Tax Policy and Heterogeneous Investment Behavior

Eric Zwick and James Mahon*

*The views expressed here are the authors' and do not necessarily reflect those of the Internal Revenue Service or the Office of Tax Analysis.

Zwick: Chicago Booth and NBER, ezwick@chicagobooth.edu
Mahon: Deloitte, james.mahon.3@gmail.com

Motivating Questions

1. **Do tax incentives affect business investment?**

   Hall and Jorgenson (1967); Summers (1981); Feldstein (1982); Poterba and Summers (1983); Auerbach and Hassett (1992); Cummins, Hassett and Hubbard (1994, 1996); Chirinko, Fazzari and Meyer (1999); Desai and Goolsbee (2004); House and Shapiro (2008); Edgerton (2010); Yagan (2015)

Motivating Questions

1. **Do tax incentives affect business investment?**

   Hall and Jorgenson (1967); Summers (1981); Feldstein (1982); Poterba and Summers (1983); Auerbach and Hassett (1992); Cummins, Hassett and Hubbard (1994, 1996); Chirinko, Fazzari and Meyer (1999); Desai and Goolsbee (2004); House and Shapiro (2008); Edgerton (2010); Yagan (2015)

2. **Do financial frictions affect business investment?**

   Fazzari, Hubbard and Petersen (1988); Hoshi, Kashyap, and Scharfstein (1991); Kaplan and Zingales (1997); Lamont (1997); Erickson and Whited (2000); Almeida, Campello and Weisbach (2004); Rauh (2006); Cummins, Hassett and Oliner (2006); Chernenko and Sunderam (2012); Bakke and Whited (2012); Chaney, Sraer and Thesmar (2012)

Motivating Questions

1. **Do tax incentives affect business investment?**

   Hall and Jorgenson (1967); Summers (1981); Feldstein (1982); Poterba and Summers (1983); Auerbach and Hassett (1992); Cummins, Hassett and Hubbard (1994, 1996); Chirinko, Fazzari and Meyer (1999); Desai and Goolsbee (2004); House and Shapiro (2008); Edgerton (2010); Yagan (2015)

2. **Do financial frictions affect business investment?**

   Fazzari, Hubbard and Petersen (1988); Hoshi, Kashyap, and Scharfstein (1991); Kaplan and Zingales (1997); Lamont (1997); Erickson and Whited (2000); Almeida, Campello and Weisbach (2004); Rauh (2006); Cummins, Hassett and Oliner (2006); Chernenko and Sunderam (2012); Bakke and Whited (2012); Chaney, Sraer and Thesmar (2012)

3. **Which model of firm behavior best fits the data?**

   Jorgenson (1963); Lucas (1967); Tobin (1969); Jensen and Meckling (1976); Auerbach (1979); Hayashi (1982); Myers and Majluf (1984); Stein (1989); Bertola and Caballero (1990); Abel and Eberly (1996); Caballero and Engel (1999); Cooper and Haltiwanger (2006); Abel and Eberly (2011)

Motivating Questions

1. Do tax incentives affect business investment?

   Tax changes as natural experiments + New data

2. Do financial constraints affect business investment?

   Tax changes reveal financial frictions.

3. Which model of firm behavior best fits the data?

   The response to the tax changes we study:
   - **is large, and**
   - **is amplified by costly external finance, but**
   - **only when the policy immediately affects cash flow.**

Model Firm

Consider a firm buying \$1M of computers.

Year	0	1	2	3	4	5	Total
Deductions (000s)	200	320	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	70	112	67.2	40.3	40.3	20.2	350

Model Firm

Consider a firm buying \$1M of computers.

Normal times:

Year	0	1	2	3	4	5	Total
Deductions (000s)	200	320	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	70	112	67.2	40.3	40.3	20.2	350

Cash back NPV = \$311K.

Bonus times (50%):

Year	0	1	2	3	4	5	Total
Deductions (000s)	**600**	160	96	57.5	57.5	29	1000
Tax Benefit ($\tau = 35\%$)	**210**	56	33.6	20.2	20.2	10	350

Cash back NPV = \$331K.

Model Firm

Consider a firm buying \$1M of computers.

Normal times:

Year	0	1	2	3	4	5	Total
Deductions (000s)	200	320	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	70	112	67.2	40.3	40.3	20.2	350

Cash back today = \$70K.

Bonus times (50%):

Year	0	1	2	3	4	5	Total
Deductions (000s)	**600**	160	96	57.5	57.5	29	1000
Tax Benefit ($\tau = 35\%$)	**210**	56	33.6	20.2	20.2	10	350

Cash back today = \$210K.

Our Approach

1. Baseline Effect
   - Policy Setting
   - Research Design
   - Data
   - Findings

2. Financial Frictions
   - Costly Finance
   - Managerial Myopia

Our Approach

1. **Baseline Effect**
   - **Policy Setting**
   - **Research Design**
   - Data
   - Findings
2. Financial Frictions
   - Costly Finance
   - Managerial Myopia

Estimate investment response to depreciation incentives

- Large firm temporary policy (Bonus $\times 2$), different recessions
  - Difference-in-differences research design
  - House and Shapiro (2008) study Bonus I with agg data.
- Small firm policy always in place (Section 179)
  - Previously unstudied
  - Regression discontinuity research design

Our Approach

1. **Baseline Effect**
   - **Policy Setting**
   - **Research Design**
   - Data
   - Findings
2. Financial Frictions
   - Costly Finance
   - Managerial Myopia

Focus on one policy tool

- Past tax studies pool different reforms for power
  - Corporate/dividend rate, ITC, corporate form rule changes, depreciation incentives
- Mechanism for taxes on investment remains unclear.
  - Yagan (2015) finds dividend cut doesn't affect investment.

Our Approach

1. **Baseline Effect**
   - Policy Setting
   - Research Design
   - **Data**
   - **Findings**

2. Financial Frictions
   - Costly Finance
   - Managerial Myopia

Use tax data for a large sample of public and private firms

- Sample 10X size of Compustat, mostly private firms
- Past tax studies use Compustat $\Longrightarrow$ big SEs
  - Edgerton (2010) 95% confidence interval: [-0.046,-1.28].

Our Approach

1. Baseline Effect
   - Policy Setting
   - Research Design
   - Data
   - Findings
2. **Financial Frictions**
   - **Costly Finance**
   - **Managerial Myopia**

Reveal financial frictions with heterogeneity analysis

- I-CF sensitivities provide unreliable test of constraints
  - Kaplan and Zingales (1997), Abel and Eberly (2011)
- Clean shocks to cash flow, credit are rare
  - Exceptions: Lamont (1997), Chaney et al (2012)
- Small, private firms better setting for frictions

Our Approach

1. Baseline Effect
   - Policy Setting
   - Research Design
   - Data
   - Findings
2. Financial Frictions
   - Costly Finance
   - Managerial Myopia
3. Macro
   - Substitution
   - Aggregation

Part 1: The effect of bonus on investment

Policy Setting, Research Design, Data

Bonus Depreciation Background

- Allows additional first-year deductions for new equipment.

Bonus Depreciation Background

- Allows additional first-year deductions for new equipment.

- Bonus I: 30% in 2001, 2002; 50% in 2003, 2004
- Bonus II: 50% in 2008-09, 12-13; 100% in 2010-11

- Stated goal: to promote business investment and spur growth.

  Estimated cost: $20-40B per year

Bonus Depreciation Background

- Allows additional first-year deductions for new equipment.
- Bonus I: 30% in 2001, 2002; 50% in 2003, 2004
- Bonus II: 50% in 2008-09, 12-13; 100% in 2010-11

$$\underbrace{z_T^0}_{\substack{\text{PV of \$1}\\ \text{Normal times}}} \equiv \underbrace{D_0}_{\substack{\text{Year 0}\\ \text{Deduction}}} + \underbrace{\sum_{t=1}^{T} \frac{1}{(1+r)^t} D_t}_{\substack{\text{PV of Year 1 to T}\\ \text{Deductions}}} \quad \text{with} \quad \sum D_i = 1$$

$$\underbrace{z_T(\theta)}_{\substack{\text{PV of \$1}\\ \text{Bonus times}}} \equiv \underbrace{\theta}_{\text{Bonus}} + (1-\theta) z_T^0 \quad \text{with} \quad \theta \in (0,1]$$

Bonus Depreciation Background

$$\underbrace{z_T(\theta)}_{\substack{\text{PV of \$1}\\ \text{Bonus times}}} \equiv \underbrace{\theta}_{\text{Bonus}} + (1-\theta) z_T^0 \quad \text{with} \quad \theta \in (0,1]$$

Normal times:

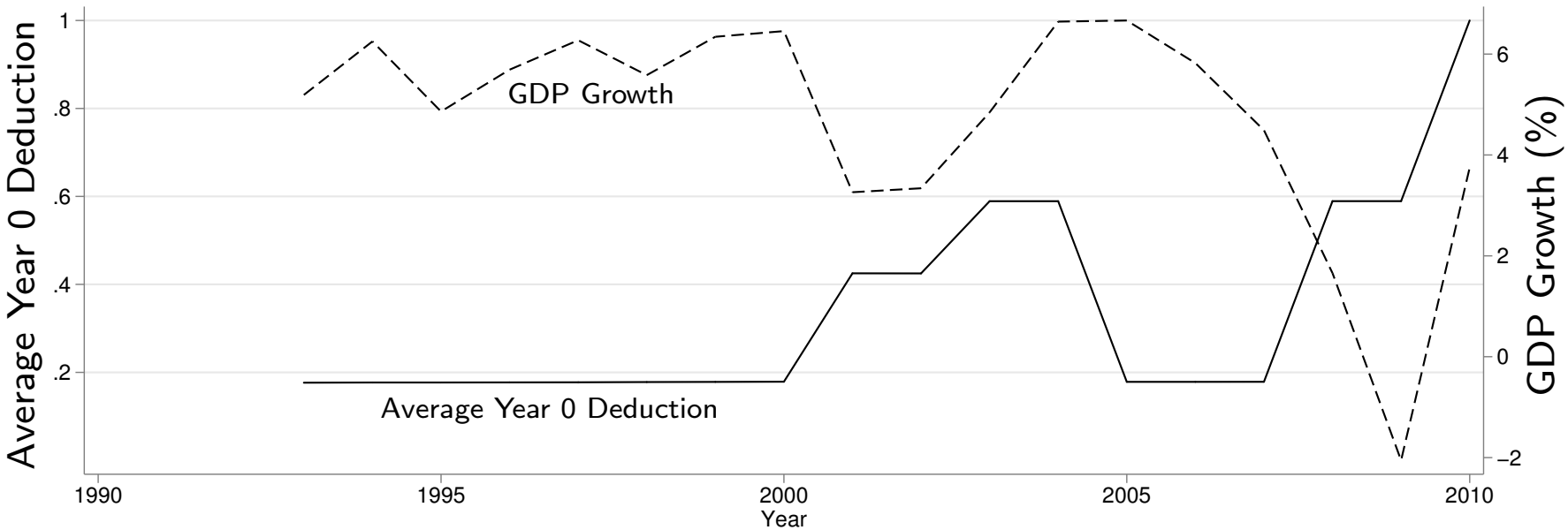
Year	0	1	2	3	4	5	Total
Deductions	200	320	192	115	115	58	1000
$z_5(0)$							0.890

Bonus times (50%):

Year	0	1	2	3	4	5	Total
Deductions	600	160	96	57.5	57.5	29	1000
$z_5(0.5)$							**0.945**

Bonus Depreciation Background

- Allows additional first-year deductions for new equipment.
- Bonus I: 30% in 2001, 2002; 50% in 2003, 2004
- Bonus II: 50% in 2008-09, 12-13; 100% in 2010-11
- Stated goal: to promote business investment and spur growth.



Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.

	Computers	Telephone Lines
Tax Life	5 year	15 year
$z_T(0)$	0.890	0.659
$z_T(0.5)$	0.945	0.829
Δz_T	0.055	**0.170**

Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.
2. Industries differ in relative intensity of longer lived investment.

Short Duration (NAICS)	Long Duration (NAICS)
Rental and Leasing (532)	Utilities (221)
Publishing (511)	Pipeline Transport (486)
Data Processing (518)	Railroads (482)
Ground Transit (485)	Accommodations (721)
Professional Services (541)	Food Manufacturing (311)

Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.
2. Industries differ in relative intensity of longer lived investment.
3. Use tax data to compute weighted average present value of deductions, z_N, at four-digit NAICS level

$$\underbrace{z_N}_{\substack{\text{Industry} \\ \text{Average PV}}} = \sum_T \underbrace{\omega_N(T)}_{\substack{\text{Industry} \\ \text{Class } T \text{ Share}}} \times \underbrace{z_T}_{\text{Class } T \text{ PV}}$$

where $\omega_N(T)$ is computed prior to the policy (1993-2000).

Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.
2. Industries differ in relative intensity of longer lived investment.
3. Use tax data to compute weighted average present value of deductions, z_N, at four-digit NAICS level
4. Use cross-sectional variation in bonus generosity to identify the effect of bonus (diff-in-diffs)

$$\Delta I_{\text{Rental and Leasing}} \quad \text{vs.} \quad \Delta I_{\text{Utilities}}$$

$$\log(I_{it}) = \alpha_i + \delta_t + \beta z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

Approach of Cummins, Hassett and Hubbard (1994, 1996), Desai and Goolsbee (2004), Edgerton (2010).

- Larger sample, one policy change

Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.
2. Industries differ in relative intensity of longer lived investment.
3. Use tax data to compute weighted average present value of deductions, z_N, at four-digit NAICS level
4. Use cross-sectional variation in bonus generosity to identify the effect of bonus (diff-in-diffs)

$$\Delta I_{\text{Rental and Leasing}} \quad \text{vs.} \quad \Delta I_{\text{Utilities}}$$

$$\log(I_{it}) = \alpha_i + \delta_t + \beta z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

Approach of Cummins, Hassett and Hubbard (1994, 1996), Desai and Goolsbee (2004), Edgerton (2010).

- Larger sample, one policy change

Bonus Empirical Design

1. Bonus allowance is more valuable for longer lived items.

2. Industries differ in relative intensity of longer lived investment.

3. Use tax data to compute weighted average present value of deductions, z_N, at four-digit NAICS level

4. Use cross-sectional variation in bonus generosity to identify the effect of bonus (diff-in-diffs)

5. Identifying assumption: **parallel trends.**
   - If no bonus, average outcome paths similar across industries.
   - Concern: time-varying industry shocks coinciding with bonus.
     - E.g., durables investment more resilient in downturns.
   - Test graphically, with controls, placebo test, triple-diff.

Business Tax Data

1. US corporate tax data, 1993-2010
   - Size-stratified samples of $\sim 100,000$ corporate tax returns produced yearly by IRS Statistics of Income (SOI) division
   - We build a panel of returns covering 1993 to 2010.
   - Investment, income, expenses, balance sheet, payouts, employment, industry, filing geography

2. Sample restrictions
   - Subchapter C and S corporations
   - Positive deductions or income
   - Attached investment form
   - Average eligible investment greater than \$100K

Final sample: 818,576 firm year observations; 128,151 firms.

Tax Data

	Mean	Median	Count
Outcome Variables			
Investment (000s)	6,786.87	367.59	818,576
Policy Variables			
$z_{N,t}$	0.90	0.89	818,576
Characteristics			
Sales (000s)	180,423.8	25,920.92	818,576
Net Income Before Depreciation (000s)	15,392.59	1,474.65	818,576

Compustat

	Mean	Median	Count
Outcome Variables			
Capital Expenditures (000s)	145,068	3,757	151,919
Characteristics			
Sales (000s)	1,866,779	89,915	162,095
Net Income Before Depreciation (000s)	205,268	5,015.5	157,310

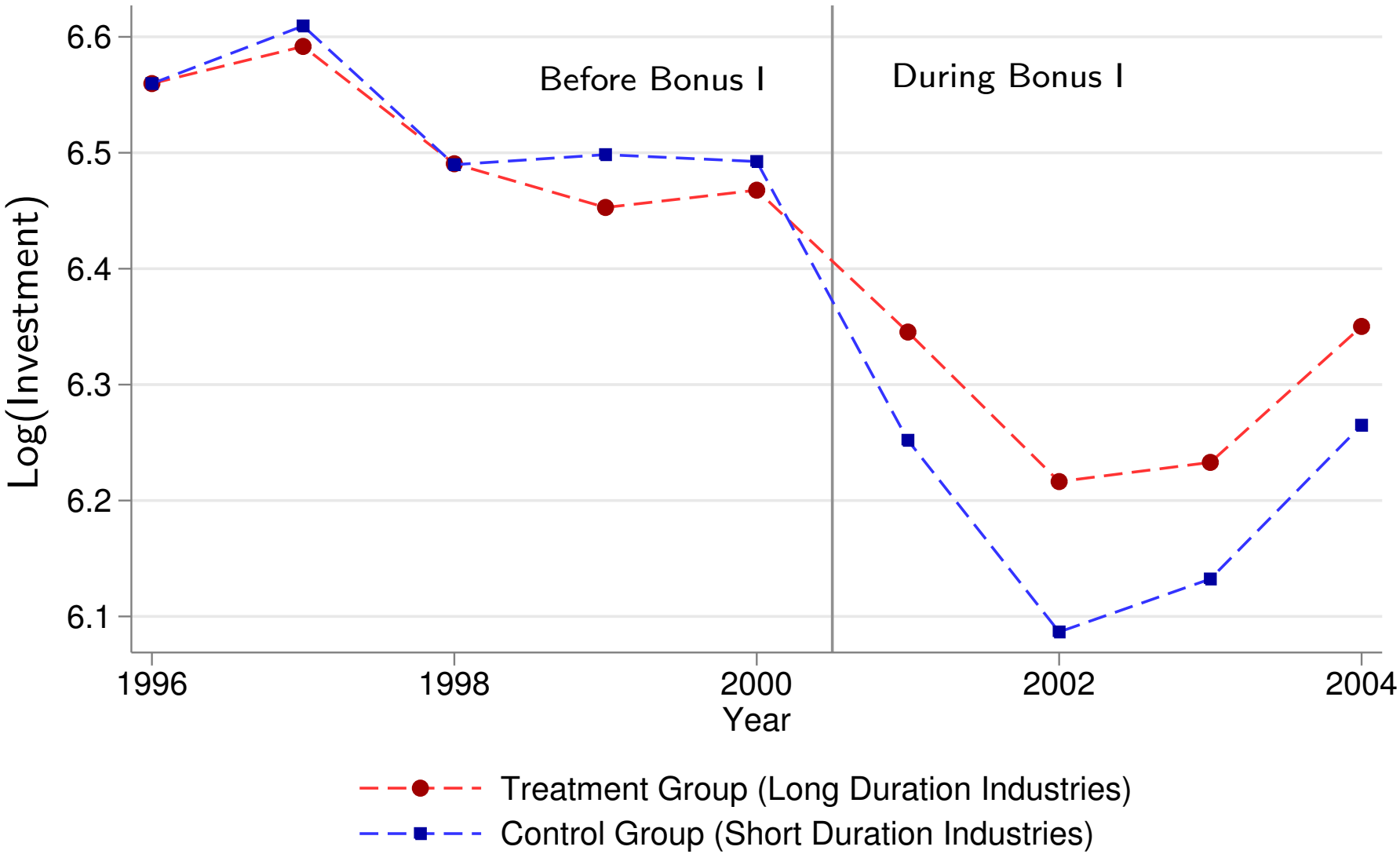
"Percentiles" are averages for all observations in the $(P-1, P+1)$th percentiles.

Part 1: The effect of bonus on investment

Findings

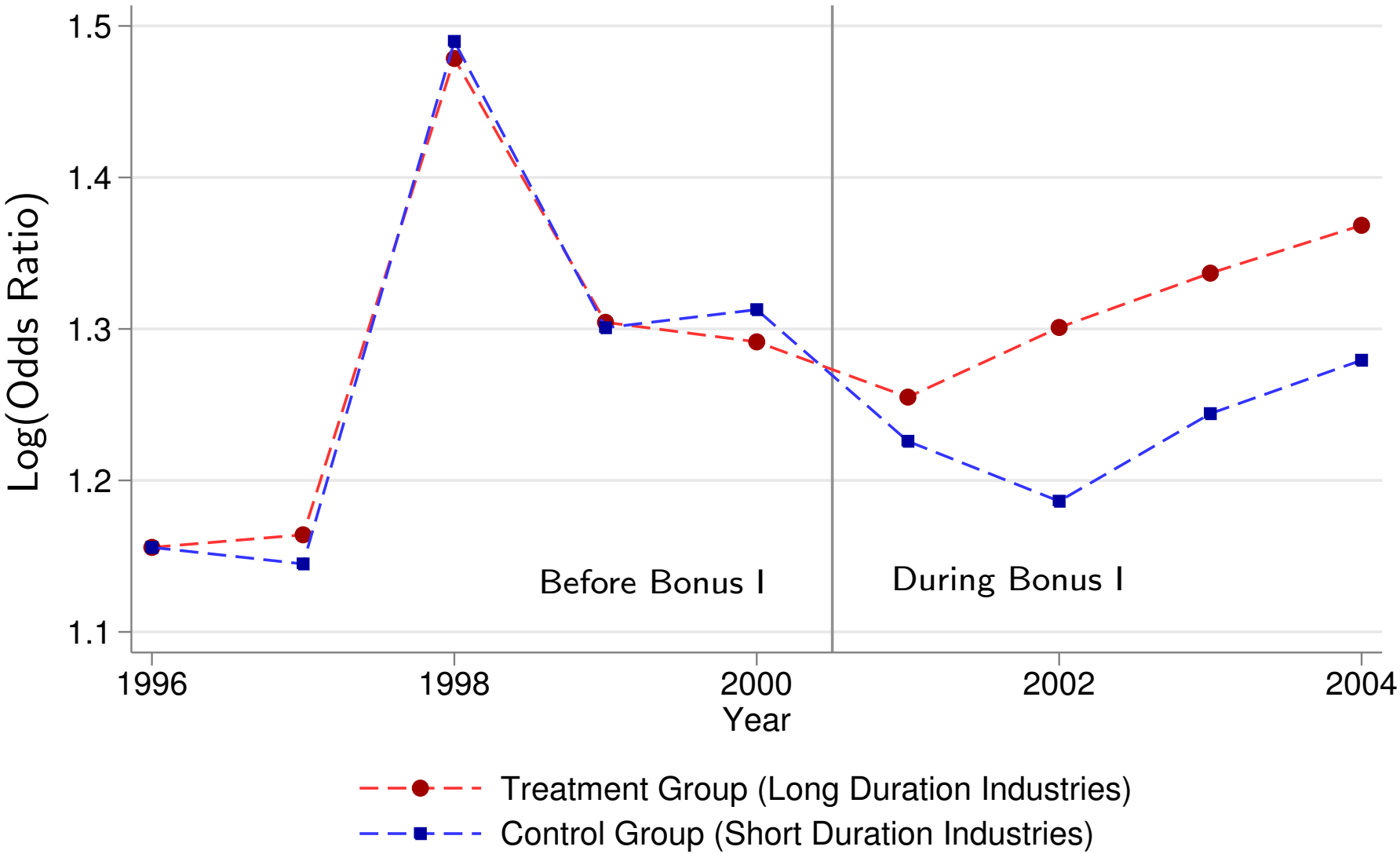
Calendar Diff-in-Diffs: Bonus I

Intensive Margin



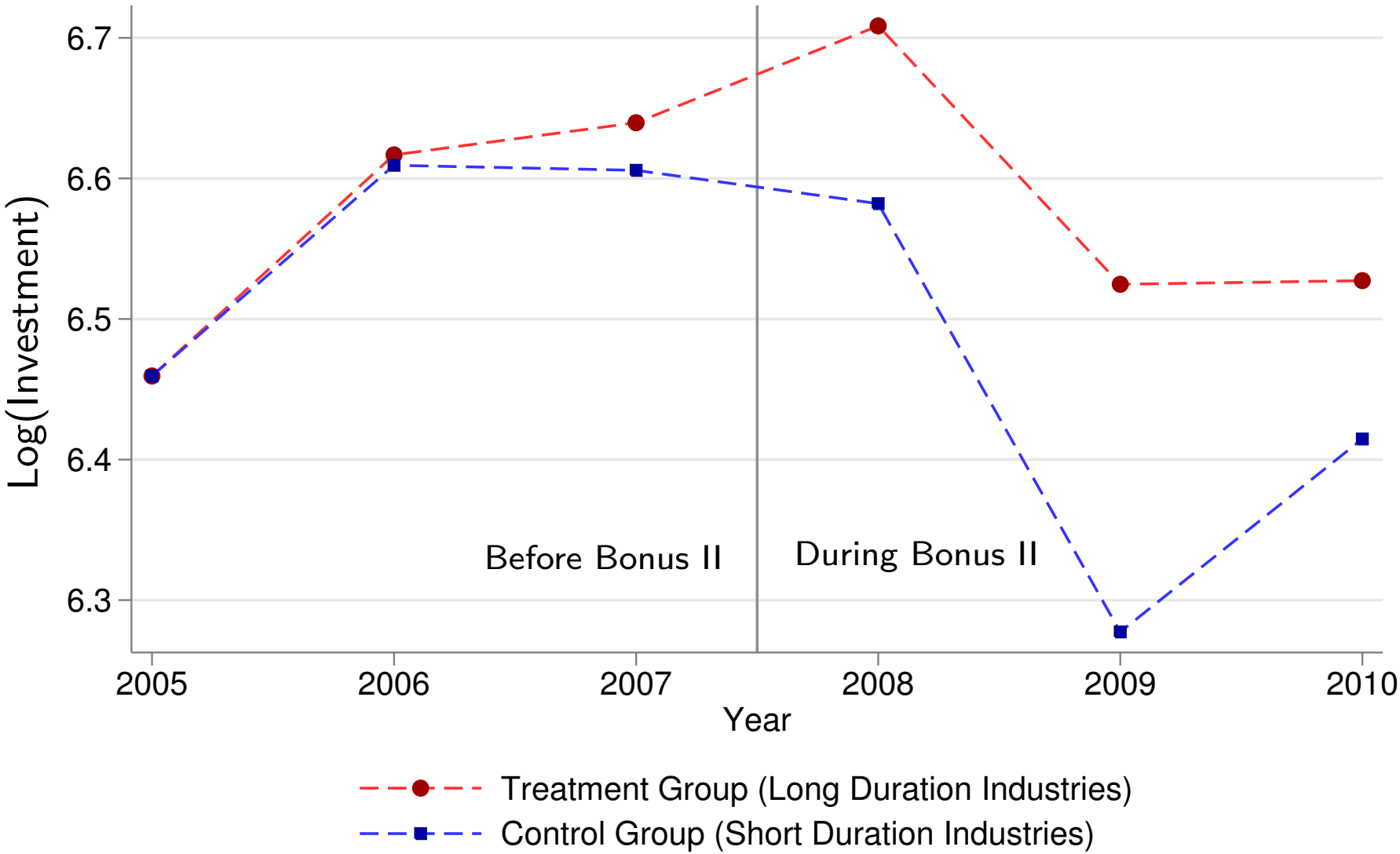
Calendar Diff-in-Diffs: Bonus I

Extensive Margin



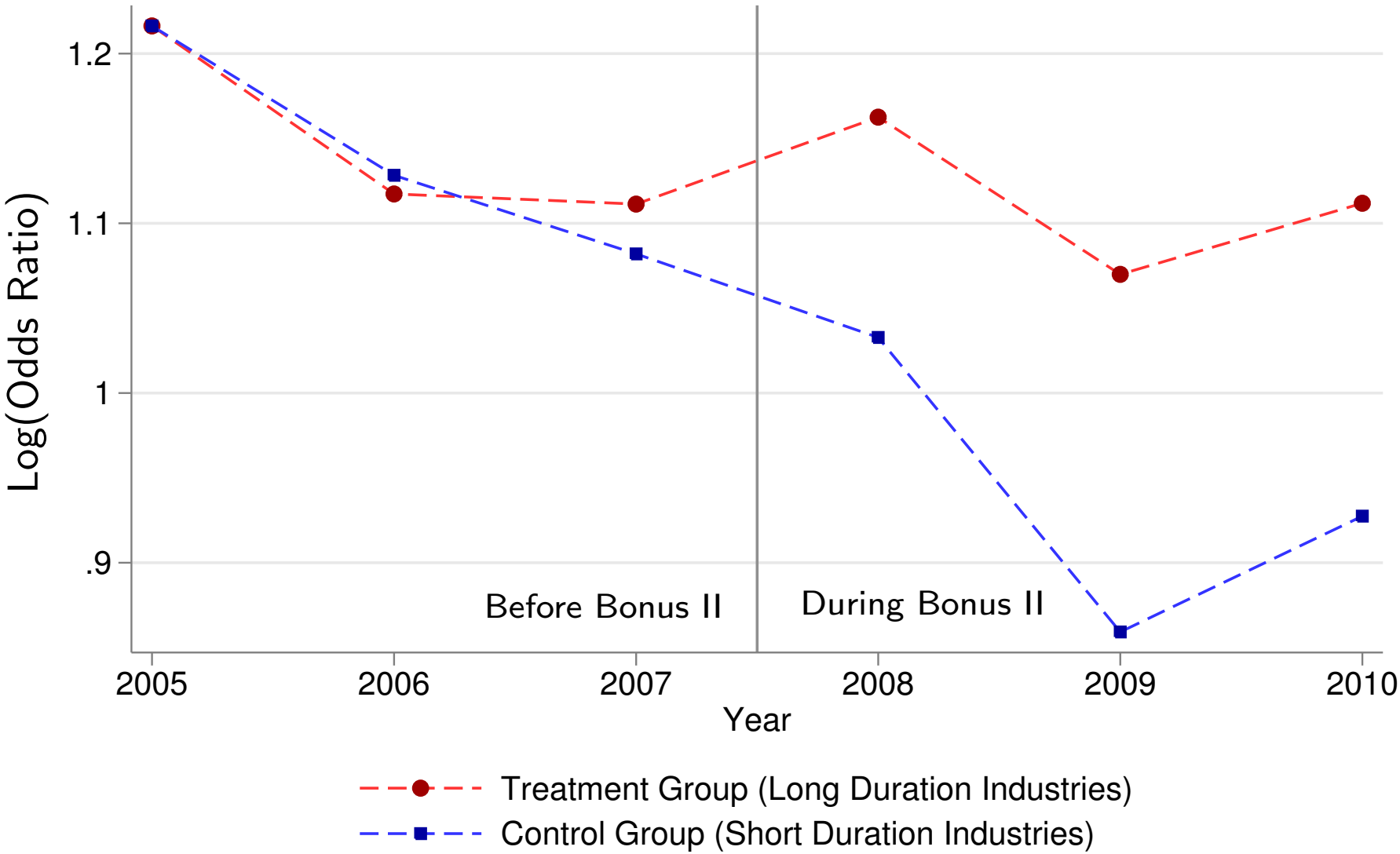
Calendar Diff-in-Diffs: Bonus II

Intensive Margin



Calendar Diff-in-Diffs: Bonus II

Extensive Margin



$$f(I_{it}) = \alpha_i + \delta_t + \beta g(z_{N,t}) + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	3.69***	3.78***	3.07***	3.02***	3.73***	4.69***
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	LHS Variable is Log(Odds Ratio)					
$z_{N,t}$	3.79**	3.87**	3.12	3.59**	3.99*	4.00***
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
Observations	803659	641173	556011	247648	643913	803659
Clusters (Industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90
	LHS Variable is Eligible Investment/Lagged Capital					
$\frac{1-t_c z}{1-t_c}$	-1.60***	-1.53***	-2.00***	-1.42***	-2.27***	-1.50***
	(0.096)	(0.095)	(0.16)	(0.13)	(0.14)	(0.10)
Observations	637243	633598	426214	211029	510653	631295
Clusters (Firms)	103890	103220	87939	57343	90145	103565
R^2	0.43	0.43	0.48	0.54	0.45	0.44

All regressions include firm and year effects. Controls: cash flow in (2); 4-digit Q, quartics in sales, assets, profit margin, age in (5); 2-digit NAICS $\times t^2$ in (6).

▸ Back

$$f(I_{it}) = \alpha_i + \delta_t + \beta g(z_{N,t}) + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	3.69***	3.78***	3.07***	3.02***	3.73***	4.69***
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	LHS Variable is Log(Odds Ratio)					
$z_{N,t}$	3.79**	3.87**	3.12	3.59**	3.99*	4.00***
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
Observations	803659	641173	556011	247648	643913	803659
Clusters (Industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90
	LHS Variable is Eligible Investment/Lagged Capital					
$\frac{1-t_c z}{1-t_c}$	-1.60***	-1.53***	-2.00***	-1.42***	-2.27***	-1.50***
	(0.096)	(0.095)	(0.16)	(0.13)	(0.14)	(0.10)
Observations	637243	633598	426214	211029	510653	631295
Clusters (Firms)	103890	103220	87939	57343	90145	103565
R^2	0.43	0.43	0.48	0.54	0.45	0.44

All regressions include firm and year effects. Controls: cash flow in (2); 4-digit Q, quartics in sales, assets, profit margin, age in (5); 2-digit NAICS $\times t^2$ in (6).

▸ Back

$$f(I_{it}) = \alpha_i + \delta_t + \beta g(z_{N,t}) + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	3.69***	3.78***	3.07***	3.02***	3.73***	4.69***
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	LHS Variable is Log(Odds Ratio)					
$z_{N,t}$	3.79**	3.87**	3.12	3.59**	3.99*	4.00***
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
Observations	803659	641173	556011	247648	643913	803659
Clusters (Industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90
	LHS Variable is Eligible Investment/Lagged Capital					
$\frac{1-t_c z}{1-t_c}$	-1.60***	-1.53***	-2.00***	-1.42***	-2.27***	-1.50***
	(0.096)	(0.095)	(0.16)	(0.13)	(0.14)	(0.10)
Observations	637243	633598	426214	211029	510653	631295
Clusters (Firms)	103890	103220	87939	57343	90145	103565
R^2	0.43	0.43	0.48	0.54	0.45	0.44

All regressions include firm and year effects. Controls: cash flow in (2); 4-digit Q, quartics in sales, assets, profit margin, age in (5); 2-digit NAICS $\times t^2$ in (6).

▸ Back

$$f(I_{it}) = \alpha_i + \delta_t + \beta g(z_{N,t}) + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	3.69***	3.78***	3.07***	3.02***	3.73***	4.69***
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	LHS Variable is Log(Odds Ratio)					
$z_{N,t}$	3.79**	3.87**	3.12	3.59**	3.99*	4.00***
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
Observations	803659	641173	556011	247648	643913	803659
Clusters (Industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90
	LHS Variable is Eligible Investment/Lagged Capital					
$\frac{1-t_c z}{1-t_c}$	-1.60***	-1.53***	-2.00***	-1.42***	-2.27***	-1.50***
	(0.096)	(0.095)	(0.16)	(0.13)	(0.14)	(0.10)
Observations	637243	633598	426214	211029	510653	631295
Clusters (Firms)	103890	103220	87939	57343	90145	103565
R^2	0.43	0.43	0.48	0.54	0.45	0.44

All regressions include firm and year effects. Controls: cash flow in (2); 4-digit Q, quartics in sales, assets, profit margin, age in (5); 2-digit NAICS $\times t^2$ in (6).

▸ Back

$$f(I_{it}) = \alpha_i + \delta_t + \beta g(z_{N,t}) + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	3.69***	3.78***	3.07***	3.02***	3.73***	4.69***
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	LHS Variable is Log(Odds Ratio)					
$z_{N,t}$	3.79**	3.87**	3.12	3.59**	3.99*	4.00***
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
Observations	803659	641173	556011	247648	643913	803659
Clusters (Industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90
	LHS Variable is Eligible Investment/Lagged Capital					
$\frac{1-t_c z}{1-t_c}$	-1.60***	-1.53***	-2.00***	-1.42***	-2.27***	-1.50***
	(0.096)	(0.095)	(0.16)	(0.13)	(0.14)	(0.10)
Observations	637243	633598	426214	211029	510653	631295
Clusters (Firms)	103890	103220	87939	57343	90145	103565
R^2	0.43	0.43	0.48	0.54	0.45	0.44

All regressions include firm and year effects. Controls: cash flow in (2); 4-digit Q, quartics in sales, assets, profit margin, age in (5); 2-digit NAICS $\times t^2$ in (6).

▸ Back

Robustness and Identification

1. Research design
   - Slow moving technology $\times$ rule changes, well-measured
   - Instrument "close" to the outcome
   - Two separate episodes, separate recessions, same effect size

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

Robustness and Identification

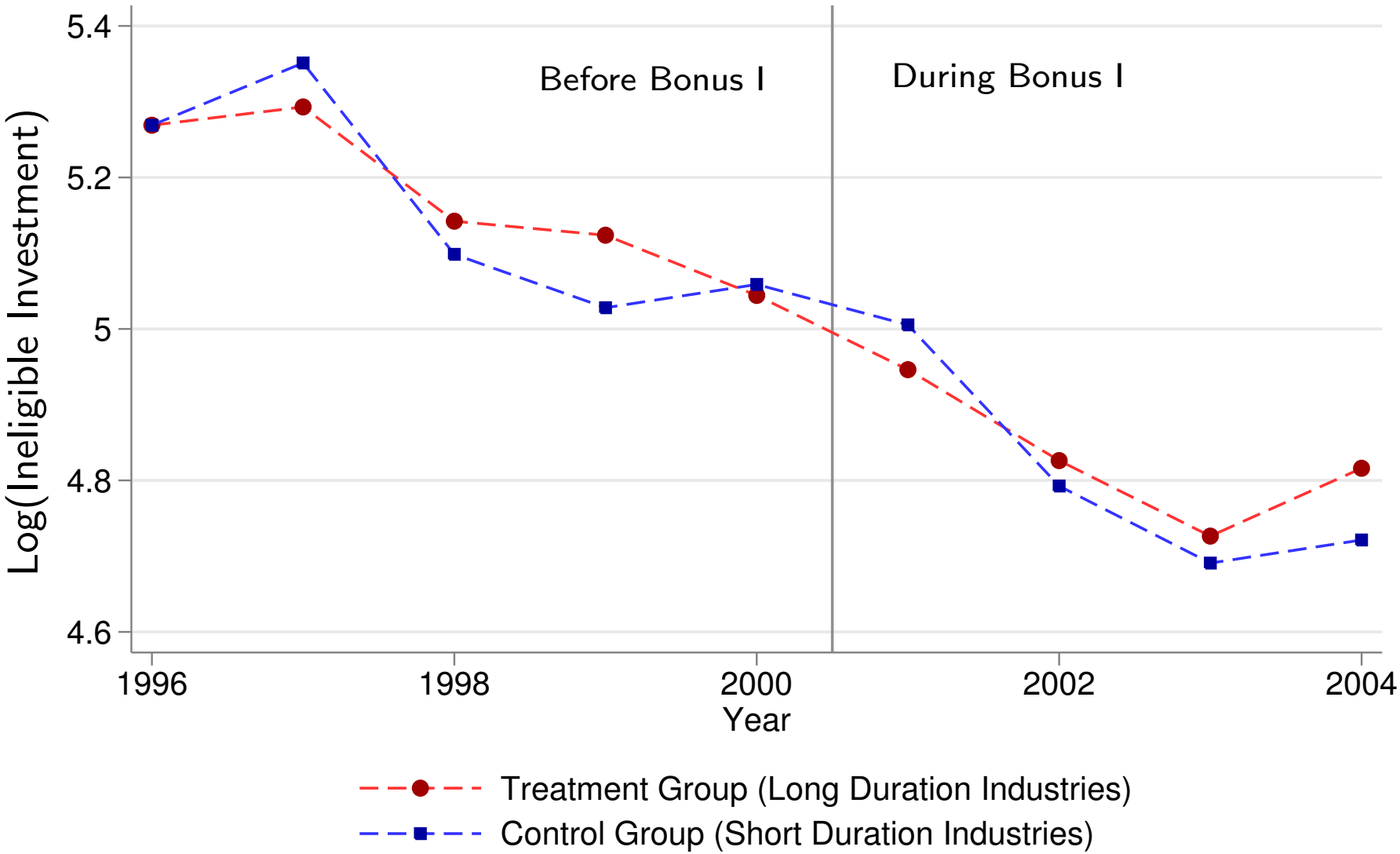
1. Research design

2. Industry omitted variables
   - Parallel trends pictures
   - **Placebo test with structures (ineligible) investment**
   - Evidence of industry cyclicality goes other way (Dew-Becker, 2011)
   - Industry controls: industry Q; 2-digit industry-by-t^2, 2-digit industry-by-GDP, 2-digit industry-year FE
   - Difference-in-difference-in-differences (DDD) test using regional variation in policy salience/state coordination
   - Heterogeneity analysis (in a few slides)

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

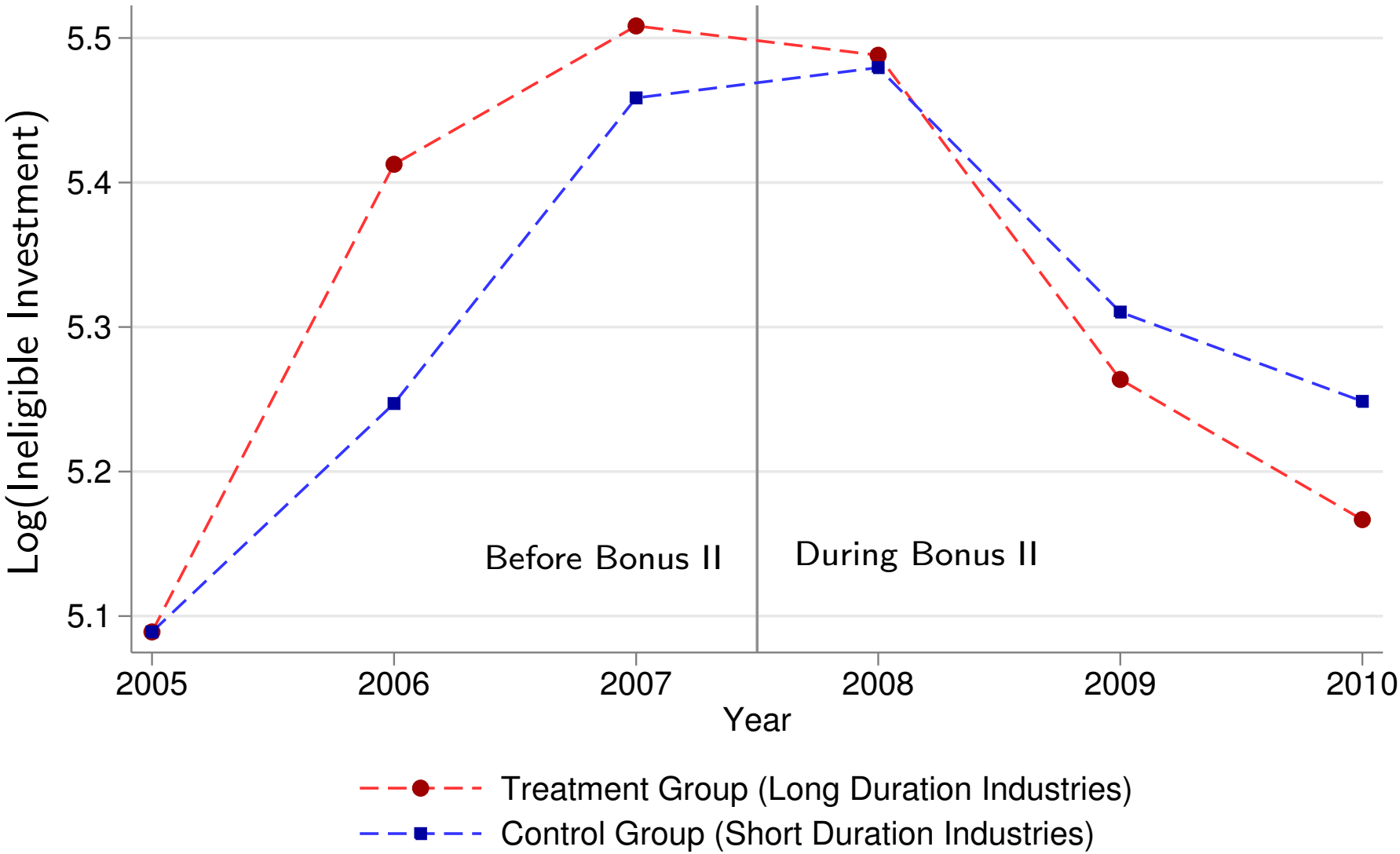
Calendar Diff-in-Diffs: Bonus I

Placebo Test



Calendar Diff-in-Diffs: Bonus I

Placebo Test



Robustness and Identification

1. Research design

2. Industry omitted variables
   - Parallel trends pictures
   - Placebo test with structures (ineligible) investment
   - Evidence of industry cyclicality goes other way (Dew-Becker, 2011)
   - Industry controls: industry Q; 2-digit industry-by-t^2, 2-digit industry-by-GDP, 2-digit industry-year FE
   - Difference-in-difference-in-differences (DDD) test using regional variation in policy salience/state coordination
   - Heterogeneity analysis (in a few slides)

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

Robustness and Identification

1. Research design

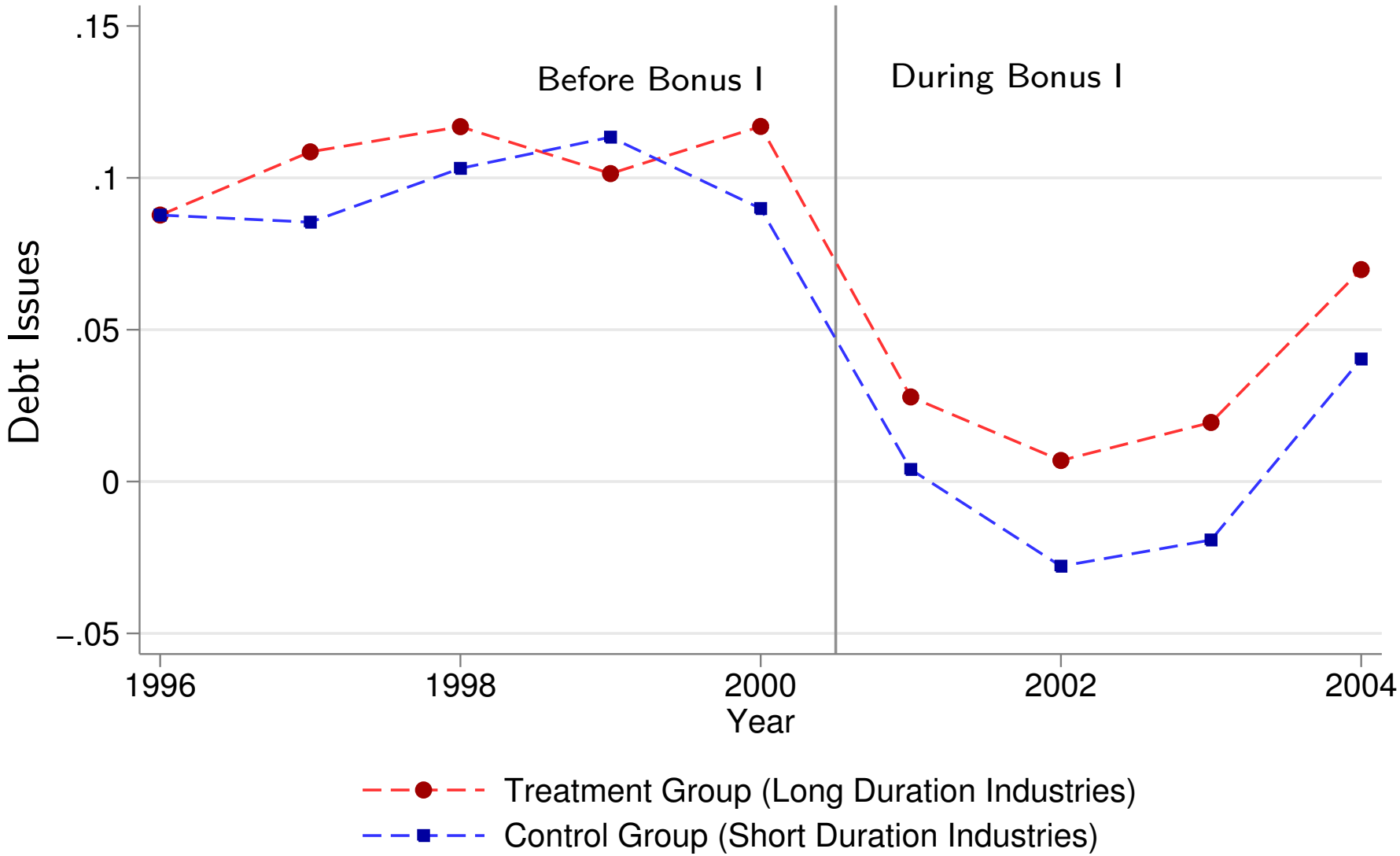
2. Industry omitted variables

3. Firm-level omitted variables and data issues
   - Alternative outcome variables: log(Odds), I/K, net investment ($\Delta \log(K)$), bonus take-up, **debt issues, dividends**, payroll
   - Limited compliance concerns
   - Firm-level controls: cash flow; ten-piece splines in age, profit margin, sales, assets, lagged sales growth

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

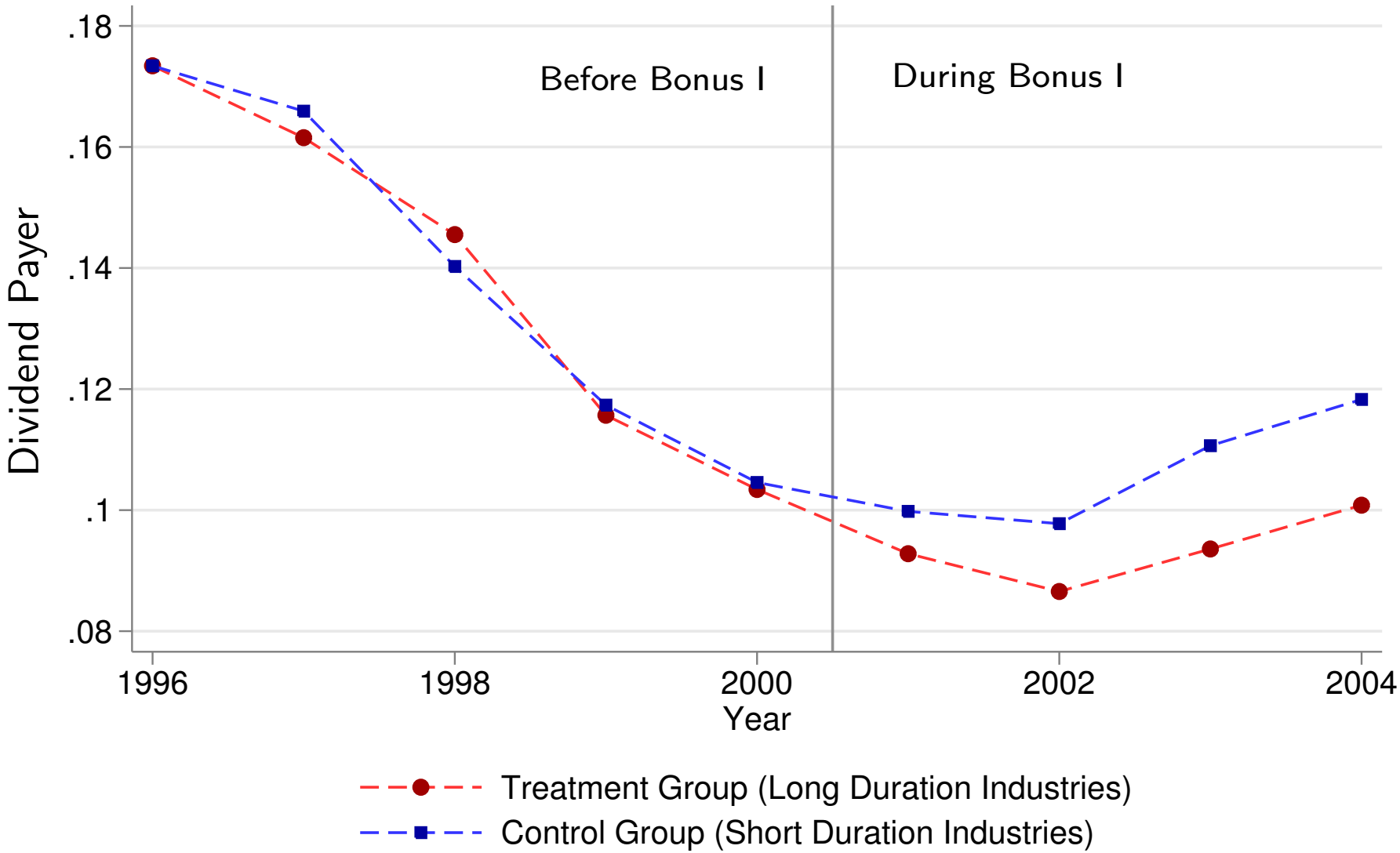
Calendar Diff-in-Diffs: Bonus I

Flow of Funds: Net Borrowing



Calendar Diff-in-Diffs: Bonus I

Flow of Funds: Payouts



Robustness and Identification

1. Research design

2. Industry omitted variables

3. Firm-level omitted variables and data issues
   - Alternative outcome variables: log(Odds), I/K, net investment ($\Delta \log(K)$), bonus take-up, debt issues, dividends, payroll
   - Limited compliance concerns
   - Firm-level controls: cash flow; ten-piece splines in age, profit margin, sales, assets, lagged sales growth

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

Robustness and Identification

1. Research design
   - Slow moving technology $\times$ rule changes, well-measured
   - Instrument "close" to the outcome
   - Two separate episodes, separate recessions, same effect size
2. Industry omitted variables
   - Parallel trends pictures
   - Placebo test with structures (ineligible) investment
   - Evidence of industry cyclicality goes other way (Dew-Becker, 2011)
   - Industry controls: industry Q; 2-digit industry-by-t^2, 2-digit industry-by-GDP, 2-digit industry-year FE
   - Difference-in-difference-in-differences (DDD) test using regional variation in policy salience/state coordination
   - Heterogeneity analysis (in a few slides)
3. Firm-level omitted variables and data issues
   - Alternative outcome variables: log(Odds), I/K, net investment ($\Delta \log(K)$), bonus take-up, debt issues, dividends, payroll
   - Limited compliance concerns
   - Firm-level controls: cash flow; ten-piece splines in age, profit margin, sales, assets, lagged sales growth

▸ Parallel Trends ▸ Placebo Test ▸ Industry Controls ▸ Triple Diff ▸ Firm Controls ▸ Other DVs

Fact 1: The Effect is Large

Consider a firm buying \$1M of computers.

- Estimates imply 50% bonus increases investment by \$166K.
  - Recall PV cash back = \$20K, first period cash back = \$140K.
  - Investment-cash flow sensitivities are less than 0.2.
  - Cannot be a direct "cash windfall" effect.

Fact 1: The Effect is Large

Consider a firm buying \$1M of computers.

- Estimates imply 50% bonus increases investment by \$166K.
  - Recall PV cash back = \$20K, first period cash back = \$140K.
  - Investment-cash flow sensitivities are less than 0.2.
  - Cannot be a direct "cash windfall" effect.

- Equivalent to an interest rate/price elasticity = 7.2

$$(1-\tau)\Pi'(I) = p_I(1+r)(1-\tau z)$$

Fact 1: The Effect is Large

Consider a firm buying \$1M of computers.

- Estimates imply 50% bonus increases investment by \$166K.
  - Recall PV cash back = \$20K, first period cash back = \$140K.
  - Investment-cash flow sensitivities are less than 0.2.
  - Cannot be a direct "cash windfall" effect.

- Equivalent to an interest rate/price elasticity = 7.2

$$(1-\tau)\Pi'(I) = p_I(1+r)(1-\tau z)$$

- User cost estimates twice the size of Edgerton (2010)
  - 50% bonus increases I/K by 40 percent (from 0.10 to 0.14).

Part 2: Explaining large effects with financial frictions

Story 1: Costly external finance

Past Estimates

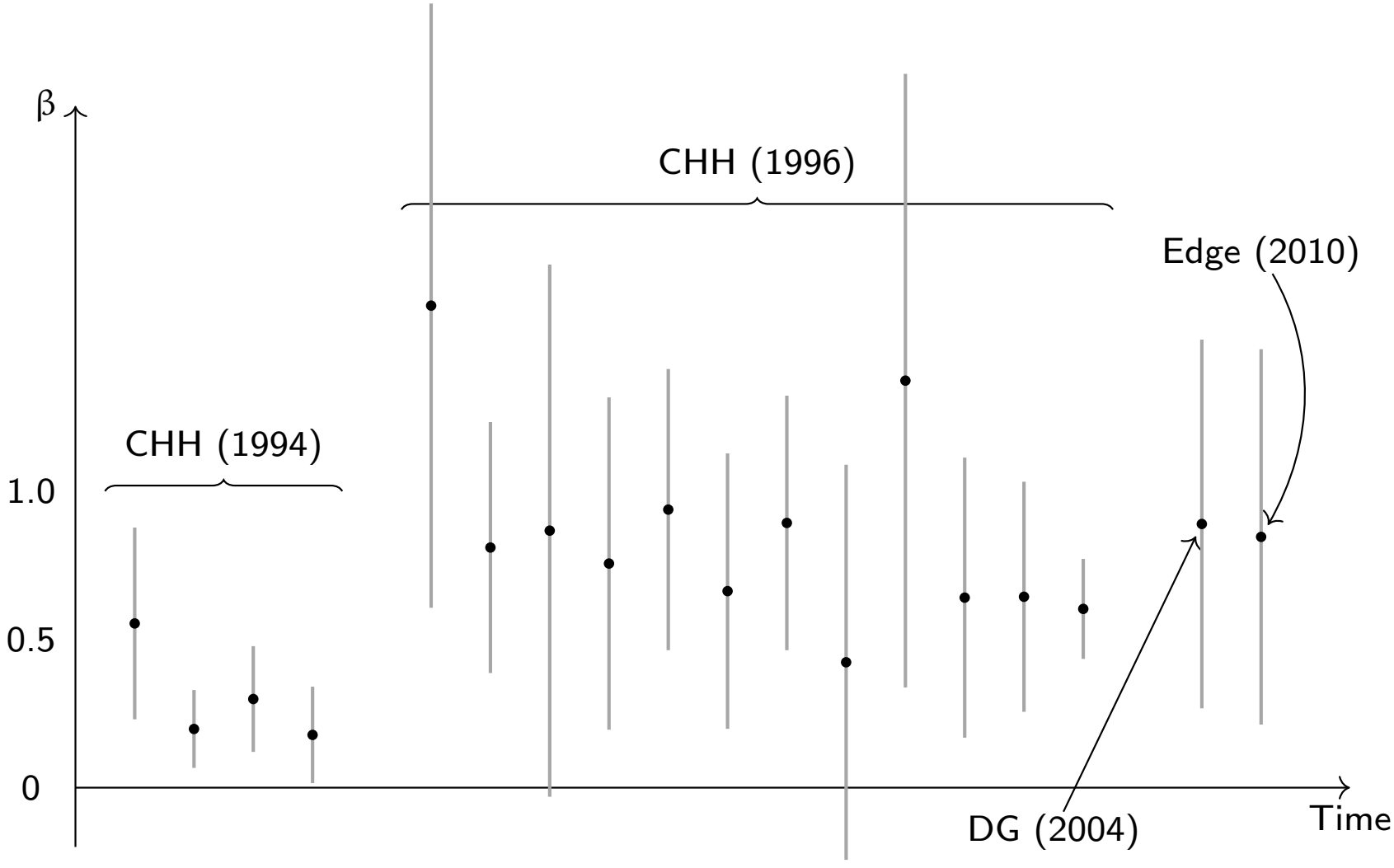
$$\frac{I_t}{K_{t-1}} = \alpha_i + \beta \underbrace{\left(\frac{Q}{1-\tau} - \frac{1-\tau z}{1-\tau} \right)}_{\text{tax-adjusted } Q} + \varepsilon_{it}$$

Past Estimates

$$\frac{I_t}{K_{t-1}} = \alpha_i + \delta_t + \beta \frac{1-\tau z}{1-\tau} + \gamma X_{it} + \varepsilon_{it}$$

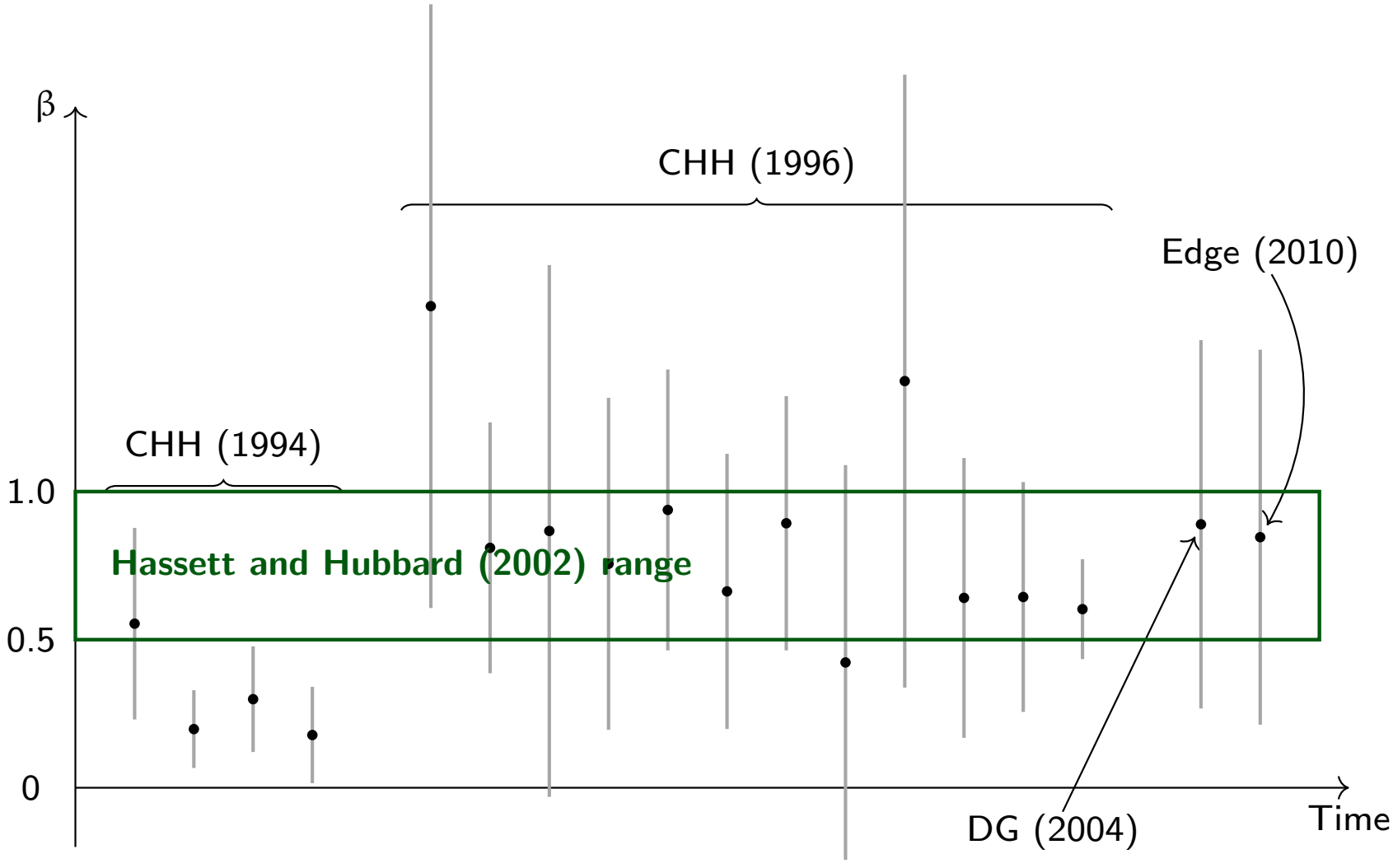
Past Estimates

$$\frac{I_t}{K_{t-1}} = \alpha_i + \delta_t + \beta \frac{1-\tau z}{1-\tau} + \gamma X_{it} + \varepsilon_{it}$$



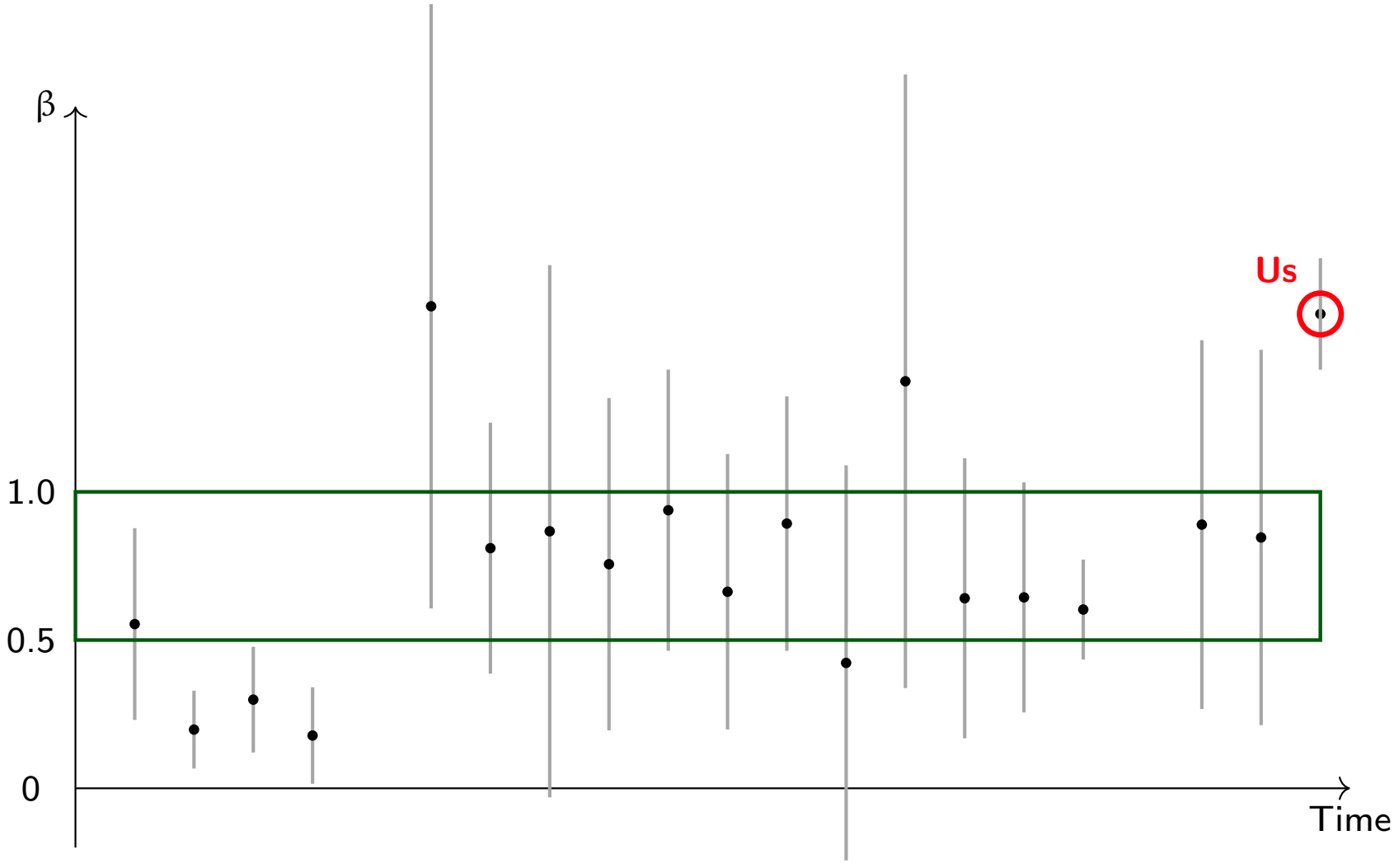
Past Estimates

$$\frac{I_t}{K_{t-1}} = \alpha_i + \delta_t + \beta \frac{1-\tau z}{1-\tau} + \gamma X_{it} + \varepsilon_{it}$$

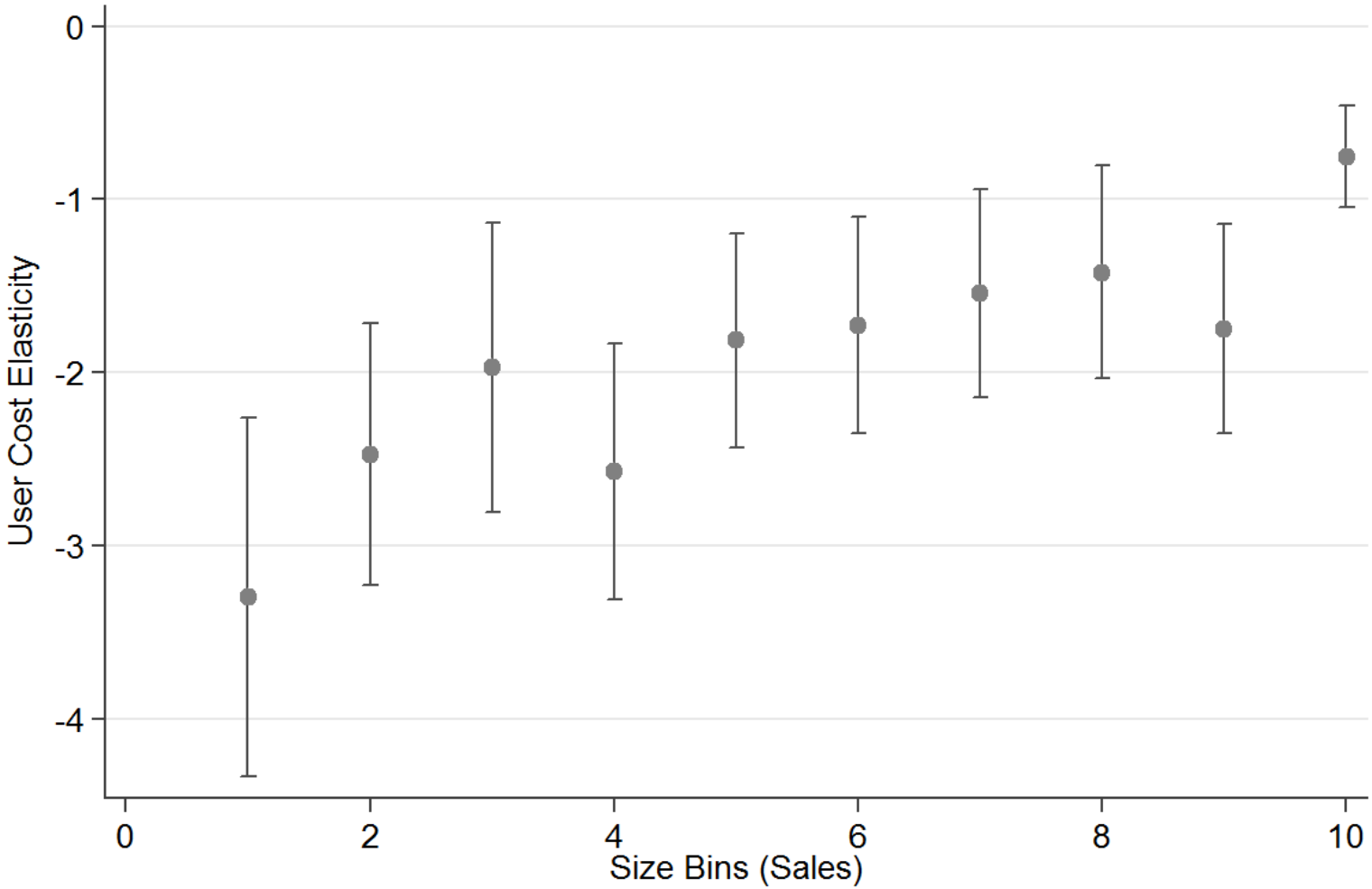


Past Estimates

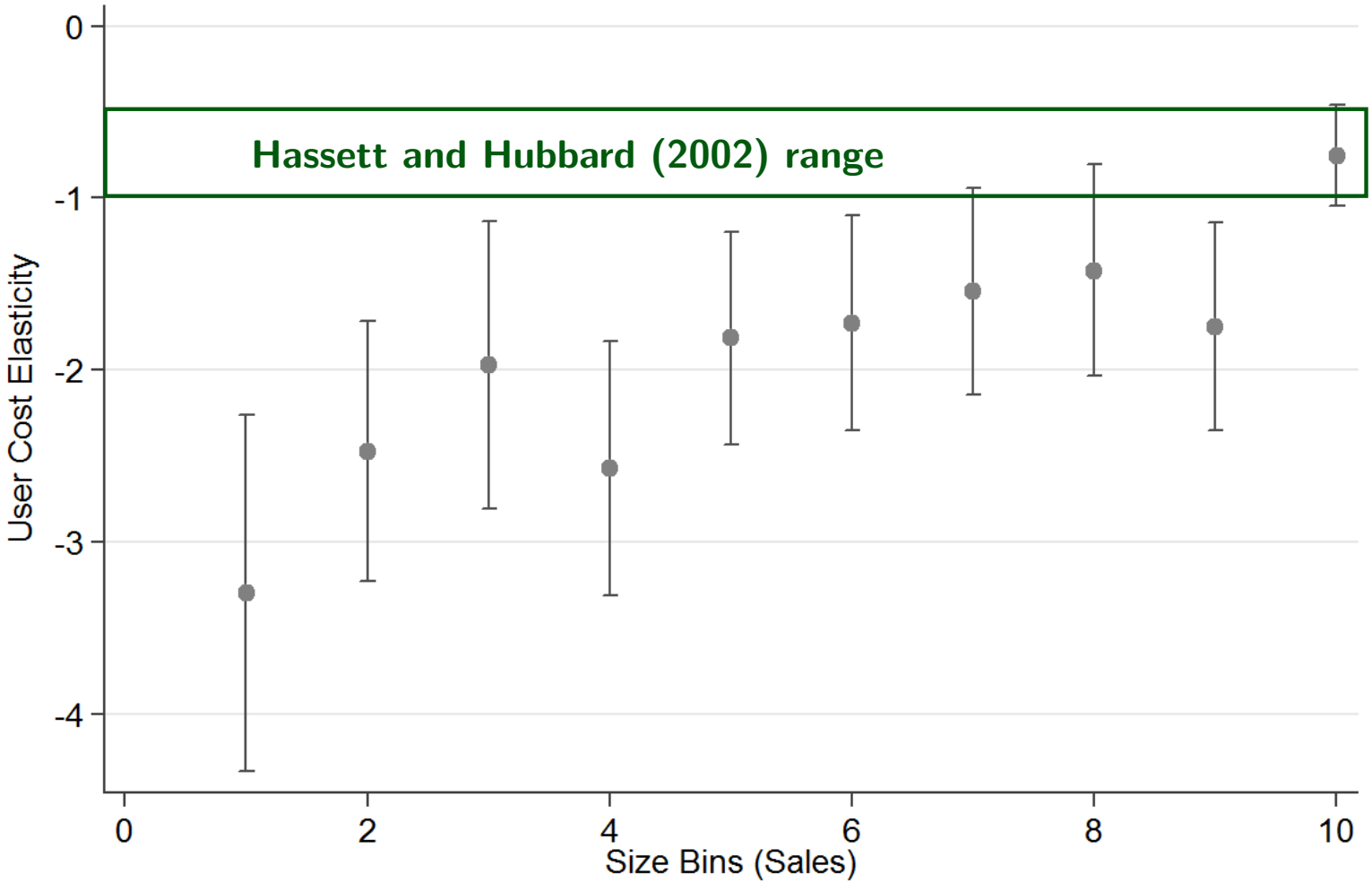
$$\frac{I_t}{K_{t-1}} = \alpha_i + \delta_t + \beta \frac{1 - \tau z}{1 - \tau} + \gamma X_{it} + \varepsilon_{it}$$



Heterogeneous Effects by Firm Size



Heterogeneous Effects by Firm Size



Heterogeneous Effects by Firm Size

Fact 2: Costly Finance Amplification

$$\log I_{it} = \alpha_i + \delta_t + \beta z_{N,t} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)							
	Sales		Div Payer?		Lagged Cash		Ever Fail?	
	Small	Big	No	Yes	Low	High	Yes	No
$z_{N,t}$	6.29***	3.22***	5.98***	3.67***	7.21***	2.76**	1.78**	4.37***
	(1.21)	(0.76)	(0.88)	(0.97)	(1.38)	(0.88)	(0.78)	(0.69)
Test	$p = .030$		$p = .079$		$p = .000$		$p = .012$	
Obs	177620	255266	274809	127523	176893	180933	242267	493074
Clusters	29618	29637	39195	12543	45824	48936	57157	70844
R^2	0.44	0.76	0.69	0.80	0.81	0.76	0.71	0.71

Fact 2: Costly Finance Amplification

$$\log I_{it} = \alpha_i + \delta_t + \beta z_{N,t} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)							
	Sales		Div Payer?		Lagged Cash		Ever Fail?	
	Small	Big	No	Yes	Low	High	Yes	No
$z_{N,t}$	6.29***	3.22***	5.98***	3.67***	7.21***	2.76**	1.78**	4.37***
	(1.21)	(0.76)	(0.88)	(0.97)	(1.38)	(0.88)	(0.78)	(0.69)
Test	$p = .030$		$p = .079$		$p = .000$		$p = .012$	
Obs	177620	255266	274809	127523	176893	180933	242267	493074
Clusters	29618	29637	39195	12543	45824	48936	57157	70844
R^2	0.44	0.76	0.69	0.80	0.81	0.76	0.71	0.71

How does the costly finance story work?

- Retiming deductions increases after-tax NPV **and** reduces today's liquidity needs. $\implies$ **Higher discount rate**
- **Complication:** Investment still requires cash up front.
  - Firms must be able to borrow, even if at a large spread.

Part 2: Explaining large effects with financial frictions

Story 2: Managerial myopia

Model Firm Tax Split

Consider a **nontaxable** firm buying \$1M of computers.

Year	0	1	2	3	4	5	Total
Deductions (000s)	0	520	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	0	182	67.2	40.3	40.3	20.2	350

Model Firm Tax Split

Consider a **nontaxable** firm buying $1M of computers.

Normal times nontaxable:

Year	0	1	2	3	4	5	Total
Deductions (000s)	0	520	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	0	182	67.2	40.3	40.3	20.2	350

Tax benefit NPV = $307K.

Bonus times nontaxable (50%):

Year	0	1	2	3	4	5	Total
Deductions (000s)	0	**760**	96	57.5	57.5	29	1000
Tax Benefit ($\tau = 35\%$)	0	**266**	33.6	20.2	20.2	10	350

Tax benefit NPV = $317K.

Model Firm Tax Split

Consider a **nontaxable** firm buying $1M of computers.

Normal times nontaxable:

Year	0	1	2	3	4	5	Total
Deductions (000s)	0	520	192	115	115	58	1000
Tax Benefit ($\tau = 35\%$)	0	182	67.2	40.3	40.3	20.2	350

Tax benefit today = $0.

Bonus times nontaxable (50%):

Year	0	1	2	3	4	5	Total
Deductions (000s)	0	**760**	96	57.5	57.5	29	1000
Tax Benefit ($\tau = 35\%$)	0	**266**	33.6	20.2	20.2	10	350

Tax benefit today = $0.

Fact 3: Firms Ignore Future Tax Benefits

$$\log(I_{it}) = \alpha_i + \delta_t + \varphi T_{it} + \beta z_{N,t} + \eta T_{it} \times z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
Taxable	3.83***	3.08***	1.95*	6.43***	4.32***	4.15***
$\times z_{N,t}$	(0.79)	(0.93)	(0.92)	(1.46)	(0.96)	(0.82)
$z_{N,t}$	-0.15	0.60	0.38	-3.03*	-0.69	0.88
	(0.90)	(1.05)	(1.06)	(1.55)	(1.15)	(0.94)
Medium LCF						
$\times z_{N,t}$						
High LCF						
$\times z_{N,t}$						
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.74	0.80	0.73	0.72

$T_{it} = 1 \iff$ first dollar of depreciation deduction affects taxes this year

Fact 3: Firms Ignore Future Tax Benefits

$$\log(I_{it}) = \alpha_i + \delta_t + \varphi T_{it} + \beta z_{N,t} + \eta T_{it} \times z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
Taxable	3.83***	3.08***	1.95*	6.43***	4.32***	4.15***
$\times z_{N,t}$	(0.79)	(0.93)	(0.92)	(1.46)	(0.96)	(0.82)
$z_{N,t}$	-0.15	0.60	0.38	-3.03*	-0.69	0.88
	(0.90)	(1.05)	(1.06)	(1.55)	(1.15)	(0.94)
Medium LCF $\times z_{N,t}$						
High LCF $\times z_{N,t}$						
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.74	0.80	0.73	0.72

$T_{it} = 1 \iff$ first dollar of depreciation deduction affects taxes this year

Fact 3: Firms Ignore Future Tax Benefits

$$\log(I_{it}) = \alpha_i + \delta_t + \varphi T_{it} + \beta z_{N,t} + \eta T_{it} \times z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
Taxable	3.83***	3.08***	1.95*	6.43***	4.32***	4.15***
$\times z_{N,t}$	(0.79)	(0.93)	(0.92)	(1.46)	(0.96)	(0.82)
$z_{N,t}$	-0.15	0.60	0.38	-3.03*	-0.69	0.88
	(0.90)	(1.05)	(1.06)	(1.55)	(1.15)	(0.94)
Medium LCF						
$\times z_{N,t}$						
High LCF						
$\times z_{N,t}$						
Observations	735341	580422	514035	221306	585914	722262
Clusters (Firms)	128001	100883	109678	63699	107985	124962
R^2	0.71	0.74	0.74	0.80	0.73	0.72

$T_{it} = 1 \iff$ first dollar of depreciation deduction affects taxes this year

Fact 3: Firms Ignore Future Tax Benefits

$$\log(I_{it}) = \alpha_i + \delta_t + \varphi T_{it} + \beta z_{N,t} + \eta T_{it} \times z_{N,t} + \gamma X_{it} + \varepsilon_{it}$$

	LHS Variable is Log(Eligible Investment)						
	All	CF	Pre-2005	Post-2004	Controls	Trends	LCF
Taxable	3.83***	3.08***	1.95*	6.43***	4.32***	4.15***	
$\times z_{N,t}$	(0.79)	(0.93)	(0.92)	(1.46)	(0.96)	(0.82)	
$z_{N,t}$	-0.15	0.60	0.38	-3.03*	-0.69	0.88	5.68***
	(0.90)	(1.05)	(1.06)	(1.55)	(1.15)	(0.94)	(1.70)
Medium LCF							-2.56
$\times z_{N,t}$							(1.46)
High LCF							-3.70*
$\times z_{N,t}$							(1.55)
Observations	735341	580422	514035	221306	585914	722262	119628
Clusters (Firms)	128001	100883	109678	63699	107985	124962	40282
R^2	0.71	0.74	0.74	0.80	0.73	0.72	0.84

Concern: Poor growth opportunities for nontaxable firms

Fact 3: Firms Ignore Future Tax Benefits

	LHS Variable is Log(Eligible Investment)						
	All	CF	Pre-2005	Post-2004	Controls	Trends	LCF
Taxable	3.83***	3.08***	1.95*	6.43***	4.32***	4.15***	
$\times z_{N,t}$	(0.79)	(0.93)	(0.92)	(1.46)	(0.96)	(0.82)	
$z_{N,t}$	-0.15	0.60	0.38	-3.03*	-0.69	0.88	5.68***
	(0.90)	(1.05)	(1.06)	(1.55)	(1.15)	(0.94)	(1.70)
Medium LCF							-2.56
$\times z_{N,t}$							(1.46)
High LCF							-3.70*
$\times z_{N,t}$							(1.55)
Observations	735341	580422	514035	221306	585914	722262	119628
Clusters (Firms)	128001	100883	109678	63699	107985	124962	40282
R^2	0.71	0.74	0.74	0.80	0.73	0.72	0.84

How does the myopia story work?

- Firms ignore future tax effects. $\Longrightarrow$ **Higher discount rate**
- **Complication**: Investment is a forward-looking decision.
  - Firms must use different accounts for investment decisions and tax implications.
- Results inconsistent w/simple costly finance story.
  - Firms ignore future constraints.

Bunching Empirical Design

1. Section 179 allows firms to **expense** equipment up to a limit and **ignore depreciation schedule.**

$$\theta, z = 1 \quad \text{for} \quad I_t \leq \text{Kink}_t$$

2. Each year, there is a **maximum deduction**.

$$z < 1 \quad \text{for} \quad I_t > \text{Kink}_t$$

3. From 1993 to 2009, the kink went from \$17.5K to \$250K.

Bunching Empirical Design

Consider a firm buying \$50K of computers in 2005.

Without Section 179:

Year	0	1	2	3	4	5	Total
Deductions	10	16	9.6	5.75	5.75	2.9	50
$z_5(0)$							0.890

With Section 179:

Year	0	1	2	3	4	5	Total
Deductions	50	0	0	0	0	0	50
$z_5(1)$							**1.0**

Bunching Empirical Design

1. Section 179 allows firms to **expense** equipment up to a limit and **ignore depreciation schedule.**

$$\theta, z = 1 \quad \text{for} \quad I_t \leq \text{Kink}_t$$

2. Each year, there is a **maximum deduction**.

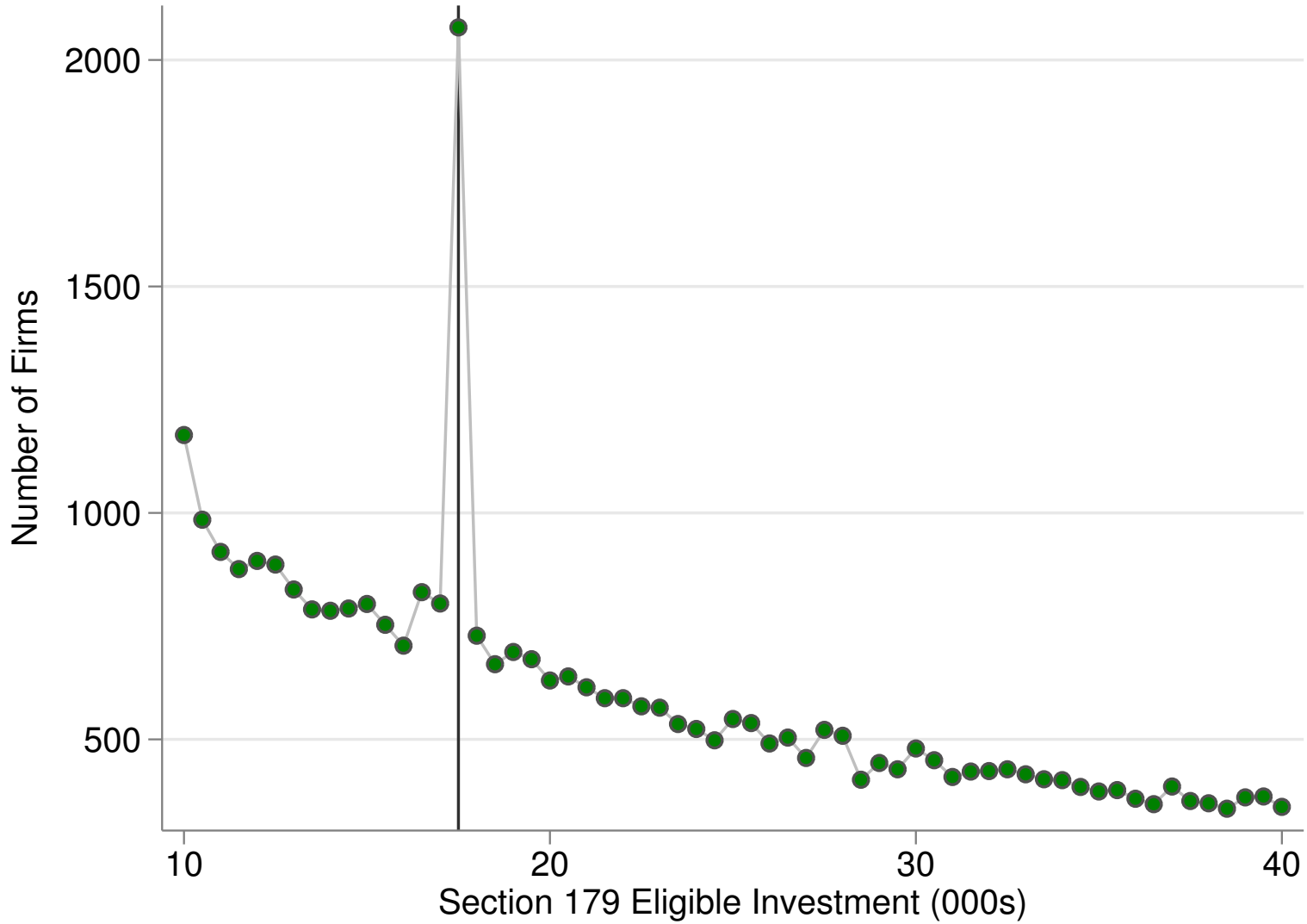
$$z < 1 \quad \text{for} \quad I_t > \text{Kink}_t$$

3. From 1993 to 2009, the kink went from \$17.5K to \$250K.

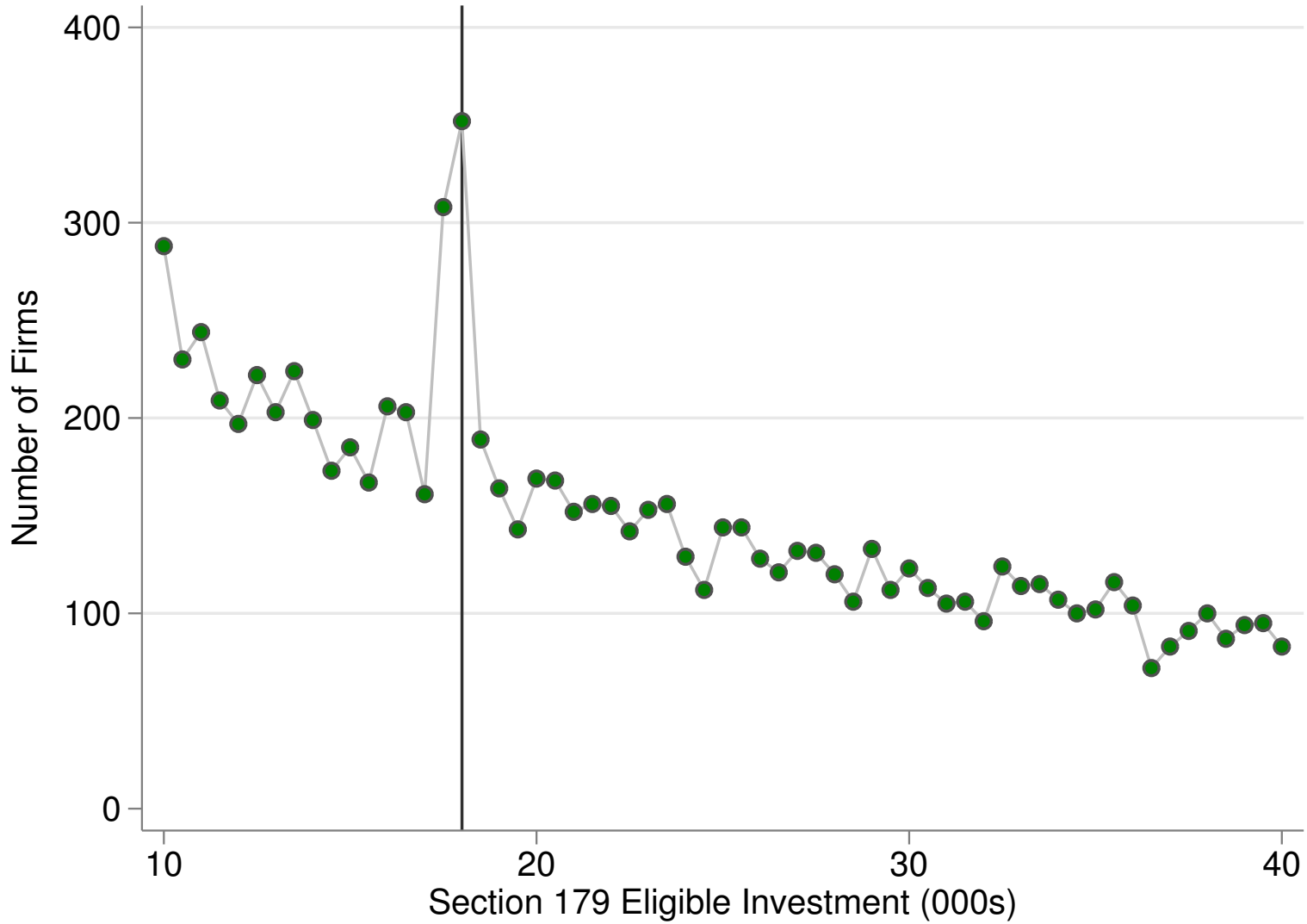
Empirical design:

1. Cut-off induces cross sectional variation at the kink
2. Bunching around this cut-off reveals depreciation savvy

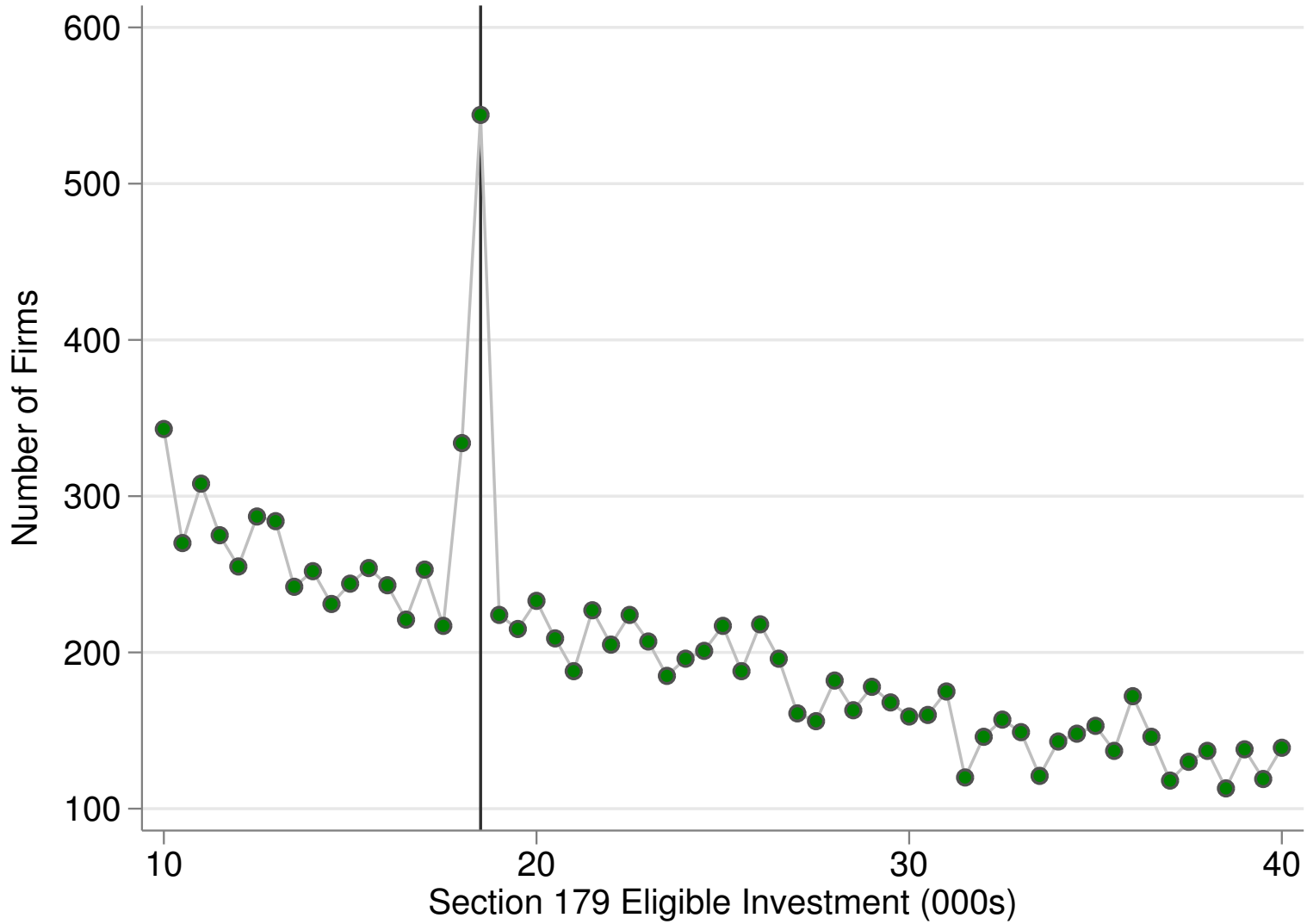
Bunching in 1993-96



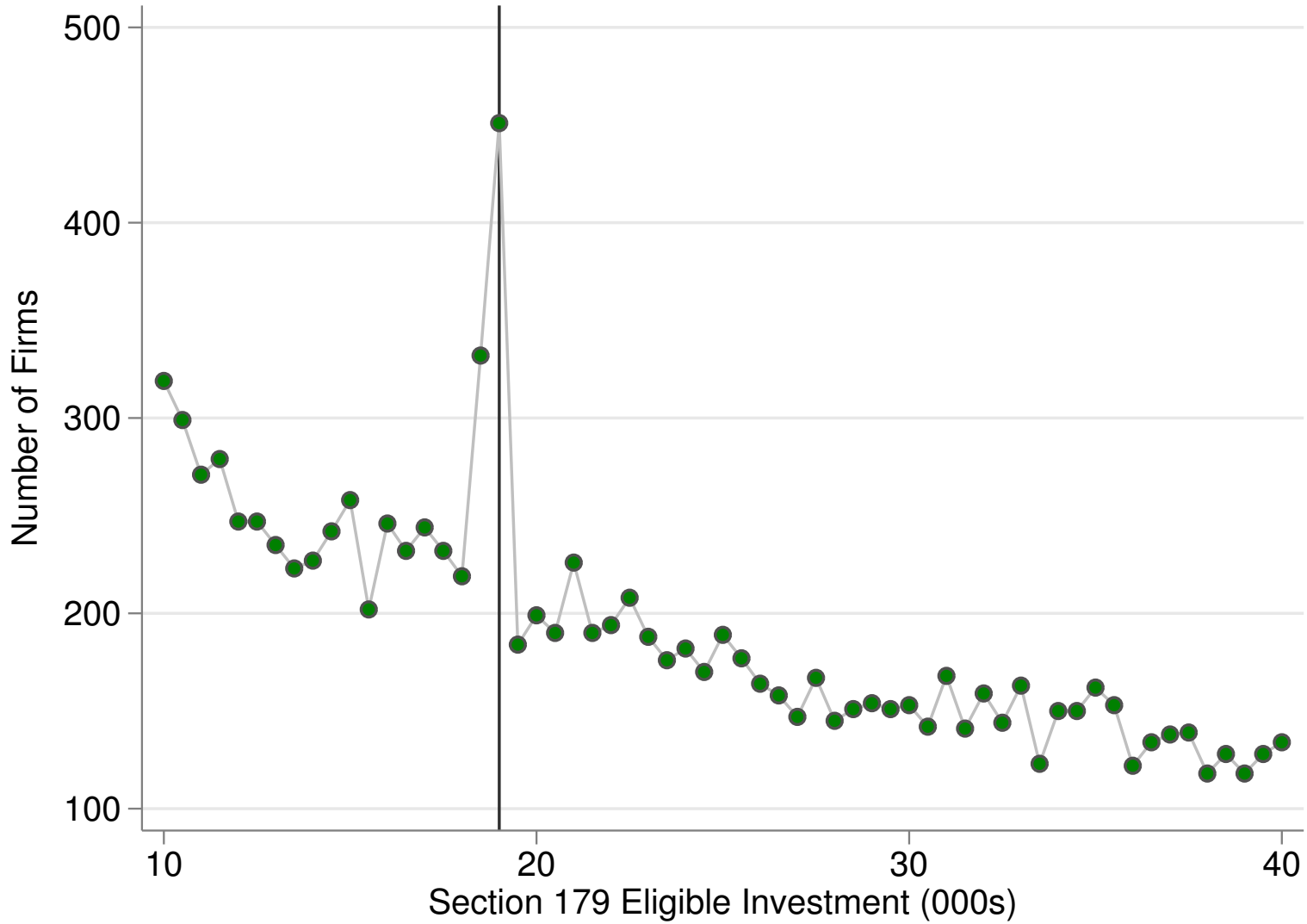
Bunching in 1997



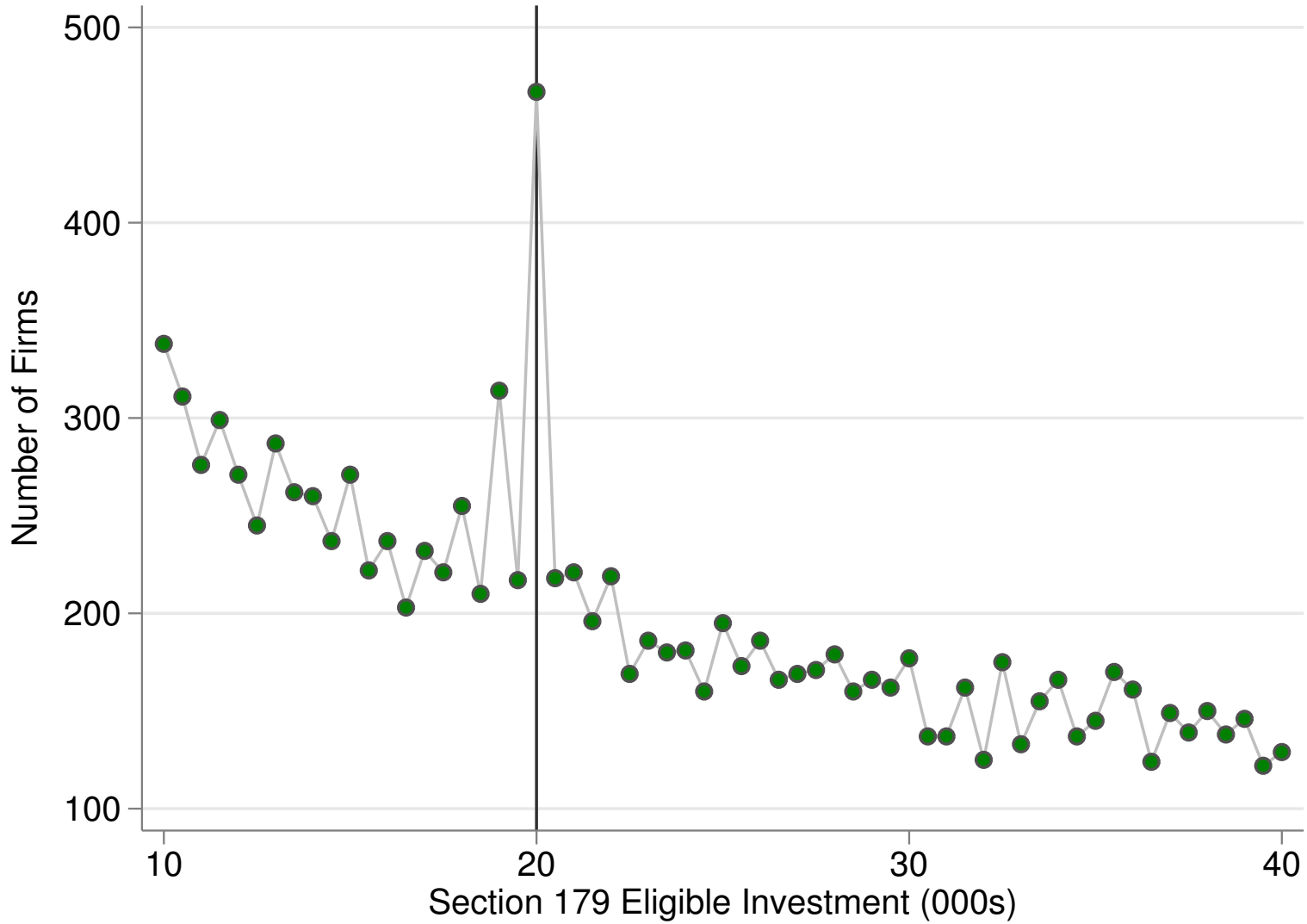
Bunching in 1998



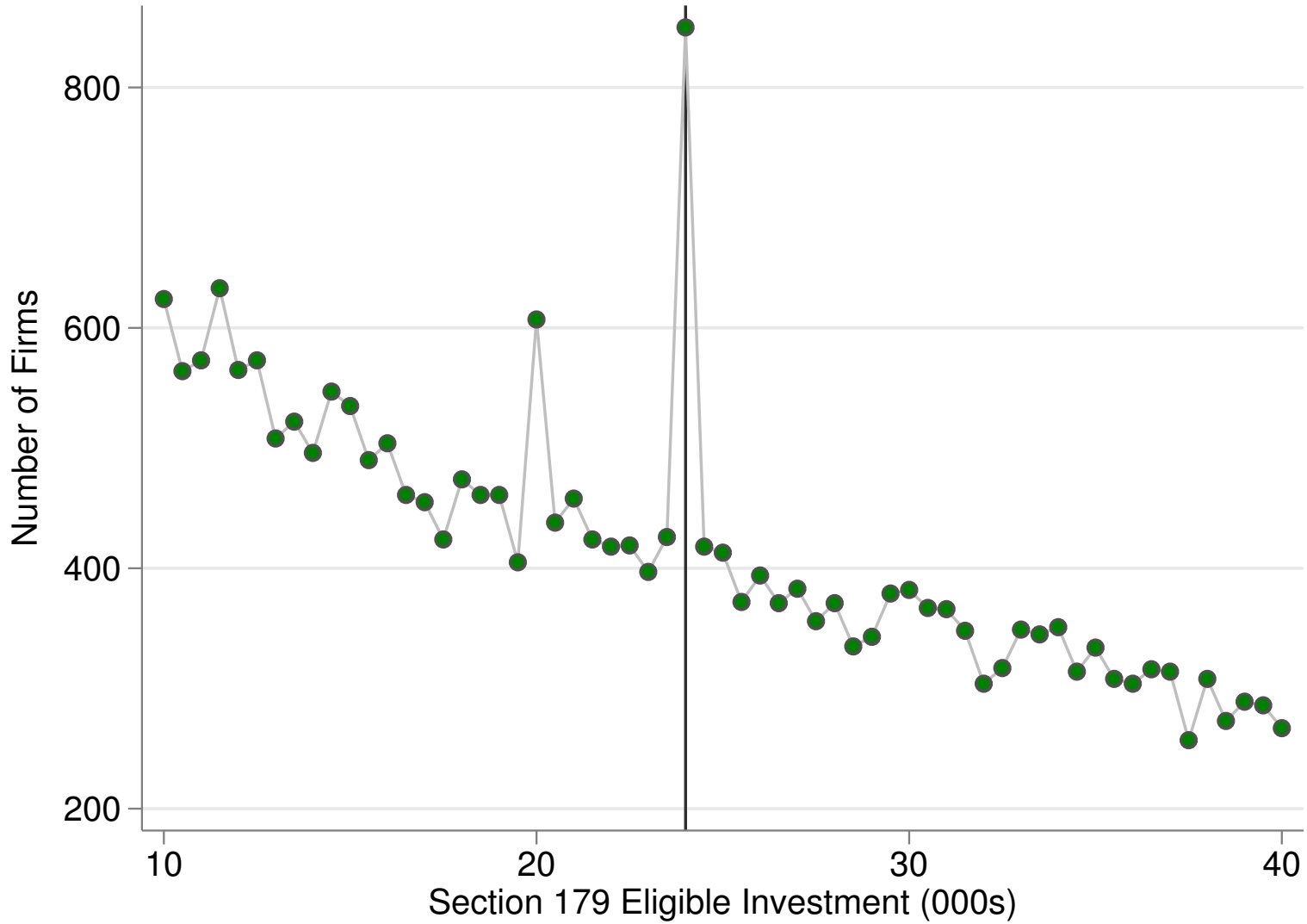
Bunching in 1999



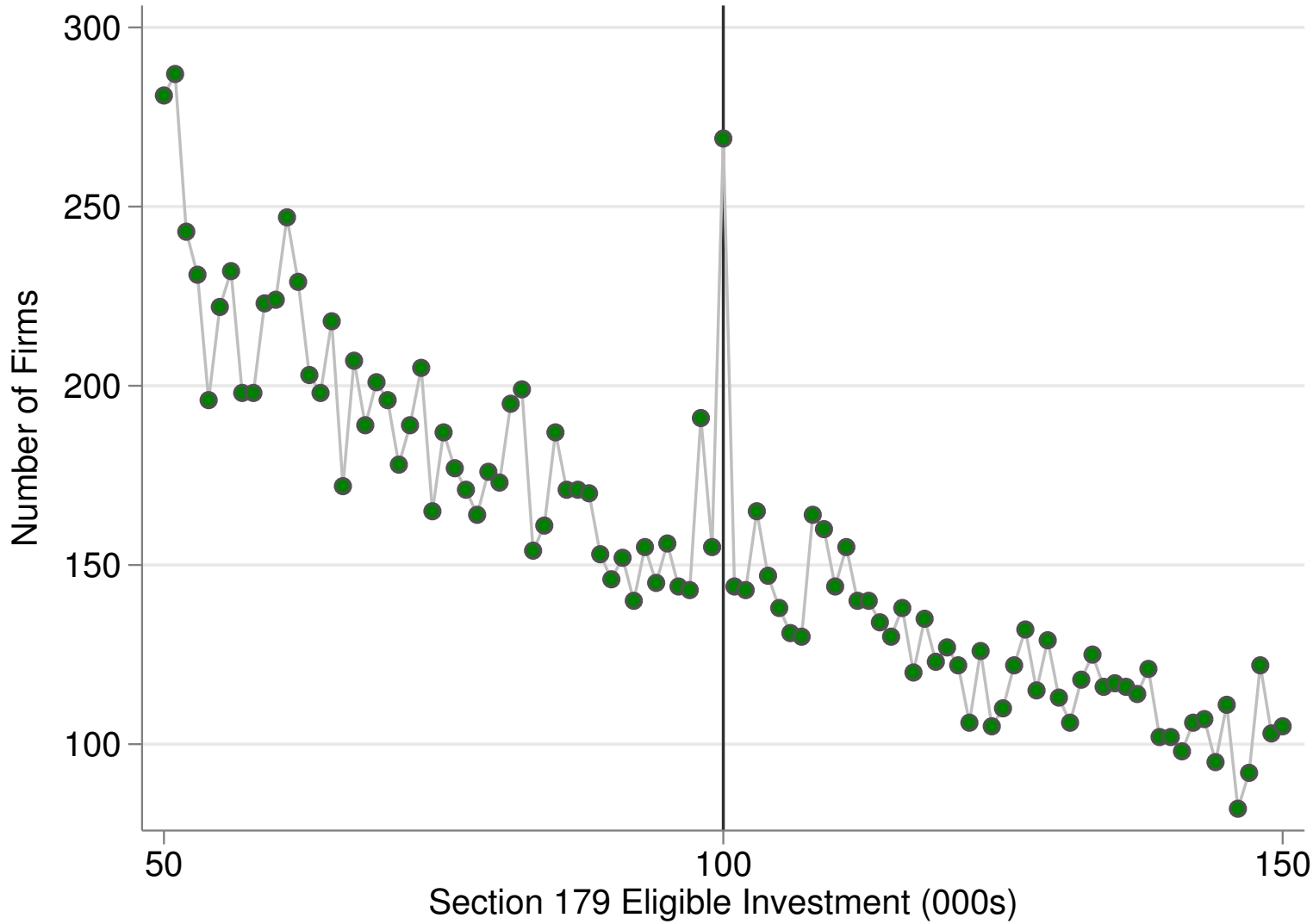
Bunching in 2000



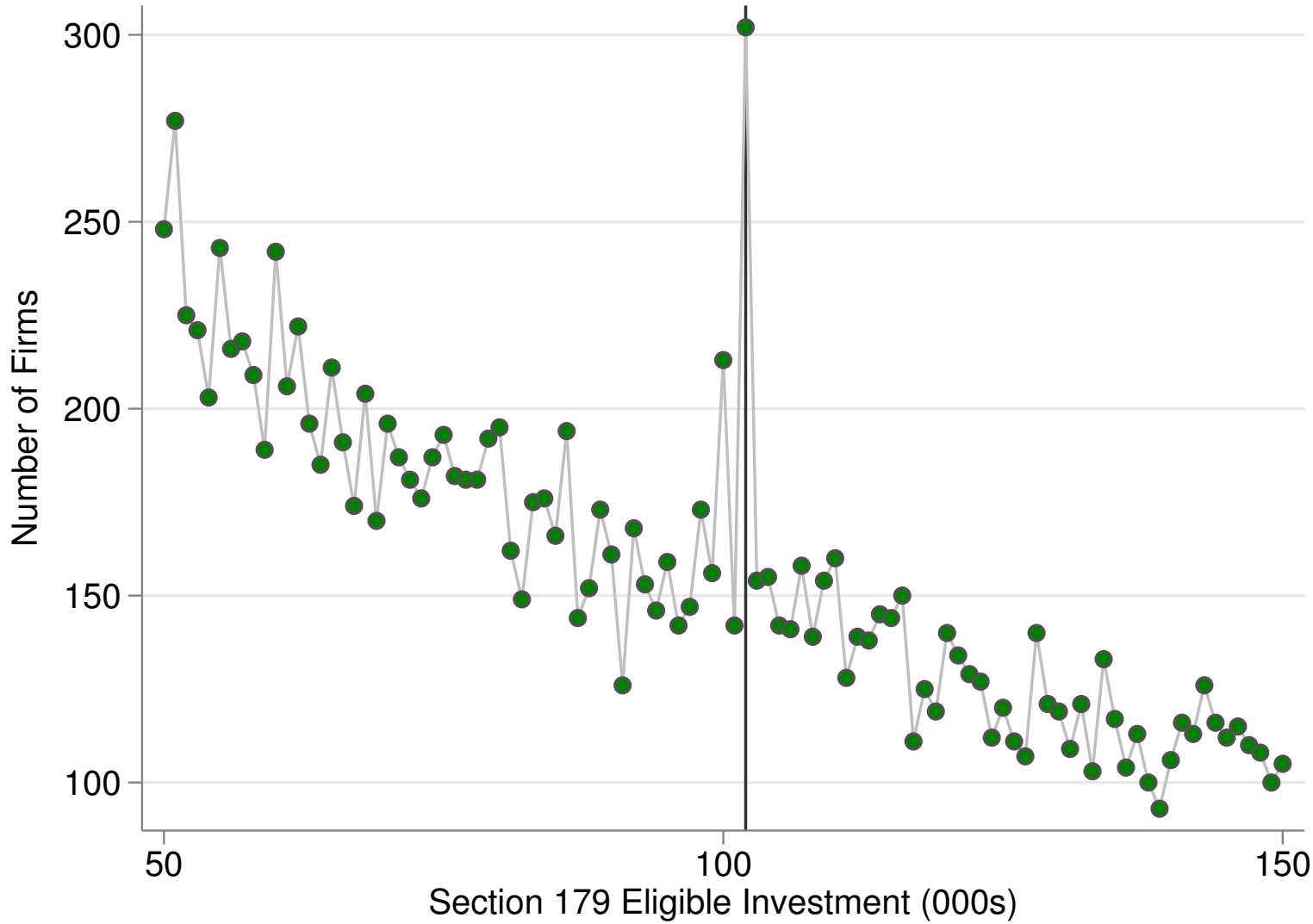
Bunching in 2001-02



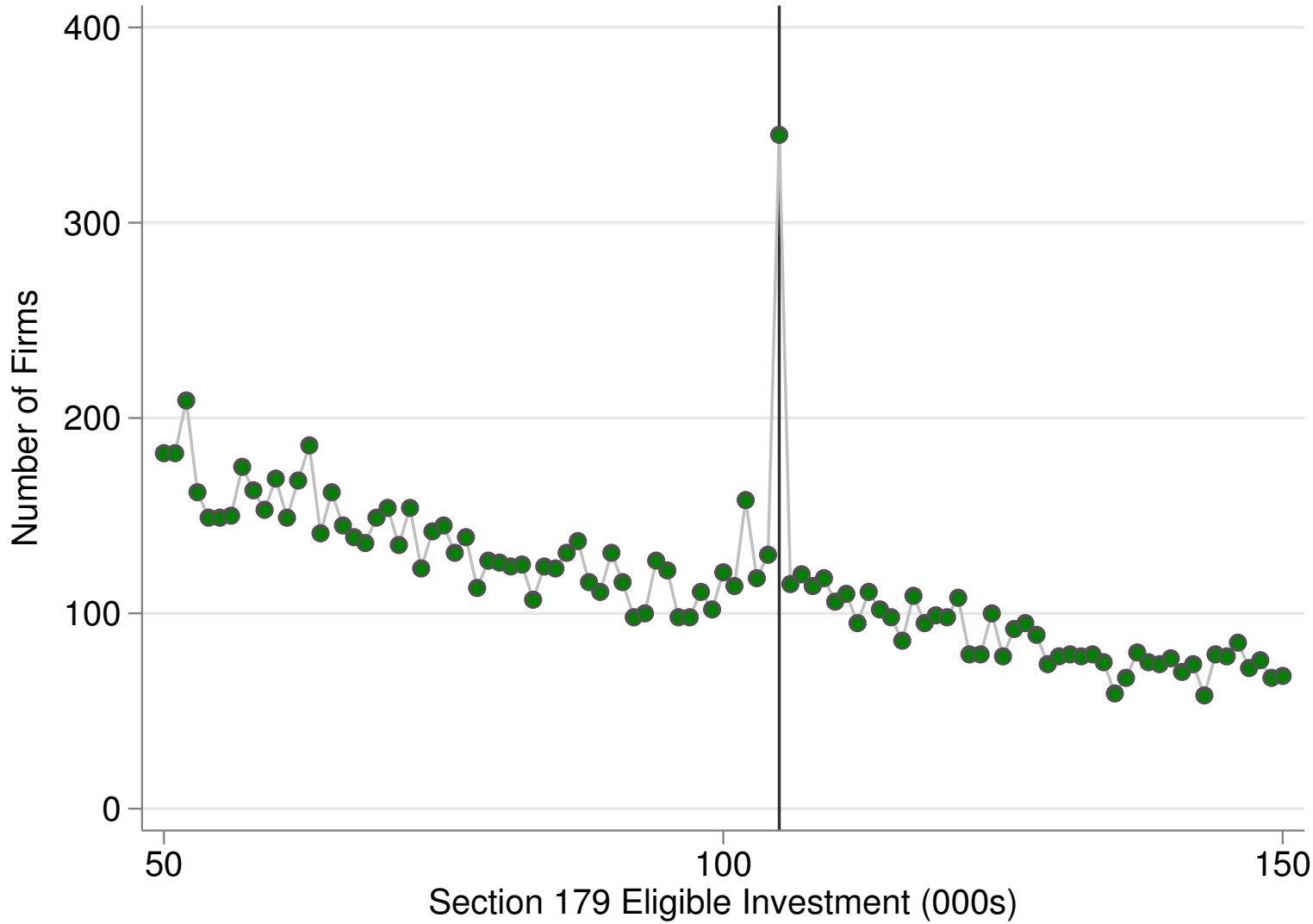
Bunching in 2003



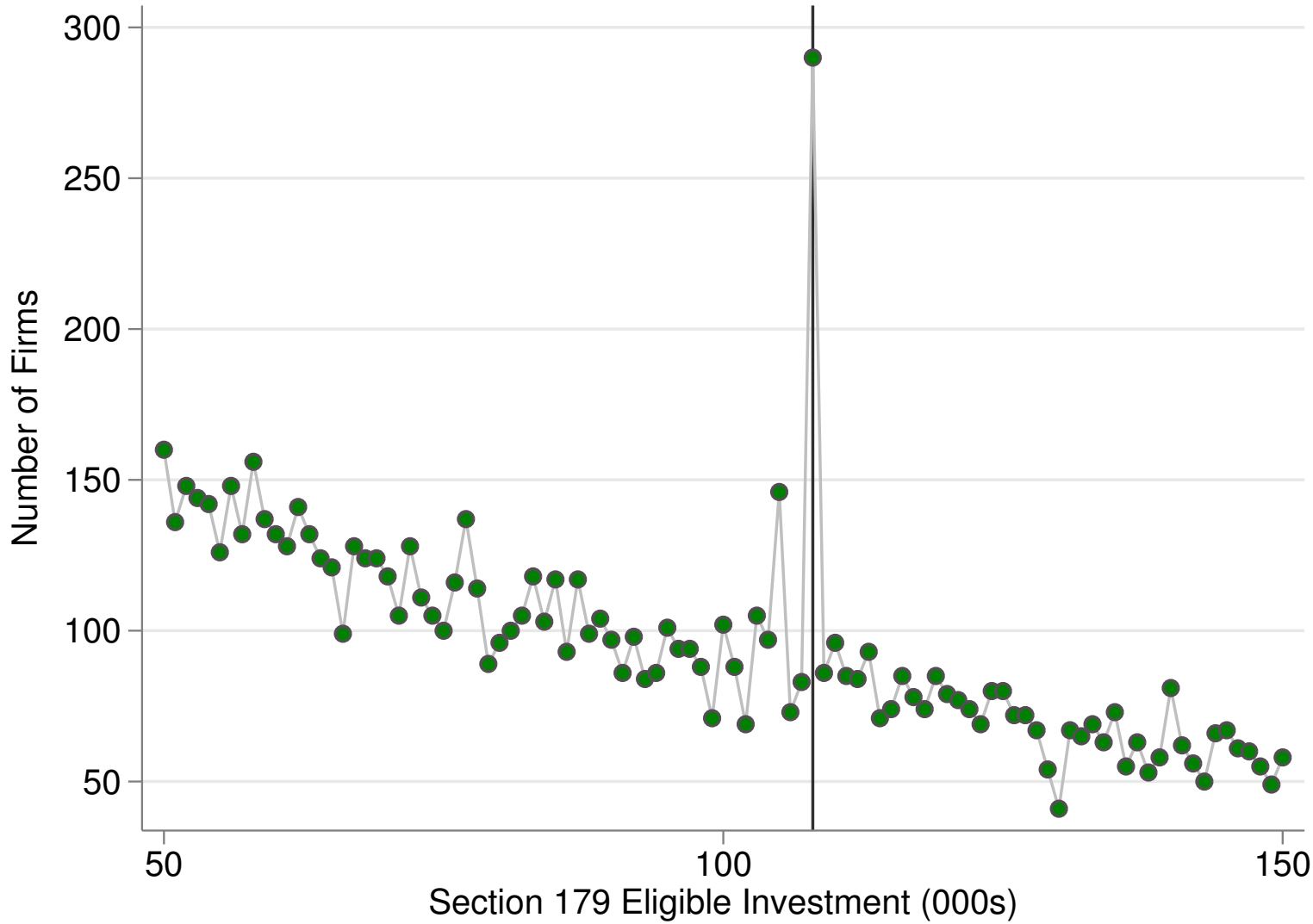
Bunching in 2004



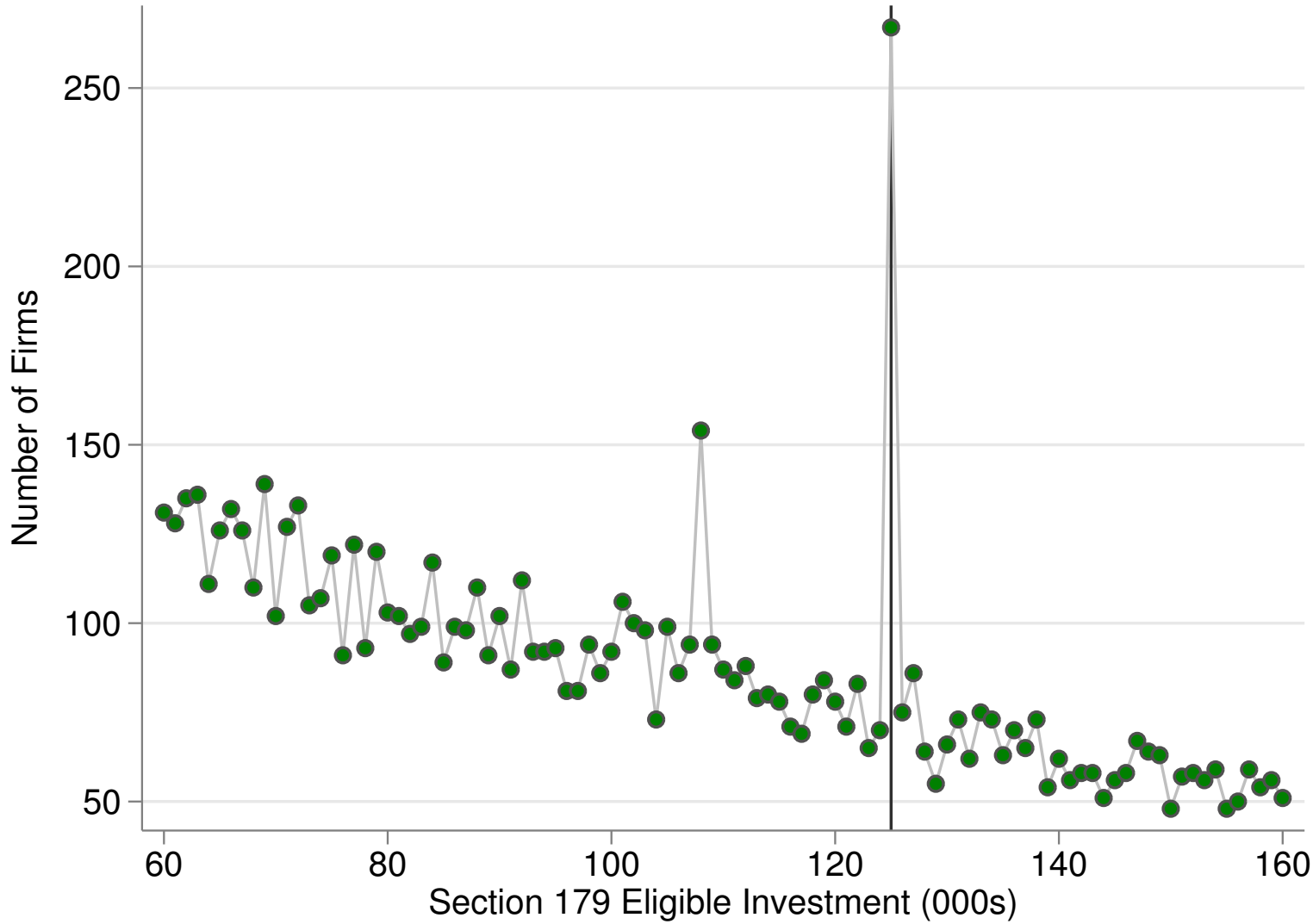
Bunching in 2005



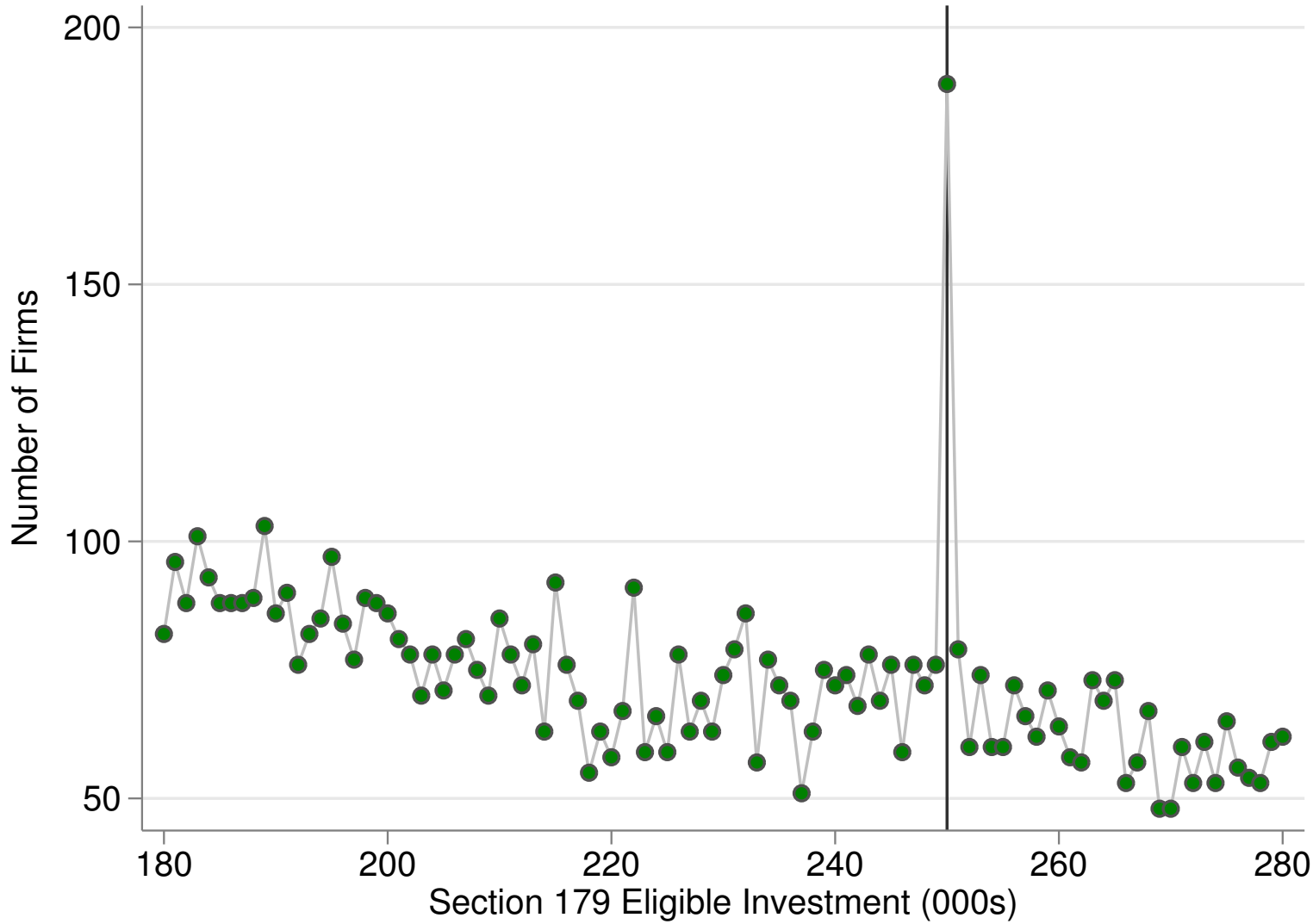
Bunching in 2006



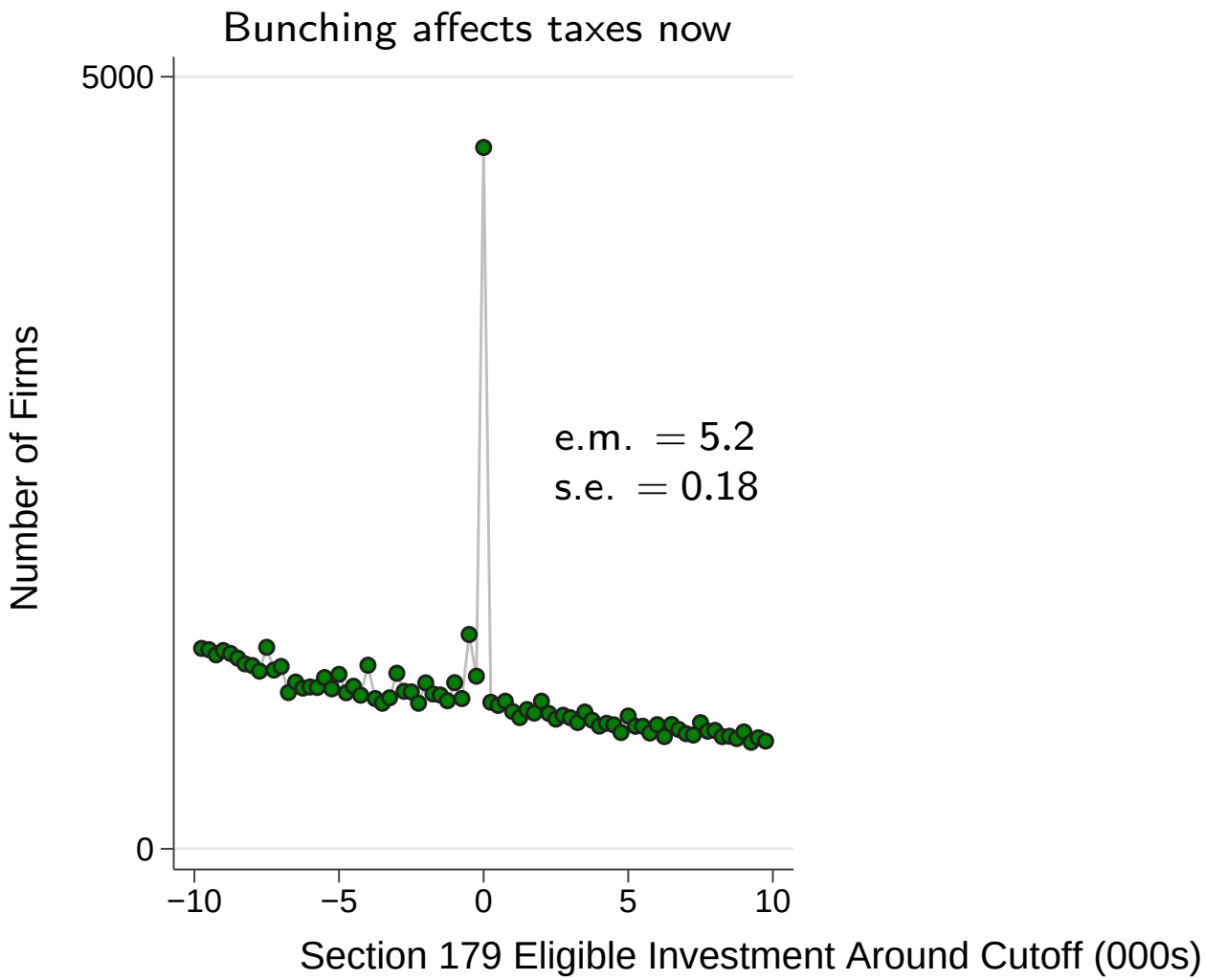
Bunching in 2007



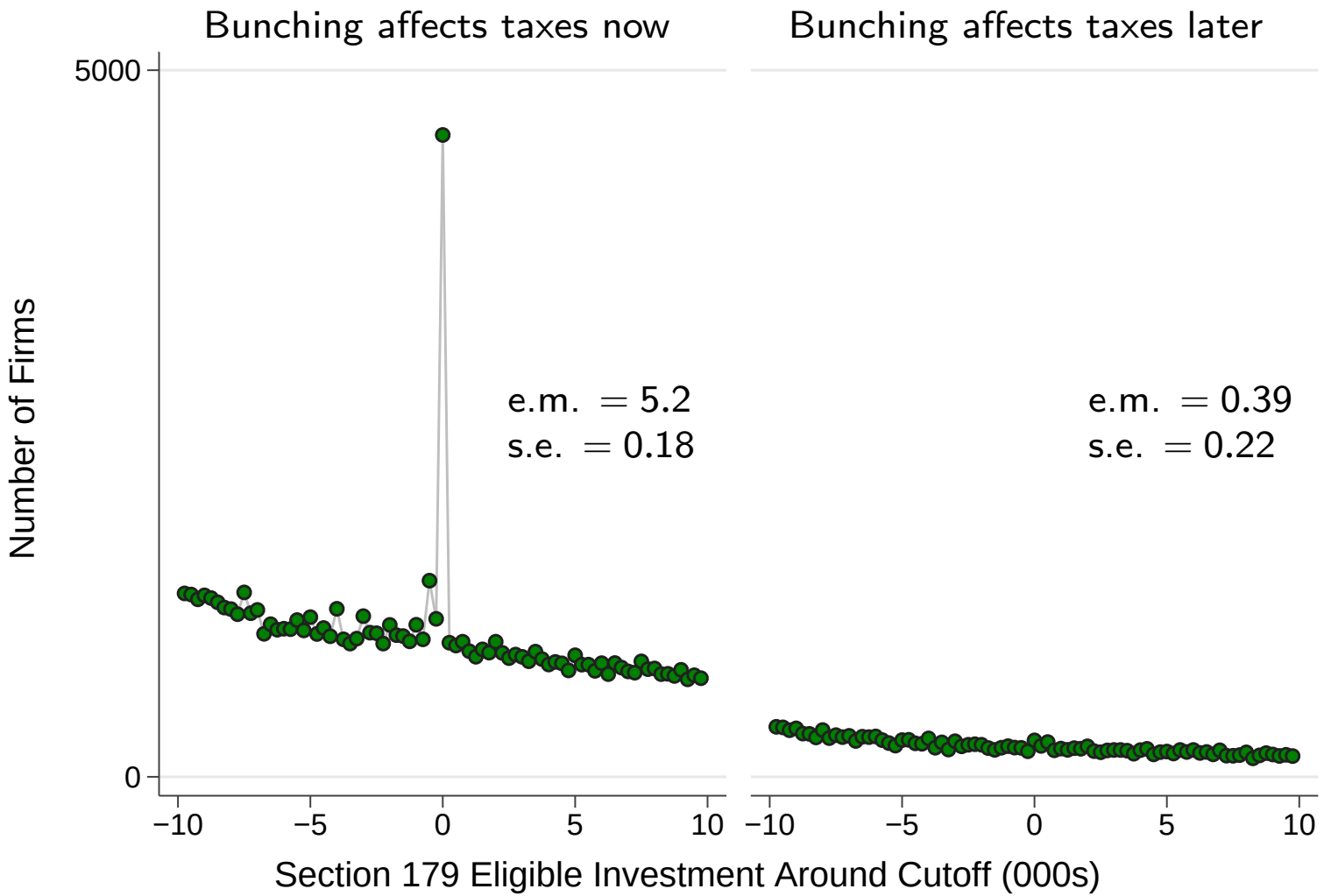
Bunching in 2008-09



Fact 3: Firms Ignore Future Tax Benefits

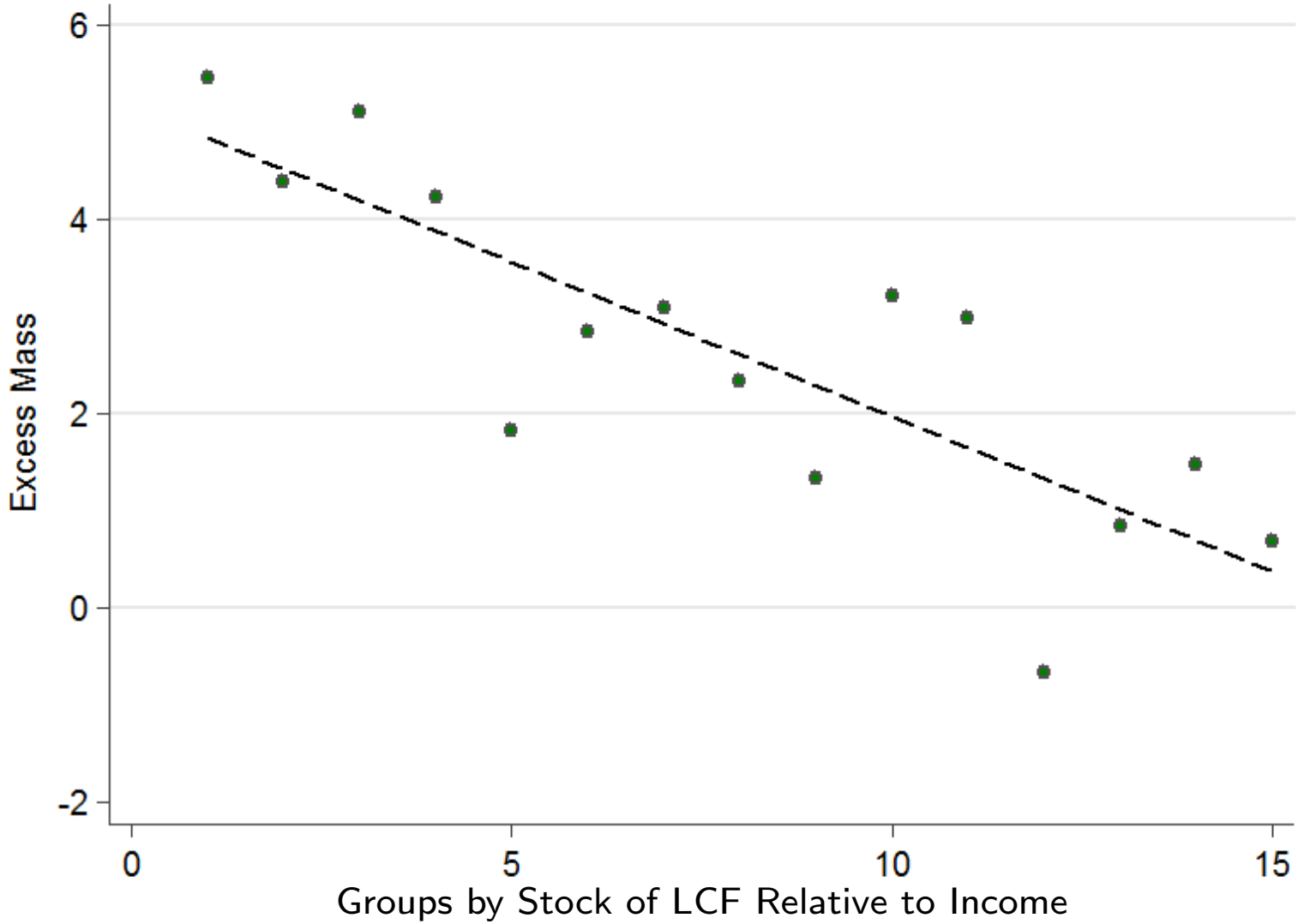


Fact 3: Firms Ignore Future Tax Benefits

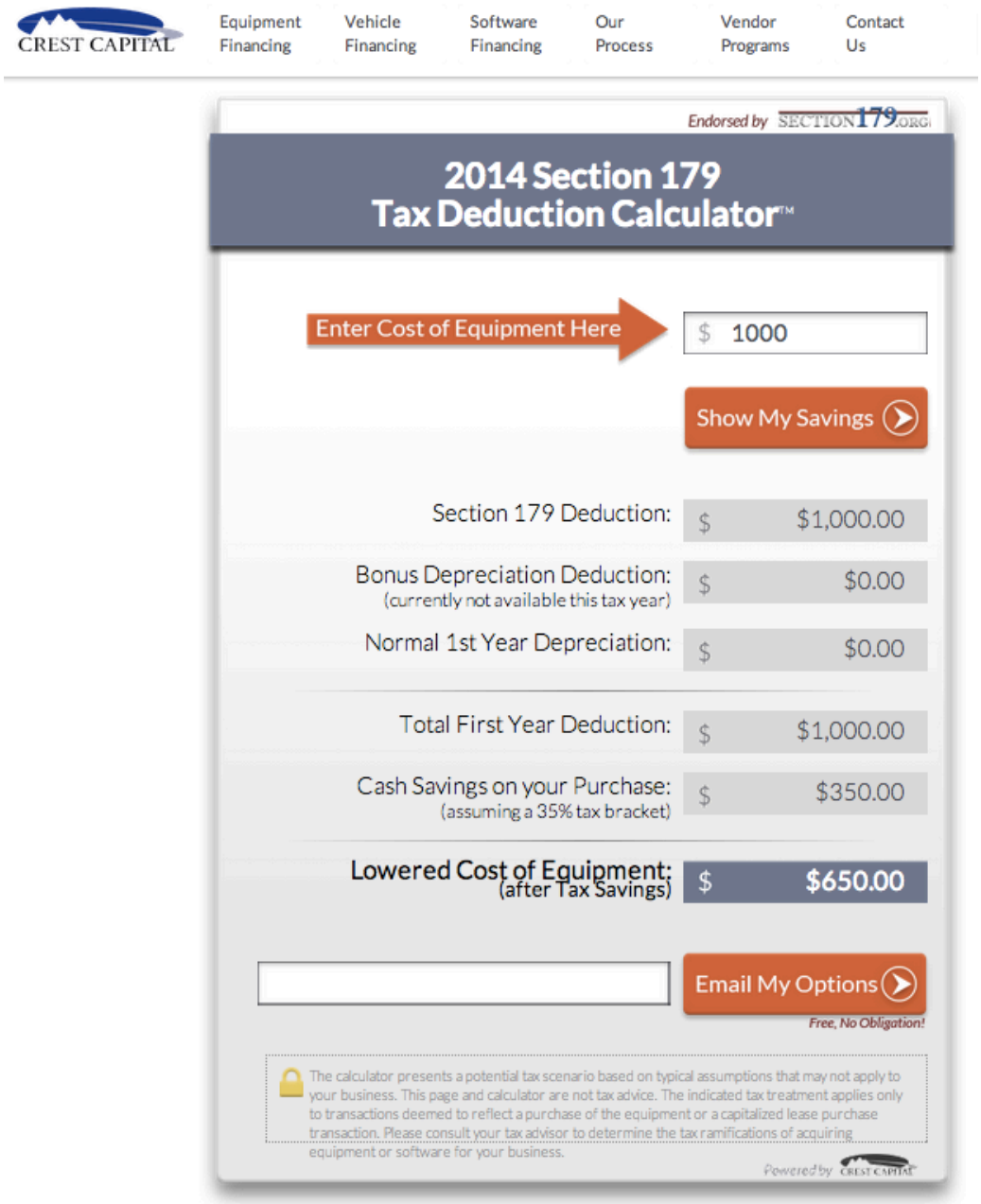


Bunching by Tax Shields

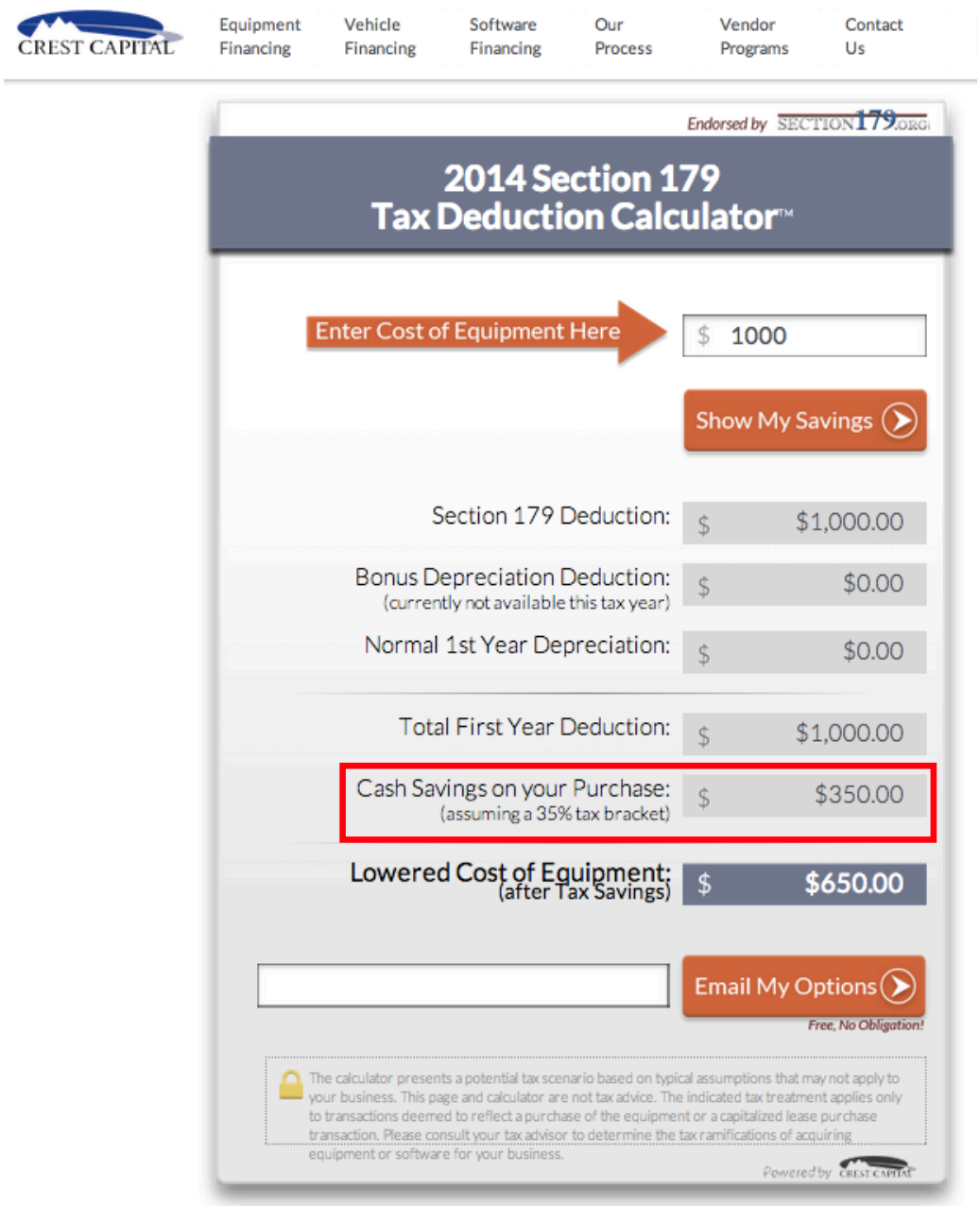
Breakdown by LCF Stock (Excludes Current Year Loss Firms)



Advertisers Ignore Future Tax Benefits

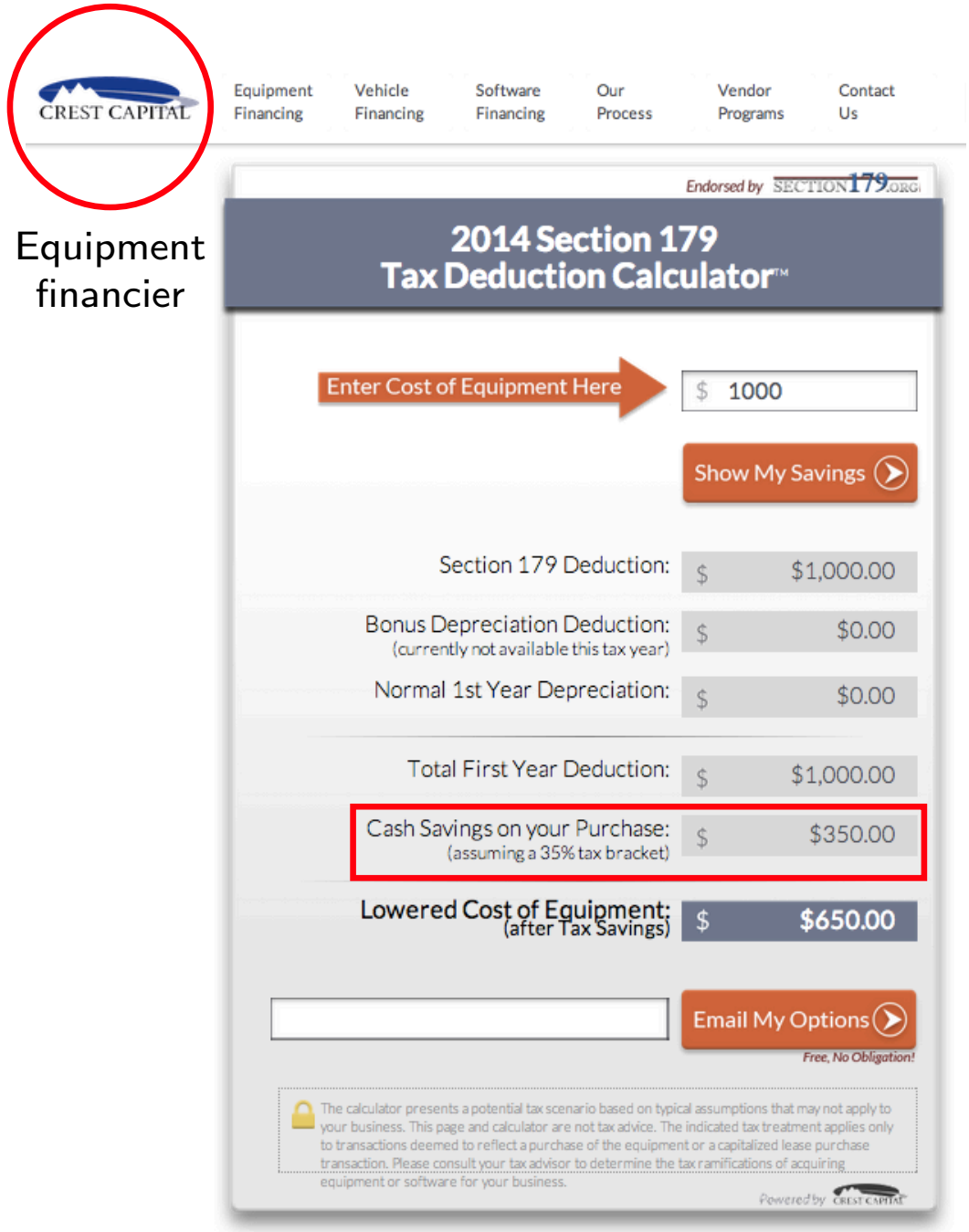


Advertisers Ignore Future Tax Benefits



Savings computed relative to zero deduction benchmark

Advertisers Ignore Future Tax Benefits



Equipment financier

Savings computed relative to zero deduction benchmark

Synthesis

1. Baseline Effect
   - Policy Setting
   - Research Design
   - Data
   - Findings

2. Financial Frictions
   - Costly Finance
   - Managerial Myopia

Synthesis

1. **The response to the tax changes we study is large.**
   - Policy Setting
   - Research Design
   - Data
   - Findings

2. **It is amplified by costly external finance, but only when the policy immediately affects cash flow.**
   - Costly Finance
   - Managerial Myopia

Bottom line: Results demand a major role for financial frictions; understanding financial frictions requires looking past Compustat.

Synthesis

1. Baseline Effect
   - Policy Setting
   - Research Design
   - Data
   - Findings
2. Financial Frictions
   - Costly Finance
   - Managerial Myopia
3. Macro
   - Substitution
   - Aggregation

Part 3: Macroeconomic implications

Substitution and aggregation

Aggregate estimates

Step 1. Account for size heterogeneity

1. Top vigintile = 62% of investment
2. $\beta = 3.69$ vs. $\beta_W = 2.89$ vs. $\beta_{\text{Top 5\%}} = 2.27$
3. Implied effect of Bonus II falls from 28.9% to 22.7%

$\Longrightarrow$ BII increases investment by \$77.5B per year within sample

Aggregate estimates

Step 1. Account for size heterogeneity

$\Longrightarrow$ BII increases investment by \$77.5B per year within sample

Step 2. Map estimates out of sample

1. Aggregate investment in sample = 44% of eligible investment
2. Exotic forms and small corporations = 22%
3. Partnerships = 20%
4. Sole proprietorships = 13%
5. Account for size diffs, take-up, and Section 179
6. Implied effect of Bonus II is 16.9%

$\Longrightarrow$ BII increases investment by \$135B per year in aggregate

Aggregate estimates

Step 1. Account for size heterogeneity

$\Longrightarrow$ BII increases investment by \$77.5B per year within sample

Step 2. Map estimates out of sample

$\Longrightarrow$ BII increases investment by \$135B per year in aggregate

Step 3. Follow Mian and Sufi (2012) to derive lower bound

1. Produce estimates relative to lowest exposure group
2. In BII, bottom 5% sees a 6.5 cent increase in z; top 5% sees a 12.4 cent
3. Apply elasticity from Step 1 to Δz for each group relative to bottom 5%

$\Longrightarrow$ BII increase $\geq$ \$32.1B in sample and $\geq$ \$55.9B in aggregate

Substitution Margins

1. Do firms buy more equipment while **leasing less**?

$$Y_{it} = \alpha_i + \delta_t + \beta z_{N,t} + \varepsilon_{it}$$

	LHS Variable is ΔLog(Rent Payments)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	0.77**	0.68**	1.18**	0.45	0.95**	0.66*
	(0.26)	(0.33)	(0.42)	(0.37)	(0.37)	(0.33)
Obs	573,638	569,529	379,403	194,235	466,885	568,442
Firms	98,260	97,494	82,643	53,907	85,561	97,932
R^2	0.18	0.17	0.21	0.28	0.19	0.18

All regressions include firm and year effects.

Substitution Margins

1. Do firms buy more equipment while **leasing less**?
   No.
2. Do firms buy more equipment while **hiring less labor**?

$$Y_{it} = \alpha_i + \delta_t + \beta z_{N,t} + \varepsilon_{it}$$

	LHS Variable is ΔLog(Wage Compensation)					
	All	CF	Pre-2005	Post-2004	Controls	Trends
$z_{N,t}$	1.48***	1.31***	1.71***	1.43***	2.22***	1.52***
	(0.21)	(0.20)	(0.37)	(0.27)	(0.27)	(0.24)
Obs	624,352	620,185	418,625	205,727	503,671	618,548
Firms	101,871	101,100	86,403	55,832	88,771	101,552
R^2	0.23	0.23	0.28	0.35	0.25	0.24

All regressions include firm and year effects.

Substitution Margins

1. Do firms buy more equipment while **leasing less**?
   No.
2. Do firms buy more equipment while **hiring less labor**?
   No.
3. Do firms buy more equipment now while **buying less later**?

$$Y_{it} = \alpha_i + \delta_t + \beta z_{N,t} + \varepsilon_{it}$$

	LHS Variable is Log(Investment)			
	All	CF	Controls	Trends
$z_{N,t}$	4.15***	4.03***	5.13***	4.51***
	(0.62)	(0.62)	(0.81)	(0.70)
$z_{N,t-2}$	-1.10	-1.15	-1.62	-2.18**
	(0.70)	(0.70)	(0.90)	(0.72)
Obs	476,459	474,478	382,653	472,134
Firms	84,699	84,300	73,271	84,369
R^2	0.76	0.76	0.77	0.76

All regressions include firm and year effects.

Substitution Margins

1. Do firms buy more equipment while **leasing less**?
   No.

2. Do firms buy more equipment while **hiring less labor**?
   No.

3. Do firms buy more equipment now while **buying less later**?
   Mostly not.

Next Steps

Policy implications:

- Importance of immediate, targeted policies
- Policies targeting financial constraints (e.g., loans)?
- Business investment vs. consumer durables
- Interaction with corporate tax rate, loss carrybacks

Next Steps

Policy implications:

- Importance of immediate, targeted policies
- Policies targeting financial constraints (e.g., loans)?
- Business investment vs. consumer durables
- Interaction with corporate tax rate, loss carrybacks

Future research:

- Deeper study of credit mechanism
- Employment effects of these policies
- Financial frictions as fixed costs
- Real effects of corporate tax planning
- Short termism vs. salience vs. agency