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The Puzzle of UK (Under-) Investment: Is Investment Short-Termism Just a Supply-Side Problem in Capital Markets?

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Investors and financial market intermediaries have been blamed for under-investment, low growth and low rates of innovation in the UK, with their behaviour being attributed to short-termism. Various reasons for short-termism have been identified, including undervaluing long-term earnings, increased financial obstacles associated with longer investment horizons, and the adoption of financial control systems to meet investors' demands for quarterly earnings reports. As a result, firms may opt for suboptimal short-term investment projects while neglecting potentially valuable long-term initiatives. Most research has focused on large corporates, which constitute a small fraction of the economy and involve multiple stakeholders. There is a significant knowledge gap regarding small owner-managed firms that rely primarily on internal financing and bank debt for investment. Our study fills this gap by analysing a comprehensive UK finance and investment decision-making survey of 1501 firms across all classes. The survey reveals that investment appraisal relies on a 'payback' period. We find that 58.8% of firms choose a payback period of 3 years or less, with shorter payback periods more prominent among the smallest firms. This suggests that financial frictions impact the investment behaviour of the smallest firms, while shareholder-driven short-termism influences the largest firms but only in relation to research and development projects.

Introduction

The UK has an identifiable under-investment problem and low levels of investment in research and development (R&D), but this is not a new problem. Concerns about the low level of investment in the UK economy date back to the 1960s and led to the formulation of the 'The National Plan' (1965),[1] which had support from all political parties and was designed to bring UK growth rates up to the level of major competitors in Europe and America. This suggests that the government was concerned that under-investment in capital stock was the main driver of low economic growth and performance and that it saw *short-termism* in the business sector as a big part of this problem.

Productivity growth in the UK has consistently been below expectations since at least the global financial crisis (GFC), and this enigma has been referred to as the 'productivity puzzle' (see Barnett, Batten, et al., 2014; Barnett, Broadbent, et al., 2014; Askenazy, et al., 2016; Weale, 2014), namely the persistent sluggishness in the UK's productivity growth. There are issues related to the measurement of productivity.[2] However, the Bank of England (Bahaj et al., 2016) has cited contributory factors to the productivity challenge such as crisis-related 'scarring' and the collapse of credit availability; policy actions that may have prevented the 'creative destruction' of firms; the slow adoption of new technologies; the lack of investment; and skills mismatches. The Bank has highlighted the need for policies that encourage investment, boost innovation, and improve human capital to address the issue. Current data (CEICDATA.com) show that UK investment levels as a share of GDP in 2022 are like those recorded in 2013, so in that sense little has changed, with the investment share at 16.1% of GDP.

[1]The National Plan stated that: 'Industry will need to step up its plans for buying more plant and equipment. The Government is looking at the incentives to do so; but firms themselves must look further ahead in making their plans' (p. 19).

[2]Bean (2016) discusses the potential mechanisms for the underestimation of GDP.

Thus, while the focus in the 1960s for solving UK under-investment was on problems with short-termism in the business sector, the wheel has turned since then, and the focus over the last 20 years has been on capital markets, investors, shareholders, and financial intermediaries. Economic researchers have identified several issues that contribute to low levels of firm investment, and, more importantly, very low levels of long-term investment in R&D and innovation-driven investments that have longer time horizons but are most likely to drive long-term productivity growth (Davies et al., 2014; Keum, 2021). This has been attributed to heavy discounting of long-term earnings (Rappaport, 2005), too much emphasis on monthly accounting earnings (Grinyer, Russell and Collison, 1998), and financial frictions. Milbradt and Oehmke (2015), argue that financing frictions increase with the investment horizon, making long-term projects more expensive and potentially subject to rationing. As a result, firms may resort to shorter-term projects.

It is the case that the vast majority of research into the under-investment problem in firms and short-termism is enshrined in principal–agent theory and in theories relating to the separation of ownership from control (Demsetz, 1983; Fama, 1980; Fama and Jensen, 1983). This leaves a significant gap in our knowledge about the other 99% of firms in the economy that are small, owner-managed, have no separation of ownership and control, and finance their investment needs almost exclusively with bank debt (Cowling, 2003; Hamilton and Fox, 1998). This is the gap that our study aims to fill by analysing a large UK finance and investment decision-making survey that includes all classes of firm. From our initial analysis, we observe that larger and older firms have a significantly lower average cost of funds (COF) for investment. We find that the causes of short-termism on the firm side are different depending on the size of the firm. As a starting point, we find that 58.8% of firms choose an investment payback period (PP) of 3 years or less. However, short-term investment payback years are most evident amongst the smallest and largest firms, suggesting that financial frictions influence the very smallest firms to invest short-term and that shareholder short-termism influences the largest firms to invest short-term. We find that the industry sector in which a firm operates is central to understanding why some firms have short investment PPs and some take a longer-term approach.

The rest of the paper is organized as follows. In the following section, we focus on the literature relating to investment and how capital markets and firms interact to either support or inhibit investment. We consider how the two interact to determine the time horizon of investments and why some firms may be limited to short-term investments whilst others are willing to invest over the long term. Next, we discuss the data available to us, which is derived from a survey of 1501 UK firms and representative of the actual business population, for the empirical analysis of investment PPs, and we present the basic demographic data. We then estimate econometric models that seek to identify the core characteristics associated with the firm's COF and attitudes to risk and then incorporate these factors into our analysis of investment PPs. Finally, we draw some conclusions.

Literature review

In this section, we review the literature relating to discretionary capital investment, financial constraints, how firms appraise investment opportunities, capital market frictions, and short-term behaviours on the supply side of capital markets and, importantly, on the firm side of the investment nexus.

Capital investment and appraisal

While replacing depleting capital stock or complying with new regulations may not be subject to intense appraisal and scrutiny, discretionary capital investment is often subject to quantitative and data-driven appraisal, particularly when the scale of potential investment is large (Weingartner, 1969). This appraisal process takes account of the relative tolerance for risk that decision-makers have, and the level of uncertainty in the wider economy. Capital budgeting theory, the evaluation of investment projects, typically assumes that the primary goal of a firm's shareholders is to maximize firm value and that firms can separate investment and financing decisions, investing in all positive Net Present Value projects. The most common forms of investment appraisal include discounted cash flow (DCF) methods and PP, and both include estimates of the future stream of cash flows and returns that are predicted to derive from the investment. Discount rates, the required rate of return for the project, are posited to be positively related to the cost of capital, directly affecting the valuation and attractiveness of investment opportunities. Studies on evidencing investment and investment appraisal focus on larger (or listed) companies, and often find results that are contrary to textbook theory. For instance, in a recent paper, Gormsen and Huber (2023) discuss the effects of changes in the cost of capital on investment appraisal (discount rates). Contrary to stylized theory, the authors suggest that 'fluctuations in the cost of capital in financial markets are largely irrelevant to firm investment' and 'the discount rate may incorporate a host of other, time-varying factors apart from the perceived cost of capital. It is thus possible that discount rates hardly comove with the financial cost of capital' (p. 1). Gutierrez and Philippon (2017) examine evidence on the relationship between investment activity and

profitability (or Tobin's Q) and find that, contrary to theory, high Qs can be associated with low investment. They cite a number of factors driving this result [financial frictions, asset intangibility, (global) competition, governance], but *short-termism* is a relevant factor. The authors suggest that 'equity markets put excessive emphasis on quarterly earnings, and that stock-based compensation incentivizes managers to focus on short-term capital gains' (p. 109). The behavioural theory 'myopic loss aversion' (Thaler et al., 1997) suggests that individuals tend to prioritize avoiding short-term losses over maximizing long-term gains. In the context of business investment appraisal decisions, it can be argued that businesses may make suboptimal choices by focusing excessively on avoiding immediate losses rather than considering the potential long-term benefits. This bias can reinforce a preference for focussing on the short-term appraisal of projects and result in missed opportunities for growth and innovation.

In relation to smaller firms, Keasey and Watson (1993) hypothesized that the factors that influence capital budgeting decisions differ significantly from those for larger firms.[3] Peel and Wilson (1996) find empirical support for this arguing that 'since small firm owners may be pursuing objectives other than wealth maximisation (e.g. survival), then, *ceteris paribus*, they would be less likely to use capital budgeting techniques consistent with this objective (i.e. discounted cash flow techniques), but may, for example, focus on minimising risk (e.g. by using the payback method' (p. 54). The authors' small and medium enterprise (SME) survey revealed that 67.6% of firms in the sample likely used the payback method. In addition to having multiple objectives, small-firm owners lack expertise in finance and are not able to make reliable estimates of future cash flows, as required in DCF analysis. Consequently, they use the simpler payback appraisal rather than evaluating projects using DCFs. Moreover, capital constraints can make it essential for small firms to maintain sufficient cash balances, in order to respond to potentially profitable investments as they become available (Almeida, Campello and Weisbach, 2004). Thus, financing constraints provide small privately held firms with a legitimate economic reason to be concerned about how quickly a project will generate cash flows (i.e. the PP). Of course, young and developing businesses often have uneven cash flows and/or have difficulty forecasting future cash flow as the business progresses through its growth life-cycle (Colombo, Montanaro and Vismara, 2023). The owners consequently look for a shorter payback on investments.

Thus, many firms, and particularly smaller firms, favour the payback method of investment appraisal, which seeks to establish how many years from the investment are required for the initial capital outlay to be recouped from the predicted cash flows generated from the investment. Whilst this method is relatively unsophisticated, as it does not consider cash flows generated after the payback cut-off period, it is a simple decision-making rule and widely prevalent in the smaller-business sector (Danielson and Scott, 2006; Peel and Wilson, 1996; Rossi, 2015). Further, where studies have identified the actual PP, for smaller firms it is most commonly 3 years or less (Block, 1997; Lane and Rosewall, 2015; Lefley, 1996).

This suggests that firms, particularly smaller firms, place a high premium on recovering their capital investment outlay. However, the reasons for this may differ for capital-constrained and capital-unconstrained firms. For the former, the need to stabilize cash flow as quickly as possible is paramount (Wambach, 2000). For the latter, early payback sustains a favourable credit rating and increases the firm's ability to borrow capital in the future. Broader justifications for the use of PP methods include increasing the probability that an investment generates a positive return over and above the cost of capital, and an ability to screen investment projects in the presence of asymmetric information, for example when an R&D employee puts forward an investment proposal with a high technical content to the owner–manager.

Uncertainty in respect of the life-time of an investment in terms of the period over which it will generate returns is a consideration when adopting a PP appraisal method. If we assume that, on average, the more distant from the initial capital outlay the potential returns are, the greater the uncertainty about the nature of those expected returns is. Choosing a shorter PP will reduce the level of uncertainty around the stream of future returns. There is also some evidence of a tightening in investment criteria since the GFC. For example, some firms have reduced their maximum PP, and this might indicate that firms are applying a higher discount rate to their investment appraisal. Melolinna, Miller and Tatomir (2018), in their analysis of UK firms' investments, also found that the higher level of uncertainty in the macroeconomic environment was a major driver of the collapse in investment after the GFC.

Cost of capital and market frictions

It is a stylized fact that smaller firms have a finance pecking order that is shaped by a strong preference for internal capital as the first-best option (Frank and Goyal, 2008; Watson and Wilson, 2002). This is rational on the part of the smaller firm, as internal funds are lower

[3]They suggest that, 'the presence of multiple objectives, high levels of uncertainty, information impactedness and problems in obtaining long-term financing, etc., leads to an investment environment where a number of other factors come into play. The non-diversified owner-manager has to consider the survival of the business and the provision of funding in the future' (p. 238).

cost than external funds owing to the presence of asymmetric information, which can lead to credit rationing (Stiglitz and Weiss, 1981). When internal funds are insufficient, debt is the strongly preferred second-best option (Cowling, Liu and Zhang, 2021). Both options reflect the desire to minimize the potential for what Hamilton and Fox (1998) call 'intrusion' into the firm's closely held business. However, the preference for internal funds requires that firms retain sufficient cash from earnings to fund their operational and investment needs, and this is often not the case (Cowling, Brown and Rocha, 2020).

There are additional information-based problems that can lead to borrower discouragement, whereby a firm with a need for external capital does not wish to incur the costs of application, as they fear rejection (Kon and Storey, 2003), although other studies have estimated that between a third and half of discouraged borrowers would have been able to access funds if they had applied (Cole and Sokolyk, 2016; Cowling et al., 2016). Recent European research has also shown that the discouraged status can last for up to 4 years (Cowling and Sclip, 2022) and that discouragement leads to a decline in firm investment and job creation (Ferrando and Mulier, 2022). Other research has identified borrower 'scarring', such that a previous loan application rejection, either in full or partially, can precipitate this move into a state of non-borrowing even when a firm has exhausted all its internal reserves (Cowling, Liu and Calabrese, 2021).

For firms that do apply for external debt, empirical evidence has established that smaller, younger and also innovative firms are the most likely to face absolute or partial credit rationing owing to their perceived higher risk, heightened information asymmetry, and lack of track record (Freel, 2007; Kirschenmann, 2016; Levenson and Willard, 2000). Credit rationing per se is subsequently related to lower investment, as firms cannot fund all projects with an expected positive net present value (Jaffee and Stiglitz, 1990). Banks often seek to mitigate against information asymmetries, and this often manifests itself by the incorporation of collateral into loan contracts (Coco, 2000). However, owing to asymmetric valuations of collateral, this often presents an additional hurdle to firms with their own collateral (Chan and Kanatas, 1985) and an absolute barrier to firms with no assets. The latter is often used as a justification for public loan guarantee schemes (Cowling, 2010). It is also why researchers have established a strong causal link between housing wealth and a weakening of firm credit constraints (Reuschke and Maclennan, 2014).

It is the case that loan interest rate premia (or margins) are, on average, higher for smaller, younger and innovation-driven firms (Cowling and Westhead, 1996; Ughetto, Scellato and Cowling, 2017; Cowling, Ughetto and Lee, 2018), although this can be mitigated to some extent by lengthy relationships with a lender (Berger and Udell, 1995). These general loan price effects reflect the higher intermediation costs associated with lending to informationally opaque firms (Aber and Biekpe, 2006). The net result is that for an investment project with a common expected return, the COF for informationally opaque (i.e. smaller, younger, and innovation-driven) firms will be higher and represent a larger proportion of the total gross expected returns. With a higher cost of capital, it follows that the PP will be extended over a period where the expected flow of earnings can recoup the initial capital investment. Thus, a greater share of potential investments will fail to meet the required PP threshold.

Short-termism in capital markets

The user cost of capital, capital stock, and output are related, and it follows that investment and growth in capital stock have a long-run and proportional relationship (Ellis and Price, 2004). If the user cost of capital is the important step in the determination of investment, then it should exert a strong effect upon investment, and subsequently output at the firm and aggregate level. In this sense, financing terms and conditions and investment decisions are jointly determined and impacted by financial frictions as discussed above, but also by the investment time horizon. If finance for longer-term investment is more expensive, and more likely to be rationed, then this may force firms to select investment projects with shorter time horizons that may be second best, for example, large R&D projects with a long and uneven time-distributed stream of future earnings weighted disproportionately to later years (Milbradt and Oehmke, 2015; Rappaport, 2005). This can lead to inefficient investment or under-investment.

This theme of short-term behaviour on the supply side of capital markets was also a feature of modern capital markets and was a central feature of research into the potential costs of short-termism by Davies et al. (2014), who argued that financial intermediaries put too much weight on near-term outcomes at the expense of longer-term more productive investments. After estimating the potential costs of these distortions, they concluded that capital market short-termism was a 'disease' that was getting worse over time. In this sense, capital markets were moving away from what theory would identify as a well-functioning market where DCFs are used to set prices. In doing so, short-termist behaviour on the part of investors was not consistent with the firm's long-term value being dependent upon its ability to generate cash to fund profitable new investment and pay dividends to its shareholders. Rappaport (2005) further established that these investor practices had permeated into the strategic investment decision-making of firm executives who, rather than focusing on long-term value creation, were disproportionately focused on

short-term accounting earnings to satisfy the needs of institutional investors and capital market intermediaries (Demirag, 1998). This view that capital market short-termism was influencing the behaviour of firms' managers was also evidenced in a study of managerial short-termism in the UK by Grinyer, Russell and Collison (1998). Using a bespoke postal survey on short-termist behaviours and R&D investment amongst the finance directors of *The Times* Top 1000 UK quoted companies, they found that short-term behaviours were widely prevalent amongst finance directors. However, the reason for this behaviour was, they concluded, 'positively associated with their perceptions of the level of emphasis placed by the capital market on measurements related to short-term reported earnings' (p. 20). Other studies reported evidence that shareholder pressure increased short-termism and had a strong and negative impact on firm-level innovation, and that this was particularly prominent in firms with large institutional blocks of shareholders.

The tension between large corporations and smaller firms

From the preceding three subsections, we can observe that there are some obvious tensions regarding where the UK problem of low investment and short-term behaviours might emanate from. The smaller-firm discussion focused on the behaviours and preferences of owner–managers, who are free to set the strategic direction of the firms they wholly own and manage subject to a minimum profit constraint such that they can live the lives they desire and pay their firms' bills. There are no external shareholders or institutional investors and often no debt, which we now call zero leverage and which has been shown to be a widespread phenomenon (Dang, 2013). In relation to smaller, often family-owned, firms, Fardnia, Kooli and Kumar (2023) found that firms choose zero leverage for two reasons: first, to maintain their financial flexibility to fund future investment, and second, to avoid loss of control. The broader literature has established that two different types of firms fall into the zero-leverage category and that this is related to their dividend policy. Dividend payers use zero leverage to protect against investment distortions as predicted by under-investment and financial flexibility theories. Firms that do not pay dividends and that have zero leverage face capital market constraints. We note here that even if a small firm pays dividends, this is simply a tax-efficient way of drawing income from their own firm. When a large firm pays dividends, it does so to external shareholders, who are often institutional investors.

In addition, small firms, owing to heightened levels of asymmetric information, are more likely to face capital market constraints when they do seek external finance (Atanasova and Wilson, 2003, 2004). Even if these firms are successful in obtaining a loan, the contract terms are likely to be more restrictive than is the case for larger firms. This creates a bigger wedge between the firms and the market cost of capital. Further, given that general uncertainty can cause short-termism in all aspects of finance, financial decision-making, and investment, smaller firms also have more firm-specific uncertainty, given their lower financial reporting requirements and often lack of track record. Thus, whilst large-firm capital investment short-termism may be strongly influenced by these firms' perceptions of the short-term behaviours of capital markets, financial intermediaries, shareholders, and investors, in small firms, it is likely that the presence of strong behavioural preferences for self-funding capital investment, precarious liquidity positions, and wider capital market rationing may drive any short-term investment behaviour. This is reinforced and exacerbated using PP methods of investment appraisal that favour short-term earnings that deliver their initial capital investment outlay to them in the shortest possible time to avoid a further deterioration in their liquidity position.

Data and descriptive statistics

The data

The data we have available to us are from a bespoke UK Government-funded (Department for Business and Trade) finance and investment decision-making survey carried out in 2018. In total, we have 1501 firm-level responses. The survey was designed to capture detailed information on firms' financing and investment decision-making and used a stratified sampling approach to ensure representativeness with the known population of firms. Its overarching aim was to help improve our understanding of why the UK demand for finance was so weak, what any market failures might be, and what, if anything, policy-makers could do to improve the incentives for businesses to engage with capital markets and increase investment.

Specifically, we conducted a detailed survey of 1501 employer businesses in the UK that were at least 3 years old in 2018. The equivalent UK business population for this segment is around 1,257,500 businesses. The survey was conducted with owners, managing directors, financial controllers, and finance directors, with oversampling of larger businesses to ensure robust estimates. The quantitative survey was supplemented by 20 in-depth case study interviews with individuals at this level of seniority within a mixed sample of companies. All responses to the quantitative survey, conducted by IFF Research using Computer-Aided Telephone Interviewing (CATI), were weighted to adjust the achieved sample to the UK business population to ensure that our evidence is representative of the UK business

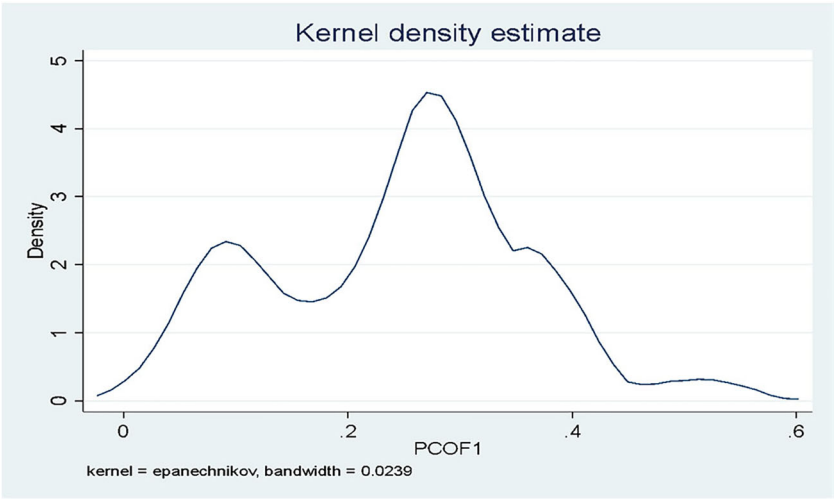

Figure 1. Cost of funds distribution [Colour figure can be viewed at wileyonlinelibrary.com]

population for employer businesses (defined as businesses that have at least one employee). Actual UK industry and size distribution data for the business population are contained in the UK Business Population Estimates (BPE_2017_detailed_tables (1)).

The 'typical' respondent firm was classified as a micro (0–9 employees) or small (10–49 employees) firm, had been trading for 10 years or more, and operated in a service sector. Over a 5-year window, the typical firm level of investment was between £50,000 and £100,000. On average, UK firms were quite tolerant of risk, but more than one in five felt that they had under-invested. The survey also contains detailed information on COF and PP and the specifics of investments that each firm had made over a 5-year window dating back to 2014. Variable descriptors are included in Appendix A.

Cost of funds

The COF in this context relates to the relative share of the expected returns to an investment that will be required to fully repay the cost of the initial capital outlay, and the total interest expense. It follows that when the wedge between the future earnings and COF from an investment is high (low), then the investment is more (less) profitable for the firm. We find that the mean and median COF are 24.246% (std dev. = 11.563) and 25.931%, respectively. This would imply that for the average firm capital investment of £1 that generates a revenue stream of £2 in the next period (with no discount applied to the cash flow), the net profit from the investment is £0.76. For firms at the 99th percentile of the COF distribution, their profit is only £0.47. Figure 1 shows the COF distribution, which is bi-modal with a modest clustering around 10% and a pronounced clustering around 28%. After this peak, the density of firms with a higher COF diminishes significantly.

In relation to how firm size class relates to COF, we find that on average large firms (250 employees or more) have the lowest COF at 14.42%, and micro firms and small firms (10–49 employees) have the highest COF at 24.79% and 23.03%, respectively (Figure 2). Medium-sized firms also have a much lower COF than micro and small firms, with an average of 16.13%. This gives large firms a distinct advantage when investing, as their COF is much lower than that for all other firm size classes, as predicted by theory and empirical evidence. We also observe that the COF spread is much more widely distributed for micro (0–9 employees) and small firms than it is for medium and large firms, suggesting greater heterogeneity amongst smaller size classes of firms.

Figure 3 shows that the COF distributions for firms that are investing in R&D projects are fairly similar to those for firms that are not investing in R&D, although a larger share of high COF R&D investing firms are at the high extremity of the distribution. On average, R&D investments face a COF of 21.16%, and this compares to 24.66% for other investments. This suggests that capital markets do place a significantly lower premium on COF for R&D projects, although the modest magnitude of the actual difference in favour of R&D investment might also be explained by the nature of the R&D projects themselves, which may reflect incremental innovation projects rather than long-term radical innovation investments.

From Table 1, we observe that COF is significantly different across firm age classes. The general pattern is that COF is diminishing in the firm age class. Firms <5 years old face a COF of between 31.63% and 31.17%, whereas firms of 10 years or older face a COF of between 12.08% and 12.23%. In this respect, firm age reduces the share of the future revenue streams associated with an investment that is allocated to paying the costs of making the investment. For a common investment,

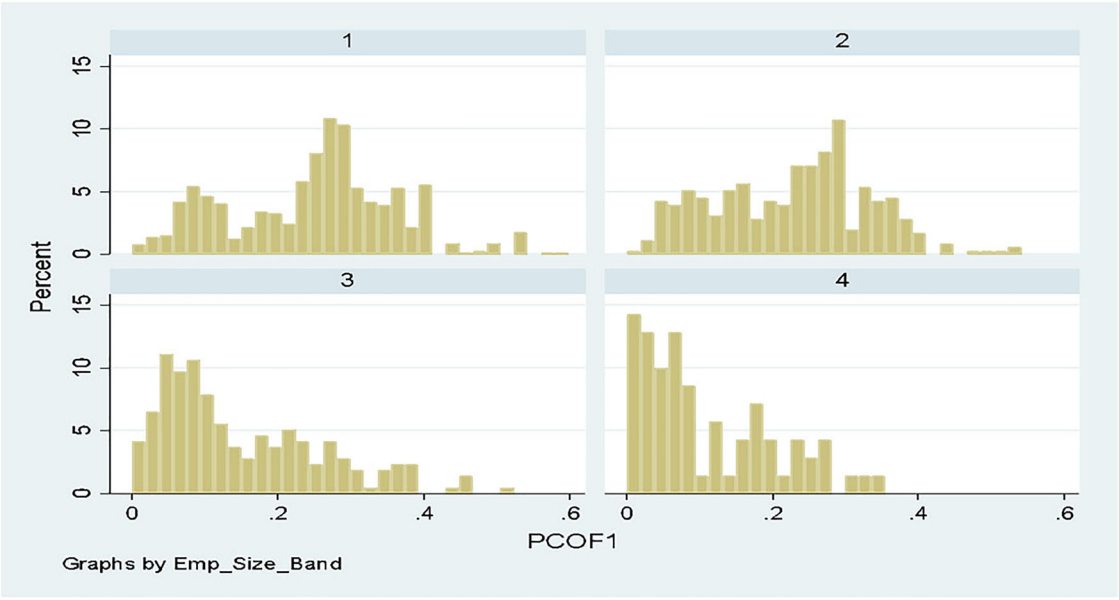

Figure 2. Cost of funds by firm size class. Notes: 1 = micro firm, 2 = small firm, 3 = medium-sized firm and 4 = large firm [Colour figure can be viewed at wileyonlinelibrary.com]

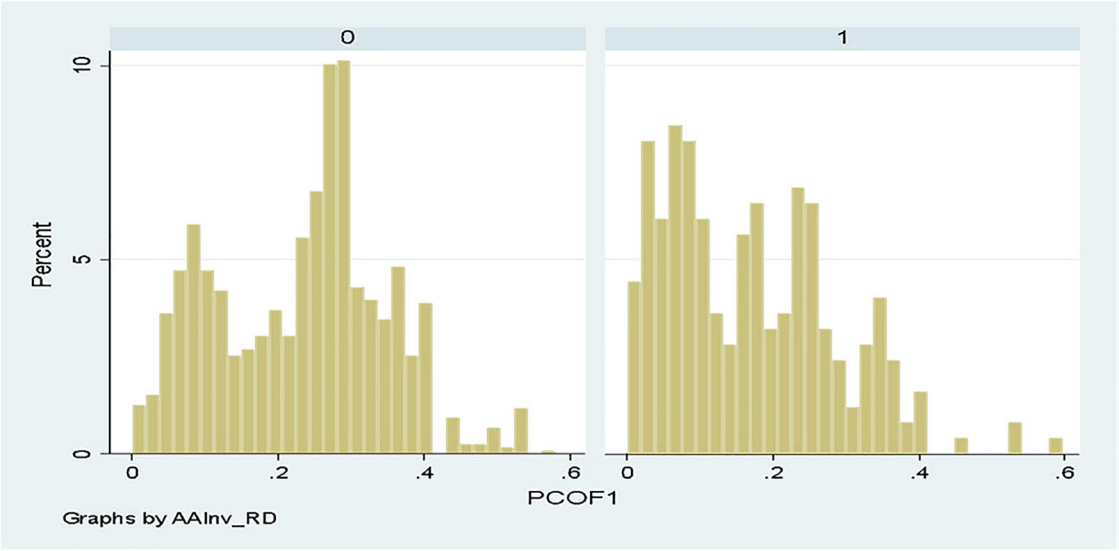

Figure 3. Cost of funds by R&D investment [0,1]. Notes: 0 = not R&D, 1 = R&D investment [Colour figure can be viewed at wileyonlinelibrary.com]

the relative profitability should be higher for older firms. The pattern also suggests that younger firms might face higher financing costs when raising investment capital.

We find significant regional and industry sector variation in COF. In respect to geography, we observe that firms in Wales and in the Yorkshire and The Humber region had, on average, the highest COFs, at 46.73% and 31.22%, respectively. This compares to relatively low average COFs in North East England and Scotland, at 17.14% and 18.73%, respectively. The fact that we find spatial differences in COF reflects wider evidence that geography is an important determinant of all aspects of firm financing, including demand for external finance, outcomes, and contract terms, across countries and across time (Ghosh, 2015; Kano and Tsutsui, 2003; Cowling, Nightingale and Wilson, 2023). In relation to the industry sector, again we observe significant COF differences. Industry sectors with the highest average COF include Other Services at 33.49% and Accommodation and Food Services at 30.79%, which are both much higher than the average COF faced by firms in Financial Services at 9.66% and in Agriculture, Forestry and Fishing at 15.04%. On balance, we find that both geography and industry are very important in understanding differences in firms' COF.

Table 1. COF and PP years descriptive statistics

	COF	Std dev.	Significance	PP years	Std dev.	Significance
Firm size class						
Micro	24.788	11.622		3.714	1.191	
Small	23.034	10.825		3.701	1.062	
Medium	16.128	10.515		3.753	1.086	
Large	14.420	10.144	***	4.001	0.914	***
Firm age						
<3 years	31.169	8.861		3.729	1.114	
3–4 years	31.634	8.060		3.702	1.268	
4–5 years	29.612	6.944		3.810	1.159	
5–10 years	29.999	7.201		3.737	1.122	
10–15 years	12.232	6.247		3.533	1.207	
15+ years	12.076	6.325	***	3.839	1.170	***
Region						
East Midlands	22.279	10.033		3.999	0.829	
East of England	23.903	9.464		3.912	1.123	
London	29.546	10.090		3.222	0.929	
North East	17.141	8.704		2.950	0.713	
North West	19.797	9.069		3.963	1.282	
Northern Ireland	18.883	10.337		3.131	1.151	
Scotland	18.725	9.133		4.518	1.189	
South East	19.752	9.241		3.545	1.076	
South West	20.743	9.208		3.894	1.147	
Wales	46.725	9.125		2.648	0.698	
West Midlands	20.868	9.600		3.452	1.066	
Yorkshire and The Humber	31.223	10.229	***	4.395	1.092	***
Industry						
A – Agriculture, Forestry and Fishing	15.039	8.997		6.042	0.426	
BDE – Mining and Quarrying, Public Utilities	25.061	10.366		3.962	0.566	
C – Manufacturing	17.659	10.787		3.088	0.460	
F – Construction	24.906	9.361		5.930	0.410	
G – Wholesale and Retail Trade	27.497	11.860		3.158	0.471	
H – Transport and Storage	20.166	11.264		3.306	0.388	
I – Accommodation and Food Service	30.793	10.751		4.218	0.486	
J – Information and Communication	19.895	9.422		3.517	0.427	
K – Financial and Insurance	9.662	6.855		4.009	0.424	
L – Real Estate	15.971	8.619		3.547	0.398	
M – Professional, Scientific and Technical	23.739	10.863		3.216	0.433	
N – Administrative and Support Services	22.906	10.563		2.823	0.464	
P – Education	15.312	9.380		2.804	0.389	
Q – Human Health and Social Work	24.428	9.997		4.610	0.470	
R – Arts, Entertainment and Recreation	24.325	9.784		1.369	0.484	
S – Other Services	33.488	10.705	***	2.799	0.480	***
R&D [0,1]						
No R&D Investment	24.657	11.516		3.746	1.189	
R&D Investment	21.155	11.472	***	3.476	0.954	***
Attitude to risk						
Loving	23.907	11.360		3.687	1.140	
Neutral	24.939	11.235		3.731	1.152	
Averse	24.835	12.786		3.763	1.258	
Export [0,1]						
Not exporter	24.925	11.546		3.807	1.191	
Exporter	22.125	11.404	***	3.424	1.040	***
No observations	1289			1347		

COF = cost of Funds; Std Dev = Standard Deviation; PP Years = Payback Period Years.

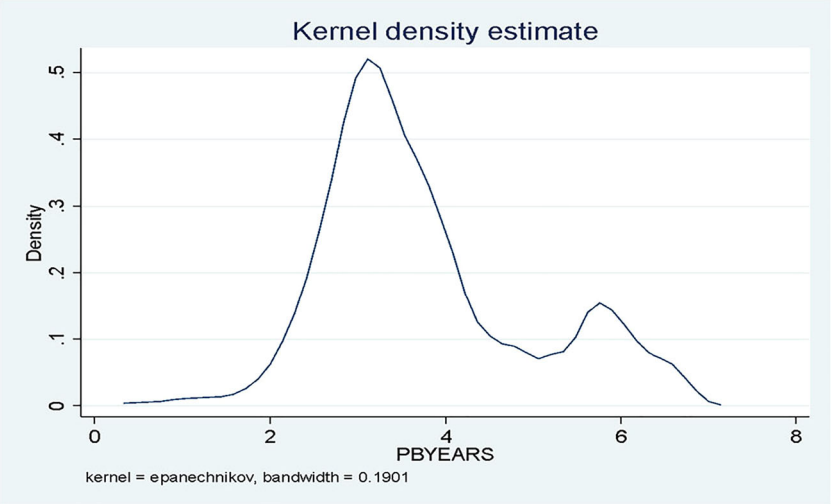

Figure 4. Payback years distribution [Colour figure can be viewed at wileyonlinelibrary.com]

Finally, we did not find that differences in firms' tolerance of risk influenced firms' COF, but we did find that exporting did. A priori, we might have expected that both would be associated with a higher COF. In fact, for risk, we find no significant differences, and for exporters, we observe a lower average COF at 22.13% compared with 24.93% for non-exporters. This might suggest that exporting allows firms to diversify their markets and reduce their dependence on economic conditions in a single-country market. However, it may also capture some influence from the significant support from the UK Department for Business and Trade, which offers a range of schemes to promote UK exporting.

Payback period

The PP is simply the amount of time required from the initial investment to fully recoup the capital outlay. The mean and median PP years are 3.71 (std dev. = 1.17) and 3.43, respectively. Both of these PP years are higher than those previously reported in other countries, which ranged from 2.8 to 3.0 years. This would imply that in the period 2014–2019, UK firm investments, on average, had to work hard to repay the initial capital investment and generate a strong income stream fairly quickly, although not as hard as in many other countries. At the 99th percentile in the PP distribution, the average was only 6.6 years, which suggests that very little firm-level investment in the UK has a very long-term payback horizon. So, for example, a £100,000 investment would have to generate free cash flows of £15,151.50 per annum on average over its target payback term (assuming no discounting is applied to future revenue streams). And if we add on the 24.25% COF, then it would need to generate £18,825.73 per annum gross. In reality though, it is unlikely that the annual returns will be constant (Figure 4).

From Figure 5, which reports the PP distributions by size class of firm, we observe that the distributions are broader for micro and small firms, which both have a larger concentration of PP years to the right-hand side, which captures longer PPs. Large firms have the most concentrated PP distribution, with a significant peak between 3 and 5 years. On average, a large firm had a PP of 4.00 years, and all other firm size classes had a PP in the range of 3.70–3.75 years. Thus, the average PP difference was around 92 days. This suggests that most UK firms are short term in their investment horizons, although the reasons for this may be different for firms across the size class distribution. From Figure 6, we note that there is a significant difference in average PP for R&D-investing firms and non-R&D-investing firms, with PP years of 3.47 and 3.77, respectively which highlights the fact that R&D investment projects have a shorter average PP than other investments. Again, it is unlikely that a radical R&D investment could generate sufficient cash flows to repay the initial investment in full within 3.5 years, which might imply that UK firms are particularly impacted by short-term behaviours with respect to radical innovation.

As with COF, we observe significant differences by firm age class, geography, and industry sector for average PP years. In the firm age class, we find that, in general, there was more variation on COF, but we find that the very oldest firms had the longest average PP at 3.84 years, and that 4–5-year-old firms also had a longer PP at 3.81 years. This contrasts with 10−15-year-old firms, which had the shortest average PP at 3.53 years. With respect to regional PP differences, we observe that firms in Scotland and in Yorkshire and The Humber had the longest average PP years, at 4.52 and 4.40, respectively, which contrasts with relatively low PP years for firms in Wales and North East England, at 2.65 and 2.95 years.

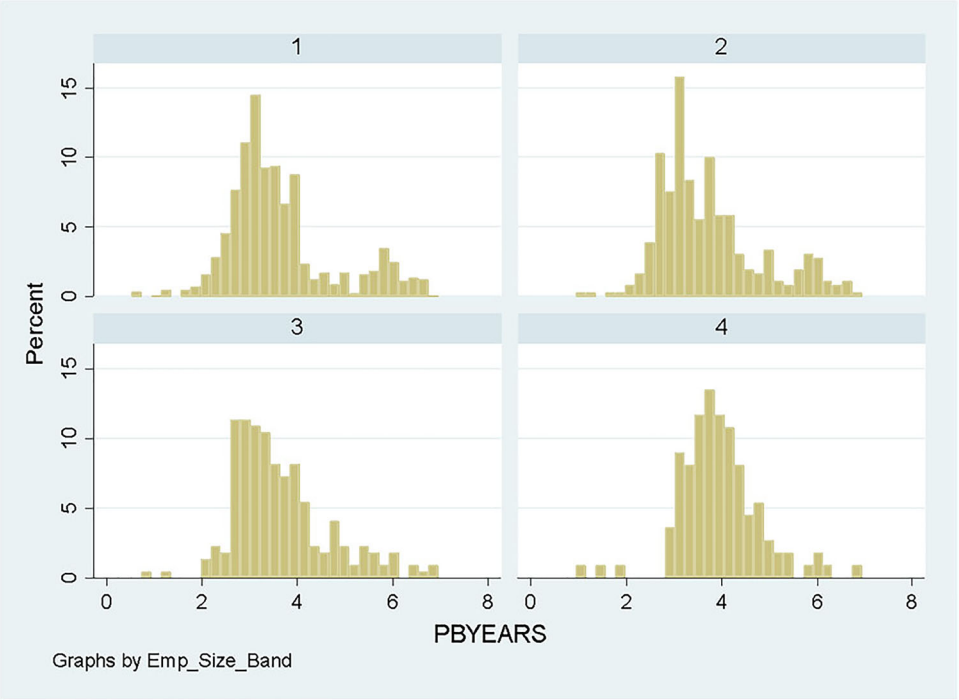

Figure 5. Payback years by firm size class. Notes: 1 = micro firm, 2 = small firm, 3 = medium-sized firm and 4 = large firm [Colour figure can be viewed at wileyonlinelibrary.com]

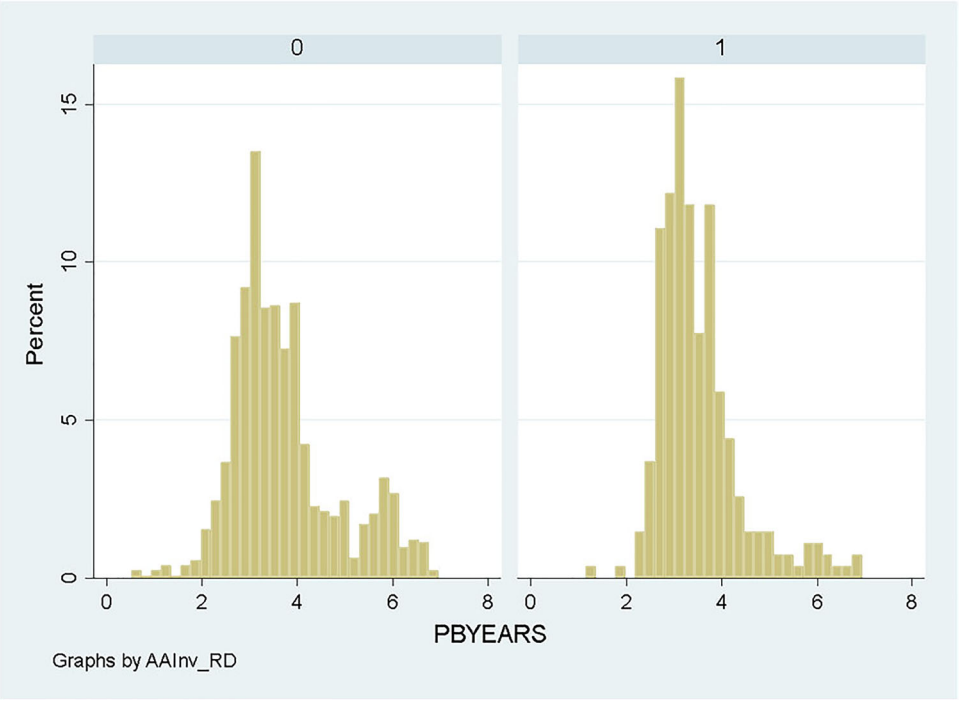

Figure 6. Payback years by R&D investment [0,1]. Notes: 0 = not R&D, 1 = R&D investment [Colour figure can be viewed at wileyonlinelibrary.com]

In relation to the industry sector, we observe that average PP years are highest in Agriculture, Forestry and Fishing at 6.04, and also high in Construction at 5.93, and in Health at 4.61. This contrasts with relatively low average PP in Arts, Entertainment and Recreation, at 1.37 years, in Education, at 2.80 years, and in Administrative Services, at 2.82 years. This suggests that there are some fundamental differences in the future stream of earnings associated with investments that clearly differentiate between service and non-service sectors

of the economy. Agriculture, Forestry and Fishing industry firms face a high COF and also have a longer average of PP years.

Firms investing in R&D had a significantly lower average PP than firms making other types of investment, although the average difference was only 99 days. Again, this suggests that R&D investments were not typically likely to be radical innovation requiring years of intensive work. Further, just as tolerance of risk when investing did not differentiate between firms in respect of COF, neither did it differentiate on PP years. However, exporting firms were found to have lower average PP years than non-exporters, and this difference was, on average, equivalent to 140 days.

Results

Econometric model

In this section, we wish to formally model how COF affects Pay Back Years (PBY), as well as identifying other factors that influence the years required for an investment to return the initial capital to the firm. However, we are concerned about the possibility of inconsistent parameter estimates owing to endogenous regressors. For example, there may be factors outside of the firm that exogenously determine the COF. We might think of an increase in the general level of risk and uncertainty about the direction of inflation, for example, which may in turn influence the behaviour of capital markets. In the PP years equation, the error term captures all of the factors other than COF that determine PP years, but COF may in turn be lower for firms that have (unobserved) higher quality, and also higher quality may influence the choice of PP years. In short, there is an association between COF and the error term in the PP model. We know that geographic region has been identified as an important determinant of firms' financing outcomes, but there is no clear and obvious reason why it would independently impact a firm's choice of PP years. Rather, we would expect that firm demographics and the nature of the investments they make would be the major factors driving the PP years decision. To address this potential issue, we choose to estimate an instrumental variables regression of the form

$$y_i = y_i\beta_1 + x_{1i}\beta_2 + u_{i,}$$

$$Y_i = x_{1i}\Pi_1 + x_{2i}\Pi_2 + \nu_i$$

Here y_i is the dependent variable for the ith firm observation, Y_i represents the endogenous regressors, x_1 represents the included exogenous regressors, and x_2 represents the excluded exogenous regressors. From this, x_{1i} and x_{2i} are the instruments, and u_i and ν_i are zero-mean error terms.

From this, the actual models we estimate are expressed thus:

$$ln\,(COF) = \pi_0 + \pi_1 Size + \pi_2 Age + \pi_3 Industry + \pi_4 RD + \pi_5 Risk + \pi_6 Export + \pi_7 Region + \nu_i,$$

$$ln\,(PP) = \beta_0 + \beta_1 COF + \beta_2 Size + \beta_3 Age + \beta_4 Industry + \beta_5 RD + \beta_6 Risk + \beta_7 Export + u_i$$

In addition, we estimate the traditional two-stage least squares specification (2SLS), and the Generalized Method of Moments (GMM) specification, which allows for orthogonality of the instruments with the uncorrelated u_i. We also estimate models with a firm size class * R&D investment interaction term to test for specific effects relating to whether a smaller or larger firm is investing in innovation.

Cost of funds

Our baseline COF models show (Table 2) that COFs are similar for micro and small firms, but increasingly smaller for medium and large firms. The large-firm coefficient is more than five times the magnitude of the medium-sized-firm coefficient, which suggests that large firms have a very large advantage with respect to their average COF over all other firm size classes. The marginal effects are such that a micro firm faces an average predicted COF of 26.53%, a small firm one of 24.47%, a medium-sized firm one of 13.86% and a large firm one of only 5.72%. Firm age was also important, with firms over 10 years of age having a significantly lower average COF. The marginal effects predict a COF between 9.39% and 9.99%, and this compares with a predicted COF of 34.94% for the youngest class of firms under 3 years old. These two findings are consistent with smaller and younger firms facing more restrictive financing conditions that ultimately lead to a higher COF and hence to lower relative returns to new investment. Capital markets tend to reward size and age, as predicted in information-based theories of capital intermediation.

On average, we find that average COFs are very significantly lower for firms in financial services and education, although there is more generally a significant degree of variation in COF across industry sectors per se. For example, predicted COF in other services is 38.80% and in accommodation and food services is 35.76%. In contrast, neither of our COF model specifications identified any significant variation due to R&D investment, tolerance of risk, or exporting. However, in our second model specification, we find the large firm * R&D investment interaction was negative and significant, which implies that large firms are able to secure a much lower

Table 2. COF models

First-stage models	Model [1] lnCOF				Model [2] lnCOF + interaction			
	Coefficient	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**
Firm size class								
Micro								
Small	0.0463	0.0649	0.71	0.476	0.0366	0.0711	0.52	0.606
Medium	−0.1667	0.0835	−2.00	0.046	−0.1588	0.0945	−1.68	0.093
Large	−0.9202	0.1330	−6.92	0.000	−0.5750	0.1621	−3.55	0.000
Firm age								
<3 years								
3–4 years	−0.0030	0.1074	−0.03	0.978	−0.0238	0.1074	−0.22	0.824
4–5 years	−0.0115	0.1157	−0.10	0.921	−0.0238	0.1153	−0.21	0.836
5–10 years	−0.0267	0.0801	−0.33	0.739	−0.0390	0.0800	−0.49	0.626
10–15 years	−1.1281	0.0933	−12.09	0.000	−1.1301	0.0931	−12.14	0.000
15+ years	−1.1786	0.0762	−15.47	0.000	−1.1691	0.0760	−15.38	0.000
Region								
East Midlands								
East of England	0.0071	0.1280	0.06	0.956	0.0101	0.1276	0.08	0.937
London	0.4203	0.1191	3.53	0.000	0.4144	0.1189	3.49	0.001
North East	−0.5209	0.1849	−2.82	0.005	−0.5275	0.1843	−2.86	0.004
North West	−0.2111	0.1355	−1.56	0.120	−0.2161	0.1355	−1.60	0.111
Northern Ireland	0.0804	0.2205	0.36	0.716	0.0496	0.2202	0.23	0.822
Scotland	−0.4826	0.1393	−3.46	0.001	−0.4868	0.1388	−3.51	0.000
South East	−0.2151	0.1219	−1.76	0.078	−0.2241	0.1215	−1.84	0.065
South West	−0.3740	0.1328	−2.82	0.005	−0.3750	0.1324	−2.83	0.005
Wales	0.7434	0.1639	4.54	0.000	0.7437	0.1636	4.55	0.000
West Midlands	−0.2036	0.1357	−1.50	0.134	−0.2024	0.1352	−1.50	0.135
Yorkshire and The Humber	0.4238	0.1374	3.09	0.002	0.4132	0.1369	3.02	0.003
Industry								
A – Agriculture, Forestry and Fishing								
BDE – Mining and Quarrying, Public Utilities	−0.0850	0.2772	−0.31	0.759	−0.0662	0.2762	−0.24	0.811
C – Manufacturing	−0.3470	0.1658	−2.09	0.037	−0.3384	0.1653	−2.05	0.041
F – Construction	0.0127	0.1665	0.08	0.939	0.0285	0.1660	0.17	0.864
G – Wholesale and Retail Trade	0.0989	0.1560	0.63	0.526	0.1165	0.1556	0.75	0.454
H – Transport and Storage	−0.5847	0.2007	−2.91	0.004	−0.5807	0.1999	−2.90	0.004
I – Accommodation and Food Service	0.0177	0.1698	0.10	0.917	0.0364	0.1692	0.21	0.830
J – Information and Communication	−0.2207	0.1810	−1.22	0.223	−0.2286	0.1804	−1.27	0.205
K – Financial and Insurance	−1.6048	0.2644	−6.07	0.000	−1.5894	0.2636	−6.03	0.000
L – Real Estate	−0.7146	0.2258	−3.16	0.002	−0.7181	0.2250	−3.19	0.001
M – Professional, Scientific and Technical	−0.1303	0.1587	−0.82	0.412	−0.1170	0.1582	−0.74	0.460
N – Administrative and Support Services	−0.1823	0.1684	−1.08	0.279	−0.1608	0.1680	−0.96	0.339
P – Education	−2.8833	0.2841	−10.15	0.000	−2.8673	0.2830	−10.13	0.000
Q – Human Health and Social Work	−0.0429	0.2049	−0.21	0.834	−0.0089	0.2043	−0.04	0.965
R – Arts, Entertainment and Recreation	−0.0632	0.2452	−0.26	0.797	−0.0526	0.2443	−0.22	0.830
S – Other Services	0.2470	0.1971	1.25	0.210	0.2528	0.1964	1.29	0.198
R&D [0,1]								
No R&D investment								
R&D investment	−0.0709	0.0752	−0.94	0.346	0.0623	0.1239	0.50	0.615
Attitude to risk								
Loving								
Neutral	0.0850	0.0770	1.10	0.270	0.0829	0.0768	1.08	0.281
Averse	−0.0940	0.0648	−1.45	0.147	−0.0906	0.0646	−1.40	0.161
Export [0,1]								
Not exporter								
Exporter	0.0268	0.0624	0.43	0.668	0.0273	0.0622	0.44	0.661
Constant	3.5569	0.1868	19.04	0.000	3.5397	0.1864	18.99	0.000
Interactions								
Micro∗RD								
Small∗RD					−0.0456	0.1713	−0.27	0.790
Medium∗RD					−0.1408	0.1851	−0.76	0.447
Large∗RD					−1.0027	0.2758	−3.63	0.000
No observations	1379				1379			
Prob>F	1E − 05				0.00001			
Adj R2	0.417				0.422			

SE = Standard Error; t-stat = T statistic; Pr > t = probability value.

COF than any other size class of firms when investing in R&D. We also identified significant regional variation in average COF, as expected. On this, we find that firms in Wales faced the highest average COF, with a predicted 58.67% average COF, and firms in the North East faced the lowest average COF, with a predicted average COF of 15.68%.[4]

Payback years

The full model results for our 2SLS and OLS estimates of PP years are presented in Table 3. Across all models, the (ln) COF variable is negative and significant, which implies that PP years are diminishing in COF. In short, a higher COF reduces the term over which the full initial capital investment is re-couped. The implied marginal effects are such that a 1% increase in COF reduces PP years by between 104 days (Model 3) and 166 days (Model 5). In this sense, when the COF for firms is higher, this induces short-term investment behaviour, and firms (and financiers) have a stronger desire to recoup their capital more quickly, which is consistent with placing a high discount rate on far-off streams of earnings that accrue from the initial investment. It follows that when the COF is low, firms and financiers are more willing to support longer-term investment.

Firm size effects are evident in all model specifications, but the nature of these effects varies. In Model 3, there is an increasingly positive and significant effect on PP years as we move from small to large firms. In Model 4, which includes the firm size * R&D interaction term, only a positive and significant large-firm effect remains, although it is of large magnitude. In Model 5, small firms are found to have the longest PP, although the large-firm coefficient is positive at the 10% level. The final OLS model with the interaction term (Model 6) shows positive and significant effects for both small and large firm size classes, although the magnitude of the large-firm effect is more than five times as large as the small-firm (10–49 employee) size class effect. On balance, our evidence suggests that large firms, in particular, are more likely to have longer PP years when investing and that micro firms appear to have a significantly shorter time horizon when making new investments. This may relate to their weaker liquidity and balance sheet position, but also to the high time discount that financiers place on earnings streams for micro firms.

Our findings relating to the firm age class are intriguing and show that older firms, particularly those that have been trading for 10 years or more, have shorter PP horizons. In general, new firms (under 3 years of age) on average are more patient in terms of their investment horizons and re-couping all their initial capital outlay. This is fairly strong evidence that shareholders and financiers are inducing older, more established, firms to behave in a short-term way when investing. Equally, when a new firm is in the formative years of its life-cycle and needs to invest in long-term survival and growth, it is not subject to undue outside influence, as the majority of its investment needs are met from owner's funds.

Industry sector is the source of significant variation in average PP years. Here, we observe that agriculture, forestry and fishing, and also construction industry firms had the longest average PP years, with mining and utilities along with education having the shortest PP years. The findings for agriculture and construction are consistent with long-term investment horizons and the need for patient investing. For example, investing in a new housing development would take a number of years from initial planning, through site clearance, connecting to utilities, and then fully building out the site and connecting to arterial roads. Understanding the short-term perspectives of firms in mining and utilities is harder, although certain types of mining activity, for example gold prospecting, are high risk. We note here that a large number of new energy companies that entered the market in the last decade in the UK went bankrupt when the Russo–Ukraine war began, as their business models failed when energy prices rose, as their model was to undercut the established competition through fixed-price guarantees, as predicted by Wright (2005). The short-term PP in education may reflect the high degree of regulation in the industry and the short-term balance sheet requirements that reflect annual local authority budget allocations.

We find no evidence that R&D investments per se or tolerance of risk have an impact on PP years. In relation to the latter, it may be that tolerance of risk is not revealed to financiers, and thus there is no penalty for risk-taking behaviour, nor any impact on the timing of investment returns. However, when we consider the firm size class * R&D interaction term, we find that for large firms only, investing in R&D is associated with lower average PP years. This again suggests that R&D projects are unlikely to be radical and more likely to be incremental, as it is likely that the investment time horizons would be quite different. The consequence is that short-termism in financial markets is stifling radical innovation in the large-firm sector of the economy.

We estimated an additional model with four measures of financial constraints, including borrowing constraints due to prohibitively high interest rates, lack of collateral, borrower discouragement, and the total costs of debt being too expensive. From this model [Appendix B Model (8)], we found that payback years increased

[4]We also estimated additional models with four measures of financial constraints, including borrowing constraints due to prohibitively high interest rates, lack of collateral, borrower discouragement, and the total costs of debt being too expensive. These firm financial constraints variables [see Appendix B Model (7)] were not found to be significant in the COF model.

Table 3. PP years models

	Model [3] lnPP years: 2SLS				Model [4] lnPP years + interaction: 2SLS				Model [5] lnPP years: OLS				Model [6] lnPP years + interaction: OLS			
	Coefficient	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**
lnCOF	−0.0759	0.0117	−6.47	0.000	−0.0761	0.0117	−6.48	0.000	−0.0092	0.0036	−2.58	0.010	−0.0092	0.0036	−2.58	0.010
Firm size class																
Micro																
Small	0.0167	0.0101	1.65	0.099	0.0177	0.0111	1.60	0.110	0.0130	0.0090	1.45	0.147	0.0151	0.0099	1.53	0.126
Medium	0.0249	0.0131	1.90	0.058	0.0175	0.0148	1.18	0.238	0.0357	0.0116	3.09	0.002	0.0270	0.0131	2.05	0.041
Large	0.0736	0.0226	3.25	0.001	0.1034	0.0258	4.01	0.000	0.1270	0.0186	6.83	0.000	0.1337	0.0226	5.92	0.000
Firm age																
<3 years																
3–4 years	−0.0271	0.0167	−1.63	0.104	−0.0283	0.0167	−1.69	0.091	−0.0309	0.0149	−2.08	0.038	−0.0307	0.0149	−2.06	0.040
4–5 years	0.0111	0.0180	0.62	0.537	0.0105	0.0180	0.59	0.558	0.0090	0.0160	0.56	0.574	0.0094	0.0160	0.59	0.556
5–10 years	−0.0083	0.0124	−0.67	0.504	−0.0088	0.0125	−0.71	0.479	−0.0093	0.0111	−0.84	0.403	−0.0089	0.0111	−0.80	0.424
10–15 years	−0.2266	0.0192	−11.81	0.000	−0.2270	0.0193	−11.79	0.000	−0.1545	0.0134	−11.52	0.000	−0.1545	0.0134	−11.50	0.000
15+ years	−0.0624	0.0182	−3.42	0.001	−0.0620	0.0182	−3.41	0.001	0.0165	0.0114	1.45	0.147	0.0165	0.0114	1.45	0.148
Industry																
A – Agriculture, Forestry and Fishing																
BDE – Mining and Quarrying, Public Utilities	−0.4155	0.0431	−9.65	0.000	−0.4150	0.0431	−9.63	0.000	−0.4154	0.0384	−10.82	0.000	−0.4164	0.0384	−10.84	0.000
C – Manufacturing	−0.6979	0.0259	−26.93	0.000	−0.6972	0.0259	−26.88	0.000	−0.6799	0.0229	−29.63	0.000	−0.6797	0.0230	−29.58	0.000
F – Construction	−0.0161	0.0259	−0.62	0.535	−0.0146	0.0259	−0.56	0.573	−0.0247	0.0231	−1.07	0.285	−0.0242	0.0231	−1.05	0.294
G – Wholesale and Retail Trade	−0.6387	0.0243	−26.23	0.000	−0.6371	0.0244	−26.09	0.000	−0.6555	0.0216	−30.41	0.000	−0.6552	0.0216	−30.32	0.000
H – Transport and Storage	−0.6245	0.0315	−19.85	0.000	−0.6232	0.0315	−19.80	0.000	−0.5971	0.0278	−21.52	0.000	−0.5959	0.0278	−21.46	0.000
I – Accommodation and Food Service	−0.3450	0.0264	−13.09	0.000	−0.3434	0.0264	−13.01	0.000	−0.3589	0.0234	−15.33	0.000	−0.3584	0.0234	−15.30	0.000
J – Information and Communication	−0.5502	0.0281	−19.58	0.000	−0.5497	0.0281	−19.54	0.000	−0.5443	0.0250	−21.75	0.000	−0.5431	0.0251	−21.68	0.000
K – Financial and Insurance	−0.5086	0.0434	−11.72	0.000	−0.5084	0.0434	−11.72	0.000	−0.4262	0.0367	−11.61	0.000	−0.4268	0.0368	−11.61	0.000
L – Real Estate	−0.5514	0.0353	−15.62	0.000	−0.5515	0.0353	−15.61	0.000	−0.5217	0.0311	−16.75	0.000	−0.5213	0.0312	−16.72	0.000
M – Professional, Scientific and Technical	−0.6104	0.0245	−24.87	0.000	−0.6093	0.0246	−24.80	0.000	−0.6141	0.0219	−28.09	0.000	−0.6138	0.0219	−28.04	0.000
N – Administrative and Support Services	−0.7680	0.0260	−29.49	0.000	−0.7655	0.0261	−29.34	0.000	−0.7676	0.0232	−33.07	0.000	−0.7663	0.0233	−32.94	0.000
P – Education	−0.9823	0.0534	−18.41	0.000	−0.9816	0.0533	−18.41	0.000	−0.8108	0.0403	−20.12	0.000	−0.8107	0.0403	−20.11	0.000
Q – Human Health and Social Work	−0.2710	0.0318	−8.52	0.000	−0.2679	0.0319	−8.40	0.000	−0.2824	0.0283	−9.97	0.000	−0.2816	0.0284	−9.93	0.000
R – Arts, Entertainment and Recreation	−1.5205	0.0380	−40.01	0.000	−1.5199	0.0380	−39.97	0.000	−1.5319	0.0338	−45.29	0.000	−1.5318	0.0339	−45.25	0.000
S – Other Services	−0.7511	0.0309	−24.30	0.000	−0.7508	0.0309	−24.27	0.000	−0.7779	0.0273	−28.53	0.000	−0.7779	0.0273	−28.51	0.000
R&D [0,1]																
No R&D investment																
R&D investment	−0.0025	0.0117	−0.21	0.833	0.0028	0.0194	0.14	0.887	0.0024	0.0104	0.23	0.819	−0.0016	0.0172	−0.09	0.928

Table 3. (Continued)

	Model [3] lnPP years: 2SLS				Model [4] lnPP years + interaction: 2SLS				Model [5] lnPP years: OLS				Model [6] lnPP years + interaction: OLS			
	Coefficient	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**	**Coefficient**	**S.E.**	**t-stat**	**Pr > t**
Attitude to risk																
Loving																
Neutral	−0.0078	0.0120	−0.65	0.516	−0.0083	0.0120	−0.69	0.491	−0.0167	0.0106	−1.57	0.117	−0.0171	0.0107	−1.61	0.108
Averse	−0.0163	0.0101	−1.61	0.108	−0.0163	0.0101	−1.61	0.108	−0.0090	0.0090	−1.01	0.314	−0.0093	0.0090	−1.04	0.301
Export [0,1]																
Not exporter																
Exporter	−0.0131	0.0097	−1.35	0.178	−0.0135	0.0097	−1.39	0.165	−0.0208	0.0086	−2.42	0.016	−0.0213	0.0086	−2.47	0.013
Constant	2.0630	0.0457	45.16	0.000	2.0624	0.0456	45.24	0.000	1.8409	0.0243	75.91	0.000	1.8411	0.0243	75.74	0.000
Interactions																
Micro∗RD																
Small∗RD					−0.0080	0.0268	−0.30	0.765					−0.0065	0.0238	−0.27	0.786
Medium∗RD					0.0166	0.0289	0.58	0.565					0.0289	0.0257	1.12	0.261
Large∗RD					−0.0816	0.0447	−1.83	0.068					−0.0140	0.0386	−0.36	0.717
No observations	1379				1379				1381				1379			
Prob > F	0.00001				0.00001				0.00001				0.00001			
Adj R2	0.759				0.759				0.809				0.808			
Test of endogeneity																
Durbin	50.1452	0.00001			50.4436	0.00001										
Wu–Hausman	50.9420	0.00001			51.1429	0.00001										

SE = Standard Error; t-stat = T statistic; Pr > t = probability value.

with firm size but diminished with firm age, and that risk-averse firms had marginally shorter PPs (at the 10% level of significance). It was also the case that discouraged borrowers were associated with marginally (at the 10% level of significance) shorter PPs.

We also tested for alternative measures of investment horizons by estimating a series of three probit models for (a) firms that invested in R&D or not, (b) firms that invested in working capital or not, and (c) firms that distributed free cash to shareholders. The underlying premise was that R&D investment requires patience before any returns are realized, and that investment in working capital is a shorter-term liquidity-driven type of investment. Firms that made historical profits have a choice whether to retain them in the business to fund day-to-day operations, hold precautionary savings or fund future investment, or to distribute them to their shareholders as a return to their investments in the equity of the firm. In respect of R&D [see Appendix B Model (9)], we found that it was positively associated with firm size, and that very young firms were the least likely to invest in R&D. Risk-averse firms were also significantly less likely to invest in R&D, which again is consistent with myopic loss aversion and the uncertain returns to R&D. However, we found no significant effects from COF or PP on R&D investment. Similar results were obtained for working capital investments, with the notable exception that firm age played no role [see Appendix B Model (12)]. In respect of distributing free cash to shareholders [see Appendix B Model (11)], we found that older firms were more likely to pay out funds to their shareholders, and that risk-averse firms were significantly less likely to do so. This suggests that risk-averse firms are very cautious about stripping cash out of the firm, and this may be suggestive of precautionary savings behaviour. Neither COF nor PP were found to be significant in this decision.

Investment amounts

We estimated an additional ordered probit model for the cash amount of investment and included COF and PP in the model [see Appendix B Model (10)]. Neither COF nor PP were found to be significant in terms of investment amounts. It was the case that investment scale was positively associated with firm size, as expected, and negatively associated with risk aversion, and this is also consistent with myopic loss aversion as presented by Thaler et al. (1997) if firms over-emphasize the left tail of the return distribution. That is, firms that are risk-averse are overly concerned about committing to larger investments, as they have a concern about the scale of the potential loss rather than about the scale of the potential gain. We also found that firms that invested in R&D, on average, invested larger amounts, which suggests that firms that do commit to R&D back this commitment up by investing at scale.

Conclusions

The UK economy has faced low investment rates in R&D over the past 60 years, leading to comparably low growth rates compared with major competitors. Debates about the lack of investment have shifted from focusing on firms' short-term behaviours to short-term behaviours in capital markets, shareholders, and financial intermediaries. These debates have overlooked smaller firms, which make up the majority of businesses in the UK and account for a significant portion of employment. Research focusing on investment and financial decision-making in the UK reveals that firms face high COF and short PPs, indicating a prevalent short-term investment behaviour. Furthermore, larger and older firms seem to face lower COF compared with smaller and younger firms, potentially hindering innovative activities. Geographic and industry factors also play a significant role in firms' variation in COF. It is evident that capital market influences contribute to short-term investment behaviours, affecting firms of different sizes and ages in distinct ways. Policy measures to reduce the COF for smaller firms and support longer-term investment in radical innovation-related R&D for larger firms are deemed necessary. Additionally, specific place-based financial initiatives may benefit smaller firms owing to the observed regional funding cost discrepancies.

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