Earnings Management and Investment

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Abstract

Earnings management – the strategic reporting of firm revenues and expenses to achieve specific earnings benchmarks – is a common practice. In many firm-level datasets, the distribution of firm profitability shows clear bunching just above zero. This paper explores the macroeconomic consequences of such behaviour, with a focus on its impact on corporate investment. Using UK firm-level balance sheet data, I identify a bunching mass region in the earnings distribution. I find that firms in this bunching area cut capital and research investment spending; but benefit from lower borrowing costs. To examine the macro consequences, (*work in progress*) I build a model in which lenders evaluate earnings to infer management quality, creating a sharp increase in borrowing costs when firms report losses. Compared to a smoothly-varying bond price, the sharp discontinuity imposes substantial macro costs, acting as a form of short-termism. Firm capital accumulation is depressed, firms are slow to reach optimal size. At the macro level, the constraint misallocates capital across firms, and distorts the set of active firms.

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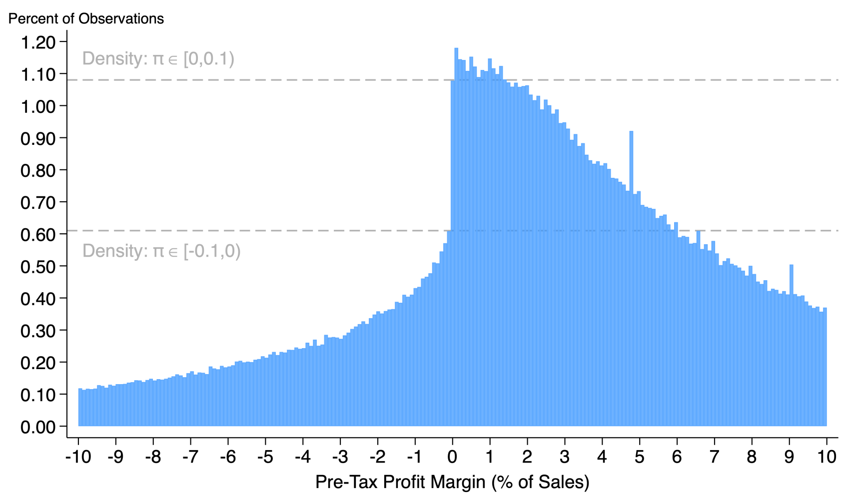
1. Introduction

Firm managers navigate intense scrutiny of earnings and continuous competitive pressure. In this dynamic environment, managers face a key intertemporal trade-off: investing in future growth and greater productive capacity at the expense of current earnings. This tradeoff is complicated when the firm's ability to borrow is influenced by its present financial performance compared to earnings benchmarks. As a result, managers can be incentivized to limit investment today to sustain positive earnings and secure more favourable credit terms.

Figure 1: Earnings Management in UK firm microdata



Note: Profit margin is defined as pre-tax Profits after all other deductions as a percentage of sales revenue for the same period. Source: FAME database, 2003 - 2019.

A large body of work documents the fact that firms engage in so-called earnings management – firms adjust their current activities, expenses, and reporting to avoid losses, leading to bunching in the distribution of firms over profitability immediately to the right of zero. This paper argues that financial conditions are an important driver of strategic earnings reporting and explores the macroeconomic consequences of firms engaging in earnings management to boost short-term earnings.

My analysis focuses primarily on UK firms, however results are also replicated in US and EU data. I document mass bunching at zero profitability and show firms cut expenditures to boost short-run profitability while potentially sacrificing longer-run outcomes. I show that firms just to the right of zero obtain discontinuously favourable credit conditions. The firm's intertemporal problem has similarities to $\beta - \delta$ discounting (Strotz (1955); Phelps and Pollak (1968)). Every period, there is incentive to bolster earnings at the cost of investment (putting more weight on the payoff flow), even if the firm discounts the future from next period and beyond in the standard way (within the "continuation value snowball").

The distortion of investment due to earnings management at the micro-level has potentially large macro effects. In the data, approximately 1 in 3 firms fall within the profitability range suspected of distortion in the interval [0,5], where investment falls 12 percent at the threshold. Using a back-of-the-envelope calculation, this implies a macro impact of 2 percent of aggregate investment[1] and 0.4 percent of GDP[2] – meaningful at the macro-level.

Exactly how the effects of earnings management at the micro-level aggregate to affect the macroeconomy in general equilibrium, however, is unclear. On the one hand, the constraint distorts firm capital choice and slows the speed with which firms achieve optimal size, creating misallocation at both the intensive margin (of capital across firms, and therefore who is large and small) and extensive margin (of which firms are active), and aggregate TFP is lower from this misallocation. On the other hand, lower capital demand and lower aggregate TFP both put downward pressure on equilibrium interest rates, offsetting to some degree the aforementioned direct effects. Earnings management also creates selection in which lending contracts are realised and on what terms. Firms in the manipulated region would otherwise pay higher interest on borrowing, absent manipulation of earnings upward.

[1](0.33 of firms $\times$ 0.12 effect size $\times$ 0.5 for the approximately triangular area)

[2]assuming an investment-to-GDP share of 0.2

To better understand the macro implications of such features of firm decision-making, I build a structural model of firm dynamics featuring rich firm-level heterogeneity in productivity, physical capital, and liquidity/debt position. I add debt contracts with discrete jumps in cost of financing if profits drop below zero, but the bond price otherwise varies smoothly with retained earnings elsewhere in the distribution.

The model is able to generate features which match the empirical facts, namely the bunching density at zero profits, the fall in investment at zero, and the reduction in borrowing costs across the threshold. The model acts as a lab in which we can examine various counterfactual scenarios.

The rest of this paper is structured as follows. The next section (2) outlines the paper's contribution in the context of existing work, section (3) presents the empirical evidence on bunching and distorted choices, section (4) presents the model.

2. Related Literature

A large accounting literature documents in various settings that firms engage in earnings management: adjustment of activities (both real and accounting) to avoid reporting losses (Hayn (1995); Burgstahler and Dichev (1997); Healy and Wahlen (1999); Bansal (2024)).

Real versus Accounting Earnings Management A key distinction in the literature is to establish whether observed patterns in earnings management are simply adjustments to accounting entries or whether they really change business operations.

Accrual earnings management (AM) would involve adjustments to entries like depreciation rates, bad debt provisions, shifting of timing of revenue and expenses, and other actions permitted within the flexibility of accounting standards, but have no impact on business operations, activity, and cashflows. Real earnings management (RM), in contrast, would involve actions such as cutting discretionary expenditures like research and development, maintenance, and capital investment (capex) to improve short-term earnings, Roychowdhury (2006).

In an influential survey providing some of the strongest evidence for real earnings management, Graham et al. (2005) interview over 400 CFOs of major US corporations and find that "managers would rather take economic action that could have negative long-term consequences than make within-GAAP[3] accounting choices to manage earnings.

Drivers of Earnings Management The literature has focused on several channels that could drive company operators to manage earnings. The first channel operates through financial incentives of managers: if managers are paid in stock options, they may engage in activities which maintain the firm's stock price. Avoiding losses (or even just decreases in positive earnings for quarter to quarter or year to year) may help boost the stock price through reduced volatility of reported earnings. This channel is less of a concern in this work since my panel of firms contains many small and unlisted firms that are highly unlikely or simply unable to pay managers in shares.

Relatedly, but through a distinct mechanism, Terry (2023) studies bunching of the distribution of earnings forecast errors for large US firms – firms bunch just at or above consensus earnings targets as if near-misses carry a substantial penalty. He microfounds this behaviour as firm owners optimal contracting when managers are liable to malinvest in prestigious vanity projects. Short-term earnings benchmarks help align incentives between management and ownership.

The second channel that may generate earnings management is through prices of inputs, namely external financing, but potentially other inputs obtained through trade credit or

[3]Generally Accepted Accounting Practices, referring to commonly held interpretations of legal accounting requirements and standards.

firm-to-firm agreements in which there is limited commitment to repay, and so reputation among stakeholders matters. Firms which generate losses may be charged a premium on their borrowing and inputs on credit, creating the incentive to cut investment expenditures in order to optimally manage debt costs.

Consequences of Earnings Management on Firm Performance Firms that beat expectations or are shown to actively engage in real earnings management to just beat earnings benchmarks show relatively stronger performance in the subsequent period, highlighting that real management may bring current benefits which boost performance or allow effective signalling (Cohen et al., 2008; Cohen and Zarowin, 2008). I find this boost effect as well. Firms marginally above the cutoff perform substantially better in the next period, while in a falsification test there is no discrete jump in historical performance, which would have otherwise suggested that firms on the left and right of the cutoff are simply not comparable in baseline characteristics (Bartov et al., 2002; Gunny, 2010).

Terry (2023) examines the macro impact of managers' short-term focus on current earnings relative to consensus targets, and proposes a general equilibrium model in which short-term earnings targets set by firm owners are optimal given executives incentives to engage in lavish project which while prestigious are wasteful malinvestments in terms of firm performance, which owners ultimately care about. This model is about aligning firm manager and owner incentives, while my work focuses on dynamic creditworthiness channels. However, this agency-based explanation cannot fully account for earnings management among small, private firms where stock-based compensation is rare or absent—suggesting alternative channels such as credit market incentives play an important role.

Adler (2020) shows firms reduce investment to avoid costly violations of financial covenants, most of which are based on earnings. Again, firms may find it optimal to sacrifice some investment spending in order to satisfy loan conditions and

This paper is also related to a growing literature of work using methods based on bunching, discontinuities and kinks (Best et al., 2020). Methodologically, I build on the bunching estimation approach of Kleven (2016), adapting local polynomial methods to handle discontinuities near regions of high density curvature (where typical polynomial methods perform extremely poorly), similar in spirit to Best et al. (2020)'s analysis of mortgage notches.

The aggregate effects of firm-level financial frictions has received growing attention. Ottonello and Winberry (2020) show how financial heterogeneity shapes the investment channel of monetary policy, whilst Gopinath et al. (2017) document substantial productivity losses from capital misallocation driven by financial frictions in Southern Europe. Buera and Moll (2015) examine how credit crunches aggregate through both intensive and extensive margin responses. My work contributes to this literature by quantifying the aggregate impact of earnings management on investment and exploring the general equilibrium channels through which micro-level distortions affect macro outcomes.

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This paper makes three main contributions to the literature. First, I provide novel evidence that financial conditions—specifically, discontinuous borrowing costs at the zero-profit threshold—are a primary driver of real earnings management behaviour. Whilst Graham et al. (2005) document that managers prefer real manipulation, and Terry (2023) emphasises agency conflicts between managers and owners, I show empirically that credit market incentives create strong motivation for earnings management even among small, unlisted firms where agency problems and stock-price concerns are minimal. The sharp discontinuity in interest rates at zero profitability, combined with the bunching pattern and investment cuts, provides direct evidence for the creditworthiness channel.

Second, I quantify the aggregate investment impact of earnings management. Whilst prior work documents firm-level distortions (Adler, 2020; Chava and Roberts, 2008), I estimate that approximately one-third of UK firms operate in the manipulated region, leading to macro-level investment losses of 2% of aggregate investment and 0.4% of GDP. This places earnings-driven investment distortions on par with other well-studied financial frictions in terms of aggregate impact.

Third, I develop a quantitative general equilibrium model featuring heterogeneous firms with lumpy investment and earnings-dependent financing costs. Unlike Terry (2023), which focuses on listed firms and agency problems, my framework emphasises the dynamic interaction between creditworthiness, liquidity management, and capital accumulation. The model allows me to explore counterfactuals and examine how the micro-level distortions aggregate through general equilibrium channels, including interest rate responses and capital misallocation across both intensive and extensive margins.

3. Evidence of Bunching and Distorted Choices

I examine the extent of bunching at the zero-profits threshold, and consequences for firm economic activity, for listed and unlisted firms in the United Kingdom. Fitting a counterfactual distribution function that would obtain absent bunching, I am able to estimate the degree of bunching at zero, and with some further simplifications, estimate the macroeconomic relevance of such distortions.

Later sections then go on to examine how firm's choices differ over the threshold. Robustness examines past performance over the cutoff, to examine whether firm firms around the cutoff are otherwise comparable in past dynamics.

3.1 Data

The main analysis uses firm-level panel data of financial accounts from the Moody's (formerly Bureau van Dijk) FAME database. The principal strength of this dataset is that it features both privately-held, unlisted companies, as well as those with traded shares, and so features a relatively high number of small firms compared to other similar datasets such as Compustat which covers only listed firms which tend to already be large.

This dataset covers total employment of over 20 million employees in 2019, compared to a labour force of 31 million, reaching approximately 65 percent coverage of the entire public and private labour force of Great Britain (excluding Northern Ireland) and 73 percent coverage of private enterprises only (excluding, for example, the state operated National Health Service, NHS, a major employer of over 1.5 Million by headcount[4]).

Our sample covers years 2005 to 2019 inclusive. We omit 2020 due to distortions from Covid-19, as well as data from 2021-2022 due to incomplete partial coverage as the panel is updated progressively.

We exclude from our analysis all regulated industries as well as those in the financial and real estate (FIRE) sectors due to large differences in the balance sheet composition of these firms compared to those in the rest of the economy. Full details of data cleaning and sample selection can be found in the appendix.

FAME offers evidence of both types of bunching at play depending on the balance sheet item. For example, the distribution of reported depreciation in nominal GBP shows large spikes at round numbers, when expressed as a share of contemporaneous fixed assets (e.g. $2^{-1}, 3^{-1}, 4^{-1}, 6^{-1}$) with reported depreciation rates of exactly $1/3$ to many decimal places much more frequently reported than neighbouring intervals. The natural explanation in this case is that firms depreciate assets on a straight line basis over 3 years, giving a per-period

[4]Source:NHS Conferedation. Interestingly global largest employer's by rank are: US Dept of Defense, Indian Ministry of Defence, Chinese People's Liberation Army, Walmart, Amazon, and then NHS

depreciation rate of 33%. Writing Down Allowances (WDA) on most plant and machinery are capped at 18 percent and other business-integral assets at 6 percent, again creating bunching in the depreation rate distribution at these values.

Variation in Profitability Profit margin is net income before tax divided by sales revenue in a given year. For the full sample, a decomposition of variance shows that within-firm variance $E_i(Var(X_i|i))$ is approximately equal in contribution to total variance as the permanent differences in profit margins $E(\bar{X}_i)$, and so analysis around the cutoff is not fundamentally driven by two distinct sets of firms with few transitions across the threshold. Discretising the profit margin support into weakly positive or negative profits $\{N, P\}$ reveals transition probability across the threshold of $\Pi_{PN} = 0.4956$, however the reverse transition probability is only $\Pi_{NP} = 0.1516$.

3.2 Bunching and Manipulation

Profitability density is discretely approximated by counts N_b^{data} within narrow bins, where the generic bin is indexed by b, with lower and upper bounds L_b, U_b:

$$N_b^{data} = \sum_{i,t} 1(L_b \leq \pi_{it} < U_b) \tag{1}$$

The standard approach in the bunching literature would be to approximate the counterfactual distribution using a polynomial of order p, and omitting the suspected manipulated region, and then extrapolating the polynomial fit over the omitted region so smooth over the otherwise distorted density function (Kleven (2016)).

$$N_b = \sum_{p=1}^{P} \alpha_p \cdot (\pi_b)^n + \sum_{k \in M} \gamma_b \cdot 1(\pi_b = k) + u_b \tag{2}$$

where N_b is the number of observations in a bin, π_b is the level of earnings in bin b, bins indexed by k are in the manipulated region M. The polynomial-fit counterfactual is obtained from predicted values without the series of dummies in the second sum, i.e. $\tilde{N}_b = \sum_{p=0}^{P} \hat{\alpha} \cdot \pi_b^p$.

However, this method performs poorly when the manipulated regions are also close to or overlap the region of the support in which the density function has high curvature. In my setting the discontinuity is very close to the density function's turning point. Therefore, I take an alternative approach which still relies on the smoothness of underlying density function as in the standard methodology, and so is similar in spirit if not execution.

The counterfactual distribution, N_b^{cf}, is built from a local polynomial regression (LP) over the full support, with some bandwidth bw to control smoothing. While Kleven (2016) notes the standard counterfactual estimation is local to the manipulated region, and does not require knowledge of the global shape of the distribution, this approach is again ex-ante agnostic to the shape of the distribution, but assumes the degree of smoothing of excess curvature is the same across the full support.

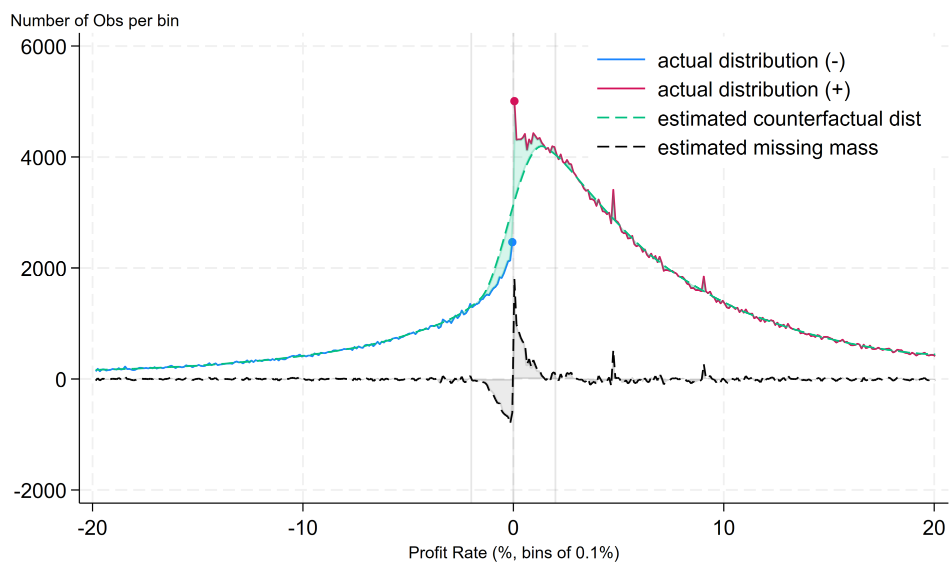
$$N_b^{cf} = \hat{\mathcal{P}}(N_b^{data}, bw^*) \tag{3}$$

The local polynomial fit performs well over the full support. Adjusting the parameter controlling bandwidth will alter how quickly the estimated counterfactual density changes with the running variable, and therefore how close the fit will be to the actual distribution. A very small bandwidth would produce a counterfactual estimate tending towards a duplicate of the empirical distribution, simply the raw counts inside each bin. The parameter bw can be adjusted to ensure estimated missing mass from one side is equal to estimated excess on the other, however at baseline I do not enforce this condition, but check how results change with such a requirement in the robustness checks in the appendix.

Missing mass is then defined as the gap between the empirical count and the constructed counterfactual.

$$MM(b) = N_b^{data} - \hat{N}_b^{cf} \tag{4}$$

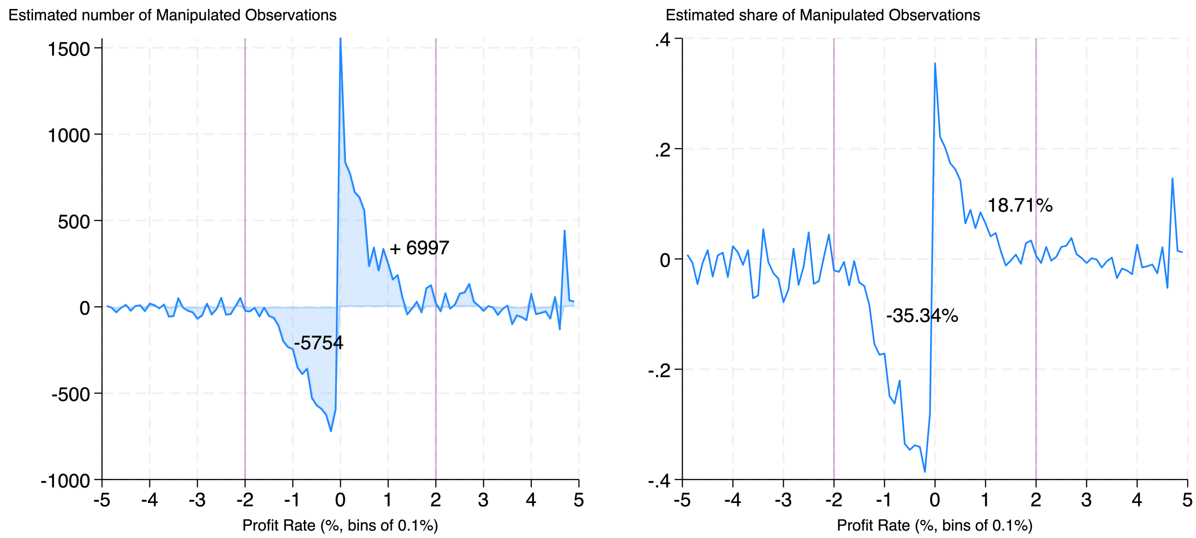
Figure 2: Counterfactual Density Function Fitting



Note: Profit margin is defined as pre-tax earnings divided by sales revenue. Source: FAME database, 2003 - 2019. The empirical density function is approximated by counts within discrete bins of fixed width. The counterfactual density is approximated using local polynomial regression fit using the empirical distribution. The missing (or excess) mass is calculated as the difference between these two distributions within bins.

Figure (2) plots the empirical density function (in blue to the left of zero, red to the right), as well as the fitted counterfactual density function in dashed-green. The difference between the empirical and counterfactual functions is shaded, again in green. The amount of missing mass is also plotted in the lower part of the figure, and highlights a suspected manipulated region close to the cutoff. Away from the cutoff and manipulated region, the LP counterfactual fit appears to fit the density function very well, and so at a minimum

Figure 3: Estimated Manipulation Region with missing/excess mass



(a) Number of manipualting observations

(b) Percent manipulating (as share of estimated counterfactual density)

passes an assessment by visual inspection, even if further refinement are possible.

3.3 Effects of Earnings Management on Investment

I estimate the change in CAPEX behaviour at the threshold plausibly due to earnings management using the following regression specification as baseline:

$$\text{CAPEX}_{it} = \alpha + f(\pi_{it}) + \beta \cdot \mathbb{I}[\pi_{it} \geq 0] + X_{it}'\Gamma + \lambda_{s(i),t} + v_{it} \tag{5}$$

CAPEX_{it} is a given measure of investment activity, the default being $I_{it}/K_{i,t-1}$, the ratio of investment to lagged capital stock. $f(\pi)$ is a flexible polynomial in profitability, and $\mathbb{I}[\pi_{it} \geq 0]$ is a dummy taking value one if the firm lies to the right of the profitability threshold. I include a vector of firm-level covariates (age effects, lagged profitability, lagged size, lagged log employment), and sector-time trends. Regression output is reported in Table

(1).

This regression yields a drop in CAPEX rates of almost 12 percent – 3.1 percentage points at the cutoff, over a baseline mean investment rate of 27.3 (exactly to the left of the cutoff, taken as the regression constant). Adding controls to this regression does not change the results substantially in the second column of Table (1). Halving the bandwidth employed does attenuate effect size and increase estimate uncertainty seen in column 3 of Table (1), while doubling bandwidth does not alter quantitative or economic interpretation in column 4.

I use the same regression specification to examine the margins of adjustment given that investment is typically lumpy, meaning investment usually occurs in infrequent, large bursts. The extensive margin is defined as $\mathbb{I}[x > 0]$ and the intensive margin as $(x|x > 0)$ and a super-extensive margin as $\mathbb{I}[x > 20\%]$, in order to capture large and infrequent "lumpy" adjustments, using the definition of Gourio and Kashyap (2007), who find that investment from lumpy episodes drives aggregate dynamics over the business cycle, and that most variation within lumpy investment occurs at the extensive margin.

All margins of capital adjustment show negative discontinuities at the cutoff, meaning firms take decisions along several dimensions which have the result of lowering average investment rates. However, the intensive margin seems to play the dominant role, falling by 2.8 ppts on a baseline rate of 30.7 percent, meaning a relative effect size of 9.1 percent.

The simple extensive margin shows least proportionate response of 3.2 percent, while the intensive and "super-extensive" lumpy margin both show effect sizes of around 10 percent. These results can be interpreted as firms altering the size of capital projects and installations around the zero-profit cutoff, but relatively few projects get stopped altogether when firms attempt to transit from reported losses to profitability. This seems natural in the context of nonconvex costs (fixed costs and disruption) involved to begin the investment cycle.

	(1)	(2)	(3)	(4)
Estimated Drop in CAPEX (ppts) at $\pi = 0$	-0.0310**	-0.0328**	-0.0201	-0.0321**
	(0.0137)	(0.0135)	(0.0181)	(0.0134)
Mean depvar	0.273	0.274	0.275	0.278
Scaled Effect Size (%)	-0.113	-0.120	-0.073	-0.116
Controls	No	Yes	Yes	Yes
Bandwidth	18.0	8.6	4.3	17.2
Observations	120,994	110,211	52,744	106,592

Note: Table presents RD estimates using $p = 2$ order polynomial. Controls include lagged size, age, and profitability. Bandwidth is chosen optimally in columns (1) and (2), and set to half and twice the optimal in (3) and (4).

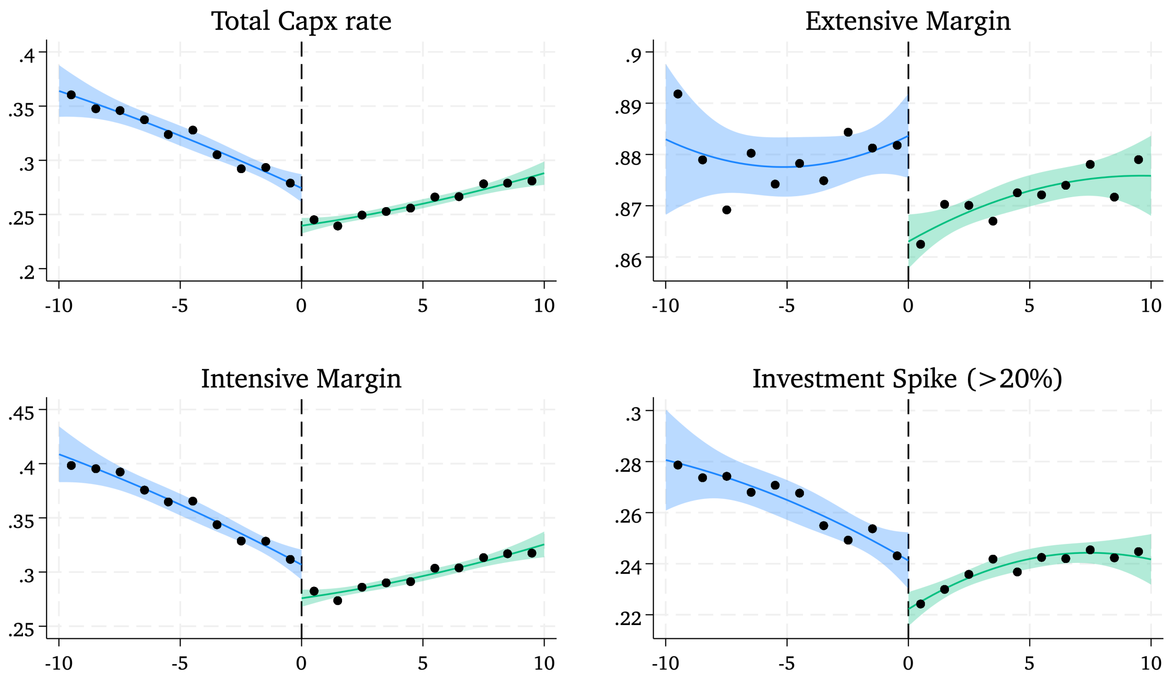
Table 1: Regression Estimates of Drop in Investment at cutoff

	(1) Total	(2) Extensive	(3) Intensive	(4) Super Extensive
Estimated disc. (ppts)	-0.0325***	-0.0284***	-0.0280***	-0.0403***
	(0.0087)	(0.0073)	(0.0094)	(0.0120)
Mean depvar	0.274	0.893	0.307	0.381
Scaled Effect Size (percent)	-0.119	-0.032	-0.091	-0.106
Controls	Yes	Yes	Yes	Yes
Bandwidth	7.5	12.4	7.8	7.1
Observations	110,230	116,330	97,860	103,829

Note: Table presents RD estimates using $p = 2$ order polynomial. Controls include lagged size, age, and profitability. Bandwidth is chosen optimally in columns (1) and (2), and set to half and twice the optimal in (3) and (4).

Table 2: Adjustment along Intensive and Extensive Margins of Investment

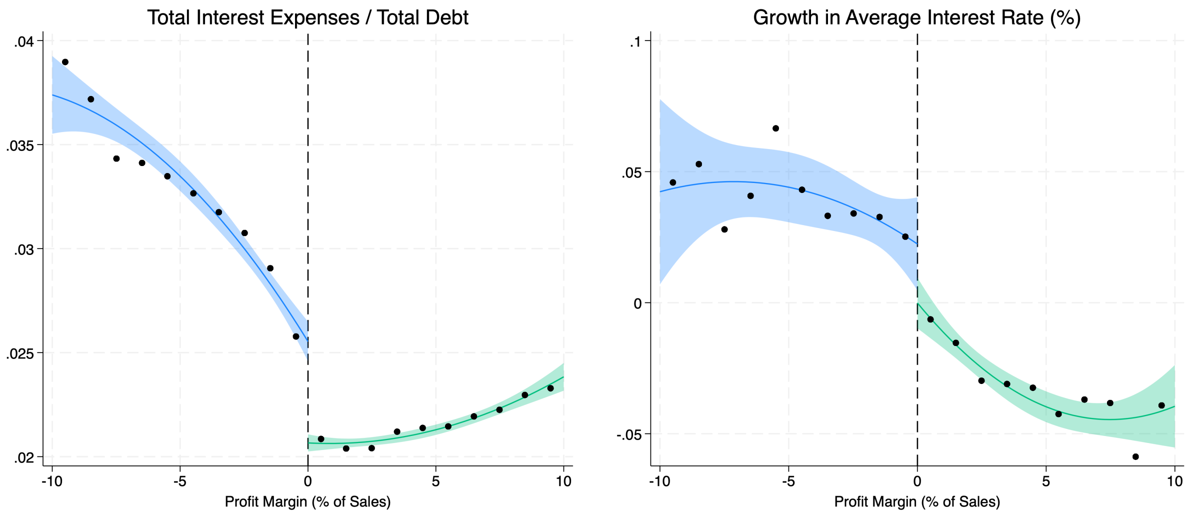
Figure 4: Investment in Fixed Assets



Note: Capx rate is defined as investment in fixed assets divided by lagged fixed assets. Extensive margin takes value one if investment is strictly larger than zero. Intensive margin excludes zero investment observations. Investment spike is simular to exetensiv margin, however for large adjustments greater than 20 percent of fixed assets.

Interest Expenses The two panels of figure 6 examine interest rate conditions and dynamics around the period t. The first panel shows contemporaneous interest rates, in levels, showing a sharp discontinuity at the cutoff, meaning that financial conditions respond strongly to within-year firm performance, indicative of active lender monitoring. A similar gap at zero profits can be seen in next year's rates as well. One can argue that level differences may reflect reverse causality – higher rates will cause worse performance. For this reason I also examine changes in financial conditions, both from period t, but also relative to the year before. Contemporaneous growth in interest expenses (third panel) shows firms

Figure 5: Interest Expenses, levels and changes



Note: Interest rate is defined as interest expenses `xint` over current liabilities and long-term debt. Similar results obtain with alternative denominators, however a breakdown of interest expenses by type of liability is not available.

making losses see rates rise, while firms in the profitable region of the running variable see costs fall, again with a jump downwards at zero.

Future Outcomes I now examine the future evolution of firm performance around the profitability cutoff. I run the same specification of regression as above however now I examine outcomes: future sales growth, and future changes in employment and capital stock (all in log differences). All changes are relative to period $t-1$ before the potential manipulation episode under examination.

$$y_{i,t+1} - y_{i,t-1} = \alpha + f(\pi_{it}) + \beta \cdot \mathbb{I}[\pi_{it} \geq 0] + X_{it}'\Gamma + \lambda_{s(i),t} + v_{it} \tag{6}$$

	(1) Interest rate, r_t	(2) Change in Interest rate, Δr_t
Estimated disc. (ppts)	-0.4793***	-2.6775***
	(0.0520)	(0.7642)
Mean depvar	1.420	-1.439
Scaled Effect Size (%)	-33.740	186.118
Controls	Yes	Yes
Bandwidth	10.0	10.0
Observations	135,966	120,836

Note: Table presents RD estimates using $p = 2$ order polynomial. Controls include lagged size, age, and profitability. Bandwidth is chosen optimally in columns (1) and (2), and set to half and twice the optimal in (3) and (4).

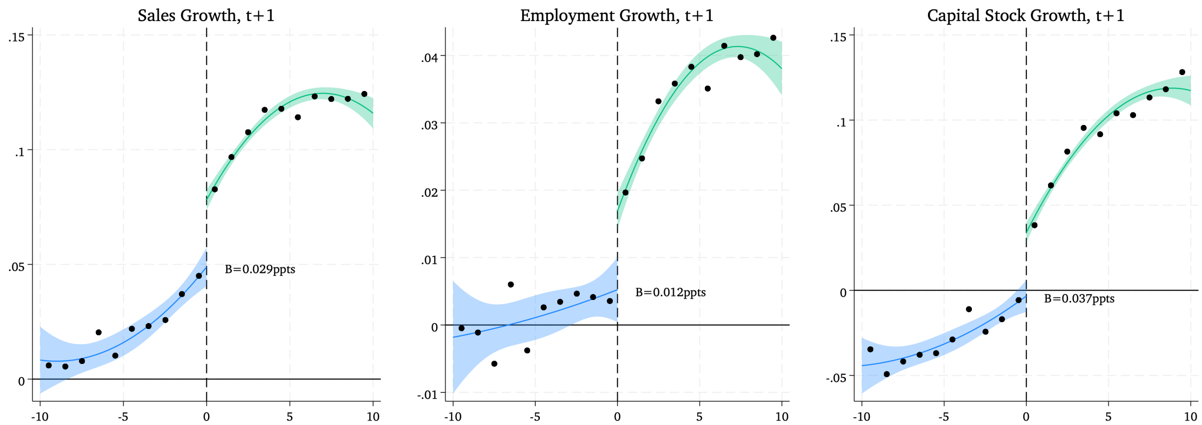
Table 3: Regression Estimates of Drop in Investment at cutoff

	(1) Past Sales gr	(2) Past Employment gr	(3) Past Capital gr
Estimated disc. (ppts)	-0.0037	0.0056*	0.0023
	(0.0030)	(0.0027)	(0.0064)
Mean depvar	-0.207	0.022	-0.058
Scaled Effect Size (%)	1.804	25.960	-3.950
Controls	Yes	Yes	Yes
Bandwidth	10.0	10.0	10.0
Observations	320,426	320,435	300,654

Note: Table presents RD estimates using $p = 2$ order polynomial. Controls include lagged size, age, and profitability. Bandwidth is chosen optimally in columns (1) and (2), and set to half and twice the optimal in (3) and (4).

Table 4: Regression Estimates of Drop in Investment at cutoff

Figure 6: Future Sales, Employment and Captial Stock growth



Note: Growth variables are calculated as log differences between periods $t+1$ and $t-1$.

3.4 Robustness

While firm decision making setting does not meet the no-manipulation requirement to be able to make causal claims from a well-identified RDD, I now highlight that firms close to the cuttoff are ex-ante similar before the period in which they manipulate.

I run regression 6 in a backward looking direction, with outcomes dated $t-1$ or changes from $t-2$ to $t-1$, again in order to avoid direct effects of manipulation within year t (or the growth that takes place from year-end $t-1$ to year-end t).

I plot the RD plots for past sales, employment, and capital growth, as well as lagged profit margins in levels. The latter three show no visual sign of discontinuity, suggesting that firms immediately to the left and right of zero are comparable in the past performance. Sales growth does show some discontinuity using an order 2 polynomial, however this may be due to high non-linearity, lack of controls, use of optimal bandwidth and triangular kernel in a proper RD regression.

While statistically significant, the effect size is not economically meaningful in magnitude.

Figure 7: Falsification Regressions, Dependent Variable: Past Dynamics

Note: .

4. A Model of Investment with Earnings Management

In this section I build a heterogeneous firms model with costly external finance in order firstly rationalise my empirical findings, and secondly to explore counterfactuals within the model. Firms are heterogeneous in their idiosyncratic productivities, illiquid productive capital and liquid cash/bond asset positions. Firms can finance investment opportunities with internal cash reserves built up over time from retained earnings, or with external finance. Borrowing comes at a premium, with the cost of borrowing for unprofitable, "risky" firms depending on new debt issuance and total stock of debt.

Qualitative performance of the model in matching the salient features of the data is good, even if the exact magnitudes do not fit perfectly.

4.1 Firms

Production Firms maximise the expected net present value of profits. Firms produce using a decreasing returns to scale production function with capital and labour as inputs.

Since labour is a static choice, it can be "optimised out" and the production function written entirely in terms of capital, TFP and parameters. Firm-specific TFP in logs follows an AR(1) process with mean μ_a, persistence ρ_a and innovation variance σ_ε

$$y = \max_n \left\{ zk^\alpha n^\theta - wn \right\} = ak^{\frac{\alpha}{1-\theta}}; \quad \alpha + \theta < 1 \tag{7}$$

Capital follows the standard law of motion, $k' = (1-\delta)k + x$, where investment is denoted as x and the installation price of new capital is P_k. The sale price of capital is $P_s < P_k$. The price of output is normalised to 1. The degree of the asymmetry in buying and selling prices reflects the degree of firm-specificity in capital installations.

Cost structure Adjustment of the capital stock is costly. The firm faces both convex and nonconvex costs of adjusting capital:

$$\mathcal{AC}(x,k) = \left[\frac{\gamma}{2} \left(\frac{x}{k} \right)^2 + F \cdot \mathbb{I}_{\{x \notin [0, \delta k]\}} \right] k \quad s.t. \quad \gamma > 0, \; F > 0 \tag{8}$$

The first quadratic term punishes large adjustments and therefore encourages hump-shaped dynamics of capital. Maintenance investment of capital is free of fixed costs, however fresh installations or removals of capital are treated as qualitatively different adjustments and therefore face a nonconvex cost F if $x > \delta k$ or $x < 0$. F is needed to generate lumpiness - periods of inaction followed by large, infrequent adjustments (Doms and Dunne (1998); Cooper and Haltiwanger (2006); Gourio and Kashyap (2007)).

Both components scale with firm size, so both costs are multiplied by k. Finally, firms face a per-period fixed operating cost which cannot be avoided, ξ. This cost helps generate sufficient mass in the profit distribution below zero.

External Finance Premium The firm holds both fixed, illiquid assets (k) and can borrow and save in cash (b), borrowing up to a limit $b' > -B$. External financing of investment is subject to a premium based on perceived riskiness of the firm. The firm is seen as risky by lenders if net cashflow is negative - that is, if the firms spending exceeds resources and requires increases in indebtedness. Let r be the risk-free interest rate determined exogeneously. "Safe" firms can borrow and save at the risk-free rate. Denote net cashflow as ω, defined as:

$$\omega = zk^{\alpha} - P_k \mathbb{I}_{(x>0)} x - P_s \mathbb{I}_{(x<0)} x - \mathcal{AC}(x,k) + (1+r)b - b' - \xi \tag{9}$$

The lender charges a premium on external finance based on two components (similar to Görtz et al. (2023); Benigno et al. (2020); Gomes (2001)), in which a higher premium is charged for (1) new bond issuance (2) total stock of outstanding debt. Both λ_1, λ_2 are strictly positive.

$$\lambda^{EXT} = \begin{cases} 0 & if\ \omega \geq 0 \\ \lambda_1(-\omega) + \lambda_2 \cdot \mathbb{I}_{(b'<0)}(-b') & if\ \omega < 0 \end{cases} \tag{10}$$

I do not model the riskiness of the firm explicitly with a default decision. I assume financial markets have "deep pockets" in the sense that any debt level within the limit will be financed by lenders. The upperbound on debt is asset-based[5], given by the present-value of undepreciated assets, ignoring new investment which may alter balance sheet composition in the interim, i.e today's investment cannot form part of the pledgible collateral. The bound on borrowing is given by:

$$b' \geq -\psi \frac{(1-\delta)}{1+r} P_s k \tag{11}$$

[5] one could also consider an income based constraint in which the lender is will to go up to the NPV of revenues under no new investment and worst-case productivity in every period

Here $\psi \in (0, 1]$ is the haircut parameter determining the upper loan-to-value (LTV) ratio. The firm's Bellman equation can therefore be presented as follows, subject to the law of motion of capital, as well as the structures described above for adjustment costs and external finance premia.

$$V(z,k,b) = \max_{x,b'} \Big\{ af(k) - P_k \mathbb{I}_{(x>0)} x - P_s \mathbb{I}_{(x<0)} x - \mathcal{AC}(x,k) - \lambda^{EXT} + (1+r)b - b' - \xi \\ + \beta E_{z'|z} V(z', x + (1-\delta)k, b') \Big\} \tag{12}$$

As described in Görtz et al. (2023), the firm's optimal policies will imply lumpy behaviour with periods of low investment and cash-accumulation, followed by dissaving and large, infrequent increases in the capital stock. Since I allow free maintenance and natural depreciation, this model can feature states that correspond to action (large investment, $x > 0$), maintenance (small investment of δk), inaction ($x = 0$), and retirements of capital ($x < 0$)

4.1.1 Solution and Parameterisation

The firm' state space is discretised on a grid of $(k, b, z) \in \{\mathcal{K}_{N_k} \times \mathcal{B}_{N_b} \times \mathcal{Z}_{N_z}\}$. The firm's problem is solved using a hybrid value function iteration approach starting with grid-search iterations which are then fed as starting guesses for continuous solution methods featuring a function solver. The continuous solution is facilitated by allowing off-grid choices which relies on value function approximation in interpolate between grid points. Interpolation is done with order-P Chebyshev polynomials: $W(z,k,b) \approx \sum_i^P \sum_j^P \phi_{ij}(z) T_i(k) T_j(b)$, where $T(k)$ and $T(b)$ are the Chebyshev basis functions of order $i, j = 1, 2, ...P$. Coefficients $\phi_{ij}(z)$ are productivity-level-dependent and are updated with least squares.

The continuous policy functions are then interpolated onto a fine grid of N_f points. A panel of firms is then simulated with $N = 1000$ firms and $T = 10,000$ periods, with

1000 burn-in periods discarded. Intitial values (k_0, b_0) are drawn continuously from the full support of k' and b'. Optimal chocies are made using the finer grid policy rules and linear interpolation between policy grid points.

The parameterisation of the model in Table (5) is illustrative, and not calibrated to match micro and macro data moments, nevertheless, it manages to capture qualitative features of the data.

Temporal	discount factor	β	0.9500
	risk-free rate	r	0.0305
Production	capital parameter	α	0.60
	labour parameter	θ	0.15
	depreciation	δ	0.150
	fixed costs	ξ	3
	wage rate	w	0.20
Capital Adjustment	quadratic adjustment cost	γ	0.070
	nonconvex cost	F	0.029
TFP Process	TFP persistence	ρ_a	0.70
	TFP innov sd	σ_a	0.15
External Finance	premium, debt stock	λ_2	0.04
	premium, new issuance	λ_1	0.07
	haircut on collateral	ψ	0.4
Capital Prices	capital purchase price	P_k	1.2
	capital sale price	P_s	0.7 P_k
	output price (normalisation)	P_y	1

Table 5: Informal Parameterisation of the model

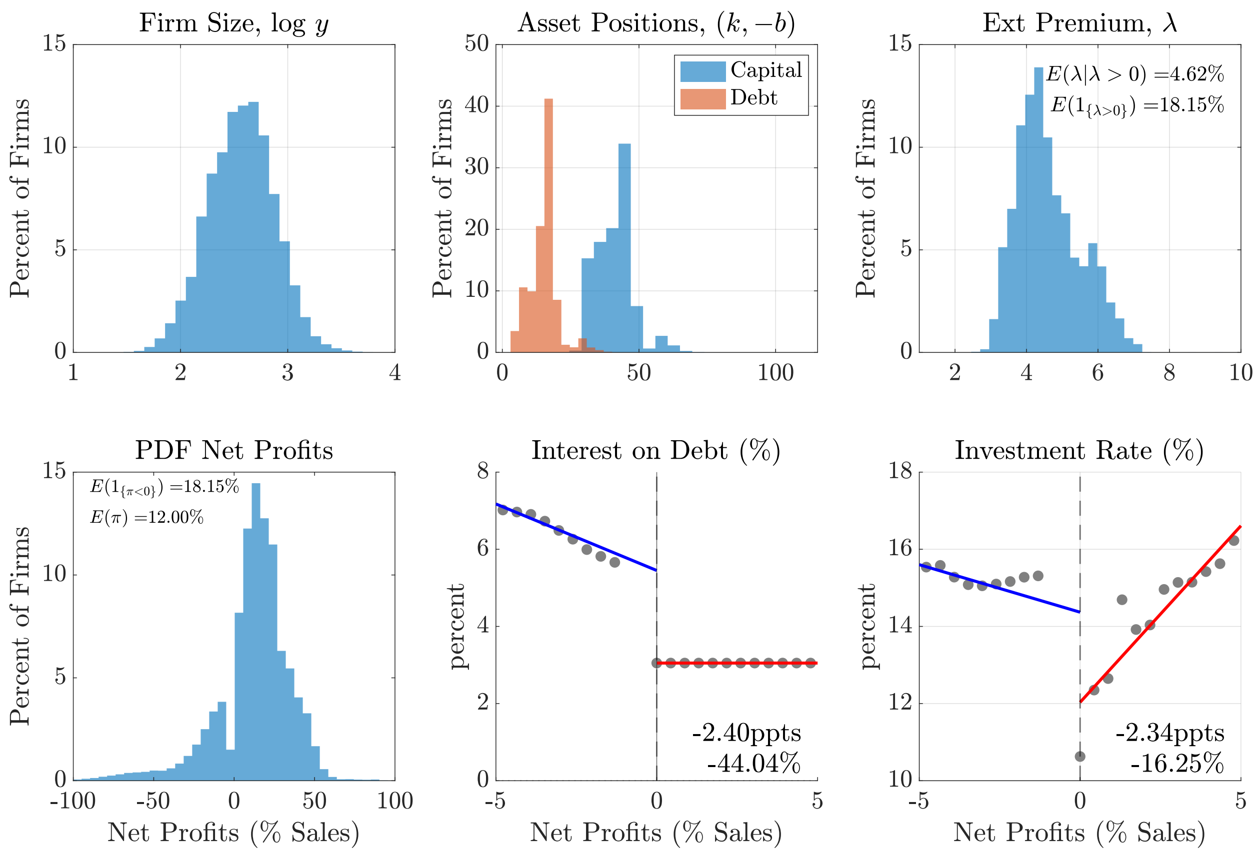


Figure 8: Results from Simulated Panel of Firms

4.2 Bunching and Earnings Management in Simulated Data

The distribution of firms is presented in Figure (8). The model is able to capture moderate variation between firms in size, the premium they pay on their borrowing as a percentage of debt stock, and their net profits. Qualitatively the model is able to deliver the two salient empirical results: namely, the bunching of mass to the right of zero in the profitability distribution (as a % of sales) and the discontinuous drop in investment around zero in an RD-style regression. Note, however, that the mass of firms drops to zero close to the threshold, hence the gap in the investment rate as a function of profit margin on the approximate interval $[-1, 0)$.

Cost of Borrowing The model yields a cost of borrowing that very much resembles the microdata – though this is somewhat deliberate. The stucture of λ^{EXT} is such that it generates a jump as firms move to negative net cash flow (and therfore negative net profits after the premium), and the fitted values are increasing with losses as shown in the data. The model is able to replicate the fall in borrowing costs at the threshold fairly well: -44 percent in the model and -33 percent in the microdata.

Bunching at zero The model is also able to qualitatively replicate the distribution of net profits seen in the data when expressed as a percentage of sales revenues. A substantial share of the observations make a loss in the period - 18 percent compared to roughly one third in the data. The model distribution also features a large jump in density at zero, however the model also features a region of declining and even zero relative frequency (hence the gap in the binner averages in the binscatter plots.

Investment For a tight window around the threshold, model investment rates show behaviour similar to the data, though the models typical investment rate is lower than the data. Firms close to the threshold are predicted to cut investment by roughly 16 percent of baseline investment in order to transit from margin loss to margin profitability, very close to a scaled effect size of 12 percent in the microdata once we add controls. The two fitted polynomials based on model-simulated data also feature the salient V-shape structure in (profit margin - investment rate) space.

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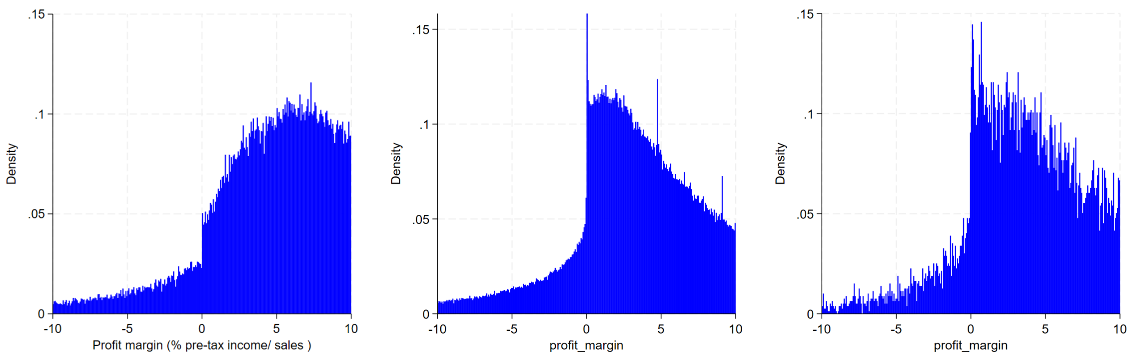
A. Additional Figures:

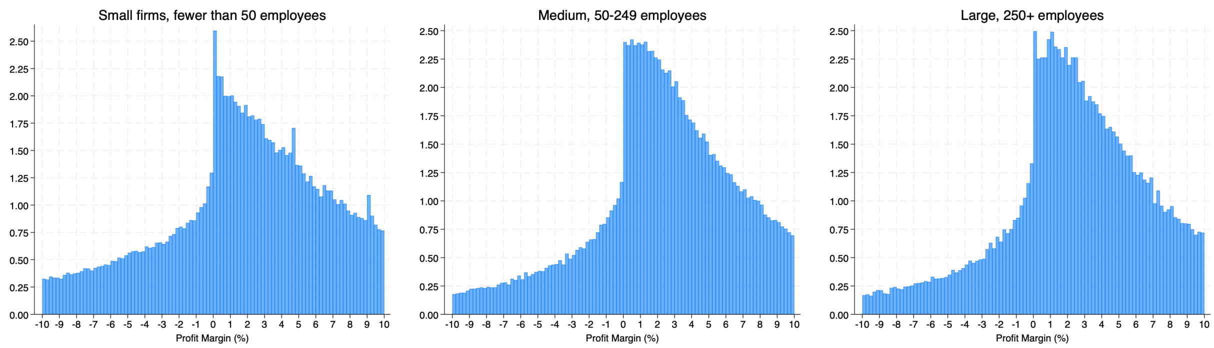
Figure 9: Profitability Distributions in microdata Samples from US, UK, EU



(a) United States (b) United Kingdom (c) European Union ex UK

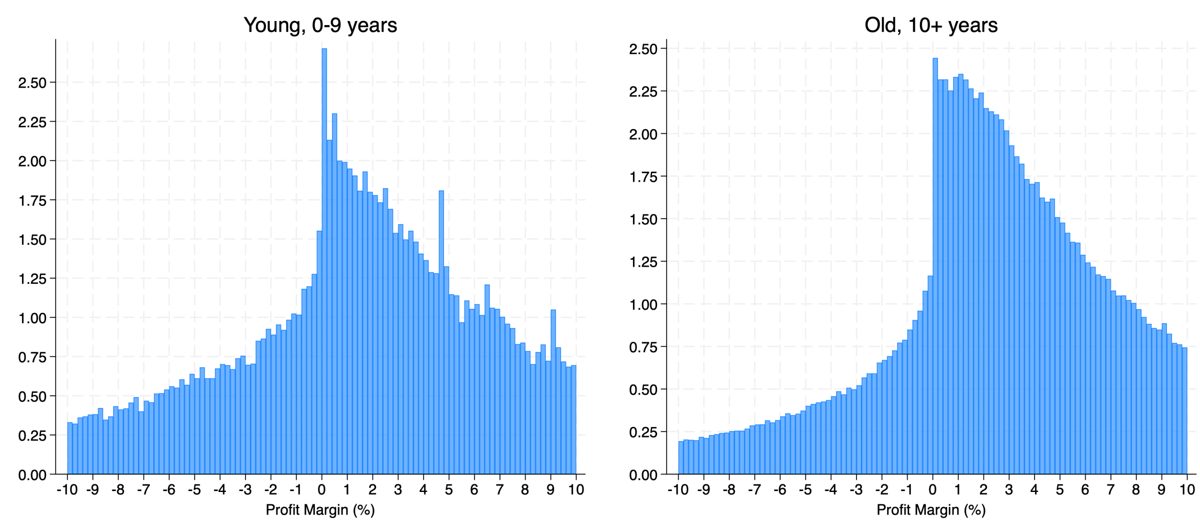
Note: sources Compustat (US), FAME (UK), Orbis (EU). Profitability measured as retained earnings before taxation relative to revenues.

Figure 10: Profitability Distributions by Firm Size



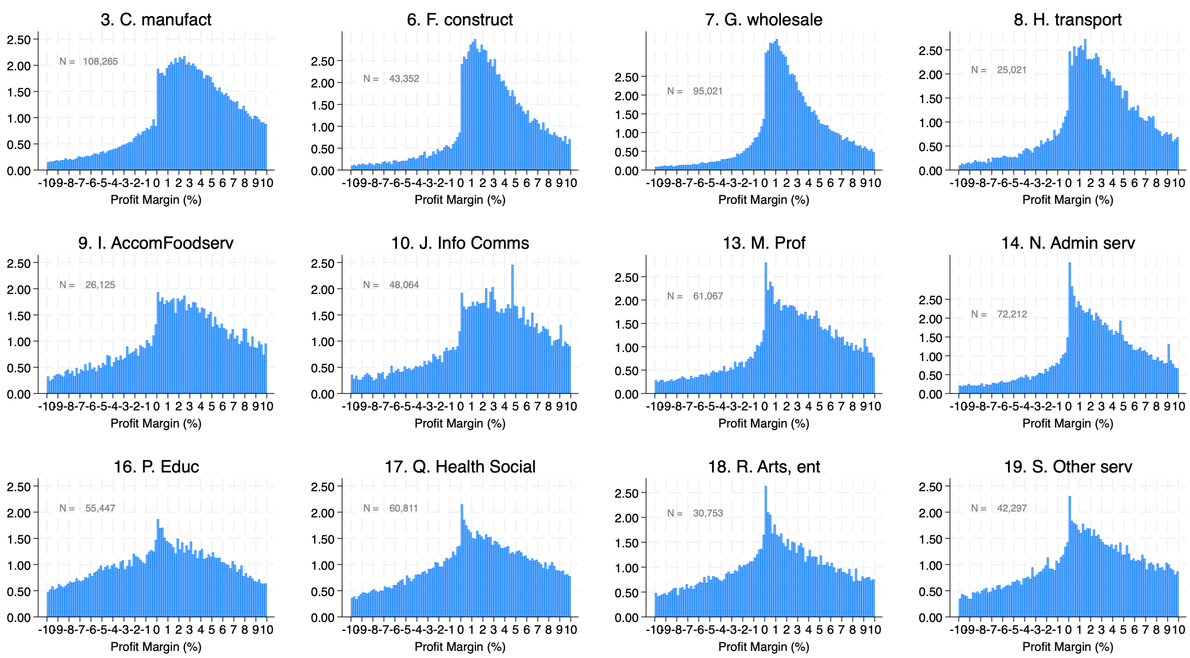
Note: FAME sample, all firms. Size measured as total number of employees. Firms are classified as small if employment is below 50, as medium if employment is between 50 and 249 and large if employment is 250 employees and above. Profitability is measured as profits before taxation over revenues.

Figure 11: Profitability Distributions by Firm Age



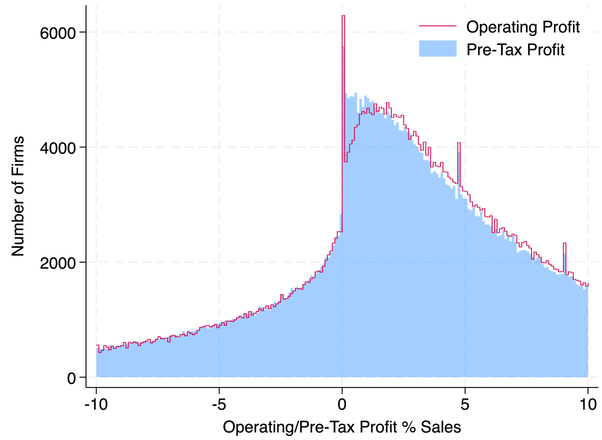
Note: FAME sample, all firms. Age measured since legal inception of company in years. Profitability is measured as profits before taxation over revenues.

Figure 12: Profitability Distributions by Industry



Note: FAME sample, all firms. Industry is UK SIC at the broad 1-digit (letter) classification level. Profitability is measured as profits before taxation over revenues. Agriculture is not presented due to too few observations. Utility sectors such as water and energy are also omitted as these are heavily regulated industries and firms may differ substantially in balance sheet composition as a result.

Figure 13: Operating versus Pre-Tax Profit Margins (% Revenue)



Note: FAME sample, all firms. Operating Profit Margin is defined as Revenue from Sales minus Operating Expenditures (Opex). Pre-Tax Profit Margin deducts all other relevant expenses except tax liabilities.

Figure 14: Capex Rate (I/K) discontinuity by Industry

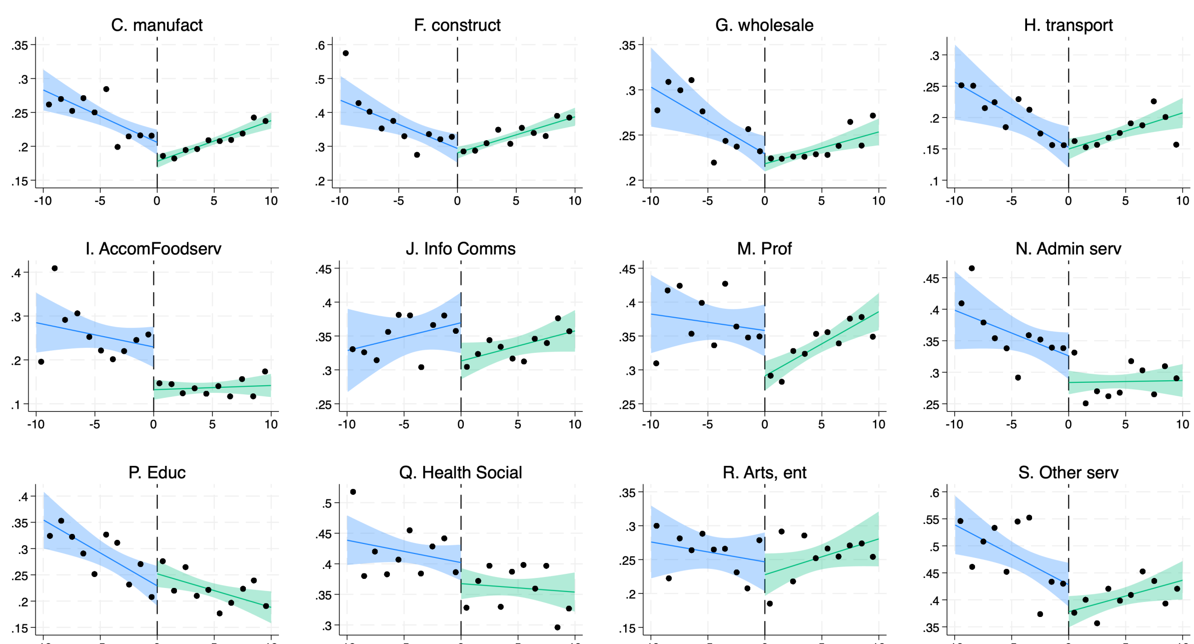


Figure 15: Predictive Regressions of discontinuity on past and future firm performance