ECOM181 Macroeconomics for Policy

2022/23 Semester 1

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Previous topic: 2001 tax rebates to households

$$C_{i,t+1} - C_{i,t} = \sum_{s} \beta_{0s} * month_{s,i}$$

$$+ \boldsymbol{\beta}_1' \mathbf{X}_{i,t} + \beta_2 R_{i,t+1} + u_{i,t+1},$$

- Regress change in consumption on
  - Time dummies and other controls
  - And a measure of rebates (amount of rebates or indicator that is 1 when household had rebates)

Previous topic: Households' responses to tax rebate

TABLE 2—THE CONTEMPORANEOUS RESPONSE OF EXPENDITURES TO THE TAX REBATE

	Panel A. Dependent variable: dollar change in expenditures on:					
	Food	Strictly nondurable goods	Nondurable goods	Food	Strictly nondurable goods	Nondurable goods
Estimation method	OLS	OLS	OLS	OLS	OLS	OLS
Rebate	0.109	0.239	0.373			
	(0.056)	(0.115)	(0.135)			
I(*Rebate* > 0)				51.5	96.2	178.8
				(27.6)	(53.6)	(65.0)
Age	0.570	0.449	1.165	0.552	0.391	1.106
	(0.320)	(0.550)	(0.673)	(0.318)	(0.548)	(0.670)
Change in adults	130.3	285.8	415.8	131.1	287.7	418.6
	(57.8)	(90.0)	(102.8)	(57.8)	(90.2)	(102.9)
Change in children	73.7	98.3	178.4	74.0	98.7	179.2
	(45.3)	(82.4)	(98.3)	(45.3)	(82.5)	(98.3)
RMSE	934	1680	2047	934	1680	2047
R^2 (percent)	0.6	0.6	0.6	0.6	0.6	0.6

Previous topic: Liquidity constraints?

	Dollar change in:		*Percent change in:*		*Dollar change in:*	
	Strictly nondurable goods	Nondurable goods	Strictly nondurable goods	Nondurable goods	Strictly nondurable goods	Nondurable goods
	Interaction: Age		*Interaction: Income*		*Interaction: Liquid Assets*	
	Low: age ≤ 39 High: age ≥ 56		Low: ≤34,298 High: >69,000		Low: ≤1,000 High: >8,000	
$Rebate_{t+1}$	0.249	0.363	0.050	0.129	−0.284	−0.243
	(0.177)	(0.209)	(0.163)	(0.184)	(0.177)	(0.217)
$Rebate_{t+1}$ * *Low*	−0.063	0.033	0.319	0.627	0.569	0.876
(Low group diff)	(0.210)	(0.238)	(0.224)	(0.266)	(0.239)	(0.284)
$Rebate_{t+1}$ * *High*	−0.095	0.034	0.275	0.256	0.312	0.404
(High group diff)	(0.264)	(0.304)	(0.251)	(0.291)	(0.299)	(0.364)
$Rebate_t$	−0.266	−0.250	−0.080	−0.064	0.201	0.283
	(0.142)	(0.167)	(0.148)	(0.172)	(0.226)	(0.261)
$Rebate_t$ * *Low*	0.271	0.425	−0.053	−0.067	−0.290	−0.292
(Low group diff)	(0.190)	(0.223)	(0.198)	(0.248)	(0.253)	(0.302)
$Rebate_t$ * *High*	−0.042	0.010	−0.310	−0.246	−0.659	−0.670
(High group diff)	(0.228)	(0.270)	(0.235)	(0.275)	(0.298)	(0.358)
N	12,730	12,730	9,233	9,233	5,951	5,951

Plan for today: Investment

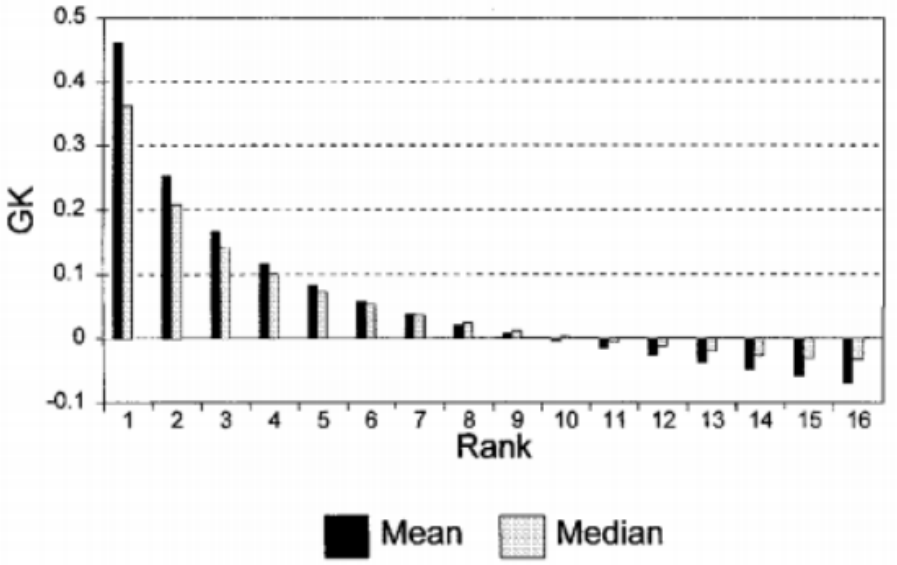
- Discuss questions about investment
- Bonus depreciation in the USA
- Capital allowances in the UK

Questions to discuss

- What are the main features of investment at the micro level?
- What drives the heterogeneity of investment responses to taxes and why?
- How would you assess the potential impact of tax incentives to promote investment and what is the difficulty of doing so based on past experiences?

Micro level investment

- User costs?
- Marginal q/ adjustment costs?
- Cash flows important
- Lumpy investment spikes



$$GK_{it} = \frac{i_{it} - \delta k_{it-1}}{0.5 \times (k_{it-1} + k_{it})}$$

Tax policy and heterogeneous investment behavior

Zwick, Eric and Mahon, James, 2017

American Economic Review, Vol. 107(1): 217-248

Bonus Depreciation of investment

TABLE 1—REGULAR AND BONUS DEPRECIATION SCHEDULES FOR FIVE-YEAR ITEMS

Year:	0	1	2	3	4	5	Total
Normal depreciation							
Deductions (000s)	200	320	192	115	115	58	1,000
Tax benefit (τ = 35 percent)	70	112	67.2	40.3	40.3	20.2	350
Bonus depreciation (50 percent)							
Deductions (000s)	600	160	96	57.5	57.5	29	1,000
Tax benefit (τ = 35 percent)	210	56	33.6	20.2	20.2	10	350

• Present value of deductions

- Present value of deductions

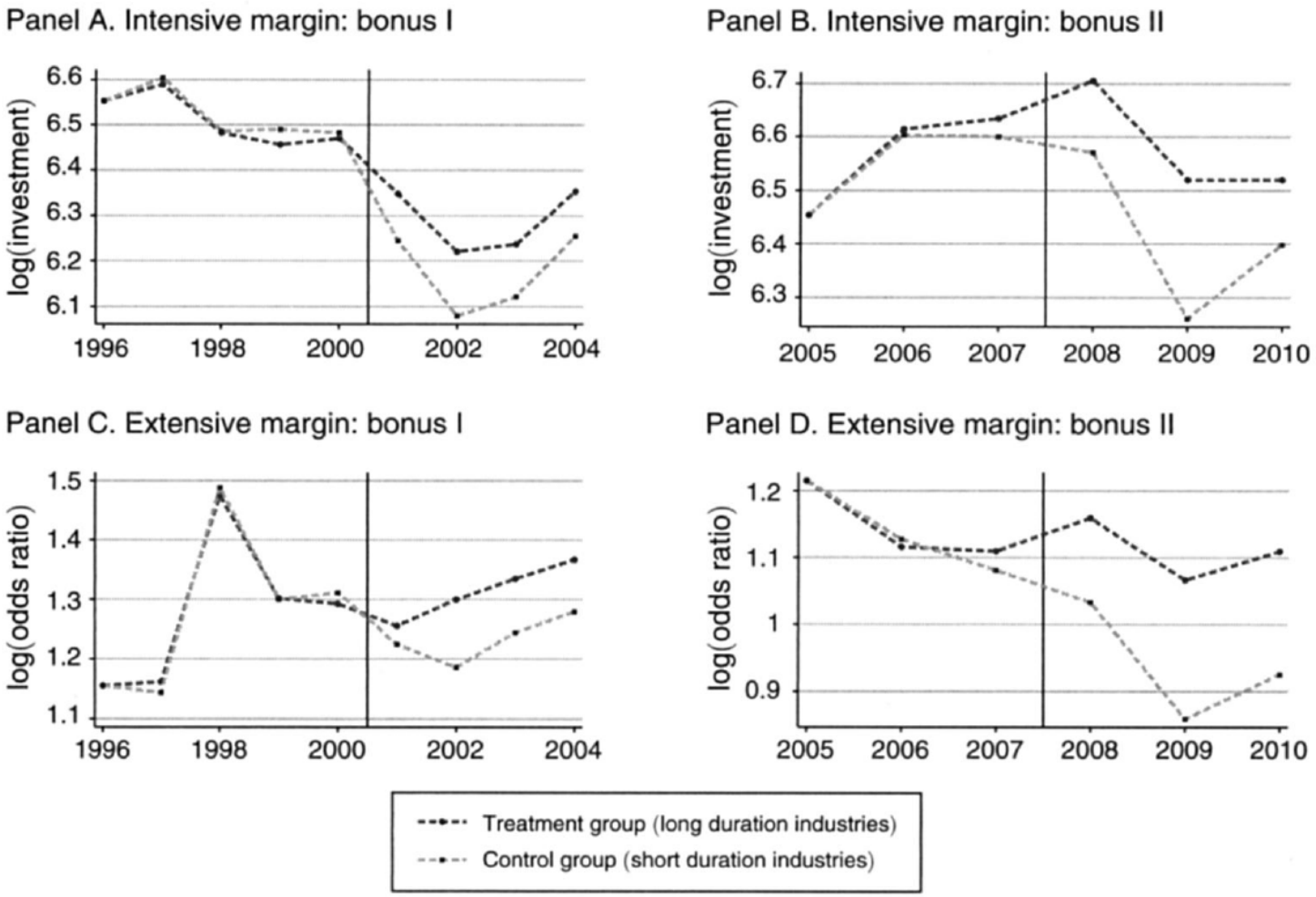
$$z^0 = D_0 + \sum_{t=1}^{T} \frac{1}{(1+r)^t} D_t,$$

- In case of bonus depreciation:

$$z = \theta + (1 - \theta) z^0.$$

- More long-lived investments benefit more from bonus depreciation
- Bonus depreciation first 0.3, then 0.5, then 0, then 0.5 then 1.

Graphical evidence



Regression evidence

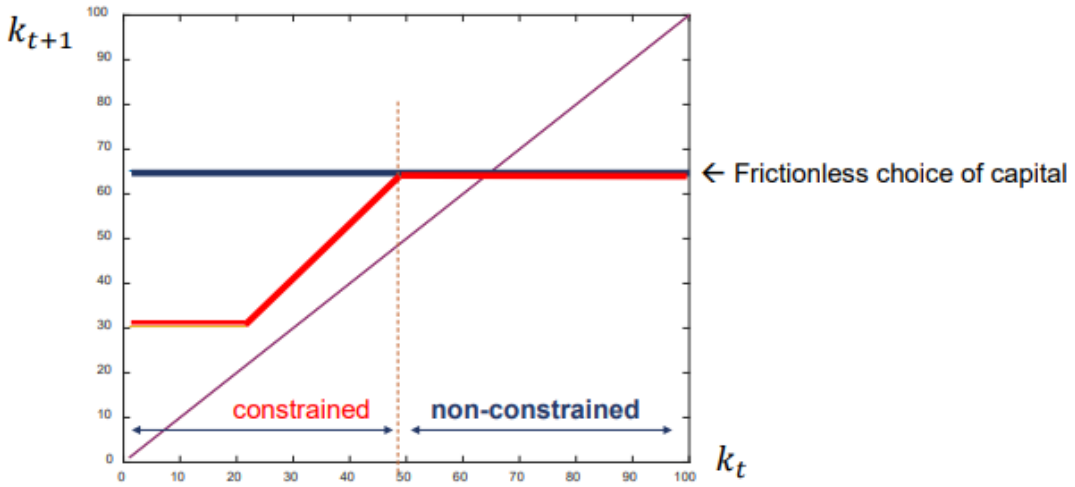
	Intensive margin: LHS variable is log(investment)					
	(1)	(2)	(3)	(4)	(5)	(6)
$z_{N,t}$	3.69	3.78	3.07	3.02	3.73	4.69
	(0.53)	(0.57)	(0.69)	(0.81)	(0.70)	(0.62)
$CF_{it}/K_{i,t-1}$		0.44				
		(0.016)				
Observations	735,341	580,422	514,035	221,306	585,914	722,262
Clusters (firms)	128,001	100,883	109,678	63,699	107,985	124,962
R^2	0.71	0.74	0.73	0.80	0.72	0.71
	Extensive margin: LHS variable is log(P(investment $>$ 0))					
$z_{N,t}$	3.79	3.87	3.12	3.59	3.99	4.00
	(1.24)	(1.21)	(2.00)	(1.14)	(1.69)	(1.13)
$CF_{it}/K_{i,t-1}$		0.029				
		(0.0100)				
Observations	803,659	641,173	556,011	247,648	643,913	803,659
Clusters (industries)	314	314	314	274	277	314
R^2	0.87	0.88	0.88	0.93	0.90	0.90

Financial frictions

$$\max_{\{i_t, k_{t+1}\}} \sum_{s=t}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} [k_s^{\alpha} - i_s + \eta(i_s, k_s)]$$

such that

$$k_{t+1} = k_t + i_t \quad (\delta = 0) \quad \text{and} \quad \eta(i_s, k_s) = \begin{cases} \eta_1(k_s^{\alpha} - i_s) & \text{if } k_s^{\alpha} < i_s \\ 0 & \text{if } k_s^{\alpha} \geq i_s \end{cases}$$



Liquidity constraints?

TABLE 6—HETEROGENEITY BY EX ANTE CONSTRAINTS

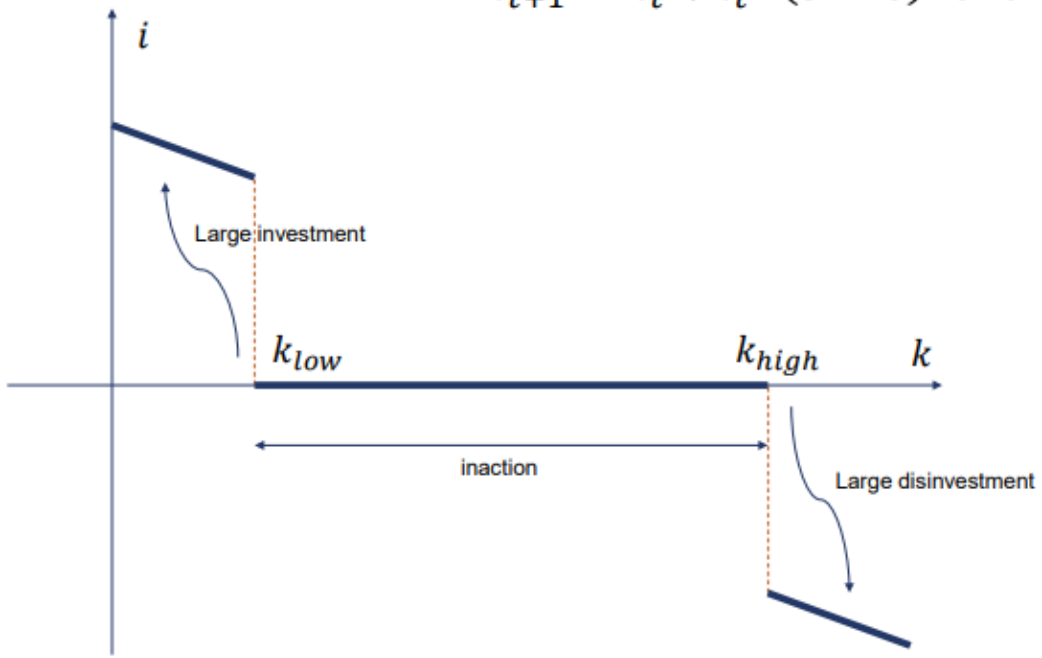
	Sales		Div payer?		Lagged cash	
	Small	Big	No	Yes	Low	High
$z_{N,t}$	6.29	3.22	5.98	3.67	7.21	2.76
	(1.21)	(0.76)	(0.88)	(0.97)	(1.38)	(0.88)
Equality test	$p = 0.030$		$p = 0.079$		$p = 0.000$	
Observations	177,620	255,266	274,809	127,523	176,893	180,933
Clusters (firms)	29,618	29,637	39,195	12,543	45,824	48,936
R^2	0.44	0.76	0.69	0.80	0.81	0.76

Non-convex adjustment costs?

$$\max_{\{i_t, k_{t+1}\}} \sum_{s=t}^{\infty} \left(\frac{1}{1+r}\right)^{s-t} [k_s^{\alpha} - i_s - C(i_s)]$$

such that

$$k_{t+1} = k_t + i_t \quad (\delta = 0) \quad \text{and} \quad C(i_s) = \begin{cases} C \text{ if } i_s \neq 0 \\ 0 \text{ if } i_s = 0 \end{cases}$$



Non-convex adjustment costs?

Table B.7: Heterogeneity by Predictors of Adjustment

	LHS Variable is Log(Eligible Investment)							
	Sales Growth		Age		P(Spike)		P(Inactive)	
	Low	High	Young	Old	Low	High	Low	High
$z_{N,t}$	5.24^{***}	2.27^{*}	3.62^{***}	4.56^{***}	6.53^{***}	4.27^{**}	3.33^{**}	6.22^{***}
	(0.93)	(1.09)	(1.03)	(0.69)	(0.91)	(1.62)	(1.14)	(1.43)
Test	$p = .038$		$p = .435$		$p = .039$		$p = .010$	
Observations	167621	162871	133752	254651	131234	131177	136625	126549
Firms	22659	22653	30503	29525	39723	45391	33434	28504
R^2	0.65	0.70	0.70	0.73	0.82	0.80	0.77	0.57

The impact of investment incentives: Evidence from UK corporation tax returns

Maffini, Giorgia, Xing, Jing, Devereux, Michael P., 2019.

American Economic Journal: Economic Policy, Vol. 11(3): 361-389

Capital allowance in the UK

- Small and medium-sized firms had larger accelerated first-year capital allowances (→ deduct larger proportion of investment in plants and machinery from taxes in first year)
- But how small is medium-sized?
- The definition for this suddenly changed considerably in 2004
- Compare firms that used to be large and suddenly became ‘medium sized‘ (treated firms) with firms that remained large throughout (control)

Capital allowance in the UK

TABLE 1—RATES OF CAPITAL ALLOWANCES FOR PLANT AND MACHINERY IN FIRST YEAR (PERCENT)

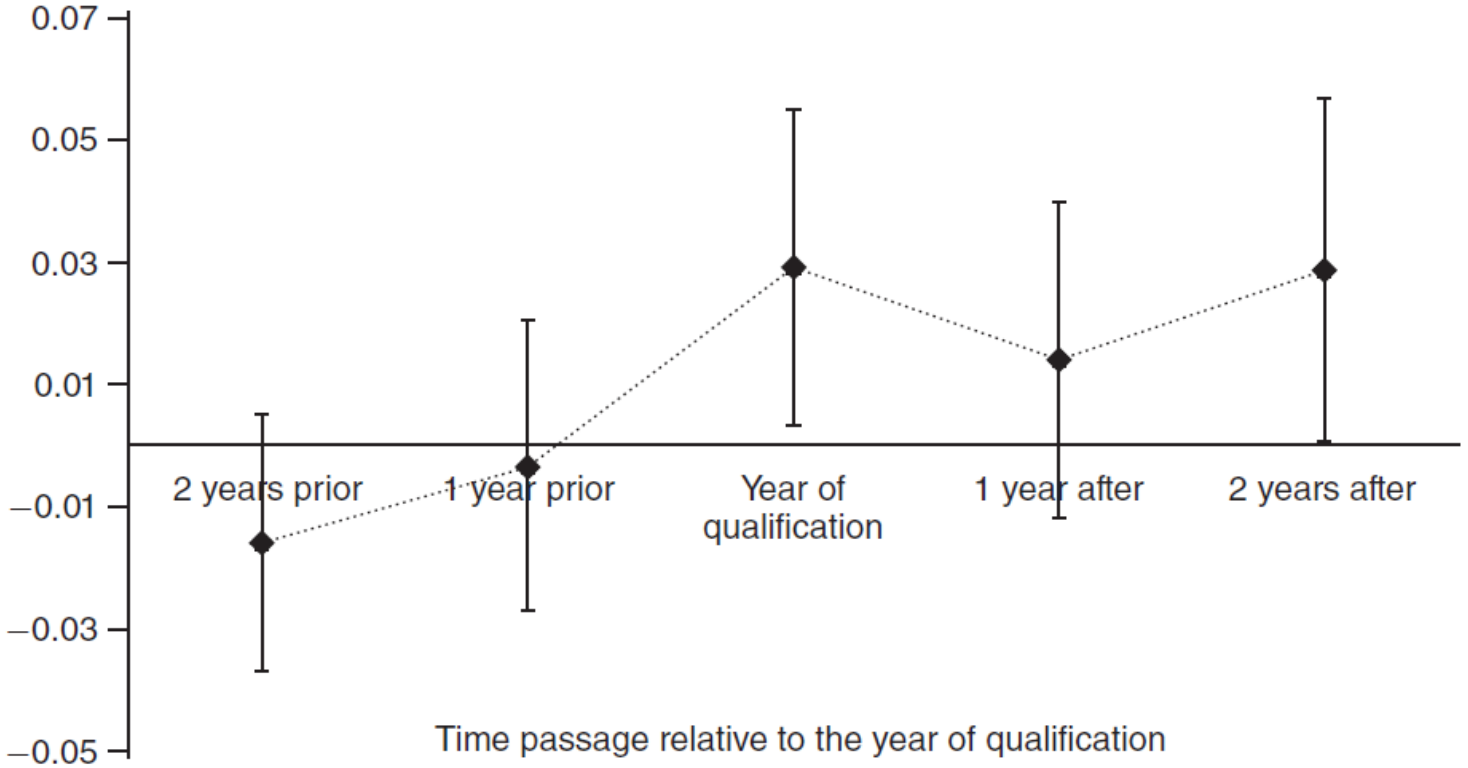
	Treated	Control	Always small	Always medium
2001–2002	25	25	40	40
2002–2003	25	25	40	40
2003–2004	25	25	40	40
2004–2005	40	25	50	40
2005–2006	40	25	40	40
2006–2007	40	25	50	40
2007–2008	40	25	50	40
2008–2009	20	20	20	20

Comparison before and after policy change

TABLE 5—GROSS INVESTMENT RATE

	Mean	SD	Mean	SD	t-test statistics	$\Pr(T < t)$
Treatment group						
	Non-qualifying years		Qualifying years			
Investment rate	0.169	0.300	0.192	0.349	−2.258	0.012
Observations	1,812		2,718			
Control group						
	Before policy change		After policy change			
Investment rate	0.203	0.337	0.205	0.337	−0.356	0.360
Observations	5,134		7,701			

Difference between treated and control



Difference-in-difference

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta_1 d_{i,t}^R + \beta_2 d_i^T + \beta_3 d_{i,t}^R \times d_i^T + \gamma \overline{X}'_{i,t} + \zeta_t + \eta_i + \varepsilon_{i,t},$$

- We are interested in beta3: how much more do **treated** firms invest **after the reform.**

Regression results

TABLE 6—ESTIMATED RESPONSE OF INVESTMENT RATE TO TAX SUBSIDY: BASELINE ESTIMATES

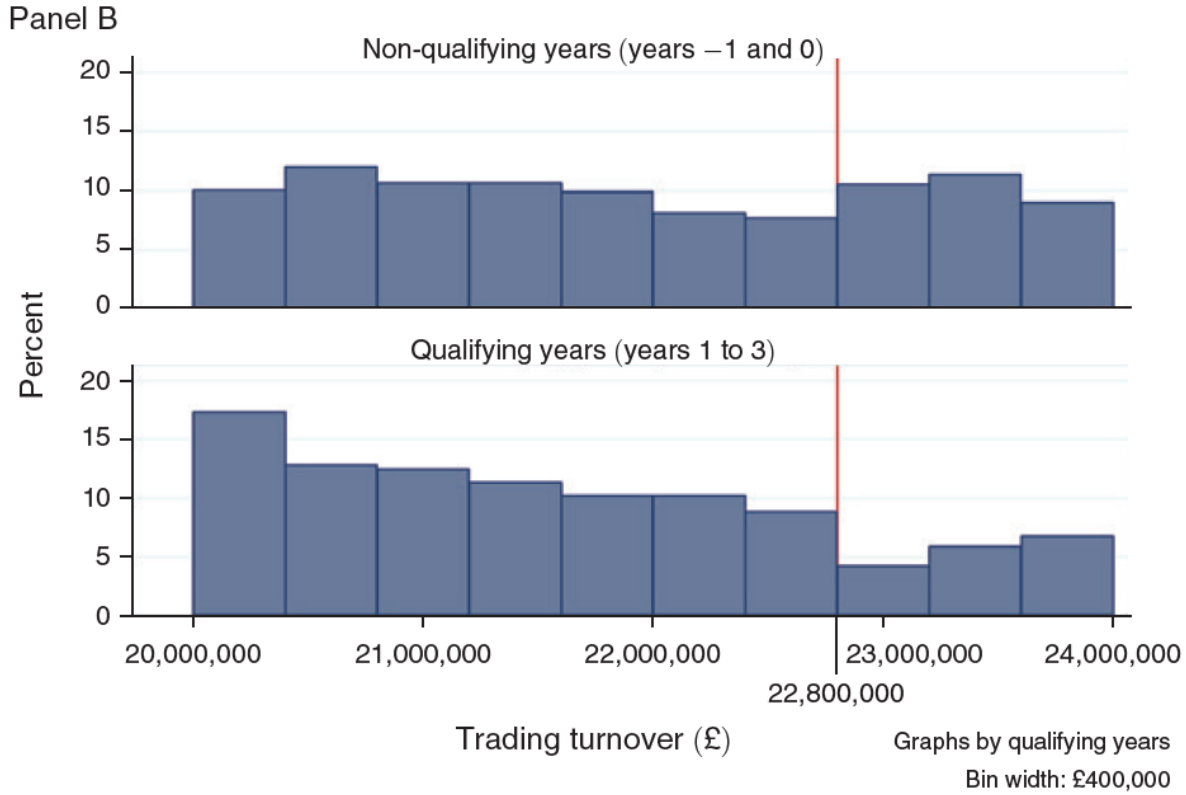
Dependent variable: $I_{i,t}/K_{i,t-1}$	(1)	(2)	(3)	(4)	(5)	(6)
$d^R_{i,t} \times d^T_i$	0.021	0.022	0.022	0.023	0.025	0.025
	(0.012)	(0.012)	(0.012)	(0.010)	(0.012)	(0.012)
$d^R_{i,t}$	0.002	0.001				
	(0.007)	(0.007)				
Growth rate of turnover$_{i,t}$		0.111	0.112	0.109	0.116	0.114
		(0.016)	(0.016)	(0.016)	(0.016)	(0.016)
$MTR_{i,t}$					−0.042	−0.042
					(0.021)	(0.022)
$Profitability_{i,t-1}$					0.298	0.300
					(0.047)	(0.048)
Growth rate of total assets$_{i,t}$					0.015	0.015
					(0.006)	(0.006)
Year fixed effects	No	No	Yes	No	Yes	No
Sector-year fixed effects	No	No	No	Yes	No	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	3,473	3,473	3,473	3,473	3,473	3,473
Observations	17,365	17,365	17,365	17,365	17,365	17,365

Reaction time: different year-end

TABLE 8—ESTIMATED RESPONSE OF INVESTMENT RATE TO TAX SUBSIDY: ADJUSTMENT COSTS

	Balanced		Not balanced after reform	
	Jan–June	July–Dec	Jan–June	July–Dec
Dependent variable: $I_{i,t}/K_{i,t-1}$	(1)	(2)	(3)	(4)
$d_i^T \times$ Year 1	0.000	0.036	0.005	0.020
	(0.032)	(0.015)	(0.028)	(0.010)
$d_i^T \times$ Year 2	0.053	0.012	0.076	−0.005
	(0.034)	(0.019)	(0.031)	(0.019)
$d_i^T \times$ Year 3	0.086	0.024	0.076	0.026
	(0.030)	(0.015)	(0.027)	(0.010)
Control variables	Yes	Yes	Yes	Yes
Sector-year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Number of firms	427	3,046	500	3,712
Number of observations	2,135	15,230	2,448	17,811

Firms somehwat manipulate their size



But bunching is not driving results

TABLE 11—ESTIMATED RESPONSE OF INVESTMENT TO TAX SUBSIDY: EXCLUDING COMPANIES BUNCHING AT TURNOVER THRESHOLDS

Dependent variable: $I_{i,t}/K_{i,t-1}$	(1)	(2)
$d^R_{i,t} \times d^T_i$	0.024	0.025
	(0.012)	(0.012)
Control variables	Yes	Yes
Year fixed effects	Yes	No
Sector-year fixed effects	No	Yes
Firm fixed effects	Yes	Yes
Number of firms	3,424	3,424
Observations	17,120	17,120

Cash flow effects (liquidity constraint) ?

- Firms that receive cash-flow in year 2 react already in year 1

Dependent variable: $I_{i,t}/K_{i,t-1}$	In arrears in Year 1 (1)	Always in arrears (2)
$d_i^T \times$ Year 1	0.040	0.037
	(0.021)	(0.019)
$d_i^T \times$ Year 2	0.019	0.020
	(0.021)	(0.020)
$d_i^T \times$ Year 3	0.035	0.039
	(0.016)	(0.018)

Cash flow effects (liquidity constraint) ?

Dependent variable: $I_{i,t}/K_{i,t-1}$	In arrears in Year 1 (1)	Always in arrears (2)	Negative cash flow (3)	Cash flow above mean (4)	Ownership structure (5)
$d_i^T \times$ Year 1	0.040	0.037			
	(0.021)	(0.019)			
$d_i^T \times$ Year 2	0.019	0.020			
	(0.021)	(0.020)			
$d_i^T \times$ Year 3	0.035	0.039			
	(0.016)	(0.018)			
$d_{i,t}^R \times d_i^T$			0.025	0.035	0.027
			(0.012)	(0.019)	(0.011)
$d_{i,t}^R \times d_i^T \times$ Negative lagged cash flow			0.012		
			(0.030)		
$d_{i,t}^R \times d_i^T \times$ Lagged cash flow above mean				−0.014	
				(0.020)	
$d_{i,t}^R \times d_i^T \times$ Stand-alone company					−0.026
					(0.030)

Cash flow effects (liquidity constraint) ?

- Time of boom in UK economy, unlike stimulus during the recession in the USA inthe other paper
- Responses to tax incentives may differ over time and over the business cycle!