Cost of Capital and Investment: Evidence from the UK

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Abstract

This study investigates the longstanding underperformance of UK business investment and examines how firms' external financing conditions and internal investment thresholds shape investment behaviour between 2013 and 2022. Employing a comprehensive firm-level dataset, the analysis examines heterogeneity by listing status, firm size, and financial constraints. The results show a significant negative relationship between market-based financing costs, especially the cost of debt, and tangible investment. This effect is particularly pronounced for unlisted, smaller, lower-productivity, and financially constrained firms. By contrast, intangible investment is much less sensitive to observed financing costs, consistent with its greater reliance on internal funds, higher uncertainty, lower collateral value, and more heterogeneous payoff horizons. A further contribution of the paper is to distinguish externally observed financing costs from internally applied hurdle rates. We find clear evidence that firms' internal hurdle rates are substantially higher than standard market-based financing benchmarks. The average hurdle rate (10.7%) exceeds firm-level market-based capital cost measures by around 350–430 basis points. This internal–external wedge is significantly associated with lower investment, particularly among large and listed firms. Taken together, the findings suggest that both differences in financing conditions and firms' internal capital budgeting rules are important drivers of the UK's weak investment performance.

1. Introduction

The UK has experienced sluggish investment for years relative to other advanced economies, and has persisted for decades, with deterioration following the global financial crisis and further declines observed after Brexit and the COVID-19 pandemic (Alayande & Coyle, 2023; Mann, 2024; Carella et al., 2023). This prolonged underinvestment is particularly concerning given the central role of investment in driving productivity growth, which is essential for sustaining long-term economic prosperity and improving living standards (Mann, 2024; OECD, 2023). Investment contributes to productivity growth by increasing the amount of capital available per worker which is a process known as capital deepening, and by fostering innovation through research and development (R&D) and other intangible assets. Consequently, the UK's low levels of capital investment have contributed to slower growth in labor productivity, compounding to the broader productivity slowdown seen since 2008.

Investment in both physical capital and intangibles is also a key determinant of total factor productivity (TFP), as it allows firms to adopt new technologies, innovate, and improve operational efficiency (Gutierrez & Philippon, 2017; Corrado et al., 2022; Mann, 2023, 2024). As Mann (2024) highlights, although many advanced economies face challenges to investment, the UK appears especially vulnerable due to factors such as prolonged uncertainty (e.g., related to leaving the EU), a focus on short-term financial returns, and weak competitive pressures to invest. These conditions raise important questions about the firm-level drivers of investment behavior and their role in the UK's productivity puzzle.

A key factor underlying investment behaviour is the cost of capital. In this paper, the term cost of capital is used in a broad sense to refer to several related but distinct measures, including the

cost of debt, the cost of equity, weighted average cost of capital (WACC), return on invested capital (ROIC), and internally reported hurdle rates. These measures are quantitatively different and capture different aspects of the financing benchmark or return threshold relevant for investment decisions, ranging from externally observed borrowing costs to firms' own internally applied required rates of return. From a theoretical standpoint, the link between investment and the cost of capital is well established. In a standard neoclassical framework, firms are expected to invest until the expected return on capital equals the user cost of capital, which includes interest rates, the cost of equity, taxes, and depreciation (Hall & Jorgenson, 1967). A higher cost of capital raises the threshold for profitable investment and therefore reduces desired capital expenditure. Modern discounted cash flow (DCF) approaches similarly evaluate projects using a discount rate that reflects the firm's financing costs, commonly proxied by WACC. In practice, however, observed market-based cost of capital measures may not fully capture the internal return thresholds firms apply when making investment decisions. Survey evidence shows that firms often use DCF tools alongside other decision rules, such as payback periods and internally set required rates of return, so investment choices need not follow a purely mechanical net-present-value criterion (Graham & Harvey, 2001; Graham, 2022). Recent UK survey evidence likewise suggests that investment decisions are shaped by a broader approval process involving expected returns, costs, resource availability, funding constraints, and internally applied target rates of return (Golubova & Roper, 2025).

Despite this theoretical clarity, empirical evidence on the sensitivity of investment to cost of capital measures remains relatively limited, particularly outside the United States and for unlisted firms. This gap is especially salient for the UK, where micro-level evidence is urgently needed to understand persistent underinvestment. Frank and Shen (2016), for example, show that estimated

investment sensitivity depends crucially on how the cost of equity is measured, while Drobetz et al. (2018) find that uncertainty weakens the relationship between investment and the cost of capital, especially for more opaque firms with limited external information. These findings suggest that both measurement choices and institutional context matter for identifying investment responses. They also point to a broader challenge: externally observed financing benchmarks may not coincide with the internal discount rates that govern firms' capital allocation decisions.

This issue is particularly relevant in the UK. Empirical research shows that UK business investment has become increasingly concentrated among large firms, while smaller firms face persistent barriers to investment arising from weak internal funds and, when external finance is needed, higher borrowing costs and tighter credit availability (Haskel & Westlake, 2018; Mann, 2023; Department for Business and Trade, 2024). At the same time, a growing body of evidence suggests that firms often apply internal hurdle rates that substantially exceed market-based financing costs. Survey-based evidence indicates that UK firms commonly use minimum required returns that are materially above standard benchmarks such as WACC, and that these hurdle rates respond only weakly to changes in monetary policy (Shah, Bunn, & Melolinna, 2024). This implies that weak investment may persist even when external financing conditions appear favourable, because firms' own internal capital budgeting rules remain restrictive. Understanding this internal–external wedge is therefore central to explaining underinvestment in the UK. While the present paper does not permit a clear cross-country comparison of whether UK managers are more conservative than their international counterparts, it contributes by showing that, within the UK, this wedge is economically large and strongly associated with realised investment behaviour. This pattern does not appear to be unique to the UK. Survey-based evidence from other settings likewise

shows that firms often apply hurdle rates materially above their cost of capital (Jagannathan, Meier, & Tarhan, 2011; Graham, 2022). More recent international evidence further suggests that elevated hurdle rates are widespread across firms rather than a purely country-specific feature. Barry et al. (2024), for example, report that nearly 80% of surveyed CFOs use hurdle rates above their cost of capital, with an average hurdle-rate buffer of 6.6 percentage points. Taken together, this evidence suggests that conservative internal return thresholds are a broader feature of corporate investment practice, although their implications may vary across institutional settings.

While a growing literature examines investment in the UK (e.g., Melolinna et al., 2018; Haskel & Westlake, 2018; Shah et al., 2024), most studies focus on listed firms, aggregate conditions, or a single measure of the cost of capital. By contrast, we provide a firm-level analysis of how different market-based financing benchmarks, together with internally reported hurdle rates, shape investment decisions across a broad UK firm population. This allows us not only to test whether standard theoretical predictions hold across listed and unlisted firms, but also to assess whether internal required returns help explain weak investment over and above externally observed financing costs.

This study provides new evidence on the relationship between the cost of capital and firm investment in the UK using a dataset of more than 43,000 firms over 2013–2022. A key advantage of the data is the broad coverage of unlisted firms, which enables us to study investment behaviour beyond the publicly traded sector that dominates most existing empirical work. We examine several measures of firms' financing conditions and required returns, including the realised cost of debt, return on invested capital, implied cost of equity, WACC, and, for a subset of firms, internally reported hurdle rates. Because around 95% of our firm-year observations are unlisted, and because

firms without observable debt data are already excluded from the sample, the cost of debt is consistently available by construction across the estimation sample. We therefore use it as the main external financing benchmark for the broad unlisted population. Then we examine how these measures affect both tangible and intangible investment[1], recognising that different forms of investment may respond differently to financing conditions.

Our empirical results show that the cost of capital is an important determinant of firm-level investment, especially for tangible capital formation. Higher debt costs are robustly associated with lower investment, with the effects strongest among unlisted firms and among smaller, less productive, and more financially constrained firms. In economic terms, a one standard deviation increase in the cost of debt is associated with a decline in the investment rate equivalent to approximately 13% of the sample mean. However, one of the paper's most important findings concerns firms' internal hurdle rates. Using a smaller subsample of firms with explicitly reported hurdle rates, drawn mainly from large and listed firms, we show that internal required returns are materially higher than market-based financing benchmarks. On average, the hurdle rate is 10.7%, around 350–430 basis points above standard market-based capital cost measures. This internal–external wedge is strongly associated with lower realised investment: firms with a larger gap between hurdle rates and WACC invest significantly less. The result suggests that weak investment in the UK reflects not only external financing costs but also conservative internal capital budgeting rules. This result is particularly policy relevant because it implies that improving external financing conditions alone may be insufficient to revive investment. In particular, the response to easier

[1] In this paper, intangible investment refers to a narrower R&D-based measure, constructed from R&D expenditure net of amortisation, rather than a comprehensive measure of intangible capital. Broader intangible categories, such as software, organisational capital, branding, and design, are not consistently available for the full sample.

financing conditions need not mirror the response to tighter conditions if firms' internal return thresholds remain elevated and slow to adjust.

We also show that investment sensitivity to financing conditions is highly heterogeneous across firms. Unlisted firms are more sensitive to debt costs than listed firms, and the negative effect of debt costs becomes stronger as firm size declines. Geographic, productivity, growth, and financial-constraint heterogeneity further reveal that the aggregate relationship between financing conditions and investment masks substantial differences in firms' financing exposure and investment responsiveness. These patterns underscore the need for more differentiated policy approaches to UK investment, rather than treating firms as facing a common financing environment.

In sum, this paper contributes to literature in four ways. First, it provides new firm-level evidence on the relationship between financing conditions and investment in the UK using a broad sample in which unlisted firms account for most observations. This helps address an important gap in literature that has focused disproportionately on listed firms. Second, it brings together multiple market-based financing benchmarks within a single empirical framework, allowing a more nuanced assessment of which measures matter for which firms and for which types of investment. Third, and most distinctively, it shows that internally reported hurdle rates, and the wedge between internal hurdle rates and market-based financing costs, are strongly associated with realised investment behaviour. This highlights an important internal source of underinvestment that is often overlooked when attention is confined to external financing conditions alone. Fourth, the paper documents substantial heterogeneity across firm size, listing status, productivity, geography, growth profile, and financial constraints, with direct implications for investment policy and capital allocation reform in the UK.

The remainder of the paper is organized as follows. Section 2 describes the data and sample. Section 3 presents empirical results, and Section 4 concludes.

2. Data and Sample

Our firm-level data is primarily sourced from Orbis, which provides comprehensive financial information for both public and private firms in the UK. The initial sample comprises 43,639 UK firms over the period 2013 to 2022, corresponding to 221,337 firm-year observations. Approximately 95% of the sample consists of unlisted firms, reflecting the broader composition of the UK economy (Hutton, 2024). This broad coverage provides a more representative view of the UK business investment.[2]

In this paper, the term cost of capital is used in a broad sense rather than to refer to a single measure. Our key explanatory variables therefore include several market-based financing benchmarks, together with internally reported hurdle rates, each capturing a different aspect of firms' financing conditions or required returns. These include the cost of debt, the cost of equity, weighted average cost of capital (WACC), return on invested capital (ROIC), and internally reported hurdle rates. Given the predominance of private firms in our sample, the primary measure of interest is the cost of debt. While private firms also face an economic cost of equity, the market-based inputs needed to estimate it, such as equity betas and expected returns, are not directly observable, and cost-of-equity and WACC measures are available for only a much smaller subset of observations. We therefore focus on the cost of debt because it is consistently observed for a much larger share

[2] Since business investment is highly concentrated among a relatively small number of firms, especially larger firms, it is important to note that the analysis is based on unweighted firm-year observations. The estimates therefore speak most directly to the average firm-level relationship between financing conditions and investment, rather than to the aggregate investment response. To address this, we complement the baseline analysis with heterogeneity tests by firm size in Section 3.2.2, which allow us to assess separately how borrowing conditions are associated with investment among very large, large, medium, and small firms. This helps clarify whether the baseline patterns are driven by segments of the firm size distribution.

of firm-year observations and provides an observable firm-level borrowing benchmark for the broad unlisted sample. This should not be interpreted as implying that most UK firms finance investment primarily through debt. Existing evidence suggests that many UK firms, especially SMEs, rely heavily on retained earnings and owner injections, with external finance often playing a secondary role. Our preferred interpretation is that observed debt costs proxy firm-level borrowing conditions and are most informative in cases where external debt finance is relevant for investment decisions. Since business investment is highly concentrated among larger firms, we complement baseline estimates with heterogeneity analyses by size and listing status to assess where financing conditions are most relevant. Consistent with the broader macro picture, UK business investment growth has been modest and volatile in recent data. Additionally, we incorporate explicitly reported firm-level hurdle rates from Gormsen and Huber (2023), yielding approximately 1,577 observations and enabling a more refined analysis of internal hurdle rate policies and the gap between internal hurdle rates and external financing benchmarks. As a robustness check, we also report results on the subsample of listed firms, supplementing the data with stock market information from the Capital IQ database, which allows us to construct additional equity-based variables, such as Tobin's Q, for more detailed analysis of that subsample.

2.1. Investment Ratios

Consistent with prior literature, our key dependent variables are the investment ratio and the intangible investment ratio (Gutiérrez & Philippon, 2017; Melolinna et al., 2018; Gormsen and Huber, 2023). The investment ratio is measured as capital expenditures (CAPEX) [3] less

[3] In the Orbis database, capital expenditures represent additions to fixed assets and are reported as non-negative investment outlays. Asset disposals are not consistently reported for private firms and are therefore not directly netted out in this

depreciation[4], scaled by the net book value of plant, machinery, and equipment (PPE).[5] This definition isolates real tangible investment flows net of capital consumption. The intangible investment ratio is defined as research and development (R&D) expenditures less amortization, also scaled by the net book value of PPE, capturing firms' net investment in intangible assets.[6] We acknowledge that the dataset is limited in its coverage of intangible investments due to constrained financial disclosures among private firms of our sample. Nevertheless, we leverage the available information to robustly analyze how different the cost of capital measures affects firms' investment behavior between tangible and intangible assets, carefully adjusting the sample sizes and controlling for relevant characteristics.

2.2. Cost of Capital Measures and Internal Hurdle Rates

Our key explanatory variables include several market-based financing benchmarks, together with internally reported hurdle rates. These variables capture different aspects of firms' financing conditions and required returns. The market-based measures include the cost of debt, the cost of equity, return on invested capital (ROIC), and weighted average cost of capital (WACC), while the hurdle rate captures the internal return that firms apply when evaluating investment projects. The

measure. As a result, CAPEX less depreciation may be negative when depreciation exceeds new investment, reflecting net reductions in the capital stock.

[4] Depreciation is measured using firms' reported accounting depreciation from financial statements in Orbis. This corresponds to book depreciation, typically calculated using accounting rules such as straight-line depreciation over the expected useful life of assets, rather than economic depreciation measures used in national accounts statistics (e.g., ONS estimates).

[5] In the empirical specification, investment in fiscal year $t + 1$ is scaled by PPE in fiscal year t, so that the denominator reflects the beginning-of-period capital stock.

[6] In this study, intangible investment ratio should be interpreted narrowly as an R&D-based proxy for one component of intangible investment, rather than as a comprehensive measure of intangible capital. Broader categories of intangible investment, such as software, organisational capital, branding, design, and firm-specific knowledge assets, are not consistently available for the full sample, particularly for private firms.

primary measure used in our analysis is the cost of debt, calculated as interest expenses scaled by total interest-bearing debt. We focus on this measure mainly because it is observable for a much larger percentage of firm-year observations in Orbis, whereas market-based cost-of-equity measures and WACC are only available for a much smaller subset of firms. We therefore use the cost of debt as the main observable firm-level financing benchmark for the broad unlisted sample. This does not imply that most UK firms finance investment primarily through debt. Many UK firms, especially SMEs, rely heavily on retained earnings and other internal funds, with external finance often playing a secondary role. Even where investment is financed internally, the external cost of debt may still serve as a benchmark in firms' internal capital budgeting. Managers may use observed borrowing costs as a reference point when evaluating projects, setting internal required returns, or assessing the opportunity cost of committing internal funds rather than preserving liquidity or borrowing capacity. Our interpretation is therefore that observed debt costs capture variation in external borrowing conditions and financing benchmarks that may still matter for investment decisions, even when debt is not the direct marginal source of funding.

The realised cost of debt should not, however, be interpreted as a direct measure of the marginal cost of financing a new investment project. In firm-level accounting data, it reflects the average servicing cost of existing debt and may therefore incorporate both current financing arrangements and earlier borrowing conditions. This is particularly relevant for unlisted firms, which may adjust debt intermittently rather than continuously. The estimated coefficients should

therefore be interpreted as capturing the relationship between investment and firm-level borrowing conditions, rather than structural elasticities with respect to the marginal cost of new debt finance.[7]

We compute ROIC as net operating income after taxes divided by invested capital, providing insight into operational efficiency and internal returns on investment. For listed firms, we further estimate an implied cost of equity following Botosan (1997). This approach infers the expected return required by equity investors from observed market valuations together with information on firms' earnings, growth prospects, and payout patterns, and therefore provides a market-based measure of the cost of equity. WACC is then constructed as the weighted average of the cost of debt and the cost of equity, providing an assessment of the firm's overall market-based financing cost.

In addition, the hurdle rate, obtained directly from Gormsen and Huber (2023), captures the explicit managerial discount rate applied to investment projects. These hurdle rates represent the minimum acceptable return firms require when evaluating new investments, offering a unique perspective on managerial conservatism, internal capital allocation decisions, and strategic risk assessment beyond standard market-based cost of capital measures.

Figure 1 presents annual averages and medians of market-based cost of capital measures and internal hurdle rates for UK firms from 2013 to 2022. Internal hurdle rates[8] are consistently and

[7] More specifically, we do not interpret the realised cost of debt as a clean structural measure of the user cost of capital. Instead, we treat it as an observable firm-level borrowing benchmark that reflects the price of external finance and may also partly capture broader credit-market conditions. The estimated coefficients should therefore be understood as reduced-form relationships between investment and borrowing conditions, rather than as evidence on a single mechanism alone.

[8] Hurdle rates are taken from firms' disclosures (Gormsen & Huber, 2023) and may embed project-specific assumptions about risk, horizon, and financing. WACC and cost of debt are constructed at the firm-year level from available data and should be interpreted as corporate-wide financing benchmarks.

substantially higher than external benchmarks such as firm-level WACC and the accounting-based cost of debt. While these measures may not be perfectly comparable in all respects (e.g., tax treatment, horizon, and target capital structure), the persistent and economically large gap suggests a meaningful wedge between internal required returns and market-based financing benchmarks. This gap highlights managerial conservatism, reflecting potential internal risk aversion or cautious strategic investment approaches. The cost of debt remains relatively stable throughout the sample period, indicating limited variation in average effective borrowing rates in our firm-level data. Conversely, the cost of equity and ROIC exhibit greater year-to-year variation, which for the cost of equity likely reflects valuation-driven volatility and estimation noise in market-implied measures. ROIC variation may similarly capture changes in operating performance and accounting-based measurement variation. A notable divergence between means and medians exists consistently across most measures. Specifically, median values for cost of debt, cost of equity, ROIC, and hurdle rates are consistently lower than the corresponding means, indicating positively skewed distributions. Such skews typically arise from the presence of long tails, suggesting a subset of firms face disproportionately high capital costs or achieve higher returns. This pattern implies significant heterogeneity, potentially driven by poorly performing or financially constrained firms. Over time, these differences between means and medians remain pronounced, particularly for hurdle rates, highlighting persistent managerial conservatism and heterogeneous investment evaluation criteria among firms (Jagannathan et al., 2016).

Figure 1: Time Series of Cost of Capital Measures

This figure presents the annual averages (means) and medians of key cost of capital measures for UK firms from 2013 to 2022. The measures include cost of debt (CoD), cost of equity (CoE), return on invested capital (ROIC), weighted average cost of capital (WACC), and hurdle rate (Hurdle).

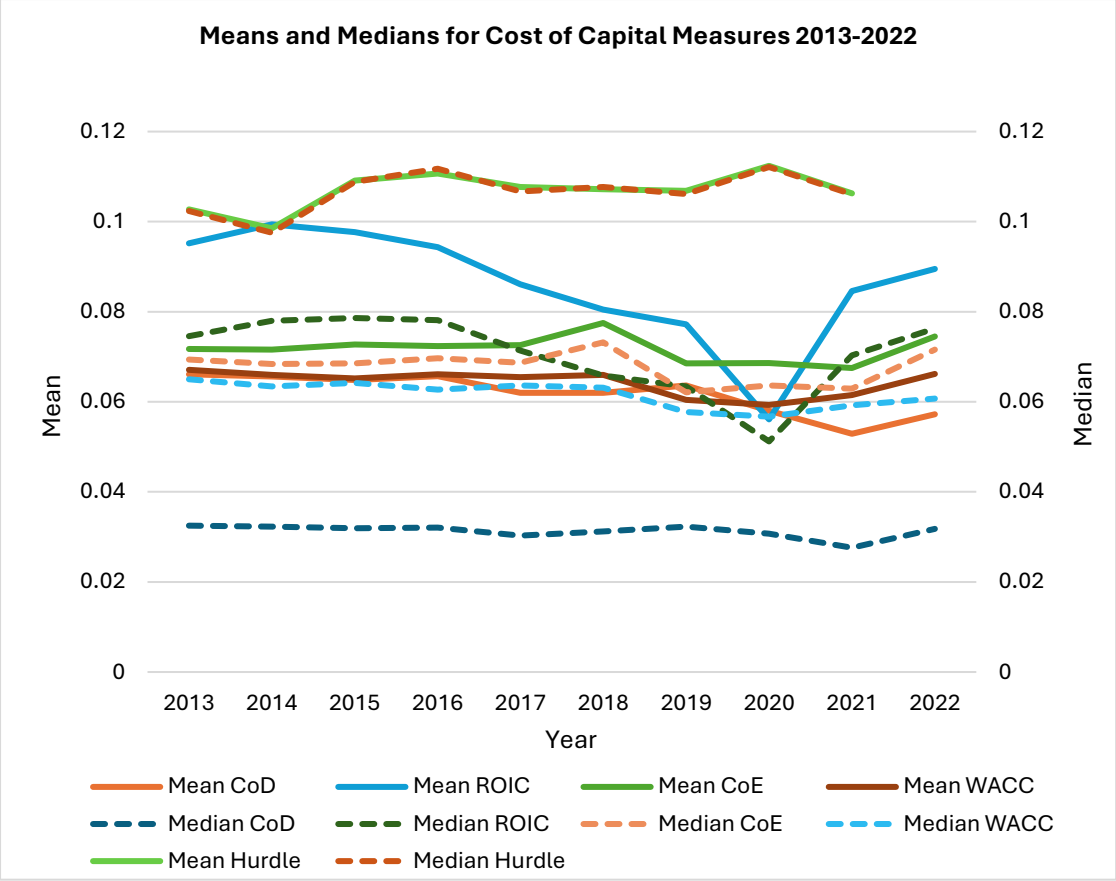
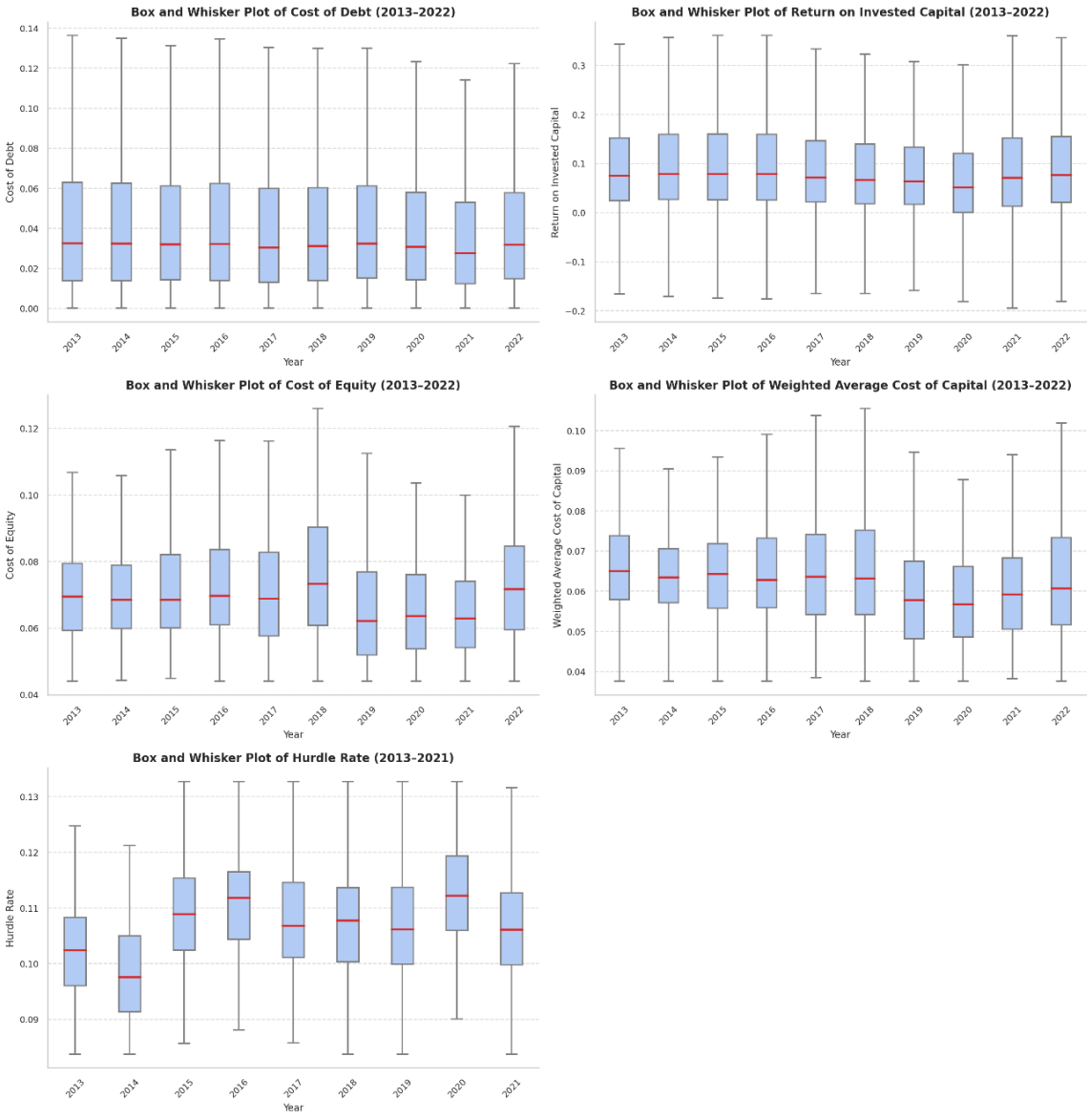


Figure 2 further illustrates the distributional properties of these measures using box-and-whisker plots, demonstrating within-year variations. While maximum values across the market-based financing measures and internal hurdle rates remain broadly stable year on year, notable differences appear in interquartile ranges and median positions within the boxes. Hurdle rates and cost of equity exhibit consistently higher medians and wider interquartile ranges, reflecting extensive heterogeneity and indicating that a considerable proportion of firms consistently face managerial heterogeneity in risk assessment and investment evaluation criteria, and high and equity financing costs. Conversely, cost of debt and WACC exhibit more compact distributions, with medians typically centrally positioned, suggesting relatively uniform external financing conditions for most firms. ROIC similarly shows substantial variability, capturing diverse levels of operational

efficiency and profitability across firms. Collectively, the varied distributions and differing positions of median lines relative to boxes across these measures highlight important differences in firms' exposure to capital market conditions, managerial conservatism, and performance outcomes, all critical factors shaping firm-level investment behavior in the UK (Gutierrez & Philippon, 2017; Melolinna et al., 2018).

Figure 2: Whisker and Box Plots of Cost of Capital Measures

This figure presents box and whisker plots for four key market-based cost of capital indicators, cost of debt, return on invested capital (ROIC), cost of equity, weighted average cost of capital (WACC), and internal hurdle rate for UK firms over the period 2013 to 2022 (2013-2021 for hurdle rate). The plots illustrate the distribution, median, interquartile range, and outliers for each measure by year.



2.3. Control Variables and Sample Characteristics

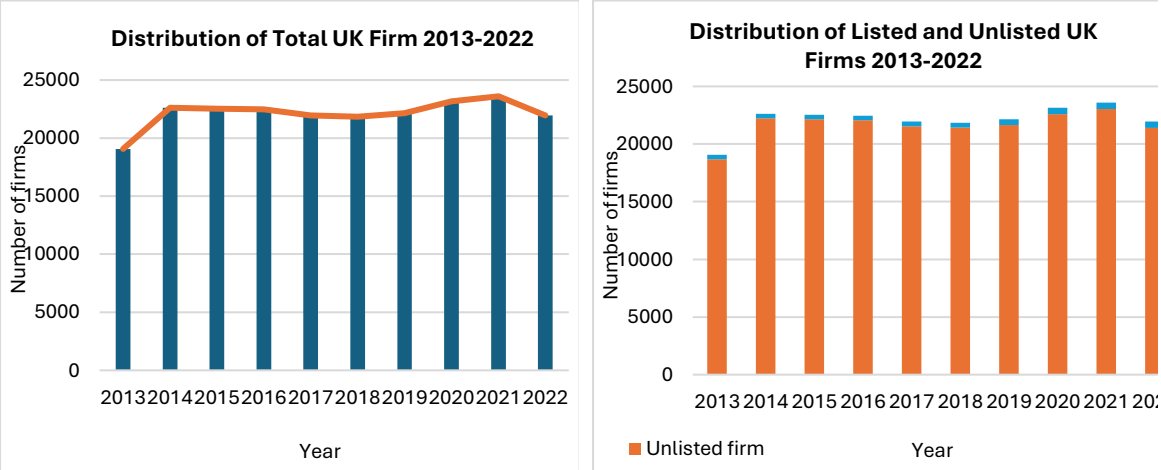
We incorporate several firm-level control variables. These include sales growth, capturing growth prospects and demand conditions (Fazzari, Hubbard, & Petersen, 1988); lagged return on assets (ROA), as a proxy for past profitability influencing investment capacity; liquidity measures such as current ratio and cash holdings (Almeida et al., 2004), as measures of liquidity and financial flexibility; and firm size (natural logarithm of total assets), controlling for scale effects and differential financing capacity. Furthermore, we include the Lerner Index as an accounting-based proxy related to markups or pricing power. In this setting, it should be interpreted cautiously, as it may capture not only competitive conditions, but also differences in efficiency, capital intensity, and product mix, all of which may also be related to profitability and investment behaviour. Incorporating market power helps to discuss the potential influence of competitive pressures on firms' investment responsiveness to changes in capital costs. Additionally, for the subsample of publicly listed firms, we further incorporate Tobin's Q as an additional control variable to capture growth prospects and market expectations. The definitions of all variables are provided in Appendix A. To minimize potential bias from outliers, all continuous variables are winsorized at 2% and 98% levels.

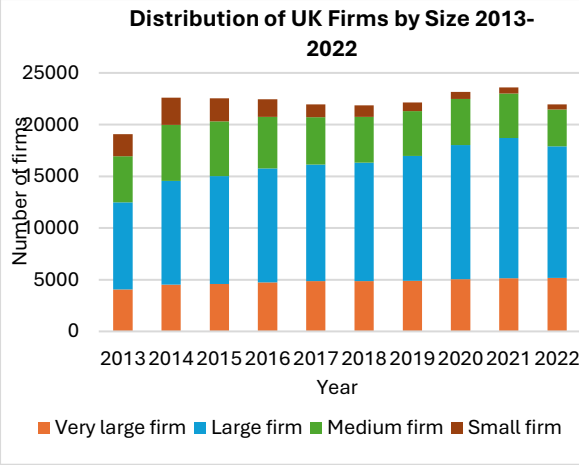
Figure 3 presents an overview of the distribution of the UK firms included in our dataset from 2013 to 2022. We first show the total distribution, followed by breakdowns by listing status, firm size, and industry sector. The total number of firms each year remains relatively stable at around 20,000 to 22,000, consistent with the stable but relatively subdued firm growth conditions observed in the UK economy over the past decade (Hutton, 2024). Most firms, in our sample,

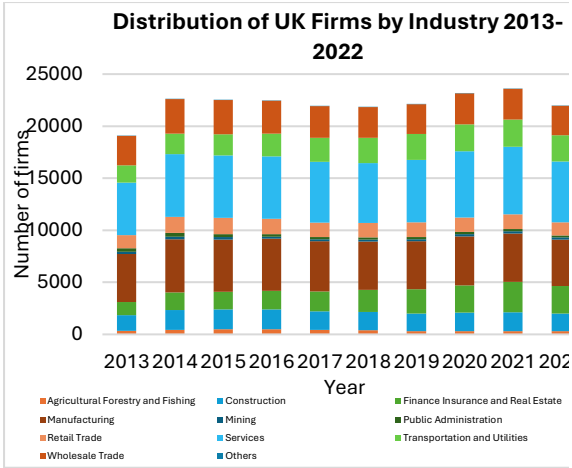
approximately 95% of the observations each year, are unlisted, which makes the cost of debt the most consistently observable external financing benchmark for this sample. Firm-size distribution shows a clear predominance of small and medium-sized enterprises, consistent with the broader UK business structure where SMEs significantly outnumber larger firms (Hutton, 2024). This pattern is also consistent with recent UK policy evidence showing substantial heterogeneity in business investment across firm sizes and a high concentration of total investment among a relatively small group of firms (Department for Business and Trade, 2024). The industry breakdown indicates that the sample is dominated by services, with manufacturing representing the largest non-service sector. This broad sectoral coverage ensures the generalizability and relevance of our findings across the UK economy.

Figure 3: Distribution of UK Firms with Cost of Capital Measures

This figure illustrates the distribution of UK firms with available cost of capital data from 2013 to 2022 across four key dimensions: (1) total number of firms over time, (2) listing status (listed vs. unlisted), (3) firm size category (very large, large, medium, small), and (4) industry classification. Industry groups include agriculture, construction, finance, insurance and real estate, manufacturing, mining, public administration, retail trade, services, transportation, wholesale trade, and others.







We further illustrate the entry and exit patterns of UK firms with available cost of capital data from 2013 to 2022 in Figure 4. The figure categorizes firms into four groups based on their presence across the sample period: (1) firms continuously present all over the period, (2) firms entering mid-sample and remaining to the end, (3) firms present at the start but exiting during the period, and (4) firms with intermittent presence. The largest group consists of firms continuously present throughout the sample period (Group 1), reflecting a stable core of firms with consistent financial statement coverage in Orbis. The number of such firms remains constant at 4,580. Group 2 shows a steady increase in firms entering after 2013 and persisting until 2022. This upward trend indicates ongoing firm entry into the dataset, potentially reflecting new firm incorporations and improvements in coverage and financial statement availability over time. In contrast, Group 3 captures firms present in 2013 but exit before the end of the sample. The declining numbers in this group highlight firm attrition, potentially due to factors such as delisting, mergers, bankruptcies, or data attrition for SMEs. Group 4 represents firms with intermittent presence, disappearing in mid-period years but reappearing by 2022. While smaller in number, the pattern suggests temporary data gaps or firms re-entering capital markets after restructuring or ownership changes.

Overall, these dynamics reflect both structural changes in the UK corporate sector and the realities of data availability. The persistent presence of core firms provides a robust basis for longitudinal analysis, while the observed entry and exit patterns underscore the importance of accounting for sample composition when interpreting cost of capital trends over time.

Figure 4: Entry and Exit of UK Firms with Cost of Capital Measures

This figure presents the number of UK firms with available cost of capital data from 2013 to 2022, categorized to illustrate firm entry and exit dynamics. Firms are grouped as follows: (1) firms present throughout the entire sample period; (2) firms not present at the start (2013), but entering mid-sample and remaining until the end (2022); (3) firms present at the start (2013) but exiting before the end of the sample period, disappearing in the middle years; and (4) firms present at the start (2013), temporarily exiting during the sample period, but re-entering by the end (2022).

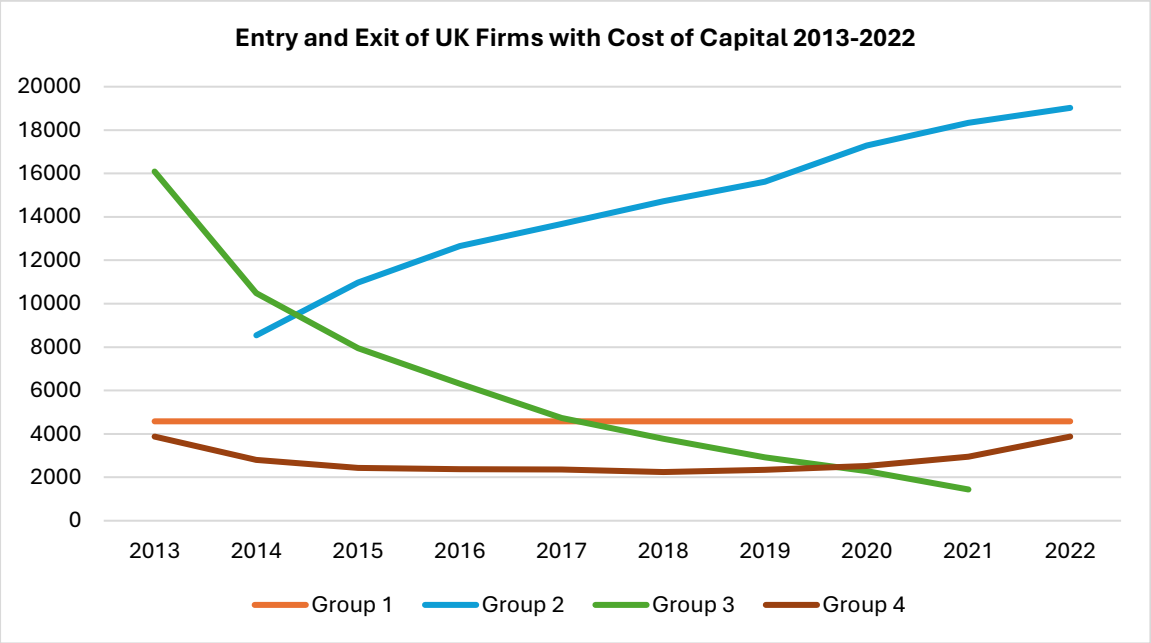


Table 1 reports descriptive statistics for the full sample. The investment ratio (mean = 0.217, median = -0.019) and the intangible investment ratio (mean = 1.113, median = 0.062) both exhibit considerable right-skewness and high standard deviations, suggesting substantial heterogeneity in investment behavior. The large discrepancy between mean and median for both investment types of points to the presence of long upper tails, is likely driven by a small subset of highly investing firms. Among the key independent variables, the cost of debt shows a relatively low mean of 6.2%, ROIC

is 8.6%, and WACC averages 6.4%, broadly consistent with figures reported in earlier UK studies (e.g., Botosan, 1997; Melolinna et al., 2018). ROIC and WACC both exhibit substantial variation, while hurdle rates (mean=10.7%) remain consistently higher than market-based capital costs, reaffirming managerial conservatism in internal capital budgeting (Gormsen & Huber, 2023). The Lerner Index has a mean close to zero but a wide range, indicating substantial variation in the markup-related characteristics captured by this measure across firms. This may be relevant for firms' pricing behaviour and their investment responses.

In Appendix Table A1, we further report summary statistics by splitting the sample into listed and unlisted firms (Panels A and B), and by firm size categories: very large, large, medium, and small firms (Panels C–F).[9] Several patterns emerge. First, the investment ratio increases with decreasing firm size, with small firms exhibiting the highest average ratio (mean = 0.229) and very large firms the lowest (mean = 0.259 but with a higher standard deviation). This possibly reflects higher volatility and lumpy investment in smaller firms. The cost of debt is relatively stable across firm sizes, but ROIC is substantially higher among smaller firms (mean = 14.9% in small firms vs. 6.7% in very large firms), suggesting that smaller firms may have higher but more volatile returns. Cash holdings are also higher in smaller firms, potentially indicating precautionary savings in the face of financing constraints (Almeida, Campello, & Weisbach, 2004). The higher cash-holdings may reflect firms' desire to maintain flexibility for seizing future investment opportunities, particularly under uncertainty or when external capital markets are imperfect (Opler et al., 1999). This motive appears more pronounced among smaller and medium-sized firms, which often lack

[9] We provide the correlation matrix for the right-hand side variables in Appendix Table A2.

access to deep equity or bond markets. The Lerner Index rises with firm size, consistent with the literature on concentration and pricing power in larger firms (Gutiérrez & Philippon, 2017).

Table 1. Summary Statistics

This table reports descriptive statistics for all UK firms with available cost of capital data from 2013 to 2022. The sample includes all firm-year observations for which the relevant variables are available. For each variable, the table presents the number of observations (N), mean, standard deviation (Std. Dev), minimum (Min), median, and maximum (Max) values. Definitions of all variables are provided in the Appendix.

Summary statistics all UK firms with available cost of capital measures from 2013 to 2022						
	N	Mean	Std. Dev	Min	Median	Max
Dependent variables						
Investment ratio	221,337	0.217	1.096	-0.631	-0.019	8.360
Intangible investment ratio	17,926	1.113	4.019	-0.053	0.062	31.005
Key independent variables						
Cost of debt	221,337	0.062	0.108	0.000	0.031	0.670
ROIC	221,337	0.086	0.170	-0.556	0.071	0.738
ROE	203,949	0.173	0.502	-2.062	0.129	2.560
Cost of equity	2,024	0.072	0.020	0.044	0.068	0.151
WACC	1,926	0.064	0.016	0.038	0.062	0.122
Hurdle rate	1,580	0.107	0.010	0.084	0.107	0.133
Control variables						
Sales growth	221,337	0.108	0.555	-0.905	0.023	5.203
ROA	221,337	5.210	13.662	-94.380	4.300	174.272
Cash holdings	221,337	0.115	0.146	0.000	0.060	1.000
Average cash holdings	174,612	0.108	0.133	0.000	0.060	1.000
Current ratio	221,337	2.094	3.665	0.000	1.408	81.310
Firm size	221,337	16.733	1.639	7.330	16.620	19.694
Lerner	221,337	-0.012	0.454	-5.714	0.021	1.000

In summary, because our dataset is dominated by unlisted firms, the cost of debt serves as the most consistently observable external financing benchmark in the analysis. This makes it particularly useful for examining how borrowing conditions are associated with tangible investment in a predominantly private firm setting, although it should not be interpreted as implying that debt is the marginal source of finance for all firms. Despite limitations in the availability of broader intangible asset data for private firms, our extensive controls and explicit consideration of firm characteristics allow us to provide a detailed analysis of how investment behaviour varies with financing conditions across UK firms.

3. Empirical Analysis

3.1. Baseline regression

To examine the relationship between market-based cost of capital measures, internal hurdle rates, and firm-level investment, we use the following formula:

$$\frac{I_{i,t+1}}{K_{i,t}} = \alpha + \beta_i CoC_{i,t} + \delta_i C_{i,t} + \mu_i + \gamma_{t+1} + \varepsilon_{i,t+1} \quad (1)$$

where $I_{i,t+1}/K_{i,t}$, the dependent variable is the investment ratio. $CoC_{i,t}$ is the market-based cost of capital measures and internal hurdle rates of firm i in fiscal year t. $C_{i,t}$ is a vector of firm-level control variables in year t. The control variables include sales growth, ROA, cash holding ratio, current ratio, firm size and Lerner Index. All models include firm and year fixed effects. μ_i and γ_{t+1} denote firm and investment-year fixed effects, respectively.[10] The standard errors are clustered by firm and year (Bertrand, Duflo, and Mullainathan, 2004) and adjusted for heteroscedasticity.

Table 2. Firm-level Investment and Cost of Capital Measures

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time *t+1*, scaled by total fixed assets at time *t*. The dependent variable in the Columns (5) to (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time *t+1*, scaled by total fixed assets at time *t*. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.263***				0.054			
	(-7.07)				(0.17)			
ROIC		-0.019				0.220		
		(-0.74)				(1.32)		
Cost of equity			-3.184*				4.742	
			(-1.73)				(1.30)	
WACC				-4.302**				0.636
				(-2.02)				(0.34)

[10] All regressions are estimated at the firm-year level and are not weighted by investment size. The resulting coefficients should therefore be interpreted as describing average relationships across firm-year observations rather than investment-weighted effects. The heterogeneity analyconservative lending sis by firm size in Section 3.2.2 provides a complementary perspective by estimating the relationship separately for different size categories.

Sales growth	0.139***	0.140***	0.148	0.183	0.191**	0.181**	0.508	0.456
	(10.51)	(10.40)	(0.63)	(0.75)	(2.52)	(2.42)	(1.19)	(1.12)
Lag ROA	0.005***	0.005***	-0.001	0.001	-0.002	-0.002	-0.033	-0.033
	(10.88)	(10.82)	(-0.14)	(0.02)	(-0.42)	(-0.52)	(-1.19)	(-1.09)
Avg cash holdings	0.802***	0.803***	1.042	0.602	1.324	1.307	-9.412	-10.195
	(11.15)	(11.16)	(1.50)	(0.86)	(1.43)	(1.42)	(-1.10)	(-1.15)
Current ratio	-0.008***	-0.008***	0.004	-0.004	-0.049	-0.050	0.135	0.153
	(-4.64)	(-4.92)	(0.28)	(-0.29)	(-1.16)	(-1.19)	(0.82)	(0.89)
Firm size	0.246***	0.253***	0.269*	0.255	0.355*	0.345	1.112	1.241
	(16.89)	(17.32)	(1.81)	(1.49)	(1.68)	(1.64)	(1.13)	(1.14)
Lerner	-0.044**	-0.042**	0.101	0.122	-0.092	-0.139	1.318	1.541
	(-2.34)	(-2.09)	(0.28)	(0.33)	(-0.64)	(-0.84)	(1.34)	(1.46)
Constant	-4.084***	-4.205***	-5.228*	-4.853	-5.520	-5.332	-22.446	-24.887
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	165,135	165,135	1,560	1,461	13,001	13,001	1,020	951
Adjusted R^2	0.051	0.051	0.174	0.150	0.743	0.743	0.581	0.558

Table 2 presents the baseline regression results on the relationship between market-based cost of capital measures and firm-level net investment using OLS estimation. Columns (1) to (4) report the results for the investment ratio, defined as CAPEX excluding depreciation scaled by fixed assets, while Columns (5) to (8) focus on intangible investment, defined as R&D expenditure net of amortisation scaled by fixed assets. A key finding is that the cost of debt is negatively and statistically significantly associated with tangible investment. In Column (1), the coefficient on the cost of debt is -0.263, implying that a one percentage point higher observed cost of debt is associated with a 0.263 percentage point lower CAPEX-to-fixed-assets ratio. In economic terms, a one standard deviation increase in the cost of debt is associated with a 2.84% decline in the investment rate, equivalent to 13.1% of the sample mean investment rate. [11]This result suggests that less favourable borrowing conditions are associated with weaker firm-level investment in tangible capital. While Modigliani and Miller (1958) imply financing irrelevance under perfect capital

[11] It is also important to note that the dependent variable is net investment, defined as CAPEX minus depreciation, rather than gross investment expenditure. Since the median of this variable is negative and many observations lie close to zero, the reported elasticities may be mechanically amplified for firms with very low or negative net investment. The estimated magnitudes should therefore be interpreted as net-investment responses and do not map one-for-one into gross investment effects.

markets, in the presence of financing conditions, the cost and availability of external finance may affect investment when internal funds are insufficient (Myers & Majluf, 1984; Fazzari et al., 1988). In our predominantly private-firm sample, we therefore interpret the cost of debt as an observable firm-level borrowing benchmark rather than as a direct measure of the marginal cost of financing new investment.

In addition, the cost of equity and WACC are included in models using subsamples with sufficient data coverage, reflecting their more limited availability for private firms. Where included, both measures exert negative and statistically significant effects on tangible investment. Column (3) reports a coefficient of -3.184 for the cost of equity, while Column (4) reports a coefficient of -4.302 for WACC, suggesting that market-based financing costs also matter for capital allocation when observable. By contrast, for intangible investment, none of the cost of capital measures, including the cost of debt, the cost of equity, or WACC, achieves conventional levels of statistical significance. This weaker relationship may reflect the fact that intangible investment is shaped less by observable borrowing conditions and more by internal funding capacity, longer investment horizons, and strategic considerations (Peters & Taylor, 2017; Haskel & Westlake, 2017).

Turning to the control variables, several patterns emerge. Sales growth is a consistently strong and positive predictor of both tangible and intangible investment, aligning with theories that firms with greater growth opportunities are more likely to invest (Erickson & Whited, 2000). Similarly, lagged ROA is positively associated with tangible investment (Columns 1&2), capturing the effect of retained earnings and profitability on capital spending.

In our main specification (Table 2), we use the three-year average of lagged cash holdings as a control variable, following prior studies that emphasize the importance of smoothing transitory

liquidity shocks to better capture a firm's structural liquidity position (e.g., Opler et al., 1999; Pinkowitz & Williamson, 2001). This approach reduces concerns about endogeneity and reflects firms' persistent financial capacity rather than temporary cash accumulation. The results show a positive and statistically significant association between average cash holdings and the tangible investment ratio, suggesting that firms with sustained internal liquidity are more likely to engage in capital investment. This finding supports theories of internal finance and financial flexibility, where access to stable cash reserves enables firms to fund investment without relying on costly or uncertain external finance (Almeida et al., 2004). In contrast, when we include contemporaneous (one period lagged) cash holdings instead (Appendix Table A3), the coefficient becomes negative and statistically significant, a result consistent with precautionary saving behavior. This divergence reinforces the interpretation that high cash balances in a single year may reflect firms' financial distress or uncertainty rather than readiness to invest (Faulkender & Wang, 2006; Bates et al., 2009). Together, these findings highlight the importance of using a smooth measure of cash holdings to better isolate the long-term investment implications of internal liquidity.

The current ratio, another liquidity measure, is negatively associated with tangible investment. This may reflect similar precautionary motives, where firms with high short-term liquidity prefer to maintain flexibility rather than commit resources to long-term capital projects. This is in line with recent evidence suggesting that financially cautious firms use liquidity defensively to weather external shocks or policy changes (Baum, Caglayan, & Stephan, 2009). Firm size shows a positive and significant relationship with investment, suggesting that larger firms invest more as they are less financially constrained, more likely to have better access to capital markets and economies of scale (Hadlock & Pierce, 2010).

Finally, the Lerner Index enters with a negative and statistically significant coefficient in the full-sample regressions (Column 1). Interpreting this result requires caution. In accounting data, the Lerner Index is best viewed as a proxy related to markups or pricing power rather than a clean measure of market power, since it may also reflect differences in efficiency, capital intensity, and product mix. The negative coefficient therefore indicates that firms with higher observed markups or pricing power tend to invest less intensively, but it should not be read as establishing a causal effect of market power on investment. One possible interpretation is that firms facing weaker competitive pressure may have lower incentives to expand capacity or undertake additional investment, which is broadly consistent with the arguments in Aghion et al. (2005) and the evidence in Gutiérrez and Philippon (2017). At the same time, the result may also partly reflect compositional or mechanical relationships in the data. We therefore interpret the Lerner coefficient as suggestive of a link between markup-related firm characteristics and investment behaviour, rather than as definitive evidence that market power itself reduces capital formation.

In sum, the baseline regressions in Table 2 highlight the consistent negative association between the cost of debt and tangible investmen tin this predominantly private-firm sample. Intangible investment appears less sensitive to traditional capital costs, possibly reflecting its unique funding and strategic characteristics. These insights reinforce the need for careful treatment of firm heterogeneity and financing structure in investment modelling.

To further understand the mechanisms through which capital costs affect firm investment behaviour, we decompose investment responses into extensive and intensive margins. Prior research highlights that firm investment is often characterised by lumpy adjustment patterns, where aggregate investment fluctuations arise primarily from changes in the number of firms undertaking

investment rather than from continuous adjustments in investment size (Gourio & Kashyap, 2007; Disney, Miller, & Pope, 2020). Recent UK evidence further shows that firms actively manage their balance sheet composition around these lumpy adjustment episodes, building cash reserves and adjusting leverage in the lead-up to large capacity changes, with small firms relying more heavily on internal finance than larger firms (Görtz, Tsoukalas, & Walsh, 2025). Following this literature, Table 3 reports regressions examining how different cost of capital measures influence the probability of investment and the scale of investment conditional on investing. Panel A presents results for the extensive margin, where the dependent variable is an investment dummy indicating whether a firm undertakes positive investment each year. The results show that higher capital costs significantly reduce the likelihood that firms undertake investment. In particular, the cost of debt is strongly negatively associated with the probability of investment, suggesting that less favourable borrowing conditions discourage firms from initiating investment projects. Panel B further examines lumpy investment episodes, defined as investment exceeding 20 per cent of capital stock. The results again indicate a strong negative relationship between capital costs and the probability of large investment episodes, consistent with the view that firms facing higher capital costs are more likely to postpone or cancel major investment projects. Panel C focuses on the intensive margin, where the dependent variable is the investment ratio conditional on positive investment. The results indicate that capital costs also affect the scale of investment, although the magnitude of this effect is smaller compared to the extensive margin. Taken together, these findings suggest that capital costs influence firm investment primarily by affecting whether firms undertake investment at all rather than merely altering the scale of investment conditional on investing. This pattern is consistent with the lumpy investment literature, which emphasises that firms often respond to higher

financing costs by delaying or cancelling investment projects rather than continuously scaling investment levels (Gourio & Kashyap, 2007; Disney et al., 2020), and that the financial management around such episodes differs systematically across the firm size distribution (Görtz et al., 2025).

Table 3. Extensive and Intensive Margins of Firm Investment

This table reports regression examining how cost of capital measures affects firm investment along the extensive and intensive margins from 2013 to 2022. Panel A uses an investment dummy as the dependent variable, defined as an indicator equal to one if the firm undertakes positive investment in year t+1, and zero otherwise. Panel B uses a lumpy investment dummy, defined as an indicator equal to one if the firm undertakes a large investment episode in year t+1, where the investment ratio exceeds 20 percent of capital stock. Panel C examines the subsample of the intensive margin, where the dependent variable is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t, conditional on positive investment. All models include firm and year fixed effects. Control variables include sales growth, lagged ROA, average cash holdings, current ratio, firm size, and the Lerner index. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A:		***Investment dummy***		
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.1668***			
	(-10.955)			
ROIC		0.0353***		
		(4.336)		
Cost of equity			-3.9297***	
			(-3.751)	
WACC				-5.4504***
				(-4.825)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	179,182	179,182	1,582	1,481
Adjusted R^2	0.333	0.333	0.282	0.306
Panel B:		***Lumpy investment dummy***		
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.1459***			
	(-12.021)			
ROIC		0.0056		
		(0.823)		
Cost of equity			-3.0992***	
			(-3.694)	
WACC				-4.7092***
				(-5.627)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	179,182	179,182	1,582	1,481
Adjusted R^2	0.417	0.416	0.319	0.334
Panel C:		***Investment ratio***		
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.3337***			
	(-3.668)			
ROIC		-0.1737**		
		(-2.455)		
Cost of equity			-3.0519	
			(-0.850)	
WACC				-3.5683

				(-0.778)
Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	60,617	60,617	771	718
Adjusted R^2	0.453	0.453	0.530	0.476

To account for broader macro-political disruptions, Table 4 introduces a post-2020 indicator, defined as a binary variable equal to one for years 2020 onward. This variable is intended as a broad period control capturing major shocks affecting UK firms after 2020, including Brexit-related adjustment, the COVID-19 shock, associated policy responses, and supply-chain disruptions. Importantly, the core results remain intact: the cost of debt continues to exhibit a negative and statistically significant relationship with tangible investment, supporting the robustness of the baseline association between borrowing conditions and capital expenditure. The post-2020 indicator itself also enters negatively and significantly in the investment regressions, indicating weaker firm-level investment during the post-2020 period. This coefficient should, however, be interpreted as a broad period effect rather than as a clean causal estimate of Brexit alone. These findings underscore the importance of controlling for major structural disruptions in empirical investment models. While the post-2020 period effect does not overturn the main relationship between borrowing conditions and investment, its significance highlights the extent to which UK firms operated in a more adverse macroeconomic and institutional environment after 2020.

To examine whether the post-2020 effect varies across firms with different characteristics, Appendix Table A4 includes an interaction term between the post-2020 indicator and firm size. This specification allows us to capture heterogeneity in firms' exposure to post-2020 disruptions without resorting to a simple pre–post sample split, which would sharply reduce time-series variation. The results indicate that while the level effect of the post-2020 indicator is positive, its interaction with

firm size is negative and statistically significant across both tangible and the paper's narrower measure of intangible investment. This pattern is consistent with the possibility that smaller firms were relatively less exposed to post-2020 disruptions, while larger firms, given their greater exposure to international supply chains, trade frictions, and regulatory change, experienced a relatively weaker investment response. These results should again be interpreted as descriptive heterogeneity in the post-2020 period rather than as clean causal estimates of Brexit effects alone.

Table 4. Firm-level Investment and Cost of Capital Measures with Post-2020 Period Control

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022 with further control of Post-2020. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time *t+1*, scaled by total fixed assets at time *t*. The dependent variable in the Columns (5) to (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time *t+1*, scaled by total fixed assets at time *t*. All models include firm fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.257***				0.042			
	(-7.27)				(0.13)			
ROIC		-0.069**				0.274		
		(-2.22)				(0.98)		
Cost of equity			-3.103*				6.497	
			(-1.81)				(1.18)	
WACC				-6.335***				-2.072
				(-2.80)				(-0.56)
Sales growth	0.138***	0.140***	0.112	0.149	0.220**	0.210***	0.670	0.667
	(11.39)	(11.33)	(0.50)	(0.64)	(2.91)	(2.79)	(1.26)	(1.28)
Lag ROA	0.004***	0.004***	0.001	0.001	-0.001	-0.001	-0.034	-0.036
	(9.20)	(9.22)	(0.07)	(0.04)	(-0.24)	(-0.32)	(-1.09)	(-1.02)
Avg cash holdings	0.785***	0.785***	1.324*	0.799	1.276	1.266	-11.766	-12.814
	(11.51)	(11.52)	(1.85)	(1.11)	(1.39)	(1.37)	(-1.09)	(-1.13)
Current ratio	-0.007***	-0.008***	0.006	-0.001	-0.049	-0.049	0.132	0.164
	(-4.54)	(-4.82)	(0.41)	(-0.08)	(-1.17)	(-1.19)	(0.82)	(0.90)
Firm size	0.269***	0.276***	0.666**	0.716**	0.417*	0.413*	-0.618	-0.751
	(19.36)	(19.80)	(2.33)	(2.43)	(1.92)	(1.92)	(-1.08)	(-1.23)
Lerner	-0.045**	-0.037**	0.016	0.051	-0.104	-0.143	1.267	1.493
	(-2.55)	(-1.99)	(0.04)	(0.14)	(-0.72)	(-0.88)	(1.35)	(1.48)
Post-2020 Period	-0.149***	-0.147***	-0.002	-0.148**	-0.126**	-0.124**	-0.122	-0.243
	(-22.47)	(-22.36)	(-0.03)	(-1.97)	(-2.01)	(-1.99)	(-0.53)	(-0.73)
Constant	-4.417***	-4.530***	-12.581**	-13.300**	-6.474*	-6.409*	12.879	16.050
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	165,135	165,135	1,560	1,461	12,976	12,976	1,018	951
Adjusted R^2	0.048	0.048	0.162	0.147	0.744	0.744	0.574	0.550

As a robustness check[12], Table 5 then reports estimates from Poisson Pseudo-Maximum Likelihood (PPML) regressions, which account for the non-negative and often skewed distribution of investment variables. The PPML estimator is well-suited for models where the dependent variable is non-negative and may include a substantial number of zeros, various forms of heteroskedasticity and provide consistent estimates even when the linear functional form of the conditional mean is mis-specified (Silva & Tenreyro, 2006; Fuest et al., 2018). In these specifications, the tangible investment ratio is defined as capital expenditure (CAPEX) scaled by fixed assets, while the intangible investment ratio is calculated as R&D expenses over fixed assets. [13] The results for tangible investment (Columns 1–4) remain consistent with our OLS baseline: the cost of debt retains a negative and statistically significant effect, with a coefficient of –0.366 ($p < 0.01$). Similar patterns hold for the cost of equity and WACC. The coefficient magnitudes are comparable to earlier estimates, reinforcing the economic significance of financing costs. For intangible investment (Columns 5–8), the associations with cost of capital measures remain weaker and statistically insignificant in most cases, confirming our earlier interpretation that such investment may rely on alternative financing mechanisms or internal firm-specific factors. These findings confirm that the negative effect of the cost of debt on tangible investment is robust to alternative estimation methods, enhancing the credibility of our core results. This additional check is consistent with the baseline finding that the cost of debt is the most consistently significant

[12] In Appendix Table A5, we also present results for the subsample of firms with available intangible investment data, addressing potential sample selection concerns in the intangible investment regressions. Appendix Table A6 reports results for the subsample of listed firms, where Tobin's Q is included as an additional control variable to account for firms' investment opportunities.

[13] The net investment ratio which we used in our baseline regression is defined as CAPEX minus deprecation scaled by PPE or the R&D minus amortization scaled by PPE.

financing benchmark in the tangible investment regressions, particularly within a sample dominated by private firms.

Table 5. Firm-level Investment and Cost of Capital Measures with Alternative Models

This table presents results from Poisson Pseudo-Maximum Likelihood (PPML) regressions examining the effects of cost of capital measures on firm-level tangible investment and intangible investment. Due to the PPML model's requirement for non-negative dependent variables, the investment ratio is measured as capital expenditures (CAPEX) at time t+1 scaled total fixed assets at time t. And the intangible investment ratio is measured as R&D expenditures at time t+1 scaled by total fixed assets at time t. Columns (1) to (4) report results for tangible investment, and Columns (5) to (8) report results for intangible investments. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio (CAPEX/PPE)				***Intangible investment ratio (R&D/PPE)***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.366***				-0.032			
	(-5.04)				(-0.13)			
ROIC		-0.110***				0.212		
		(-2.67)				(1.47)		
Cost of equity			-10.511***				9.923**	
			(-3.42)				(2.06)	
WACC				-14.528***				-8.006
				(-3.28)				(-0.74)
Sales growth	0.186***	0.188***	0.160	0.171	0.149***	0.143***	2.611***	1.946***
	(13.29)	(13.39)	(1.31)	(1.25)	(3.13)	(3.08)	(3.62)	(2.95)
Lag ROA	0.005***	0.005***	-0.009	-0.006	-0.001	-0.001	-0.020***	-0.016*
	(6.60)	(6.79)	(-1.30)	(-0.89)	(-0.18)	(-0.28)	(-2.70)	(-1.84)
Avg cash holdings	0.877***	0.882***	1.161	1.028	0.504	0.486	-1.551	-1.338
	(6.86)	(6.89)	(1.08)	(0.94)	(1.06)	(1.02)	(-1.08)	(-0.76)
Current ratio	-0.019***	-0.019***	0.023	-0.077	-0.015	-0.016	0.504	0.520
	(-4.69)	(-4.81)	(0.29)	(-0.83)	(-1.06)	(-1.18)	(1.41)	(1.44)
Firm size	0.306***	0.317***	0.130	0.035	0.211**	0.202**	0.757*	0.918*
	(13.37)	(13.82)	(0.82)	(0.21)	(2.31)	(2.20)	(1.77)	(1.92)
Lerner	-0.157***	-0.141***	-0.393	-0.381	-0.007	-0.038	-0.452	0.253
	(-7.54)	(-6.33)	(-0.86)	(-0.78)	(-0.09)	(-0.42)	(-0.57)	(0.28)
Constant	-4.849***	-5.051***	-1.409	0.762	-1.617	-1.453	-15.221*	-17.440*
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	165,091	165,091	1,564	1,463	11,419	11,419	535	493
Adjusted R^2	0.431	0.431	0.418	0.409	0.776	0.776	0.791	0.791

To address potential endogeneity concerns, such as reverse causality or omitted variable bias, we estimate a two-stage least squares (2SLS) specification using the leave-one-out industry-level average cost of debt, defined at the 2-digit SIC industry level, as an instrument for firm-specific cost of debt. Specifically, the instrument is constructed as the average cost of debt of other firms in the same 2-digit industry, excluding firm i, which helps reduce mechanical correlation between the

firm-level regressor and the instrument. The first-stage results in Table 6 confirm the strength and relevance of the instrument: the coefficient on the leave-one-out industry-average cost of debt is 0.937 (t=34.94), while the Kleibergen–Paap rk LM statistic (p<0.001) and the Stock–Yogo weak identification test (F=16.38) indicate that the instrument is relevant and sufficiently strong. The second-stage estimates continue to show a negative and statistically significant effect of the fitted cost of debt on tangible investment, with a coefficient of −0.375 (p<0.05). This effect is larger than the corresponding OLS estimate reported in Table 2, which is consistent with the possibility that OLS attenuates the relationship because of measurement error or other sources of bias. At the same time, the exclusion restriction warrants caution. Industry-level borrowing costs may reflect not only firm-level financing conditions, but also sector-specific demand conditions, investment opportunities, or credit-market developments that could affect investment more directly. Since year fixed effects absorb common macroeconomic shocks but not all industry-year variations, the IV estimates should be interpreted as supportive evidence consistent with the main findings, rather than as fully definitive causal estimates. Taking this into account, the IV results reinforce the conclusion that less favourable borrowing conditions are associated with weaker tangible investment.

Table 6. Instrumental Variables Regression of Cost of Debt on Tangible Investment

This table reports the results of a two-stage least squares (2SLS) regression estimating the impact of cost of debt on firm-level tangible investment for UK firms over the period 2013–2022. The dependent variable in Column (2) is the tangible investment ratio, defined as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. The endogenous regressor, firm-specific cost of debt, is instrumented using the industry-average cost of debt. Column (1) presents the first-stage regression results, confirming instrument relevance. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:		
	Investment ratio	
Variables	(1) *First Stage*	(2) *Second Stage*
Industry cost of debt	0.937***	
	(34.94)	
Fitted cost of debt		-0.375**
		(-2.36)

Sales growth	-0.001	0.209***
	(-1.04)	(19.72)
Lag ROA	-0.001*	0.004***
	(-1.87)	(13.63)
Avg cash holdings	0.027***	0.317***
	(8.02)	(13.21)
Current ratio	0.002***	-0.003**
	(11.42)	(-2.56)
Firm size	-0.002***	0.023***
	(-8.52)	(13.77)
Lerner	-0.001	-0.057***
	(-0.14)	(-6.10)
Constant	0.030	-0.251
Firm FE	Yes	Yes
Year FE	Yes	Yes
N	174,612	174,612
Adjusted R^2	0.104	0.017
Underidentification test:		
Kleibergen-Paap rk		556.778
(P-value)		(0.000)
Weak identification test:		
Stock-Yogo 10% IV size		16.38

We further conduct two complementary analyses to examine the consistency of our main findings. First, we restrict the sample to firms with available intangible investment data, allowing for a more direct comparison between tangible and intangible investment behaviours. The results continue to show a strong negative association between the cost of debt and tangible investment, while intangible investment appears less sensitive to financing costs. Second, we incorporate Tobin's Q as an additional control using the subsample of listed firms. The main cost of capital effects persists. These additional analyses support the overall patterns observed in the full-sample regressions, with the results reported in Appendix Tables A4 and A5.

3.2. Firm types: listing status, size, location and growth characteristics

3.2.1. Firm listing status

Given that approximately 95% of the sample consists of unlisted firms, the primary empirical patterns observed in our main regression results are driven by these firms. Then, we explore whether the effect of financing costs differs between unlisted and listed firms. Table 7 presents results for

private firms, confirming that the cost of debt continues to exhibit a statistically significant and economically meaningful negative relationship with tangible investment. The results indicate that a one standard deviation increase in the cost of debt is associated with a 2.57% decline in the investment rate, equivalent to 12% of the average investment rate. This is consistent with the interpretation that borrowing conditions are especially relevant for these firms. Unlisted firms typically have more limited access to capital markets and therefore depend more heavily on bank lending when external finance is needed, making them more sensitive to variation in observed debt costs (Michaelas, Chittenden, & Poutziouris, 1999; Beck, Demirgüç-Kunt, & Maksimovic, 2008).

We then include the return on equity (ROE) as a proxy for the cost of equity among these unlisted firms. The coefficient on ROE is positive and weakly significant in the tangible investment regression, suggesting that higher realized returns are associated with greater physical investment. This result is consistent with that, for private firms lacking market-based equity financing, internally generated equity (retained earnings) acts as an important funding source for new investment. However, ROE shows a negative and insignificant association with intangible investment, implying that internal funds are primarily allocated to tangible rather than intangible projects.

Overall, these findings emphasize that debt-related financing costs remain the dominant channel through which monetary and credit conditions affect investment among unlisted UK firms. In the UK, while the financial system is well-developed, unlisted firms, most of them are small and medium-sized enterprises (SMEs) and are typically face more restricted access to credit and remain dependent on traditional bank loans (Bank of England, 2020). Since these firms do not issue public equity or bonds, their exposure to shifts in monetary conditions, such as changes in interest rates or credit standards, tends to operate primarily through the cost and availability of debt. This potentially

helps explain why the cost of debt is the only cost of capital variable that consistently explains variation in investment across the full sample, whereas equity-based measures, particularly ROE and ROIC, play a more limited role.

Appendix Table A7 reports the corresponding results for listed firms. A one standard deviation increase in the cost of debt is associated with a 5.84% reduction in the investment rate, equivalent to 13.8% of the sample mean (0.169). In comparison, a one standard deviation increase in the weighted average cost of capital (WACC) leads to a larger decline in investment, approximately 8.45%, or nearly 20% of the average investment rate. These results suggest that WACC may serve as a more comprehensive measure of capital cost constraints for listed firms, capturing the joint influence of debt and equity financing costs. The greater responsiveness to WACC likely reflects listed firms' broader access to capital markets and the importance of overall capital structure considerations in their investment decisions, beyond reliance on debt financing alone. While the disparity in sample size warrants caution in drawing direct comparisons, the signs and statistical significance of key control variables, such as sales growth, profitability, and firm size, are broadly consistent across the two groups. Overall, the results highlight the consistent association between the cost of debt and investment among unlisted firms and underline the importance of accounting for ownership structure and financing access in empirical analyses of corporate investment behaviour.

Table 7. Firm-level Investment and Cost of Capital Measures for Unlisted Firms

This table presents the results of regressions examining how the cost of capital measures affect firm-level net investments (in tangible and intangible capital) among unlisted UK firms from 2013 to 2022. The dependent variable in the Columns (1) to (3) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. The dependent variable in the Columns (4) to (6) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-

robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Dependent variable:					
	Investment ratio			*Intangible investment ratio*		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Cost of debt	-0.238***			-0.028		
	(-6.31)			(-0.08)		
ROIC		-0.022			0.068	
		(-0.85)			(0.34)	
ROE			0.015*			-0.072
			(1.682)			(-0.852)
Sales growth	0.136***	0.137***	0.1290***	0.114	0.111	0.1386
	(10.05)	(9.96)	(9.626)	(1.11)	(1.09)	(1.343)
Lag ROA	0.004***	0.004***	0.0051***	-0.000	-0.000	0.0021
	(9.24)	(9.21)	(10.219)	(-0.01)	(-0.04)	(0.468)
Avg cash holdings	0.803***	0.805***	0.7302***	0.812	0.808	0.8874
	(10.97)	(10.99)	(10.445)	(0.88)	(0.87)	(0.950)
Current ratio	-0.008***	-0.008***	-0.0087***	-0.073	-0.073	-0.0703
	(-4.48)	(-4.72)	(-5.064)	(-1.39)	(-1.42)	(-1.383)
Firm size	0.251***	0.257***	0.2345***	0.422**	0.420**	0.2503
	(16.81)	(17.20)	(16.752)	(2.11)	(2.12)	(1.363)
Lerner	-0.052***	-0.048**	-0.0686***	0.183	0.160	0.3244
	(-2.60)	(-2.30)	(-3.009)	(0.65)	(0.50)	(1.006)
Constant	-4.121***	-4.233***	-3.8942***	-6.229*	-6.214*	-3.3652
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
N	159,823	159,823	149,389	9,955	9,955	9,760
Adjusted R^2	0.049	0.048	0.049	0.747	0.747	0.748

3.2.2. Firm sizes

We further segment the regression analysis by firm size in Table 8 [14], with results presented separately for very large, large, medium, and small firms [15] in Panels A to D. The results reveal differences in the sensitivity of investment to the cost of capital measures across firm size

[14] Due to limitations in available market data, cost of equity and WACC are only reported for very large firms. For the remaining groups, the large, medium, and small size firms, sample sizes with available data for these variables are too limited for meaningful analysis. This reflects both the unlisted status of most UK firms and the limited public market data available for smaller enterprises, reinforcing the importance of cost of debt in understanding investment behavior across most of the UK companies. For the results of intangible, the sample size is restricted.

[15] The firm size classification is detailed in the Appendix. Very large firms are defined as those with operating revenue exceeding USD 130 million, total assets exceeding USD 260 million, or more than 1,000 employees. Large firms have operating revenue of more than USD 13 million, total assets of more than USD 26 million, or over 150 employees. Medium firms are those with operating revenue above USD 1.3 million, total assets above USD 2.6 million, or more than 15 employees. Companies that do not meet any of these criteria are classified as small firms.

distribution. The negative effect of cost of debt on tangible investment is significant across all size categories. However, the magnitude of this effect increases as firm size decreases, and it is most pronounced among small and medium firms. For very large firms, the coefficient on cost of debt is −0.190 ($p < 0.05$), while for large firms it increases to −0.243 ($p < 0.01$). Among medium-sized firms, the effect continues to increase to −0.315 ($p < 0.01$), and rises dramatically for small firms, reaching −0.637 ($p < 0.01$). This result is consistent with the existing literature, which suggests that small firms are particularly exposed to borrowing costs due to their limited access to alternative finance and weaker bargaining power in credit markets (Fazzari et al., 1988; Hadlock & Pierce, 2010). Small and medium-sized enterprises often lack long-term banking relationships, face higher collateral requirements, and pay higher interest spreads, all of which contribute to greater sensitivity of capital expenditure to debt costs (OECD, 2020; Bone et al., 2019). The Bank of England (2024) highlights that smaller UK firms often face higher spreads, tighter lending standards, and more procyclical access to credit. These constraints likely intensify the dampening effect of debt costs on investment observed in the smaller firms. Overall, the findings underscore the importance of financing conditions in shaping investment behaviour among smaller firms.

The results also provide insight into how the Lerner Index is related to investment across firms of different sizes. For very large firms (Panel A), most of which are listed, the coefficient on the Lerner Index is small and statistically insignificant. This suggests that, for the largest firms, the markup-related characteristics captured by the Lerner Index are not strongly associated with investment behaviour. In contrast, for large, medium, and small firms, the Lerner coefficient tends to be negative for CAPEX investment, with greater statistical significance and larger magnitudes among smaller firms (e.g., -0.062 for large firms, $p < 0.10$; -0.067 for medium firms, $p < 0.05$; -

0.143 for small firms, $p < 0.05$). These results indicate that higher observed markups are associated with lower tangible investment among smaller firms, although this relationship should be interpreted cautiously. In accounting data, the Lerner Index may capture not only competitive conditions, but also differences in efficiency, capital intensity, and product mix. The pattern is therefore best viewed as suggestive of a negative association between markup-related firm characteristics and CAPEX investment, rather than as clean causal evidence that market power reduces investment. In this respect, the findings are broadly consistent with theoretical arguments that weaker competitive pressure may reduce incentives for investment, as well as with empirical evidence linking higher markups or concentration to lower investment (Aghion et al., 2005; Gutiérrez & Philippon, 2017). In Appendix Table A9, Panels A to C, we further assess the robustness of the results using alternative classifications of firm size based on annual firm-level total assets, sales, and number of employees, grouped into small, medium, and large categories. The main findings remain broadly consistent across all three specifications.

Among small firms (Panel D), however, the relationship between the Lerner Index and investment differs by investment type. While the Lerner Index is negatively associated with tangible investment, it is positively and significantly associated with the paper's narrower measure of intangible investment. This suggests that, among smaller firms, higher observed markups may be associated with a reallocation of investment away from tangible capital and towards R&D-related or other strategic non-physical expenditures. At the same time, this result should also be interpreted cautiously, since the Lerner Index may reflect multiple firm characteristics beyond market power alone. We therefore view this pattern as indicating that markup-related firm characteristics may be

associated not only with the level of investment, but also with its composition across tangible and non-tangible forms.

In Appendix Table A8, we further extend the analysis by examining how the return on equity (ROE), used as a proxy for firms' cost of equity, relates to investment across different firm size categories. The results show that ROE has a positive but generally weak association with tangible investment, with statistical significance only among very large firms (coefficient = 0.037, $p < 0.10$). This suggests that higher internal equity returns may modestly support additional physical investment for larger firms that have greater retained earnings capacity. In contrast, ROE is negatively associated with intangible investment, though the estimates are not statistically significant. This pattern implies that internal equity financing may be more relevant for tangible rather than intangible investment, consistent with the idea that intangibles remain constrained by other financing conditions. Overall, the results reinforce that while internal equity plays a limited role, debt costs remain the most consistently significant financing benchmark for tangible investment across firm sizes.

Table 8. Firm-level Investment and Cost of Capital Measures by Firm Size

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022, segmented by firm size. Panel A presents results for very large firms, Panel B for large firms, Panel C for medium-sized firms, and Panel D for small firms. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. The dependent variable in the Columns (5) and (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions and firm size classifications are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Very large firms								
Dependent variables:								
		Investment ratio				***Intangible investment ratio***		
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.190**				-0.308			
	(-2.33)				(-0.61)			
ROIC		0.084				0.484		
		(1.10)				(1.61)		

Cost of equity			-3.132*				5.442	
			(-1.74)				(1.16)	
WACC				-4.806**				-3.381
				(-2.29)				(-0.83)
Sales growth	0.175***	0.174***	0.148	0.181	0.265**	0.247**	0.669	0.635
	(6.12)	(6.01)	(0.63)	(0.73)	(2.44)	(2.29)	(1.20)	(1.20)
Lag ROA	0.004***	0.004***	0.002	0.003	-0.006	-0.007	-0.033	-0.036
	(3.91)	(3.70)	(0.33)	(0.63)	(-1.23)	(-1.31)	(-1.05)	(-1.03)
Avg cash holdings	0.859***	0.859***	1.248*	0.853	2.645*	2.610*	-12.158	-12.813
	(5.51)	(5.53)	(1.66)	(1.12)	(1.77)	(1.75)	(-1.12)	(-1.12)
Current ratio	-0.008**	-0.009**	0.013	0.006	-0.009	-0.013	0.153	0.171
	(-1.99)	(-2.03)	(0.84)	(0.63)	(-0.38)	(-0.52)	(0.88)	(0.88)
Firm size	0.250***	0.252***	0.636*	0.708**	0.498	0.475	-0.599	-0.651
	(7.54)	(7.63)	(1.93)	(2.06)	(1.43)	(1.38)	(-1.14)	(-1.14)
Lerner	0.010	0.000	0.123	0.133	-0.167	-0.242	1.412	1.513
	(0.36)	(0.01)	(0.29)	(0.30)	(-1.10)	(-1.35)	(1.60)	(1.57)
Constant	-4.489***	-4.554***	-12.037*	-13.337**	-8.753	-8.366	12.537	14.150
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	38,261	38,261	1,539	1,443	6,241	6,241	1,011	943
Adjusted R^2	0.057	0.057	0.170	0.145	0.770	0.771	0.565	0.547

Panel B: Large firms

	Investment ratio		***Intangible investment ratio***	
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.243***		0.358	
	(-5.07)		(1.00)	
ROIC		-0.038		0.013
		(-1.03)		(0.08)
Sales growth	0.162***	0.162***	0.052	0.052
	(8.09)	(8.06)	(0.52)	(0.52)
Lag ROA	0.004***	0.004***	0.006*	0.006*
	(7.14)	(7.18)	(1.76)	(1.77)
Avg cash holdings	0.681***	0.682***	-0.970	-0.980
	(7.29)	(7.29)	(-1.01)	(-1.02)
Current ratio	-0.012***	-0.013***	-0.029	-0.024
	(-4.46)	(-4.74)	(-0.64)	(-0.55)
Firm size	0.254***	0.261***	0.322	0.312
	(12.45)	(12.78)	(1.44)	(1.40)
Lerner	-0.062*	-0.056	-0.044	-0.049
	(-1.70)	(-1.40)	(-0.19)	(-0.17)
Constant	-4.170***	-4.284***	-4.497	-4.316
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	87,696	87,696	5,766	5,766
Adjusted R^2	0.048	0.048	0.742	0.809

Panel C: Medium-sized firms

	Investment ratio		***Intangible investment ratio***	
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.315***		-1.013	
	(-3.47)		(-0.78)	
ROIC		-0.030		0.569
		(-0.71)		(0.99)
Sales growth	0.063***	0.064***	0.262	0.225
	(2.65)	(2.66)	(0.70)	(0.61)
Lag ROA	0.003***	0.003***	-0.013	-0.015
	(2.92)	(2.90)	(-0.81)	(-0.89)
Avg cash holdings	1.042***	1.045***	4.532	4.542
	(5.78)	(5.78)	(1.34)	(1.35)
Current ratio	-0.006***	-0.007***	-0.186	-0.191*
	(-2.74)	(-2.92)	(-1.62)	(-1.70)
Firm size	0.297***	0.307***	0.837	0.829
	(7.34)	(7.60)	(0.80)	(0.79)
Lerner	-0.067**	-0.061	-0.267	-0.494
	(-1.99)	(-1.48)	(-0.58)	(-1.04)
Constant	-4.613***	-4.783***	-10.905	-10.872

Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	31,015	31,015	897	897
Adjusted R^2	0.059	0.058	0.694	0.694
Panel D: Small firms				
		Investment ratio	***Intangible investment ratio***	
Variables	(1)	(2)	(3)	(4)
Cost of debt	-0.637***		8.581	
	(-3.30)		(0.58)	
ROIC		0.032		13.936
		(0.40)		(1.21)
Sales growth	0.076*	0.072*	0.901	0.536
	(1.78)	(1.67)	(0.09)	(0.05)
Lag ROA	0.006***	0.006***	-0.502**	-0.431*
	(4.31)	(4.29)	(-2.21)	(-2.14)
Avg cash holdings	1.297***	1.314***	-34.936	-69.954
	(3.16)	(3.19)	(-0.65)	(-0.94)
Current ratio	0.003	0.002	-0.959	-0.263
	(0.74)	(0.48)	(-1.16)	(-0.25)
Firm size	0.304***	0.323***	1.683	-0.105
	(3.82)	(3.98)	(0.57)	(-0.03)
Lerner	-0.143**	-0.152*	6.768**	4.093
	(-1.98)	(-1.78)	(2.18)	(0.80)
Constant	-4.228***	-4.536***	-13.925	14.678
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
N	7,128	7,128	27	27
Adjusted R^2	0.011	0.01	0.134	0.234

3.2.3. Firm location

To examine potential regional heterogeneity in investment sensitivity to financing costs, Table 9 presents regression results separately for firms located in London and non-London regions.[16] The cost of debt remains negatively associated with tangible investment across both groups and is statistically significant in both the non-London (-0.256, t = -7.44) and London (-0.287, t = -2.44) samples. These results suggest that borrowing costs are negatively associated with investment irrespective of geographic location, though the effect appears more precisely estimated outside of London, likely reflecting the larger sample of non-London firms. The cost of equity is statistically insignificant across specifications for both subgroups, while the WACC is negative and

[16] Results for intangible investment by London and non-London firms are reported separately in Appendix Table A10.

significant only among non-London firms, suggesting that the overall cost of capital plays a more binding role in investment decisions outside the capital, possibly due to more constrained or less diversified financing options.

Both firm size and average cash holdings exhibit positive and statistically significant associations with investment in both London and non-London firms, with comparable magnitudes, suggesting that liquidity and scale are associated with stronger investment regardless of location. Sales growth and lagged ROA also remain positively and statistically significantly associated with investment in both groups. By contrast, the Lerner Index enters with a negative and statistically significant coefficient only for non-London firms, while remaining insignificant for London-based firms. Since the Lerner Index is an accounting-based proxy related to markups or pricing power, this finding should be interpreted cautiously. It is consistent with the possibility that, outside London, weaker competitive pressure may be associated with lower capital expenditure, although the coefficient may also reflect differences in firm composition, efficiency, capital intensity, or industry structure across locations.

Taken together, the results indicate that the cost of debt remains the dominant financing constraint across regions, though firms in London may benefit from deeper capital markets and more favourable investment conditions, particularly with respect to liquidity and scale.

Table 9. Cost of Capital and Investment: London vs. Non-London Firms

This table presents the results of regressions estimating the impact of cost of capital measures on tangible investment among UK firms over the period 2013 to 2022, with a focus on geographical heterogeneity between London and non-London firms. The dependent variable in all columns is the tangible investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. Columns (1) to (4) present results for non-London firms, while Columns (5) to (8) show estimates for London-based firms. All models include firm and year fixed effects. All variables' definitions and firm size classifications are provided in the Appendix. t-statistics based on heteroskedasticity-robust

standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables: ***Investment ratio***								
	Non-London				*London*			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.256***				-0.287**			
	(-7.44)				(-2.44)			
ROIC		-0.027				-0.121		
		(-0.82)				(-1.41)		
Cost of equity			-3.181				-4.188	
			(-1.55)				(-1.05)	
WACC				-5.764**				-5.658
				(-2.23)				(-1.11)
Sales growth	0.142***	0.143***	-0.028	-0.036	0.117***	0.120***	0.337	0.383*
	(10.39)	(10.20)	(-0.09)	(-0.12)	(4.43)	(4.49)	(1.59)	(1.73)
Lag ROA	0.004***	0.004***	0.001	0.002	0.004***	0.004***	-0.005	-0.006
	(9.24)	(9.14)	(0.17)	(0.69)	(3.97)	(4.04)	(-0.39)	(-0.43)
Avg cash	0.794***	0.795***	0.140	-0.230	0.741***	0.741***	3.319**	2.627**
holdings	(11.16)	(11.17)	(0.17)	(-0.27)	(4.03)	(4.03)	(2.40)	(2.01)
Current ratio	-0.008***	-0.009***	0.124	0.042	-0.006**	-0.007**	-0.004	-0.005
	(-4.02)	(-4.28)	(0.94)	(0.39)	(-2.43)	(-2.56)	(-0.36)	(-0.40)
Firm size	0.235***	0.241***	0.596	0.690*	0.281***	0.287***	0.628	0.514
	(15.88)	(16.32)	(1.63)	(1.83)	(7.78)	(7.93)	(1.50)	(1.20)
Lerner	-0.046**	-0.043*	0.731	0.758	-0.025	-0.013	-0.532	-0.490
	(-2.12)	(-1.88)	(1.44)	(1.52)	(-0.84)	(-0.43)	(-1.07)	(-0.99)
Constant	-3.868***	-3.987***	-11.308	-12.866*	-4.672**	-4.798***	-11.931	-9.582
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	135,050	135,050	1,106	1,033	30,085	30,085	454	428
Adjusted R^2	0.054	0.054	0.185	0.157	0.032	0.032	0.186	0.186

3.2.4. Firm growth status: high-growth and other enterprises

To explore whether financing conditions affect firms differently depending on their growth trajectories, we compare investment sensitivities to the cost of capital between high-growth enterprises (HGEs) and non-HGEs. This approach is motivated by evidence that HGEs are structurally distinct from other firms, not only in their performance but also in their financing behaviour and investment needs. High-growth firms are more likely to pursue expansionary strategies requiring substantial upfront investment, yet they may also encounter heightened external financing constraints due to information asymmetries, limited collateral, or volatility in cash flow (Lee, 2014). At the same time, their growth potential may render them more attractive to certain investors, allowing some to access capital under more favourable terms. Prior research suggests that

such firms often fall outside the scope of traditional bank finance and instead rely more heavily on equity funding, venture capital, or retained earnings (North et al., 2013). Assessing whether the cost of debt plays a similar constraining role across firms with different growth profiles is therefore critical to understanding the broader investment effects of financial conditions and the potential need for targeted policy support for fast-growing but financially constrained businesses.

We define HGEs following the OECD standard, which classifies a firm as high-growth if it records an average annualised growth rate of more than 20% in employment or turnover over a three-year period, using a single-indicator approach. Additionally, the OECD requires that such firms must have had at least 10 employees in the base year to be considered in scope (OECD, 2007). Applying this definition to our dataset, we divide the sample into HGEs and non-HGEs and estimate the effect of financing costs on their tangible and intangible investment activity.

As reported in Table 10, the cost of debt has a strong negative and statistically significant effect on tangible investment for non-HGEs, with a coefficient of –0.251 (t = –6.99), whereas the same relationship is statistically insignificant for HGEs. This suggests that slower-growing firms are more exposed to debt-related financing constraints, consistent with their weaker bargaining positions, higher perceived risk, or less diversified financing sources. By contrast, HGEs appear to be less sensitive to changes in debt costs, potentially due to their stronger growth prospects, better internal cash generation, or more favourable external financing conditions. These results are consistent with prior findings that firms with high growth potential are less constrained in capital markets and often prioritised by investors and lenders (Coad et al., 2014; Lee, 2014). The distinction

further reinforces the need to account for growth condition when assessing the impact of financing costs on investment behaviour.

Table 10. Cost of Capital and Investment: Non-high-growth enterprise vs. High-growth enterprise

This table presents the results of regressions estimating the impact of capital measures on investment among UK firms from 2013 to 2022, comparing high-growth enterprises (HGEs) with non-HGEs. The classification of HGEs follows the OECD definition, where a firm is considered high-growth if it exhibits an average annualised growth rate of 20% or more in either sales or employment over a three-year period, using a single-indicator approach. In line with the OECD standard, firms must also have had at least 10 employees in the base year to be classified as HGE. Columns (1) to (4) report estimates for the tangible investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. Columns (5) to (8) present results for the intangible investment ratio, calculated as R&D expenditures excluding amortization at time t + 1, also scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions and firm size classifications are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables:								
	Investment ratio				*Intangible investment ratio*			
	Non HGE		*HGE*		*Non HGE*		*HGE*	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.251***		0.009		0.080		0.975	
	(-6.99)		(0.02)		(0.24)		(0.62)	
ROIC		-0.025		-0.581*		0.397		-2.086
		(-0.80)		(-1.80)		(1.30)		(-0.84)
Sales growth	0.128***	0.129***	0.173	0.182*	0.236***	0.221***	0.310	0.329
	(10.46)	(10.30)	(1.62)	(1.69)	(2.91)	(2.72)	(1.32)	(1.35)
Lag ROA	0.004***	0.004***	-0.000	-0.000	-0.001	-0.002	0.006	0.005
	(9.62)	(9.53)	(-0.08)	(-0.01)	(-0.39)	(-0.49)	(0.51)	(0.45)
Avg cash	0.721***	0.722***	2.350***	2.328***	1.233	1.222	4.177	4.251
holdings	(10.26)	(10.26)	(3.02)	(2.98)	(1.23)	(1.21)	(1.18)	(1.18)
Current ratio	-0.007***	-0.008***	-0.016	-0.015	-0.051	-0.051	0.079	0.146
	(-4.47)	(-4.75)	(-1.21)	(-1.14)	(-1.16)	(-1.18)	(0.78)	(1.12)
Firm size	0.251***	0.257***	0.750***	0.752***	0.487**	0.477*	-0.592	-0.577
	(16.83)	(17.27)	(4.85)	(4.93)	(1.97)	(1.94)	(-0.88)	(-0.93)
Lerner	-0.043**	-0.041**	-0.012	0.038	-0.034	-0.095	-0.233	0.023
	(-2.43)	(-2.18)	(-0.17)	(0.51)	(-0.22)	(-0.53)	(-1.08)	(0.07)
Constant	-4.131**	-4.254***	-12.814**	-12.799**	-7.774*	-7.610*	11.520	11.288
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	159,838	159,838	3,058	3,058	12,447	12,447	254	254
Adjusted R^2	0.253	0.253	0.444	0.071	0.742	0.742	0.956	0.956

3.3. Productivity and investment sensitivity to cost of capital

Productivity is a fundamental determinant of firms' capital allocation decisions, as it reflects both internal efficiency and external competitiveness. It also influences a firm's financing environment, more productive firms typically exhibit higher profitability, lower default risk, and better access to

external capital markets. Conversely, firms with low productivity often face tighter borrowing constraints, limited collateral, and are more vulnerable to adverse credit conditions (Gopinath et al., 2017; Kalemli-Özcan et al., 2019). These differences may shape how firms respond to changes in the cost of capital, particularly in relation to debt.

To examine this heterogeneity, we classify firms into three productivity groups, low, medium, and high, based on industry-adjusted labour productivity. Labour productivity is defined as sales per employee, adjusted relative to the annual average within each 2-digit SIC industry to account for sectoral variation. Firms are ranked into terciles each year based on this adjusted measure: the bottom third are labelled low productivity, the middle third medium productivity, and the top third high productivity. This approach ensures consistent within-sector comparison across time, aligning with recent empirical work that highlights the importance of relative productivity in shaping investment and financial access (Andrews et al., 2016).

The results in Table 11 focus on tangible investment[17] and reveal that the cost of debt significantly depresses investment among firms with low and medium productivity (-0.253 and -0.246, both significant at the 1% level). In contrast, the relationship is smaller in magnitude and statistically insignificant for high-productivity firms (-0.130, $t = -1.64$). This suggests that low-productivity firms are more sensitive to debt costs, likely due to weaker creditworthiness and higher exposure to financing conditions. Additionally, the weighted average cost of capital (WACC) is significant only for medium-productivity firms, while ROIC enters negatively and significantly only for high-productivity firms (-0.146, $p < 0.05$), possibly indicating more conservative internal return thresholds among firms that already deploy capital efficiently. This suggests that less productive

[17] Results for intangible investment by productivity group are provided in Appendix Table A11.

firms are more sensitive to changes in borrowing costs, potentially due to more limited access to credit, higher perceived risk by lenders, or weaker financial profiles. In contrast, more productive firms may be better positioned to maintain investment even when financing costs increase, either through stronger internal cash flows or improved access to external capital. These findings highlight that investment sensitivity to the cost of debt varies systematically with firm productivity.

Table 11. Firm-level Investment and Cost of Capital Measures by Labour Productivity Level

This table presents the results of estimating the effect of cost of capital measures on tangible investment among UK firms from 2013 to 2022. Firms are classified into three groups, low, medium, and high productivity, based on industry-adjusted labor productivity. Specifically, labor productivity is calculated as the difference between a firm's sales per employee and the three-digit SIC industry average in the corresponding year, to control for sectoral variation in productivity levels. Columns (1) to (4) report results for low-productivity firms, Columns (5) to (8) for medium-productivity firms, and Columns (9) to (12) for high-productivity firms. The dependent variable across all columns is the tangible investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: ***Investment ratio***												
	Low labour productivity				***Medium labour productivity***				***High labour productivity***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cost of debt	-0.253***				-0.246***				-0.130			
	(-3.72)				(-3.98)				(-1.64)			
ROIC		0.101				-0.102*				-0.146**		
		(1.49)				(-1.71)				(-2.28)		
Cost of equity			-6.393				-5.050				-1.126	
			(-1.23)				(-1.06)				(-0.37)	
WACC				-6.013				-13.275***				-2.134
				(-1.00)				(-2.68)				(-0.60)
Sales growth	0.142***	0.138***	-0.463*	-0.389	0.237***	0.241***	0.404***	0.372**	0.161***	0.166***	0.480**	0.510**
	(5.64)	(5.37)	(-1.84)	(-1.46)	(7.54)	(7.57)	(2.62)	(2.56)	(6.37)	(6.44)	(1.99)	(2.15)
Lag ROA	0.004***	0.004***	0.004	0.001	0.004***	0.004***	0.012**	0.015**	0.006***	0.006***	0.000	0.000
	(3.74)	(3.56)	(0.43)	(0.12)	(4.72)	(4.81)	(2.19)	(2.23)	(7.55)	(7.69)	(0.06)	(0.04)
Avg cash holdings	0.749***	0.751***	1.798	0.902	0.892***	0.892***	0.032	0.143	0.654***	0.655***	1.661	1.045
	(5.43)	(5.45)	(1.15)	(0.54)	(7.43)	(7.42)	(0.04)	(0.14)	(4.57)	(4.58)	(0.84)	(0.52)
Current ratio	-0.005***	-0.005***	0.061	-0.167*	-0.022***	-0.022***	-0.188**	-0.144**	-0.013***	-0.013***	0.010	0.011
	(-2.60)	(-2.71)	(0.33)	(-1.83)	(-3.09)	(-3.19)	(-2.40)	(-2.06)	(-2.94)	(-3.03)	(0.93)	(0.96)
Firm size	0.277***	0.282***	1.270	1.274	0.256***	0.265***	-0.045	-0.251	0.245***	0.247***	0.393	0.410
	(9.17)	(9.36)	(1.49)	(1.38)	(8.81)	(9.15)	(-0.20)	(-1.21)	(7.71)	(7.78)	(1.15)	(1.20)
Lerner	-0.031	-0.042	0.346*	0.210	-0.065	-0.045	0.123	0.617**	-0.023	0.009	-1.523	-1.487
	(-1.00)	(-1.25)	(1.87)	(1.53)	(-1.50)	(-1.00)	(0.40)	(2.27)	(-0.70)	(0.27)	(-1.17)	(-1.13)
Constant	-4.588***	-4.698***	-23.893	-23.669	-4.214***	-4.364***	1.563	5.911	-4.099***	-4.134***	-7.393	-7.611
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	43,930	43,930	341	321	44,814	44,814	503	463	46,806	46,806	537	525
Adjusted R^2	0.045	0.044	0.112	0.088	0.088	0.088	0.289	0.021	0.035	0.035	0.388	0.167

3.4. Financial constraints and investment sensitivity to cost of capital

In this subsection, we explore whether the sensitivity of investment to the cost of capital varies systematically across firms with different levels of financial constraints, using the Whited-Wu Index (*WW-index*)[1] as a proxy. As shown in Table 12, we divide the full sample into three groups, less constrained, constrained, and more constrained, based on the quartile distribution of the *WW-index*.

The results reveal a distinct U-shaped relationship between the degree of financial constraint and investment sensitivity to the cost of debt. Specifically, the coefficients on cost of debt are negative and statistically significant across all constraint groups, but they are most negative for the middle group (Column 2: β = -0.432, $p < 0.01$), followed by the highly constrained group (Column 3: β = -0.312, $p < 0.01$), with the least constrained group showing the smallest effect (Column 1: β = -0.145, $p < 0.05$). This U-shaped profile is consistent with theoretical predictions and previous empirical findings in the investment literature. Moderately constrained firms are often at a financial 'tipping point', large enough to require significant external finance, but not sufficiently creditworthy to access it at low cost. Consequently, they are the most vulnerable to fluctuations in the cost of debt (Fazzari et al., 1988; Hadlock & Pierce, 2010). In contrast, the most constrained firms may be effectively rationed from debt markets altogether, rendering their investment less sensitive to marginal changes in financing costs. Similarly, unconstrained firms benefit from

[1] The Whited and Wu (2006) index (*WW-Index*) is a firm-level proxy for financial constraints based on observable characteristics that influence access to external finance. It is computed as a weighted linear combination of several firm-specific variables: *WW Index*= -0.091 × *Cash Flow* - 0.062 × *Dividend Dummy* + 0.021 × *Long-Term Debt* - 0.044 × *Log Total Assets* + 0.102 × *Industry Sales Growth* - 0.035 × *Sales Growth*. A higher *WW-Index* value indicates a greater degree of financial constraint.

broader and more stable access to financing and can absorb interest rate increases more easily, reducing sensitivity.

Our findings align with Guariglia (2008), who documents a U-shaped relationship between investment-cash flow sensitivity and internal funding constraints in UK firms, indicating that middle-tier firms exhibit the highest sensitivity to financing conditions. Similarly, Lyandres (2007) identifies a U-shaped link between the cost of external financing and investment sensitivity, suggesting that moderately constrained firms face the sharpest effects of financing costs. Mulier et al. (2016) further corroborate this pattern in their study of unquoted European SMEs, showing that investment-cash flow sensitivity peaks among moderately constrained firms, while highly constrained and unconstrained firms display lower sensitivity. These studies underscore that firms at the middle level of constraint are particularly exposed to financing conditions, a pattern that mirrors our empirical results using the WW-index.

The evidence from Table 12 indicates that the cost of debt has a non-linear and constraint-dependent impact on firm-level investment. The sharpest effects are concentrated among moderately and highly constrained firms, suggesting that tightening credit conditions could disproportionately depress investment among firms with marginal access to credit markets. This underscores the importance of accounting for heterogeneity in firms' financial condition when examining investment responses to capital costs. Importantly, the evidence also suggests that middle-tier firms may be particularly vulnerable to shifts in credit conditions. To further illuminate the nature of these patterns, the next step in our research will investigate the industry composition

of these constraint groups, to better understand who these firms are and where constraint-induced investment frictions are most concentrated.

Table 12. Firm-level Investment and Cost of Capital Measures by Financial Constraint Level

This table presents the results of regression examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022 across firms with different levels of financial constraints. Firms are classified into three groups—less constrained, constrained, and more constrained—based on the quartile distribution of the Whited-Wu Index (WW-Index). The Whited-Wu Index is a firm-level proxy for financial constraints, developed by Whited and Wu (2006). It is constructed based on observable firm characteristics that are associated with external borrowing conditions. The detail calculation of the WW-Index is detailed in Appendix. The dependent variable in the Columns (1) to (6) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. The dependent variable in the Columns (7) and (12) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:												
	Investment ratio						***Intangible investment ratio***					
Variables	(1) Less constraint	(2) Constraint	(3) More constraint	(4) Less constraint	(5) Constraint	(6) More constraint	(7) Less constraint	(8) Constraint	(9) More constraint	(10) Less constraint	(11) Constraint	(12) More constraint
Cost of debt	-0.145**	-0.432***	-0.312***				0.304	-0.985	-0.392			
	(-2.23)	(-6.03)	(-4.21)				(1.00)	(-0.90)	(-0.58)			
ROIC				-0.108**	-0.036	0.043				0.045	0.392	-0.081
				(-2.38)	(-0.85)	(0.77)				(0.26)	(1.27)	(-0.14)
Sales growth	0.268***	0.132***	0.066***	0.272***	0.133***	0.064***	0.143	0.236	0.193	0.144	0.190	0.195
	(7.93)	(4.22)	(3.21)	(7.96)	(4.16)	(3.06)	(1.61)	(0.95)	(0.85)	(1.63)	(0.79)	(0.86)
Lag ROA	0.006***	0.004***	0.004***	0.006***	0.004***	0.004***	-0.001	-0.003	0.000	-0.001	-0.003	0.000
	(6.36)	(4.59)	(3.97)	(6.49)	(4.57)	(3.92)	(-0.23)	(-0.38)	(0.04)	(-0.21)	(-0.38)	(0.05)
Avg cash holdings	0.744***	1.154***	0.460***	0.746***	1.160***	0.465***	-0.129	0.969	-2.490	-0.128	0.878	-2.487
	(6.02)	(7.34)	(3.27)	(6.04)	(7.35)	(3.30)	(-0.14)	(0.82)	(-0.91)	(-0.14)	(0.74)	(-0.91)
Current ratio	-0.012**	-0.016***	-0.004*	-0.012**	-0.017***	-0.004**	-0.014	0.075	-0.101	-0.012	0.066	-0.102
	(-2.44)	(-3.76)	(-1.95)	(-2.55)	(-4.05)	(-2.04)	(-0.95)	(1.38)	(-1.50)	(-0.83)	(1.21)	(-1.51)
Firm size	0.299***	0.262***	0.181***	0.301***	0.274***	0.187***	0.065	0.085	1.164*	0.054	0.044	1.179*
	(10.96)	(7.88)	(6.10)	(11.02)	(8.21)	(6.30)	(0.56)	(0.21)	(1.86)	(0.47)	(0.10)	(1.91)
Lerner	-0.022	-0.010	-0.039	-0.001	-0.003	-0.045	0.310**	-0.113	0.184	0.302*	-0.169	0.194
	(-0.58)	(-0.24)	(-1.32)	(-0.02)	(-0.08)	(-1.45)	(2.15)	(-0.57)	(0.59)	(1.89)	(-0.80)	(0.55)
Constant	-5.147***	-4.107***	-2.932***	-5.178***	-4.316***	-3.058***	-0.662	-0.043	-18.748*	-0.459	0.603	-19.026*
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	52,578	43,988	44,753	52,578	43,988	44,753	6,114	1,776	2,410	6,114	1,776	2,410
Adjusted R^2	0.068	0.054	0.017	0.068	0.052	0.016	0.782	0.791	0.718	0.782	0.791	0.718

3.5. Hurdle rates

To deepen our understanding of how capital costs affect firm investment, we turn to an analysis of internally reported hurdle rates. Unlike market-based cost of capital measures, the hurdle rate represents the minimum required rate of return that a firm's management applies when evaluating new investment opportunities. This internal benchmark captures firms' subjective assessments of risk, strategic priorities, and capital allocation norms, and may diverge considerably from external financing conditions. Using a subset of data on firm-reported discount rates for investment evaluation, sourced from Gormsen and Huber (2023), we investigate whether hurdle rates exert a stronger influence on investment decisions than other cost of capital measures. While the subset of firms with available hurdle rate data is relatively limited, the inclusion of this internal metric provides a unique perspective through which to assess potential drivers of underinvestment in the UK.

Table 13 presents the results and provides a direct comparison between the explanatory power of hurdle rates and market-based capital costs. The control variables include sales growth, ROA, the cash holding ratio, the current ratio, firm size, and the Lerner Index, and all specifications include firm and year fixed effects. Panel A reports the effect of hurdle rates on tangible investment. Across all specifications, hurdle rates are consistently and significantly negatively associated with CAPEX investment. For example, in Column (1), the coefficient on the hurdle rate is -9.064 ($p < 0.05$), substantially larger in magnitude than the coefficients on the other cost of capital measures, including the cost of debt, the cost of equity, and WACC. This indicates a strong inverse relationship between internally required returns and realised capital expenditure.

The most policy-relevant result is that the wedge between internal and external capital costs also predicts investment. In Columns (6) and (7) [1], both the hurdle rate and WACC are included, allowing a direct comparison of their relative explanatory power. While WACC enters negatively, the hurdle rate remains the dominant predictor of investment outcomes. More strikingly, in Columns (8) and (9) [2], the gap between the hurdle rate and WACC enters significantly negatively, indicating that firms with a wider internal–external discount-rate wedge invest substantially less. This result suggests that weak investment cannot be understood solely through the lens of external financing conditions. Even when market-based capital costs are relatively low, internal capital budgeting rules may impose materially stricter thresholds on investment and thereby suppress capital formation.

Taken together, these findings imply that firms applying higher internal hurdle rates are systematically less likely to invest in fixed capital assets. This pattern persists even after controlling for market-based financing costs and firm-specific characteristics, suggesting that the internal rate of return threshold may act as a binding constraint on investment decisions, consistent with Poterba and Summers (1995). The findings also align with existing evidence that firms frequently apply internal discount rates that exceed market-based benchmarks and that these internal thresholds play a central role in capital budgeting decisions (Jagannathan et al., 2016; Gormsen & Huber, 2023). Similarly, Melolinna et al. (2018) show that managerial perceptions of investment risk and returns are important determinants of sluggish investment in the UK.

[1] We further control the Tobin's Q in Column (7).

[2] We further control the Tobin's Q in Column (9).

An important question is whether this wedge reflects managerial conservatism or instead conservative lending behaviour by external financiers. In the UK, however, business investment is typically financed primarily through retained earnings and owner injections, with debt financing playing a secondary role. Moreover, the time-series evidence in our data suggests that internally reported hurdle rates remain remarkably stable over the sample period, even as market-based financing costs such as the cost of debt and WACC exhibit considerably more year-to-year variation. If the elevated wedge between hurdle rates and external financing benchmarks were primarily driven by lender conservatism, one would expect hurdle rates to co-move more closely with external financing conditions, reflecting pass-through from tighter or looser lending terms. The fact that hurdle rates remain largely unchanged while external benchmarks fluctuate is more consistent with sticky internal capital budgeting rules than with lender-driven constraints.

Why internally reported hurdle rates remain systematically above market-based financing costs is an important question. While the present analysis is not designed to distinguish cleanly among competing mechanisms, several explanations from theory and practice are consistent with our findings. First, when investment is at least partly irreversible, firms may rationally require a premium over the market-implied cost of capital to preserve the option value of waiting under uncertainty (Bernanke, 1983). Second, project-level risks may exceed those captured by firm-level financing benchmarks such as the cost of debt or WACC, leading managers to apply more conservative internal discount rates as a buffer against downside risk. Third, elevated hurdle rates may reflect internal capital rationing when firms cannot fund all positive-NPV projects simultaneously and therefore prioritise only the highest-return opportunities. Finally, managerial

career concerns and internal governance incentives may also encourage the use of higher discount rates, especially if failed projects are penalised more heavily than successful projects are rewarded. In this sense, conservative hurdle rates need not imply irrationality, but may instead reflect a combination of irreversibility, risk management, internal rationing, and managerial incentives. This interpretation is also consistent with a broader international literature on capital budgeting. Survey evidence shows that firms in many settings use hurdle rates that exceed market-based financing costs (Jagannathan, Meier, & Tarhan, 2011; Graham, 2022). More recent work further suggests that elevated hurdle rates may persist not only because of irreversibility, risk, or internal capital rationing, but also because they may strengthen firms' bargaining position during project development (Barry et al., 2024). Although our data do not permit a clean international comparison of whether UK firms are more conservative than firms elsewhere, they do show that, within the UK, this internal–external wedge is economically meaningful and strongly associated with realised investment outcomes.

The concentration of explicit hurdle-rate reporting among large listed firms also help to clarify the organisational setting in which these internal discounting rules are most relevant. We further find that during the sample period, 314 unique firms reported explicit hurdle rates, with over 96% of these firms classified as very large or large, and listed companies. This distribution suggests that the formal use of hurdle rates is predominantly concentrated among large multinational corporations (MNCs). Within such complex and geographically dispersed organizational structures, hurdle rates serve not only as capital budgeting tools but also as governance mechanisms that facilitate internal coordination and resource allocation. For multinational firms, hurdle rates function as standardized benchmarks to evaluate investment proposals across diverse markets and

business units. By applying a uniform internal rate of return threshold, corporate headquarters can systematically compare investment opportunities from different regions, ensuring alignment with overarching corporate objectives. This internal capital market mechanism allows senior management to mitigate agency problems and maintain oversight of subsidiary performance, especially when investment decisions are decentralized (Stein, 1997). Beyond internal governance, the persistent use of conservative hurdle rates among large listed firms reflect managerial signalling towards external stakeholders, including shareholders and creditors. Managers are under continuous pressure to demonstrate prudent capital allocation and to safeguard shareholder value. Establishing hurdle rates significantly above the firm's actual cost of capital can thus be interpreted as a display of fiduciary discipline, signalling to investors and lenders that the firm is committed to approving only projects expected to generate returns exceeding market expectations. Empirical evidence supports this interpretation. Jagannathan, Meier, and Tarhan (2016) document that firms frequently apply discount rates well above their weighted average cost of capital (WACC), driven by managerial risk aversion and the desire to provide a conservative buffer against market volatility and unforeseen risks. Similarly, the McKinsey Global Survey on capital allocation practices finds that a majority of CFOs and senior executives report using elevated hurdle rates, motivated by a combination of historical norms, market expectations, and internal risk management considerations (McKinsey & Company, 2024). Managers often aim to outperform the market return to enhance firm valuation, maintain creditworthiness, and secure future access to capital. This behaviour is further reinforced by career concerns and performance evaluation metrics that emphasize value creation relative to market benchmarks (Graham & Harvey, 2022).

Panel B reports the effects of hurdle rates on intangible investment, revealing a markedly different dynamic. Across all specifications, the hurdle rate shows no statistically significant relationship with intangible investment. This suggests that R&D expenditures, which often entail long-term, uncertain payoffs and are not easily discounted using traditional cost of capital metrics, are not guided by the same internal financial criteria as tangible investments (Hall, 2002). Instead, profitability indicators such as ROIC emerge as more relevant: in column (3), ROIC is positively associated with R&D spending (in Column (3), $\beta = 1.165$, $p < 0.1$), consistent with the idea that firms fund intangible investments out of internally generated cash flow.

Although the subset of firms with available hurdle rate data is relatively small (approximately 1,300 observations), the strength and consistency of the results underscore the economic significance of this internal investment rate. As noted by Sharpe (1994), internal hurdle rates often persist as rigid norms within firms, resistant to changes in market conditions. Given the importance of internal decision frameworks in shaping aggregate investment trends, it is imperative to further explore the pervasiveness and determinants of hurdle rates. In the next phase of the project, we aim to broaden our dataset to capture a wider population of firms with identifiable hurdle rate proxies or disclosures in order to generalize these findings across the broader UK corporate sector.

Overall, the inclusion of internal hurdle rates reveals that firms' investment decisions, especially regarding tangible capital, are highly sensitive to internally acceptable returns. The evidence that WACC minus hurdle rate is negatively associated with investment underscores the possibility that internal discounting practices impose stricter thresholds than capital markets require, potentially contributing to sluggish capital investment in the UK. These findings reinforce the policy

relevance of understanding internal firm behaviour and budgeting processes, not just market conditions, in addressing investment shortfalls.

Table 13. Firm-level Investment and Hurdle Rates

This table presents results examining the impact of hurdle rates on firm-level net investment in tangible and intangible investments for UK firms from 2013 to 2022. Panel A reports results where the dependent variable is the investment ratio, defined as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. Panel B focuses on the intangible investment ratio, defined as R&D expenditures excluding amortization at time t+1, also scaled by total fixed assets at time t. The hurdle rate, defined as the internally used discount rate where firms apply to evaluate investment projects, as sourced from Gormsen and Huber (2023). All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Tangible investment									
Dependent variable:					***Investment ratio***				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hurdle rate	-9.064**					-20.873***	-20.880***	-29.094***	-29.182***
	(-1.98)					(-3.17)	(-3.16)	(-3.12)	(-3.09)
Cost of debt		-0.314							
		(-0.90)							
ROIC			0.144						
			(0.64)						
Cost of equity				-3.220					
				(-0.86)					
WACC					-5.194	-5.498	-5.522		
					(-1.52)	(-1.59)	(-1.570)		
Gap (Diff between WACC and Hurdle rate)								-8.033**	-8.105*
								(-1.99)	(-1.97)
Tobin's Q							-0.008		-0.017
							(-0.08)		(-0.18)
Sales growth	0.878*	0.887*	0.893*	0.344**	0.352**	0.284*	0.285*	0.269*	0.270*
	(1.89)	(1.89)	(1.92)	(2.09)	(2.17)	(1.75)	(1.75)	(1.67)	(1.70)
Lag ROA	-0.003	-0.003	-0.002	0.004	0.006	0.007	0.007	0.007	0.007
	(-0.51)	(-0.45)	(-0.39)	(0.90)	(1.17)	(1.30)	(1.26)	(1.38)	(1.40)
Avg Cash holdings	1.831*	1.543	1.583*	0.479	0.506	1.120	1.120	1.070	1.069
	(1.93)	(1.58)	(1.65)	(0.53)	(0.55)	(1.28)	(1.28)	(1.22)	(1.21)
Current ratio	0.029	0.027	0.026	-0.056	-0.045	-0.049	-0.049	-0.045	-0.046
	(0.71)	(0.66)	(0.65)	(-0.81)	(-0.60)	(-0.68)	(-0.68)	(-0.61)	(-0.62)
Firm size	0.149	0.156	0.140	0.126	0.107	0.155	0.152	0.141	0.133
	(0.98)	(1.01)	(0.89)	(0.81)	(0.70)	(1.04)	(0.95)	(0.94)	(0.82)
Lerner	-0.146	-0.128	-0.149	0.481*	0.537**	0.475*	0.483**	0.524**	0.542**
	(-0.89)	(-0.78)	(-0.94)	(1.88)	(2.03)	(1.91)	(2.06)	(2.06)	(2.24)
Constant	-1.997	-3.044	-2.774	-2.090	-1.658	-0.403	-0.318	0.052	0.240
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	1,272	1,272	1,272	792	792	792	792	792	792
Adjusted R^2	0.158	0.156	0.155	0.140	0.144	0.158	0.157	0.163	0.161
Panel B: Intangible investment									
Dependent variable:					***Intangible investment ratio***				
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hurdle rate	-0.070					-0.381	-0.232	-3.741	-3.463
	(-0.03)					(-0.07)	(-0.05)	(-0.69)	(-0.650)
Cost of debt		-0.363							
		(-1.14)							
ROIC			1.165*						
			(1.67)						
Cost of equity				0.597					
				(0.23)					
WACC					-1.734	-1.736	-1.638		
					(-0.90)	(-0.90)	(-0.87)		
Gap (Diff between WACC and Hurdle rate)								-3.154	-3.020
								(-1.11)	(-1.09)
Tobin's Q							0.0405		0.037
							(0.458)		(0.42)
Sales growth	0.405	0.396	0.428	0.825	0.807	0.805	0.807	0.797	0.799
	(1.34)	(1.34)	(1.39)	(1.19)	(1.22)	(1.21)	(1.20)	(1.21)	(1.20)
Lag ROA	-0.009	-0.009	-0.005	-0.040	-0.039	-0.039	-0.040	-0.039	-0.039
	(-0.64)	(-0.64)	(-0.57)	(-1.08)	(-1.07)	(-1.04)	(-1.06)	(-1.06)	(-1.06)
Avg Cash holdings	-5.929	-6.022	-5.966	-9.603	-9.613	-9.599	-9.600	-9.624	-9.626
	(-0.98)	(-0.99)	(-0.99)	(-1.23)	(-1.23)	(-1.21)	(-1.22)	(-1.21)	(-1.22)
Current ratio	0.038	0.039	0.043	0.272	0.280	0.280	0.280	0.284	0.284
	(0.75)	(0.75)	(0.81)	(1.24)	(1.25)	(1.25)	(1.25)	(1.25)	(1.25)
Firm size	0.189	0.164	0.058	-0.231	-0.231	-0.232	-0.216	-0.238	-0.224
	(0.97)	(0.87)	(0.32)	(-0.78)	(-0.78)	(-0.78)	(-0.74)	(-0.79)	(-0.75)
Lerner	-0.079	-0.073	-0.301	1.457	1.453	1.450	1.400	1.453	1.403
	(-0.45)	(-0.41)	(-1.52)	(1.29)	(1.29)	(1.28)	(1.29)	(1.28)	(1.29)
Constant	-2.911	-2.404	-0.459	5.337	5.483	5.522	5.136	5.744	5.385
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	867	867	867	539	539	539	539	539	539
Adjusted R^2	0.598	0.599	0.601	0.675	0.675	0.674	0.674	0.675	0.674

4. Conclusion

This paper provides firm-level evidence on the relationship between financing conditions, internal investment thresholds, and investment behaviour in the UK over the period 2013 to 2022. Our findings highlight the importance of the cost of debt as an observable external financing benchmark for tangible investment, with the negative association being especially pronounced among smaller, unlisted, non-high-growth, lower-productivity, and financially constrained firms, which account for much of the UK corporate sector. By contrast, intangible investment appears much less responsive to observed financing costs, consistent with its greater reliance on internal resources, longer horizons, and more uncertain payoffs. The analysis also points to an important role in internal managerial decision-making. Firms' hurdle rates, which are often materially above market-based financing benchmarks, are associated with significantly lower tangible investment. This suggests that conservative internal capital budgeting rules may be an important contributor to weak investment in the UK, particularly among larger and listed firms. In addition, we find that higher values of the Lerner Index are associated with lower tangible investment. Since the Lerner Index is an accounting-based proxy related to markups or pricing power, this result should be interpreted cautiously. It is broadly consistent with the view that weaker competitive pressure may be associated with lower investment (Aghion et al., 2005; Gutiérrez & Philippon, 2017), while also underscoring the importance of competitive market structures in supporting productive investment.

Taken together, these findings suggest that financing conditions, internal capital allocation rules, and competitive market structure are all relevant for understanding firm-level investment behaviour in the UK. At the same time, the estimated relationships should not be interpreted as implying either a symmetric investment response to financing conditions or a direct quantitative

explanation of the UK's aggregate investment shortfall. While tighter borrowing conditions may weigh strongly on investment, easier financing conditions may not generate an equally strong recovery if firms continue to apply elevated internal hurdle rates, face persistent uncertainty, or delay investment for strategic reasons. More generally, the analysis identifies firm-level relationships rather than a macroeconomic decomposition of underinvestment and therefore does not by itself establish how far realistic changes in financing costs would close the UK's investment gap relative to comparator economies. In this sense, the estimates are more informative about how financing conditions can restrain investment than about the extent to which lower borrowing costs alone would restore aggregate investment.

Future research could usefully extend the analysis in several directions. In particular, it would be valuable to examine sectoral differences in financing conditions and financial constraints, expand the coverage of internal hurdle-rate data across a broader range of firms, and investigate more closely how markup-related firm characteristics shape investment patterns across industries. Such work would deepen understanding of the firm-level drivers of investment and help inform more targeted policy responses to the UK's underinvestment and productivity challenges.

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Appendix

Definitions of variables

Variable	Definition
Dependent variables	
Investment ratio	Measured as the capital expenditure (CAPEX) excludes the depreciation at time t +1, scaled by the total fixed assets at time t.
Intangible investment ratio	Measured as the research and development expenses (R&D) exclude the amortization at time t +1, scaled by the total fixed assets at time t.
Key independent variables	
Cost of debt	Interest expense paid on book value of total debt
ROIC	Return on invested capital, computed as net operating profit after tax divided by invested capital, where the invested capital is measured as the total equity plus total debt plus non-operating cash.
ROE	Return on equity, calculated by net income divided by total shareholders' equity.
Cost of equity	Estimated as the earnings-to-price ratio, adjusted for growth and dividend payout, in accordance with Botosan (1997). See Botosan (1997) Equation (3) for details.
WACC	Weighted average of cost of debt and cost of equity, assuming the tax rate is 20%.
Hurdle rate	The minimum internal rate of return is required for new investments, as agreed upon by firm managers. Data obtained from Gormsen and Huber (2023).
Control variables	
Sales growth	Sales from the current period minus sales from the previous period, divided by the sales from the previous period
ROA	Net income divided by the total assets
RE capital	Retained earnings scaled by the capital from previous period
Cash holdings	The ratio of cash to total assets
Average cash holdings	The mean of the firm's cash holdings ratio over the previous three years.
Current ratio	The ratio of current assets to current liabilities
Lerner Index	Measures of concentration, price-cost ratio, computed as the ratio of operating profit to sales
Firm size (log)	Natural logarithm of total assets
Tobin's Q	Market value of total assets over book value of total assets.
Post-2020 Period	A binary indicator variable that takes the value one for observations in 2020 and subsequent years, and zero otherwise.
Financial constraints	Firm financial constraints index, defined as Whited and Wu (2006). See Whited and Wu (2006) Equation (13) for details.

Firm Size Classification

	Definition
Very large firm	For firms with operating revenue of more than 130 million USD or total assets of more than 260 million USD or employees of more than 1000.
Large firm	For firms with operating revenue of more than 13 million USD or total assets of more than 26 million USD or employees of more than 150.
Medium firm	For firms with operating revenue of more than 1.3 million USD or total assets of more than 2.6 million USD or employees of more than 15.
Small firm	Companies are not fulfilling these criteria.

Table A1. Summary statistics

This table presents descriptive statistics for UK firms with available cost of capital data from 2013 to 2022, grouped by listing status and firm size. The sample includes all firm-year observations with non-missing values for the relevant variables. Panel A reports statistics for unlisted firms, and Panel B reports statistics for listed firms. For each variable, the table presents the number of observations (N), mean, standard deviation (Std. Dev), minimum (Min), median, and maximum (Max). Definitions of all variables are provided in the Appendix.

Panel A: Summary statistics for unlisted firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	216,794	0.213	1.089	-0.631	-0.020	8.360
Intangible investment ratio	14,588	1.203	4.155	-0.053	0.084	31.005
Cost of debt	216,794	0.061	0.108	0.000	0.031	0.670
ROIC	216,794	0.087	0.170	-0.556	0.071	0.738
ROE	199,579	0.177	0.503	-2.063	0.131	2.560
Sales growth	216,794	0.107	0.551	-0.905	0.023	5.203
ROA (lag)	216,794	5.328	13.574	-94.380	4.320	174.272
Cash holdings	216,794	0.115	0.146	0.000	0.059	1.000
Average cash holdings	170,927	0.108	0.133	0.000	0.059	1.000
Current ratio	216,794	2.095	3.670	0.000	1.407	81.310
Firm size	216,794	16.692	1.620	7.330	16.593	19.694
Lerner	216,794	-0.007	0.433	-5.714	0.022	1.000
Panel B: Summary statistics for listed firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	4,543	0.399	1.354	-0.631	0.022	8.360
Intangible investment ratio	3,338	0.717	3.334	-0.053	0.000	31.005
Cost of debt	4,543	0.099	0.123	0.001	0.057	0.670
ROIC	4,543	0.018	0.151	-0.556	0.047	0.738
ROE	4,370	0.002	0.452	-2.063	0.073	2.560
Cost of equity	1,714	0.071	0.020	0.044	0.067	0.151
WACC	1,623	0.065	0.016	0.038	0.062	0.122
Sales growth	4,543	0.165	0.690	-0.905	0.039	5.203
ROA (lag)	4,543	-0.409	16.416	-94.380	3.390	99.590
Cash holdings	4,543	0.134	0.150	0.000	0.084	0.958
Average cash holdings	3,685	0.126	0.135	0.000	0.083	0.916
Current ratio	4,543	2.026	3.380	0.053	1.413	81.310
Firm size	4,543	18.678	1.298	8.657	19.295	19.694
Lerner	4,543	-0.243	1.021	-5.714	0.010	1.000
Panel C: Summary statistics for very large firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	47,961	0.259	1.145	-0.631	-0.006	8.360
Intangible investment ratio	8,297	0.905	3.673	-0.053	0.024	31.005
Cost of debt	47,961	0.066	0.113	0.000	0.032	0.670
ROIC	47,961	0.067	0.142	-0.556	0.060	0.738
ROE	44,873	0.133	0.445	-2.063	1.162	2.560
Cost of equity	1,983	0.072	0.020	0.044	0.068	0.151
WACC	1,887	0.064	0.016	0.038	0.062	0.122
Sales growth	47,961	0.131	0.594	-0.905	0.034	5.203
ROA (lag)	47,961	3.868	11.862	-94.380	3.740	174.272
Cash holdings	47,961	0.096	0.128	0.000	0.049	0.991
Average cash holdings	39,542	0.094	0.119	0.000	0.052	0.941
Current ratio	47,961	2.020	3.896	0.000	1.341	81.310
Firm size	47,961	18.589	1.114	8.657	18.829	19.694
Lerner	47,961	-0.054	0.586	-5.714	0.016	1.000
Panel D: Summary statistics for large firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	113,867	0.208	1.034	-0.631	-0.015	8.360
Intangible investment ratio	8,032	1.056	3.689	-0.053	0.090	31.005
Cost of debt	113,867	0.060	0.106	0.000	0.030	0.670
ROIC	113,867	0.090	0.153	-0.556	0.079	0.738
ROE	10,6950	0.172	0.449	-2.063	0.139	2.560
Cost of equity	41	0.070	0.022	0.044	0.067	0.151
WACC	39	0.067	0.020	0.038	0.064	0.122
Sales growth	113,867	0.105	0.504	-0.905	0.030	5.203

ROA (lag)	113,867	5.558	11.885	-94.380	4.810	174.272
Cash holdings	113,867	0.115	0.138	0.000	0.064	0.986
Average cash holdings	91,634	0.108	0.125	0.000	0.064	0.967
Current ratio	113,867	1.987	2.841	0.000	1.441	81.310
Firm size	113,867	16.789	0.892	10.348	16.690	19.694
Lerner	113,867	0.000	0.368	-5.714	0.022	1.000
Panel E: Summary statistics for medium firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	45,852	0.193	1.129	-0.631	-0.030	8.360
Intangible investment ratio	1,505	2.393	6.244	-0.053	0.146	31.005
Cost of debt	45,852	0.060	0.105	0.000	0.032	0.670
ROIC	45,852	0.077	0.189	-0.556	0.060	0.738
ROE	40,539	0.162	0.563	-2.063	0.108	2.560
Sales growth	45,852	0.094	0.610	-0.905	0.001	5.203
ROA (lag)	45,852	4.393	15.084	-94.380	3.530	174.272
Cash holdings	45,852	0.123	0.160	0.000	0.057	0.998
Average cash holdings	34,260	0.115	0.147	0.000	0.057	0.996
Current ratio	45,852	2.393	4.621	0.000	1.437	81.310
Firm size	45,852	15.573	0.961	8.501	15.715	19.694
Lerner	45,852	-0.008	0.463	-5.714	0.024	1.000
Panel F: Summary statistics for small firms						
	N	Mean	Std. Dev	Min	Median	Max
Investment ratio	13,657	0.229	1.290	-0.631	-0.049	8.360
Intangible investment ratio	92	3.892	8.172	0.001	0.438	31.005
Cost of debt	13,657	0.069	0.114	0.000	0.034	0.670
ROIC	13,657	0.149	0.271	-0.556	0.093	0.738
ROE	11,587	0.382	0.811	-2.063	0.189	2.560
Sales growth	13,657	0.091	0.615	-0.905	-0.008	5.203
ROA (lag)	13,657	9.771	23.643	-94.380	5.250	174.272
Cash holdings	13,657	0.162	0.204	0.000	0.075	1.000
Average cash holdings	9,176	0.153	0.190	0.000	0.075	1.000
Current ratio	13,657	2.243	4.991	0.000	1.270	81.310
Firm size	13,657	13.637	1.788	7.330	13.589	19.694
Lerner	13,657	0.020	0.530	-5.714	0.041	1.000

Table A2. Correlation Matrix

This table reports correlation matrix among right hand variables of all UK firms with available cost of capital measures from 2013 to 2022. Definitions of all variables are provided in the Appendix.

Correlation matrix

	Cost of debt	*ROIC*	*ROE*	*Cost of equity*	*WACC*	Sales growth	*ROA (lag)*	*Cash holdings*	*Avg cash holdings*	*Current ratio*	*Firm size*	*Lerner*
Cost of debt	1											
ROIC	0.022***	1										
ROE	0.0101***	0.719***	1									
Cost of equity	-0.079***	0.044**	0.037	1								
WACC	0.238***	0.116***	0.088***	0.671***	1							
Sales growth	-0.005**	0.082***	0.108***	-0.096***	-0.041*	1						
ROA (lag)	0.015***	0.406***	0.343***	-0.017	0.043*	-0.111***	1					
Cash holdings	0.057***	0.120***	0.114***	-0.064***	-0.021	0	0.163***	1				
Avg cash holdings	0.048***	0.090***	0.084***	-0.058	0.000	-0.006	0.166***	0.787***	1			
Current ratio	0.051***	-0.024***	-0.024***	-0.028	-0.003	0.010***	0.019***	0.055***	0.048***	1		
Firm size	-0.037***	-0.144***	-0.151***	0.098***	-0.01	0.038***	-0.154***	-0.195***	-0.163***	0.030***	1	
Lerner	-0.011***	0.331***	0.250***	0.052**	0.048**	0.051***	0.198***	0.001	-0.008***	-0.038***	-0.052***	1

Table A3. Firm-level Investment and Cost of Capital Measures with Control of Cash Holdings

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time *t+1*, scaled by total fixed assets at time *t*. The dependent variable in the Columns (5) to (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time *t+1*, scaled by total fixed assets at time *t*. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.298***				-0.012			
	(-9.23)				(-0.05)			
ROIC		-0.004				0.231		
		(-0.20)				(1.59)		
Cost of equity			-3.322**				3.404	
			(-2.20)				(0.70)	
WACC				-4.484**				-1.417
				(-2.48)				(-0.75)
Sales growth	0.173***	0.174***	0.149	0.187	0.231***	0.221***	0.402	0.313
	(18.91)	(18.73)	(0.94)	(1.16)	(2.90)	(2.77)	(1.36)	(1.15)
Lag ROA	0.007***	0.007***	0.001	0.001	0.002	0.001	-0.017	-0.020
	(15.59)	(15.48)	(0.16)	(0.23)	(0.52)	(0.37)	(-0.96)	(-0.99)
Cash holdings	-0.372***	-0.378***	-0.214	-0.519	0.828	0.791	-1.592*	-0.856
	(-9.14)	(-9.28)	(-0.37)	(-0.96)	(1.38)	(1.31)	(-1.82)	(-1.21)
Current ratio	-0.006***	-0.006***	-0.001	-0.004	-0.045	-0.046	0.044	0.058
	(-4.13)	(-4.51)	(-0.13)	(-0.41)	(-1.07)	(-1.09)	(0.75)	(0.88)
Firm size	0.194***	0.200***	0.267**	0.255*	0.127	0.118	0.866	0.938
	(15.44)	(15.96)	(2.37)	(1.88)	(0.93)	(0.87)	(1.03)	(1.02)
Lerner	-0.030**	-0.030*	0.180	0.172	-0.116	-0.161	0.425	0.408
	(-2.01)	(-1.93)	(0.70)	(0.68)	(-0.90)	(-1.14)	(1.09)	(1.10)
Constant	-3.017***	-3.133***	-5.024**	-4.728*	-1.246	-1.098	-17.742	-19.023
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	221,337	221,337	1,954	1,848	16,758	16,758	1,333	1,259
Adjusted R^2	0.074	0.073	0.213	0.215	0.720	0.720	0.484	0.610

Table A4. Firm-Level Investment and Cost of Capital Measures with Post-2020 and Size Interaction

This table presents the results of regressions examining how different cost of capital measures affect firm-level investment, controlling for the Post-2020 dummy and its interaction with firm size. The dependent variable in Columns 1 to 4 is the investment ratio, defined as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. Columns 5 to 8 report results for the intangible investment ratio, calculated as R&D expenditures excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.256***				0.036			
	(-7.26)				(0.11)			
ROIC		-0.070**				0.259		
		(-2.24)				(0.93)		
Cost of equity			-3.061*				7.017	
			(-1.81)				(1.25)	
WACC				-6.336***				-2.308
				(-2.80)				(-0.62)
Post-2020	0.417***	0.420***	1.928	-0.062	1.579*	1.564*	19.362	16.601
	(5.09)	(5.12)	(0.70)	(-0.02)	(1.75)	(1.74)	(1.47)	(1.54)
*Post-2020*Size*	-0.033***	-0.033***	-0.099	-0.004	-0.095*	-0.094*	-0.100	-0.864
	(-6.90)	(-6.92)	(-0.71)	(-0.03)	(-1.90)	(-1.89)	(-1.48)	(-1.54)
Sales growth	0.138***	0.140***	0.112	0.149	0.221***	0.211***	0.681	0.656
	(11.38)	(11.32)	(0.50)	(0.64)	(2.92)	(2.80)	(1.27)	(1.27)
Lag ROA	0.004***	0.004***	0.000	0.000	-0.001	-0.001	-0.034	-0.036
	(9.12)	(9.15)	(0.08)	(0.04)	(-0.28)	(-0.36)	(-1.10)	(-1.03)
Avg cash holdings	0.764***	0.765***	1.288*	0.798	1.219	1.210	-11.934	-12.972
	(11.17)	(11.176)	(1.82)	(1.11)	(1.32)	(1.31)	(-1.11)	(-1.15)
Current ratio	-0.007***	-0.008***	0.006	-0.001	-0.050	-0.049	0.143	0.172
	(-4.59)	(-4.86)	(0.42)	(-0.08)	(-1.16)	(-1.19)	(0.88)	(0.94)
Firm size	0.278***	0.284***	0.637**	0.714***	0.422*	0.418*	-0.822	-0.950
	(19.87)	(20.32)	(2.41)	(2.62)	(1.95)	(1.95)	(-1.32)	(-1.37)
Lerner	-0.045***	-0.037**	0.016	0.051	-0.105	-0.142	1.322	1.507
	(-2.58)	(-2.02)	(0.04)	(0.14)	(-0.74)	(-0.88)	(1.41)	(1.50)
Constant	-4.5577***	-4.670***	-12.010**	-13.275**	-6.555*	-6.496*	16.783	19.912
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	165,135	165,135	1,560	1,461	12,976	12,976	1,018	951
Adjusted R^2	0.0486	0.0482	0.162	0.147	0.744	0.744	0.581	0.554

Table A5. Firm-Level Investment and Cost of Capital Measures for the Sample of Firms with Intangible Investment Data

This table presents regression results examining the relationship between cost of capital measures and firm-level investment for a subsample of UK firms with available data on intangible investment from 2013 to 2022. The dependent variable in Columns 1 to 4 is the investment ratio, defined as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. Columns 5 to 8 report results for the intangible investment ratio, calculated as R&D expenditures excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.257**				0.058			
	(-2.44)				(0.18)			
ROIC		0.108				0.127		
		(1.09)				(0.58)		
Cost of equity			-2.248				4.886	
			(-1.34)				(1.05)	
WACC				-1.423				-3.852
				(-0.92)				(-0.80)
Sales growth	0.260***	0.251***	0.394	0.422	0.179**	0.171**	0.679	0.632
	(4.74)	(4.49)	(1.51)	(1.58)	(2.43)	(2.29)	(1.21)	(1.21)
Lag ROA	0.003**	0.003**	0.000	0.002	-0.001	-0.002	-0.035	-0.035
	(2.36)	(2.12)	(0.05)	(0.42)	(-0.42)	(-0.46)	(-1.10)	(-1.01)
Avg cash holdings	1.051***	1.046***	2.113***	1.833**	1.266	1.266	-11.639	-12.709
	(4.82)	(4.78)	(2.92)	(2.48)	(1.33)	(1.33)	(-1.08)	(-1.13)
Current ratio	0.001	-0.001	0.092	0.098	-0.047	-0.047	0.131	0.160
	(0.08)	(-0.08)	(0.95)	(0.98)	(-1.17)	(-1.18)	(0.80)	(0.86)
Firm size	0.280***	0.283***	0.427**	0.436**	0.420*	0.417*	-0.503	-0.664
	(5.76)	(5.84)	(2.41)	(2.42)	(1.86)	(1.85)	(-0.93)	(-1.150)
Lerner	-0.001***	-0.001***	-1.072	-1.058	0.001***	0.001***	0.747	0.880
	(-4.10)	(-3.95)	(-1.34)	(-1.25)	(9.03)	(8.70)	(1.18)	(1.32)
Constant	-4.942***	-5.028***	-8.275**	-8.553**	-6.557	-6.490	10.761	14.464
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	13,001	13,001	1,018	951	13,001	13,001	1,020	951
Adjusted R^2	0.102	0.102	0.262	0.263	0.743	0.743	0.570	0.546

Table A6. Firm-level Investment and Cost of Capital Measures with Tobin's Q

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) among firms while additionally controlling for Tobin's Q, using data from 2013 to 2022. Tobin's Q is computed as the market value of total assets divided by the book value of total assets, where the market value is calculated as the number of outstanding shares multiplied by the stock price at the end of the fiscal year. Market data are sourced from Refinitiv. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. The dependent variable in the Columns (5) to (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.556**				0.535			
	(-2.26)				(1.26)			
ROIC		0.634**				1.958***		
		(2.02)				(3.40)		
Cost of equity			-3.806*				5.812	
			(-1.67)				(1.04)	
WACC				-4.901**				-4.139
				(-1.97)				(-0.71)
Sales growth	0.291***	0.281***	0.179**	0.177**	0.231**	0.191*	0.707**	0.632**
	(5.81)	(5.59)	(2.28)	(2.25)	(2.18)	(1.80)	(2.19)	(1.99)
Lag ROA	0.006**	0.005**	-0.000	0.001	-0.001	-0.002	-0.035***	-0.036***
	(2.44)	(2.26)	(-0.04)	(0.09)	(-0.09)	(-0.43)	(-3.33)	(-3.40)
Avg cash holdings	1.958***	1.910***	0.694	0.725	2.013***	2.001***	-12.714***	-12.832***
	(4.53)	(4.41)	(0.88)	(0.92)	(2.62)	(2.61)	(-6.87)	(-6.93)
Current ratio	-0.036**	-0.041***	-0.004	-0.003	0.037	0.004	0.154	0.167*
	(-2.38)	(-2.69)	(-0.23)	(-0.21)	(0.90)	(0.10)	(1.53)	(1.66)
Firm size	0.391***	0.373***	0.601***	0.589***	-0.059	-0.120	-0.580	-0.686
	(4.11)	(3.89)	(2.84)	(2.77)	(-0.35)	(-0.71)	(-1.24)	(-1.46)
Lerner	0.040	-0.016	0.168	0.168	-0.331***	-0.531**	0.881*	1.378**
	(0.72)	(-0.26)	(1.14)	(0.86)	(-3.31)	(-4.61)	(1.83)	(2.36)
Tobin's Q	-0.042**	-0.045***	-0.118	-0.100	-0.303***	-0.306***	0.054	-0.025
	(-2.58)	(-2.76)	(-1.50)	(-1.29)	(-11.19)	(-11.31)	(0.31)	(-0.14)
Constant	-7.123***	-6.840***	-11.056***	-10.809***	1.762	2.955	12.087	14.918
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	3,169	3,169	1,461	1,461	2,097	2,097	951	951
Adjusted R^2	0.114	0.114	0.155	0.155	0.695	0.697	0.545	0.546

Table A7. Firm-level Investment and Cost of Capital Measures for Listed Firms

This table presents the results of regressions examining how the cost of capital measures affects firm-level net investments (in tangible and intangible capital) among listed UK firms from 2013 to 2022. The dependent variable in the Columns (1) to (4) is the investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t+1, scaled by total fixed assets at time t. The dependent variable in the Columns (5) to (8) is the intangible investment ratio, calculated as R&D expenses excluding amortization at time t+1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable:								
	Investment ratio				***Intangible investment ratio***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.477***				0.116			
	(-3.12)				(0.27)			
ROIC		0.199				0.342		
		(1.41)				(0.90)		
Cost of equity			-2.955				5.197	
			(-1.63)				(1.08)	
WACC				-4.242*				-3.238
				(-1.85)				(-0.61)
Sales growth	0.285***	0.172***	0.148	0.181**	0.119	0.266**	0.679	0.638**
	(10.30)	(2.86)	(0.64)	(2.31)	(1.27)	(2.11)	(1.22)	(2.01)
Lag ROA	0.002	0.003	-0.001	-0.000	-0.020***	-0.004	-0.036	-0.036***
	(1.32)	(1.42)	(-0.23)	(-0.06)	(-5.19)	(-0.71)	(-1.11)	(-3.44)
Avg Cash holdings	0.768***	0.942**	1.182	0.786	4.305***	2.293	-11.728	-12.826***
	(5.27)	(2.46)	(1.63)	(1.00)	(10.14)	(0.93)	(-1.09)	(-6.94)
Current ratio	-0.005	-0.014	0.004	-0.003	-0.033*	0.012	0.136	0.166*
	(-1.03)	(-0.96)	(0.30)	(-0.21)	(-1.65)	(0.28)	(0.81)	(1.66)
Firm size	-0.038**	0.369***	0.589*	0.661***	-0.130***	0.431	-0.504	-0.660
	(-2.50)	(3.60)	(1.82)	(3.20)	(-2.86)	(0.80)	(-0.93)	(-1.46)
Lerner	0.015	0.000	0.127	0.138	-0.238***	-0.282	1.129	1.359**
	(0.72)	(0.01)	(0.34)	(0.70)	(-3.71)	(-1.49)	(1.30)	(2.36)
Constant	0.972***	-6.702***	-11.075*	-12.388***	2.519***	-7.839	10.744	14.325
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	5,544	5,312	1,560	1,461	3,288	3,046	1,020	951
Adjusted R^2	0.027	0.082	0.176	0.155	0.098	0.719	0.571	0.547

Table A8. Firm-level Investment and Return on Equity by Firm Size

This table presents results examining how the return on equity (ROE), used as a proxy for firms' cost of equity, affects firm-level net investments (in tangible and intangible capital) from 2013 to 2022, segmented by firm size. ROE is available for both listed and unlisted firms, allowing the analysis to capture differences across the full firm population. Columns (1) to (4) report results where the dependent variable is the investment ratio, defined as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. Columns (5) to (7) report results where the dependent variable is the intangible investment ratio, defined as R&D expenditures excluding amortization at time t + 1, scaled by total fixed assets at time t. Results are shown separately for very large, large, medium-sized, and small firms in Columns (1) to (4), and for very large, large, and medium-sized firms in Columns (5) to (7); results for small firms' intangible investment are not reported due to limited observations. All models include firm and year fixed effects. All variables' definitions and firm size classifications are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables:							
	Investment ratio				***Intangible investment ratio***		
Variables	(1) VL	(2) L	(3) M	(4) S	(5) VL	(6) L	(7) M
ROE	0.037*	0.012	0.020	0.007	-0.099	-0.062	-0.119
	(1.87)	(0.92)	(1.09)	(0.16)	(-0.69)	(-0.72)	(-0.34)
Sales growth	0.165***	0.151***	0.067**	0.082*	0.213**	0.073	0.225
	(5.92)	(7.77)	(2.57)	(1.77)	(2.05)	(0.65)	(0.54)
Lag ROA	0.004***	0.005***	0.004***	0.008***	-0.002	0.007	-0.008
	(3.99)	(8.37)	(2.92)	(4.31)	(-0.37)	(1.59)	(-0.46)
Avg cash holdings	0.863***	0.606***	0.931***	1.270***	1.730	-0.958	5.487*
	(5.59)	(6.88)	(5.23)	(2.97)	(1.34)	(-0.96)	(1.75)
Current ratio	-0.009**	-0.012***	-0.007***	0.002	-0.014	-0.010	-0.185*
	(-2.24)	(-4.67)	(-2.78)	(0.33)	(-0.57)	(-0.23)	(-1.77)
Firm size	0.200***	0.259***	0.300***	0.279***	0.501	0.305	0.862
	(7.54)	(13.77)	(6.75)	(3.29)	(1.61)	(1.30)	(0.80)
Lerner	-0.020	-0.089**	-0.072	-0.196*	-0.114	0.284	-0.147
	(-0.67)	(-2.02)	(-1.62)	(-1.65)	(-0.70)	(1.29)	(-0.31)
Constant	-3.672***	-4.258***	-4.665***	-3.965***	-9.115	-4.275	-11.560
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	35,878	82,600	27,426	6,049	5,888	5,351	845
Adjusted R^2	0.0571	0.0496	0.0520	0.0157	0.777	0.737	0.698

Table A9. Firm-level Investment and Cost of Capital Measures by Alternative Measures of Firm Size

This table presents the results of regressions examining the impact of cost of capital measures on tangible investment across UK firms of different sizes over the period 2013 to 2022. Firm size is defined in three alternative ways across the panels: by total assets in Panel A, by total sales in Panel B, and by the number of employees in Panel C. For each definition, firms are grouped into three categories—small, medium, and large—based on their relative size distribution. The dependent variable in all panels is the tangible investment ratio, calculated as capital expenditures (CAPEX) excluding depreciation at time t + 1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Panel A: Firm size by total assets								
Dependent variable: *Investment ratio*								
	Small firm		*Medium firm*		*Large firm*			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.427***		-0.235***		-0.092			
	(-6.31)		(-4.34)		(-1.42)			
ROIC		-0.084		-0.044		0.050		
		(-1.61)		(-0.75)		(0.76)		
Cost of equity							-2.856	
							(-1.59)	
WACC								-4.011*
								(-1.66)
Sales growth	0.094***	0.096***	0.107***	0.108***	0.160***	0.159***	0.173	0.177
	(4.49)	(4.55)	(4.89)	(4.88)	(7.49)	(7.34)	(0.77)	(0.75)
Lag ROA	0.005***	0.005***	0.003***	0.003***	0.004***	0.004***	-0.000	0.000
	(8.01)	(7.98)	(3.73)	(3.76)	(4.32)	(4.14)	(-0.02)	(0.01)
Avg cash holdings	0.927***	0.934***	0.702***	0.700***	0.777***	0.776***	1.373*	0.925
	(6.44)	(6.47)	(6.63)	(6.61)	(6.01)	(6.01)	(1.92)	(1.30)
Current ratio	-0.005**	-0.006***	-0.007***	-0.007***	-0.007***	-0.008***	-0.001	-0.002
	(-2.32)	(-2.69)	(-2.58)	(-2.76)	(-2.78)	(-2.83)	(-0.09)	(-0.15)
Firm size	0.346***	0.362***	0.330***	0.337***	0.211***	0.213***	0.372*	0.416*
	(10.41)	(10.76)	(11.57)	(11.82)	(7.51)	(7.58)	(1.76)	(1.94)
Lerner	-0.079**	-0.067	-0.024	-0.018	-0.024	-0.029	0.048	0.125
	(-1.99)	(-1.54)	(-0.49)	(-0.34)	(-1.02)	(-1.16)	(0.14)	(0.35)
Constant	-5.215***	-5.480***	-5.401***	-5.523***	-3.770***	-3.817***	-6.919*	-7.707*
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	45,070	45,070	57,088	57,088	57,244	57,244	1,521	1,427
Adjusted R^2	0.035	0.034	0.055	0.055	0.058	0.058	0.178	0.174
Panel B: Firm size by sales								
Dependent variable: *Investment ratio*								
	Small firm		*Medium firm*		*Large firm*			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.430***		-0.353***		-0.094*			
	(-4.55)		(-6.58)		(-1.79)			
ROIC		-0.100		-0.140**		-0.036		
		(-1.47)		(-2.43)		(-0.71)		
Cost of equity							-2.781	
							(-1.54)	
WACC								-5.136**
								(-2.25)
Sales growth	0.055***	0.057***	0.182***	0.190***	0.194***	0.195***	0.143	0.142
	(2.84)	(2.94)	(8.03)	(8.22)	(8.13)	(8.08)	(0.64)	(0.61)
Lag ROA	0.004***	0.004***	0.004***	0.005***	0.004***	0.004***	0.001	0.002
	(5.08)	(5.10)	(6.30)	(6.40)	(5.30)	(5.31)	(0.32)	(0.42)
Avg cash holdings	1.070***	1.073***	0.707***	0.709***	0.749***	0.749***	1.196	0.695
	(5.86)	(5.87)	(6.92)	(6.94)	(7.15)	(7.16)	(1.57)	(0.91)
Current ratio	-0.006**	-0.006***	-0.014***	-0.015***	-0.017***	-0.018***	0.008	0.007
	(-2.55)	(-2.74)	(-3.11)	(-3.31)	(-3.58)	(-3.65)	(0.77)	(0.78)
Firm size	0.362***	0.373***	0.290***	0.300***	0.256***	0.258***	0.433*	0.472**
	(10.28)	(10.64)	(10.07)	(10.46)	(10.51)	(10.57)	(1.92)	(2.05)
Lerner	-0.067**	-0.020	0.049	0.092	0.065*	0.073**	0.048	0.134
	(-2.12)	(-0.78)	(0.88)	(1.44)	(1.89)	(1.99)	(0.14)	(0.37)

Constant	-5.537***	-5.731***	-4.690***	-4.859***	-4.500***	-4.541***	-8.131*	-8.752*
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	37,827	37,827	57,578	57,578	63,874	63,874	1,492	1,401
Adjusted R^2	0.055	0.054	0.068	0.067	0.054	0.054	0.163	0.155
Panel C: Firm size by employees								
Dependent variable: *Investment ratio*								
		Small firm		*Medium firm*			*Large firm*	
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	-0.318***		-0.267***		-0.158***			
	(-3.21)		(-4.75)		(-3.18)			
ROIC		-0.038		-0.091		0.001		
		(-0.54)		(-1.51)		(0.02)		
Cost of equity							-3.767**	
							(-2.15)	
WACC								-5.643**
								(-2.42)
Sales growth	0.053***	0.054***	0.167***	0.170***	0.245***	0.244***	0.125	0.126
	(2.59)	(2.58)	(6.67)	(6.60)	(9.27)	(9.17)	(0.53)	(0.50)
Lag ROA	0.005***	0.005***	0.006***	0.006***	0.003***	0.003***	0.003	0.004
	(4.77)	(4.74)	(7.37)	(7.37)	(3.84)	(3.74)	(0.87)	(1.08)
Avg cash holdings	0.814***	0.816***	0.675***	0.681***	0.849***	0.849***	1.207	0.674
	(4.96)	(4.96)	(6.35)	(6.41)	(8.03)	(8.02)	(1.52)	(0.85)
Current ratio	-0.006**	-0.006**	-0.016***	-0.017***	-0.017***	-0.018***	-0.032	-0.043
	(-2.26)	(-2.44)	(-4.13)	(-4.28)	(-3.83)	(-3.93)	(-0.39)	(-0.56)
Firm size	0.249***	0.258***	0.258***	0.266***	0.288***	0.292***	0.368	0.431*
	(7.17)	(7.44)	(9.84)	(10.17)	(11.96)	(12.16)	(1.49)	(1.67)
Lerner	-0.008	-0.006	-0.131***	-0.115**	-0.012	-0.012	0.309	0.429
	(-0.25)	(-0.18)	(-2.77)	(-2.19)	(-0.38)	(-0.37)	(0.98)	(1.28)
Constant	-3.859***	-4.027***	-4.194***	-4.340***	-5.077***	-5.150***	-6.764	-7.854
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	38,742	38,742	53,067	53,067	56,999	56,999	1,450	1,356
Adjusted R^2	0.014	0.013	0.072	0.071	0.070	0.069	0.164	0.157

Table A10. Cost of Capital and Intangible Investment: London vs. Non-London Firms

This table presents the results of regressions estimating the impact of cost of capital measures on tangible investment among UK firms over the period 2013 to 2022, with a focus on geographical heterogeneity between London and non-London firms. The dependent variable in all columns is the intangible investment ratio, calculated as R&D expenditures excluding amortization at time t + 1, scaled by total fixed assets at time t. Columns (1) to (4) present results for non-London firms, while Columns (5) to (8) show estimates for London-based firms. All models include firm and year fixed effects. All variables' definitions and firm size classifications are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variables: ***Intangible investment ratio***								
	Non-London				*London*			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cost of debt	0.081				-0.001			
	(0.23)				(-0.00)			
ROIC		0.517*				-0.701		
		(1.77)				(-0.73)		
Cost of equity			7.267				0.129	
			(1.05)				(0.78)	
WACC				-8.872				0.185
				(-0.94)				(0.16)
Sales growth	0.135*	0.115	0.995	0.919	0.503**	0.523**	0.024	0.025
	(1.71)	(1.48)	(1.24)	(1.26)	(2.06)	(2.13)	(1.48)	(1.39)
Lag ROA	-0.002	-0.003	-0.047	-0.050	0.004	0.005	0.000	0.001
	(-0.59)	(-0.73)	(-1.17)	(-1.10)	(0.36)	(0.44)	(0.19)	(0.73)
Avg cash holdings	1.609*	1.588*	-14.436	-15.674	-1.711	-1.682	-0.191	-0.093
	(1.74)	(1.72)	(-1.13)	(-1.19)	(-0.44)	(-0.43)	(-0.62)	(-0.38)
Current ratio	-0.049	-0.050	0.399	0.533	-0.058	-0.057	-0.004	-0.003
	(-1.05)	(-1.09)	(0.97)	(1.07)	(-0.88)	(-0.86)	(-1.61)	(-1.48)
Firm size	0.347	0.336	-0.313	-0.463	0.905	0.919	-0.001	0.005
	(1.48)	(1.45)	(-0.65)	(-0.89)	(1.31)	(1.35)	(-0.06)	(0.20)
Lerner	-0.257	-0.337	1.464	1.980	0.150	0.228	0.033	0.041
	(-1.35)	(-1.58)	(1.35)	(1.50)	(0.79)	(0.95)	(0.79)	(0.78)
Constant	-5.398	-5.210	6.862	10.646	-14.417	-14.642	0.091	-0.044
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11,224	11,224	742	689	1,752	1,752	276	262
Adjusted R^2	0.728	0.728	0.583	0.564	0.772	0.773	0.611	0.632

Table A11. Firm-level Investment and Cost of Capital Measures by Labour Productivity Level

This table presents the results of estimating the effect of cost of capital measures on intangible investment among UK firms from 2013 to 2022. Firms are classified into three groups, low, medium, and high productivity, based on industry-adjusted labor productivity. Specifically, labor productivity is calculated as the difference between a firm's sales per employee and the three-digit SIC industry average in the corresponding year, to control for sectoral variation in productivity levels. Columns (1) to (4) report results for low-productivity firms, Columns (5) to (8) for medium-productivity firms, and Columns (9) to (12) for high-productivity firms. The dependent variable across all columns is the intangible investment ratio, calculated as R&D expenditures excluding amortization at time t + 1, scaled by total fixed assets at time t. All models include firm and year fixed effects. All variables' definitions are provided in the Appendix. t-statistics based on heteroskedasticity-robust standard errors two-way clustered by firm and year are reported in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dependent variable: ***Intangible investment ratio***												
	Low labour productivity				***Medium labour productivity***				***High labour productivity***			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cost of debt	-0.314				0.416				-0.012			
	(-0.83)				(0.76)				(-0.02)			
ROIC		0.386				0.397				0.269		
		(0.61)				(0.70)				(0.71)		
Cost of equity			-5.515				2.398				-0.183	
			(-0.48)				(0.57)				(-0.59)	
WACC				-29.443				1.528				0.024
				(-1.06)				(0.59)				(0.03)
Sales growth	0.187	0.172	1.911	1.866	0.012	0.002	0.342	0.236	0.306*	0.291*	0.023	0.028*
	(0.79)	(0.74)	(1.18)	(1.15)	(0.10)	(0.01)	(1.55)	(0.98)	(1.87)	(1.73)	(1.62)	(1.69)
Lag ROA	-0.014*	-0.015	-0.184*	-0.198**	0.003	0.003	0.004	0.018**	0.002	0.002	0.000	0.000
	(-1.65)	(-1.61)	(-1.94)	(-2.17)	(0.61)	(0.56)	(0.50)	(2.08)	(0.57)	(0.51)	(0.56)	(0.57)
Avg cash holdings	-0.872	-0.846	-25.021	-28.051*	2.105	2.085	2.637	1.502	0.501	0.500	0.070	0.077
	(-0.37)	(-0.36)	(-1.65)	(-1.70)	(1.58)	(1.57)	(0.79)	(0.58)	(0.41)	(0.41)	(0.36)	(0.37)
Current ratio	-0.006	-0.008	0.308	0.285	-0.166	-0.165	-0.179	-0.171	-0.017	-0.017	-0.003	-0.003
	(-0.18)	(-0.23)	(1.09)	(0.99)	(-1.62)	(-1.63)	(-1.43)	(-1.32)	(-0.67)	(-0.68)	(-1.45)	(-1.44)
Firm size	-0.168	-0.157	-3.539	-4.455	0.055	0.030	0.359	-0.350	0.488	0.495	-0.002	-0.001
	(-0.86)	(-0.81)	(-1.62)	(-1.63)	(0.18)	(0.10)	(0.41)	(-0.71)	(1.39)	(1.42)	(-0.10)	(-0.02)
Lerner	0.120	0.072	2.468*	2.708*	-0.047	-0.108	0.261	0.926	-0.092	-0.154	0.093	0.100
	(0.80)	(0.40)	(1.80)	(1.81)	(-0.09)	(-0.19)	(0.20)	(0.95)	(-0.65)	(-0.98)	(1.50)	(1.55)
Constant	4.032	3.792	72.847	92.450	0.159	0.604	-6.596	7.087	-7.875	-8.015	0.109	0.066
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	2,518	2,518	196	183	4,064	4,064	322	292	4,339	4,339	352	342
Adjusted R^2	0.825	0.747	0.658	0.669	0.784	0.784	0.754	0.705	0.784	0.784	0.775	0.774