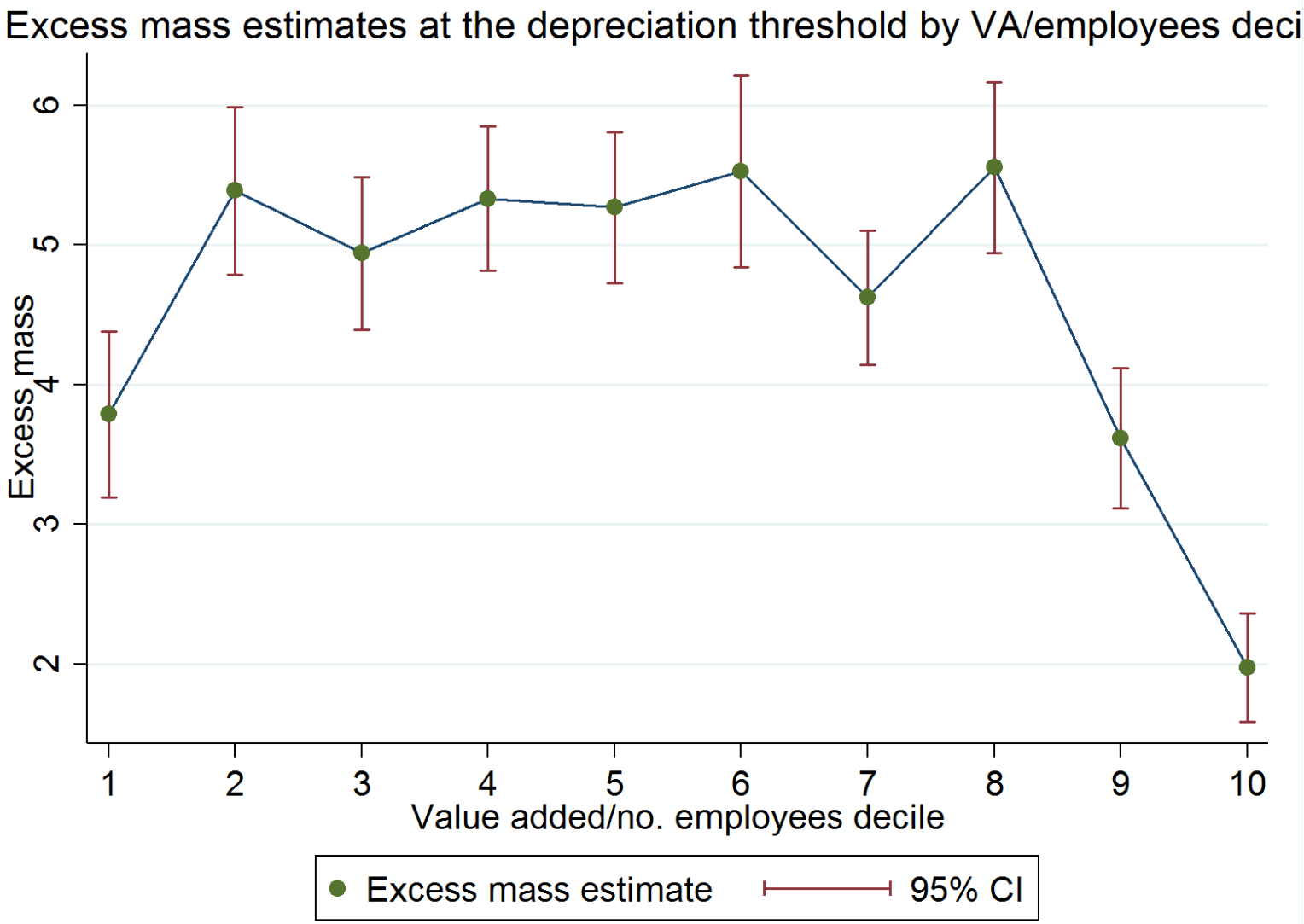
Bunching Response by Markup



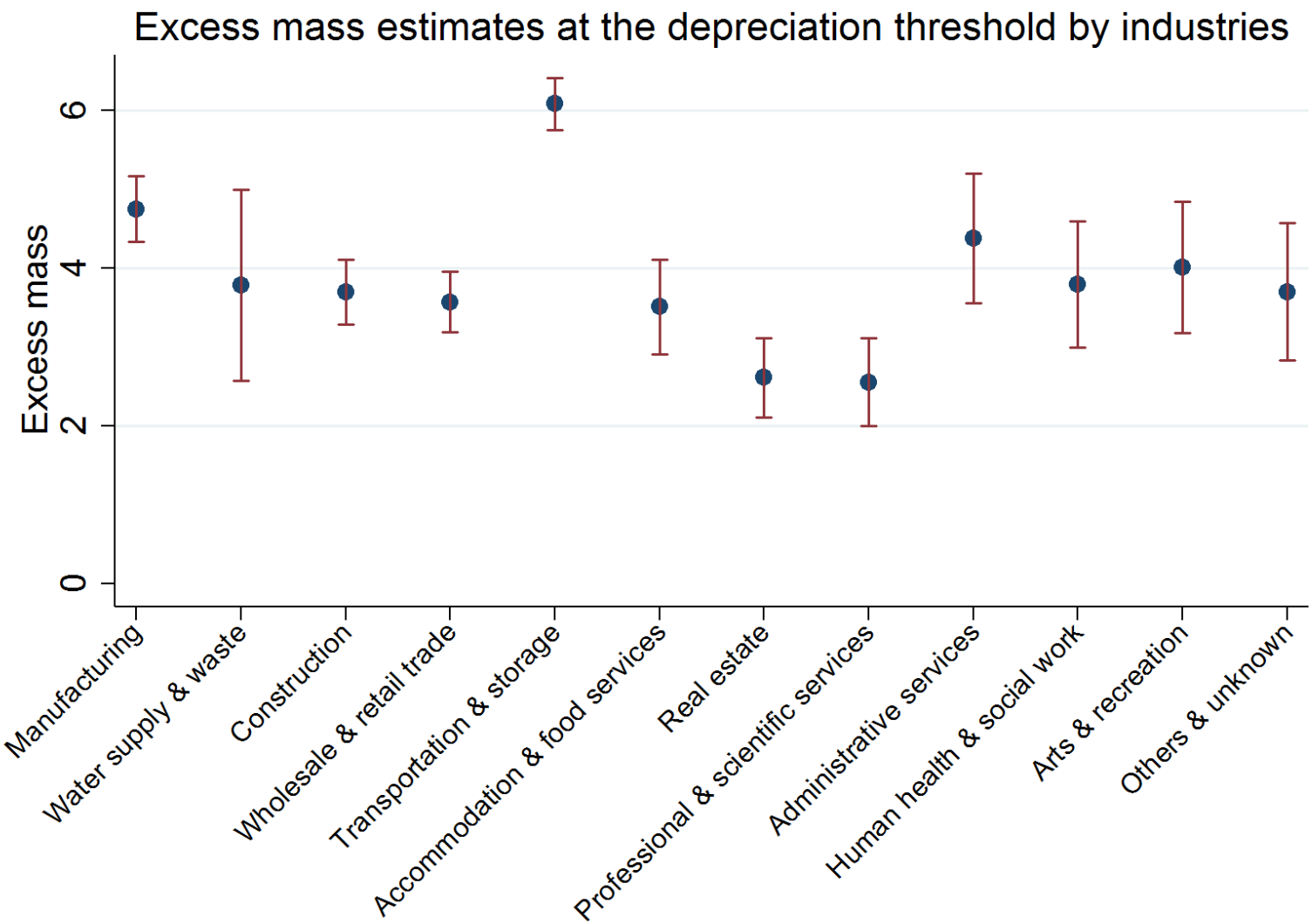
Bunching Response by Turnover Per-Employee



Bunching Response by Value Added Per-Employee



Bunching Response by Industry



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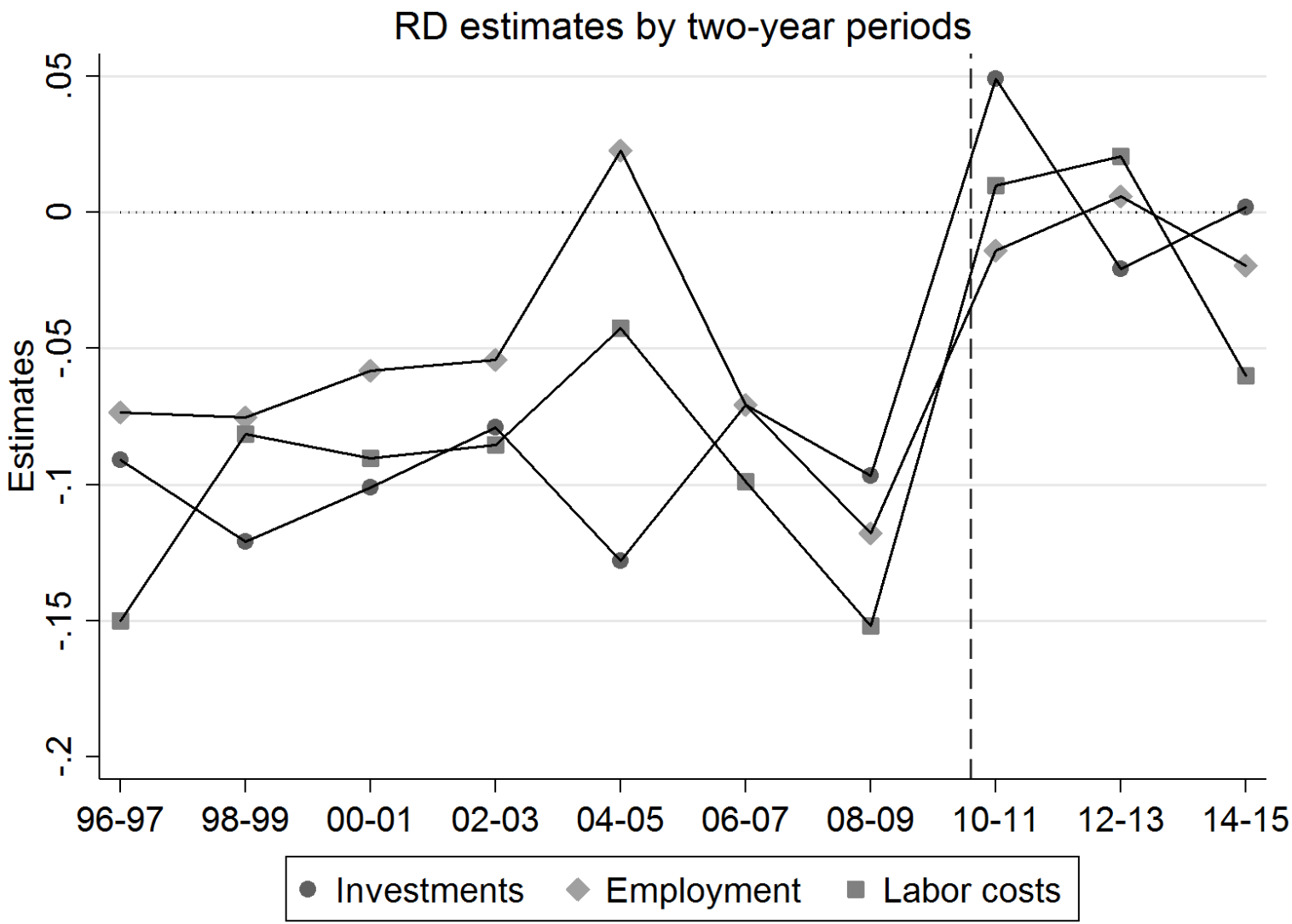
RD estimates over time



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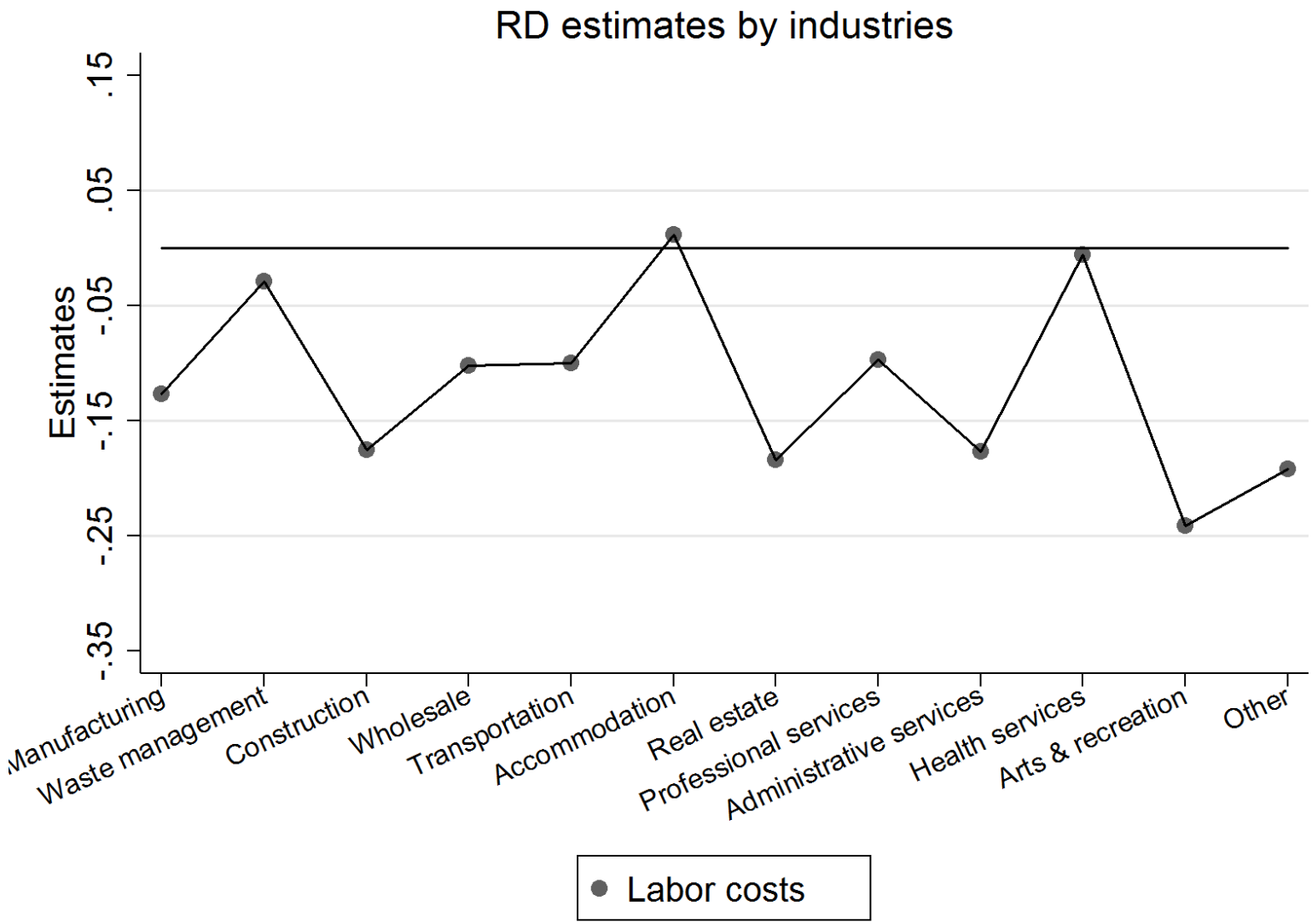
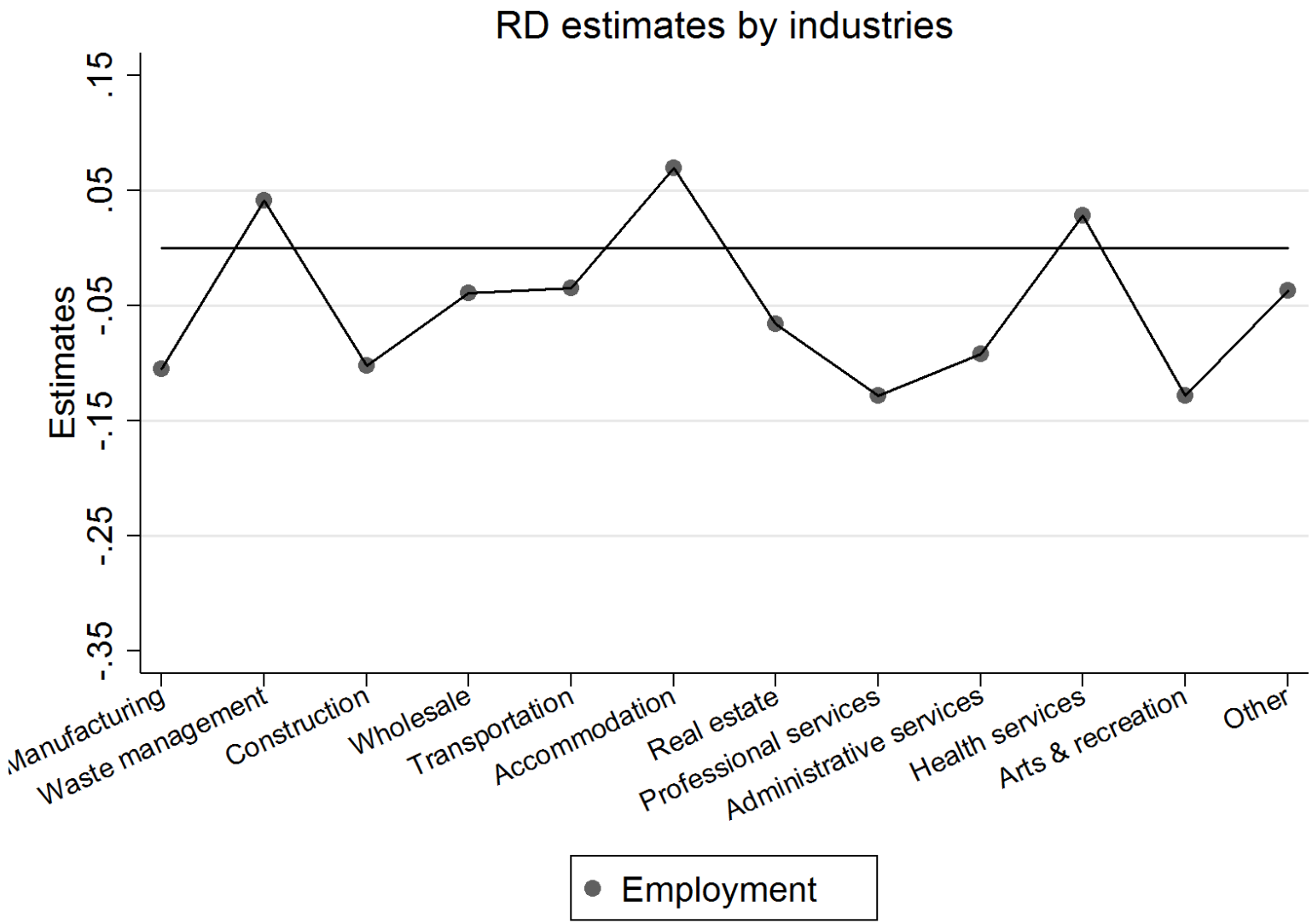
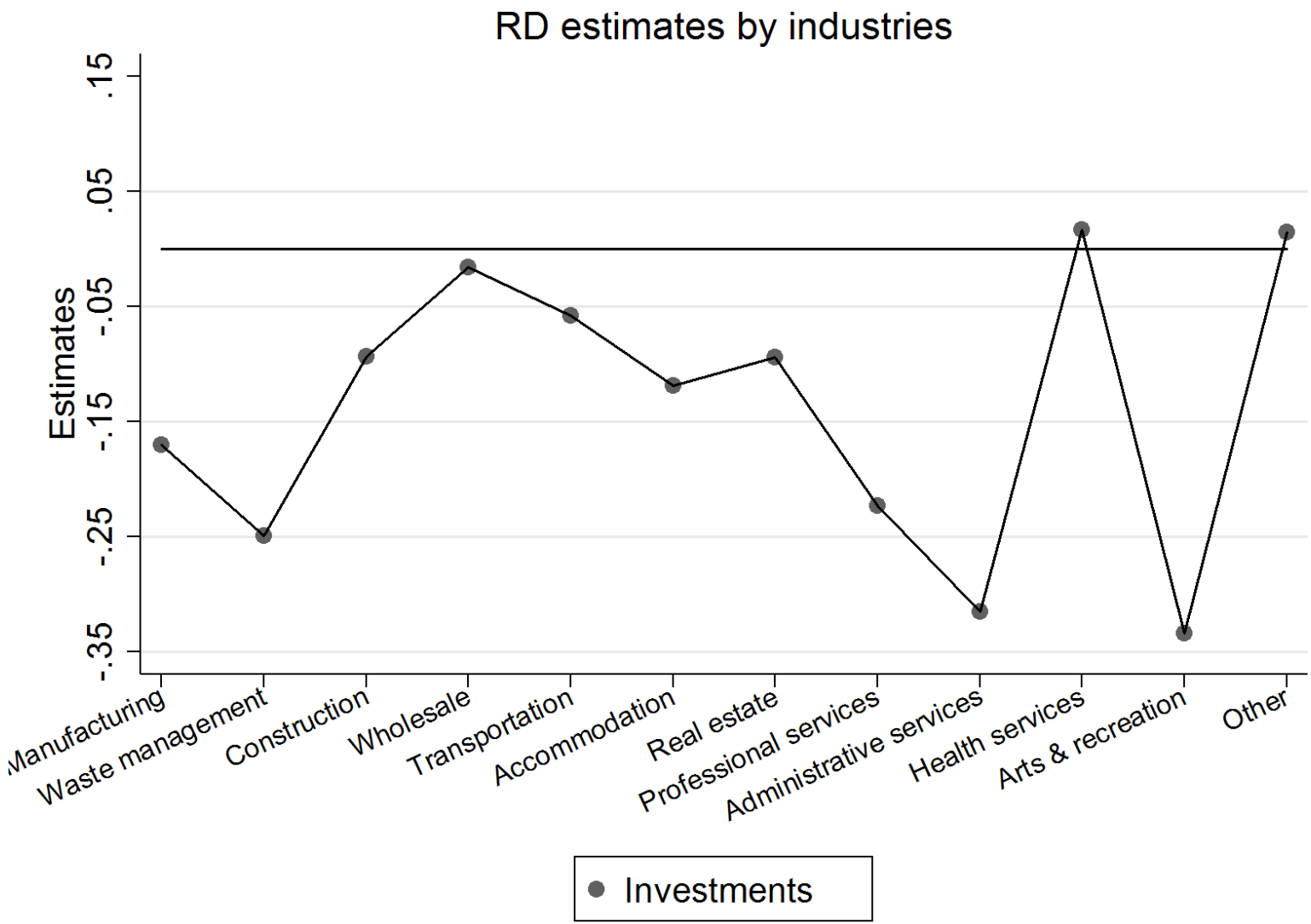
RD estimates by industries: Labor costs



RD estimates by industries: Employment



RD estimates by industries: Investments



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