Bank of England

The credit channel of monetary policy: direct survey evidence from UK firms

Staff Working Paper No. 1,138
July 2025

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Abstract

This paper investigates the role of the credit channel of monetary policy transmission in the 2022–23 tightening cycle in the UK. Using novel firm survey data, we validate three predictions of a simple model of the credit channel: firstly, firms using external finance report a higher cost of capital than those using internal funds; secondly that firms using external finance see a larger rise in their cost of borrowing for a given increase in the policy interest rate than those using internal funds; and finally that firms reliant on external financing for investment report reducing investment by more than the internally funded firms when baseline interest rates rise. Our results suggest that credit channel effects may account for up to a quarter of the total impact that monetary policy has on investment.

Key words: Credit channel, monetary policy, firms, investment, survey data.

JEL classification: D25, D22, E22, E52.

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The authors thank the Economics and Social Research Council for funding under grant ES/X013707/1, as well as the Productivity Institute for funding. Any views expressed are solely those of the authors and so cannot be taken to represent those of the Bank of England or to state Bank of England policy. This paper should therefore not be reported as representing the views of the Bank of England or its Committees.

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ISSN 1749-9135 (on-line)

1. Introduction

Monetary policy is thought to effect the level of activity and inflation in an economy via the "interest rate channel": when policy rates increase, the interest rates that firms face when borrowing funds will also rise. As the cost of borrowing rises firms will find it less attractive to invest since a larger proportion of the returns of this investment will be counterbalanced by the costs of financing it. As a result, firms will invest less and economic activity will decline.

But in addition to this standard "interest rate channel" of monetary policy, another way monetary policy can have persistent effects on the real economy is via the credit channel of monetary policy (see B. S. Bernanke (2023) for a survey of this channel). The narrative underlying this channel of monetary policy is that firms can finance investment via internal funds at an opportunity cost r which reflects something close to the risk-free rate which the firm could earn on this cash; but if they desire to invest in excess of their internal funds and seek outside finance, information frictions in the credit market mean that the cost of loans they face is r plus a premium. The gap between the internal and external cost of funds is what B. S. Bernanke (1983) called the *cost of credit intermediation* but what is generally now referred to as the *external finance premium*. This excess cost will include the explicit higher rates firms face when borrowing externally as well as the implicit costs of covenants and other borrowing restrictions. The premium reflects a range of "agency costs" which arise due to informational frictions associated with lending. For example, this may include compensation to lenders due to their inability to directly observe the riskiness of borrowers; it may act to cover the costs of monitoring and evaluating the use of borrowed funds; and it may compensate for changes in borrower behaviour due to moral hazard.

Monetary policy can have persistent impacts via the credit channel because the premium in excess of the the risk-free rate, is itself dependent on aggregate economic conditions which are influenced by the policy rate.[1] As a result, higher policy rates can increase the riskiness of firms that borrow externally and push up the cost of their borrowing over and above the change in risk-free rates - resulting in further reductions in investment.

The theory of the credit channel of monetary transmission provides three key testable predictions:

1. In the cross-section, firms who use external finance have a higher cost of capital than those who use internal finance only. This is due to the existence of the external finance premium.

[1] For convenience we will use the term "credit channel" to refer to the impact monetary policy has on firms by impacting firms credit worthiness/ability to borrow.

2. In the time series, any changes in the baseline or "safe" interest rate will be magnified for firms using external finance. This is due to the fact that policy rates influence the size of the external finance premium.

3. Finally, conditional on the demand slope a firm faces, the investment response to a rise in the policy rate will be larger for a firm using external finance relative to one reliant only on internal funds. This is due to the fact that firms borrowing externally will see a larger rise in their cost of finance and find it less attractive to invest relative to firms that finance investment internally only.

Empirical tests of these predictions face several challenges. Firstly, testing this theory requires a suitable measure of a firm's marginal cost of funds. A common proxy is to use the average cost of borrowing; however, this will become a poor representation of marginal costs if firms do not take on debt due to financial constraints or borrowing being prohibitively expensive and as a result their observed average cost of borrowing does not adjust.

Second, the theory requires distinguishing between firms that invest with external funds and those that do not, or alternatively those that are more or less exposed to the external finance premium (conditional on using external finance). Often firm size or measures of firm riskiness, such as leverage, are used but these can be misleading since within these groups firms may use borrowing for working capital rather than investment, and so their observed investment behaviour may not adjust when measured borrowing costs increase.

Third, the implications of this model can only be tested if shifts in the demand curve can be disentangled from changes in the supply curve. This may not be straightforward, given that changes in policy rates are likely to impact firm customers and therefore lower the demand that firms face, and resultantly their own investment demand.

In this paper, we use novel evidence from a set of special questions in the Decision Maker Panel (DMP) survey, matched to firm accounts data, to overcome these challenges. We directly ask firms about how they finance investment, enabling us to identify firms that use external finance for investment. This information on how firms finance their investment is particularly important for assessing the relevance of the credit channel and is not available in most other data sources. We have data on the impact that tighter monetary policy has had on firm capital expenditures and sales, allowing us to control for the demand effects of this tightening. Finally, we also have data on the interest rates that firms pay on borrowing over time.

The 2022-23 period of tightening is a good setting in which to test the importance of the credit channel as both the magnitude of the increase in policy rates and the exceptionally low levels from which rates were raised make firms more likely to interpret these increases

in interest rates as persistent and so adjust in response. [2] The Bank of England's Monetary Policy Committee raised Bank Rate in the UK from 0.25% to 5.25% between January 2022 and August 2023. Additionally, this period of rising policy rates has also coincided with a sharp increase in long-term rates, suggesting that market participants also expected this increase in interest rates to be persistent, and leading to the reference rates firms may consult when making investment decisions also rising substantially.[3]

We estimate an empirical model, using our novel data, to test the three key predictions from the theoretical credit channel. We find that firms that use external finance to fund investment do face a higher cost of capital. Second, we show that the cost of capital increases by more for externally financed firms for a given increase in the baseline interest rate. Finally, we find that firms relying on external financing cut back on investment by more than those that are reliant on internal funds as monetary policy tightens. Additionally, we explore popular proxies for firm credit risk (such as firm size and leverage) and assess the strength of their association with our estimates of the credit channel. Our results support the existence of a credit channel of monetary policy. Quantifying our results suggests that the credit channel could account for up to one quarter of the impact of monetary policy on investment.

The paper is organised as follows: in Section 2 we explore the previous approaches in the literature which investigate the credit channel of monetary policy. Section 3 sets up a simple model outlining the relationship between investment, output and interest rates, before providing an empirical analogue for the key equations. We describe our data in more detail in Section 4. We outline our results in Section 5. Section 6 concludes.

2. Literature

The literature assessing the evidence for the importance of the credit channel, has taken a variety approaches to overcome the difficulties highlighted above.

Several studies have relied on aggregate data to provide evidence for the credit channel. B. S. Bernanke & Gertler (1995) motivate the argument for the existence of the credit channel using a vector auto-regression to highlight how the magnitude, timing and the types of investment and consumption impacts resulting from unanticipated changes in the interest rate do not align well with a story of transmission reliant solely on the interest rate channel. Instead they show investment begins to decline when cashflows are at their weakest and use results from the literature (Gertler & Gilchrist (1994), B. Bernanke et al.

[2] This is particularly important if there are real rigidities which make adjustment of investment levels costly.

[3] The yield on 10yr gilts, for example, has increased by 300bps over the same period that Bank Rate has increased by 500bps.

(1996)) to argue firms with easier access to credit (such as large firms) are able to smooth through this crunch and avoid investment falls.

Generally aggregate regressions of investment on the aggregate cost of funds may struggle to provide conclusive evidence on the credit channel as it can be difficult to observe an increase in credit spreads in the aggregate data, especially, if "flight to quality" effects occur and banks re-allocate their loan portfolios to the most creditworthy firms (B. Bernanke et al. (1996)). Gertler & Karadi (2015), however, demonstrate that exogenous changes in the Federal Reserve's policy rate lead to larger changes in credit costs, reflecting both increases in term premia and wider credit spreads.

Kashyap et al. (1996) find that changes in firm financing resulting from monetary policy have real effects. Following surprise rate increases the mix of finance that firms use moves away from bank loans to commercial paper, in line with the idea that firms reduce use of expensive bank loans during tightenings. They find that these changes in borrowing mix lead to reduced investment in equipment, non-residential structures and inventories. This is consistent with firms using bank loans seeing their external finance premium increase by more relative to firms that are less reliant on loans and so reducing investment by more. We add to this literature by showing using firm-level data that monetary policy has significant impacts via firms most exposed to externally-sourced finance.

Choi et al. (2024) use industry-level panel data on output and policy shock estimates across 102 countries and also find evidence supportive of credit channel transmission. They show industries where assets are difficult to collateralise, and which contain a higher proportion of smaller firms are more sensitive to policy shocks. They also show that these effects are amplified during recessions and in countries with less developed financial systems. These results indicate that financial markets are important to the transmission of monetary policy and that output in industries which are more likely to face significant external finance premia are most sensitive to increases in baseline interest rates. However, given that they do not look at investment directly these results only speak broadly to the existence of a channel impacting firm output, whereas we look more directly at investment.

The literature also includes many firm-level studies which look at heterogeneous adjustment to changes in interest rates and how these relate to financial proxies. In much of the micro literature, firm size is taken as a measure of exposure to the external finance premium since the informational asymmetries which give rise to the credit channel are more severe for small firms. Oliner & Rudebusch (1996) take this approach by looking at how the relationship between firm investment and cashflow varies across firm size in the aftermath of monetary tightening. They find that the investment of smaller firms is more strongly related to their internal cashflow, and is more so after monetary tightening. Gertler & Gilchrist (1994) also use the differing behaviour of smaller firms to motivate the idea that monetary tightening may transmit to the real economy via financial factors.

Our results, however, suggest that firm size is an imperfect proxy for capturing credit channel effects: we find little evidence of variation in the investment behavior of large and small firms with respect to changes in borrowing costs once controlling for the use of external finance.

Cloyne et al. (2023) show the importance of financial frictions for monetary policy transmission. Using detailed firm level data in the US they find that young firms, which are most sensitive to fluctuations in collateral cut their investment significantly. They find that firm age and dividend-paying status are the most robust predictors of large investment adjustment, and argue that financial frictions contribute about one-third of the total impact of monetary policy. Jeenas (2023) also finds a strong relationship between monetary policy response and firm financial characteristics, and shows that without such channels the impact of monetary policy would be substantially weaker. Anderson & Cesa-Bianchi (2024) use a bond-level dataset and high-frequency monetary policy shocks to show that a monetary tightening leads to bigger increases in the cost of credit for levered firms. Though they find this is driven by the risk appetite of financial intermediaries rather than firms themselves.[4]

However, more recent studies have suggested the credit channel may be less important for explaining overall impacts of monetary policy. Durante et al. (2022) use the reaction of the investment of smaller firms to high-frequency monetary policy shocks, as well as those operating in durable goods sectors to compare the importance of interest rate channel of monetary policy relative to the credit channel. They find evidence that durability is associated with larger and more persistent reductions in investment than the firm-age proxied credit channel. However, this may be due to these durable industries having more rate sensitive revenues and financiers being aware of this and so constraining credit and so makes it hard to disentangle the two channels.[5]

Similarly, Ottonello & Winberry (2020) show that investment done by firms with low default risk (as measured by leverage or distance-to-default) is more responsive to monetary policy shocks and the differences in their responses persist for up to 3 years. Paranhos (2024) use heterogeneous local projections, and identify that a threshold for risk exists beyond which the majority of these risky firms' investment displays no significant reaction to policy shocks in the short term.

These empirical findings of a weak credit channel are consistent with theories incorporating credit constraints which may limit the extent to which firms can participate in the credit markets and the reaction of their observed investment to monetary policy changes. Although we find that the investment of more levered firms has reacted more strongly to the recent increase in interest rates, we argue that this remains consistent with the results

[4]Firms with access to bond markets will tend to be substantially larger than those in our dataset.

[5]The importance of revenues for access to credit is underlined in Lian & Ma (2021) who show that cashflow based financing is an important feature of developed economies.

of Ottonello & Winberry (2020) and Paranhos (2024). This is because the recent period of rising interest rates came after a period of very low rates and extraordinary credit support from the UK government during the Covid-19 pandemic. This fiscal and monetary support would have eased credit constraints for the majority of firms. When interest rates and credit markets began to normalise a number of firms may have then returned to a credit constrained state and adjusted investment more significantly than they would have done in previous hiking cycles (where they would have remained constrained throughout). We explore the possibility of credit constraints impacting firms' investment responses in our empirical design and find evidence consistent with this.

Additional difficulties in finding evidence for the the credit channel also arise due to the need to disentangle the impacts of shifts in demand. This is problematic, since changes in demand are likely to be induced by changes in the cost of funds: a rise in the cost of funds might cause a fall in demand via general equilibrium impacts, or an autonomous rise in demand might cause the monetary authorities to raise interest rates. Our novel survey-based data allows us to control for these demand impacts at a firm level. This is explained in more detail in the data description in Section 4.

3. Model

3.1 Model outline

To probe the implications of the credit channel we use Figure 1, adapted from Oliner & Rudebusch (1996), to clarify the basic mechanics of the credit channel for two investing firms sharing the same investment demand curve.

Figure 1 shows the supply and demand for investment as a function of the cost of funds. Firm A has an unlimited supply of internal capital and initially self-finances at a cost r_1 resulting in total investment of I_A. This r_1 is the opportunity cost of cash and might be the safe policy rate plus a constant premium. By contrast Firm B additionally uses external finance to invest resulting in an upward-sloping curve after its internal finance (F) has been exhausted: shown in curve S_B^1. The upward-sloping parts of the curve reflect increasing marginal costs of funds once firms go beyond using internal funds and seek outside funds. The gap between the internal rate r_1 and the r_1^B is the external finance premium, defined as the total costs faced by an external borrower in excess of the cost of internal funds. The upward slope reflects the fact that as firms borrow more the agency costs associated with borrowing become larger, and so the lender is compensated by a larger premium.

As B. S. Bernanke & Gertler (1995) sets out, tight monetary policy affects investment

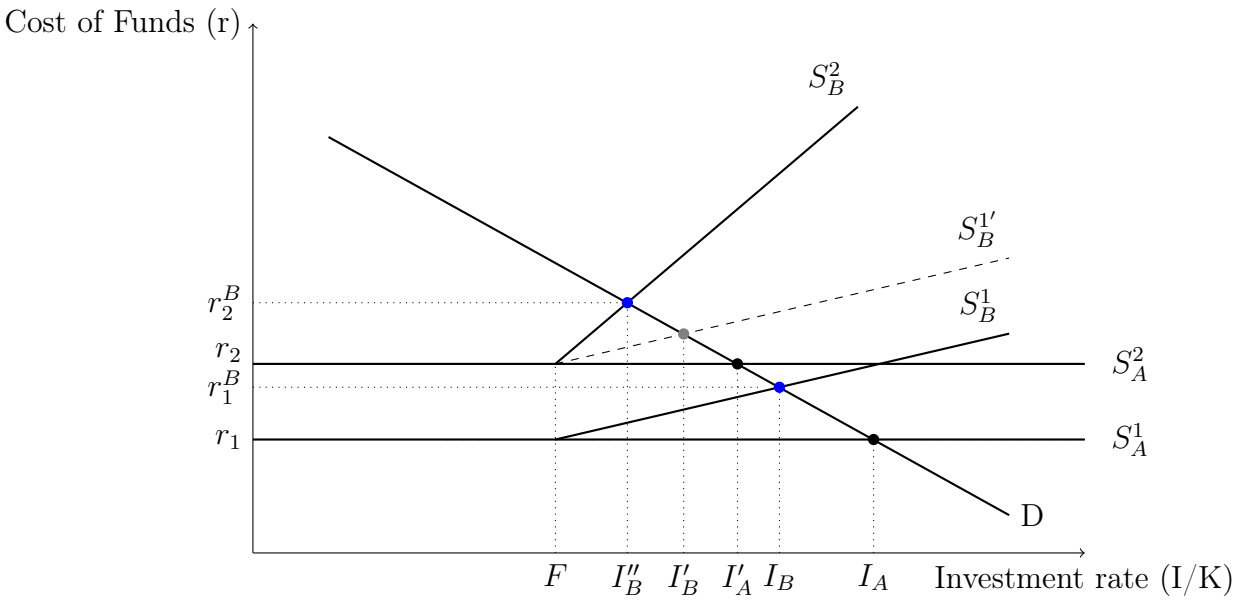

Figure 1: The credit channel of monetary policy and the external finance premium.

directly by raising the baseline interest rate (or cost of capital) for all households and firms and therefore reducing spending on investment, durable goods and housing. However, this is then further amplified by the credit channel where the external finance premium increases endogenously as a result of monetary policy. In Figure 1 a rise in interest rates directly raises the flat line to r_2: representing the direct impacts of interest rates. This shifts Firm A's supply curve upwards from S_A^1 to S_A^2 and as a result reduces investment from I_A to $I_A^{'}$.

For Firm B tighter policy would directly lead S_B^1 to rise to $S_B^{1'}$ and investment would decline to I_B'. But the increase in interest rates potentially affects creditworthiness of borrowers. Higher interest rates do this by reducing future firms profits or by reducing the value of collateral that loans are secured against for example. The importance of collateral for enabling firms to access finance for investment is shown in Bahaj et al. (2020). As a result of these indirect effects $S_B^{1'}$ rises further to S_B^2 and investment also declines from I_B' to I_B''. [6]

The theory of the credit channel of monetary transmission provides three key testable predictions:

1. In the cross-section, firms who use external finance have a higher cost of capital than those who only use internal finance. This is shown by the upward sloping supply curve for firm B.

2. In the time series, any changes in the baseline or "safe" interest rate will be magnified for firms using external finance. This is shown by the steepening of firm B's supply

[6]Note there are likely to be further, indirect effects, if demand falls and firms adjust their investment plans lower as a result.

curve as policy rates increase.

3. Finally, conditional on the demand slope a firm faces, the investment response to a rise in the baseline interest rate is larger for a firm using external finance relative to one reliant only on internal funds. Firm B's investment in this case declined from I_B to I''_B which will be larger than the decline for firm A (I_A to I''_A).

To test these implications with our data we first convert the figure to a simple set of equations. The above figure is grounded upon a relationship between investment and the price of capital. This can be conveyed by the equation:

$$\Delta I_i = \beta \Delta r_i + \Delta Z_i \tag{1}$$

Where I_i is investment, r_i is an appropriate cost of capital and Z_i represents other controls such as the investment demand curve of the firm (and depreciation if we are considering gross investment). Equation 1 represents a situation in which the firm face a supply curve with constant slope. The key insight from the model in 1 is that a rise in the baseline interest rate will have a heterogenous impact on a firm's cost of capital r_i. As such we can write the marginal impact of a rise in the baseline interest rate on the cost of capital as a function of whether or not a firm depends on external borrowing:

$$\Delta r_i = \Delta r_0 + \alpha E_i \Delta r_0 \tag{2}$$

Where r_0 is the baseline rate, and E_i represents the external borrowing position of the firm. Combining 1 and 2 gives:

$$\Delta I_i = \beta(\Delta r_0 + \alpha E_i \Delta r_0) + \Delta Z_i \tag{3}$$

The three predictions from the model are dependent on $\beta < 0$ and $\alpha > 0$ (conditional on demand ΔZ_i).

3.2 Transition to estimated model

We can look to summary statistics to provide a check on the first two predictions of the model: namely, examining the average reported borrowing rate of firms that use some external finance for investment relative to those that use internal funds and how the these borrowing rates have changed over time.[7] Adding further controls helps to show whether

[7]Note that those firms that report using internal cashflow to fund investment may use internal finance to fund working capital needs and therefore will report borrowing costs.

these patterns are robust.

To test the model's third prediction, rather than creating a structural equivalent to the equation above we run two broad empirical models which act as analogues to the simple theoretical model. In both models we proxy the left hand side variable, with firms' self-reported estimates of the impact of higher interest rates since 2021 on their investment (in percentage terms).

In the first approach we run a set of regressions using data provided by firms as to whether they finance investment internally, use external finance or use a mix of both. We create dummies for how firms fund investment and see how these are related to the investment impact from higher interest rates, while also controlling for the perceived and expected sales impacts of higher interest rates:

$$\Delta Invest_{it} = \alpha_1 \Delta Sales_{it} + \alpha_2 \mathbb{1}External_{it} + \alpha_3 \mathbb{1}External\&Internal_{it} + \epsilon_{it} \tag{4}$$

In this version of the regression the omitted financing category is whether a firm solely uses internal funds. This equation simply tests whether the status of a firm using external financing for investment is a significant predictor of how their investment has changed in response to higher interest rates.

In the model the impact of the credit channel is largely mediated by the cost of capital that firms face: externally financed firms will face a larger increase in their marginal cost of borrowing than those solely using internal sources of funding. To account for this we also incorporate firm borrowing costs into our regression; and due to possible imperfections of the measure we also explore the interactions between the change in borrowing costs and the firms' financing category:

$$\begin{aligned} \Delta Invest_{it} = &\alpha_1 \Delta Sales_{it} + \alpha_2 \mathbb{1}External_{it} + \alpha_3 \mathbb{1}External\&Internal_{it} \\ &+ \beta_1 (r_i * \mathbb{1}External_{it}) + \beta_2 (r_i * \mathbb{1}External\&Internal_{it}) \epsilon_{it} \end{aligned} \tag{5}$$

A positive coefficient on the interaction terms will tell us whether the investment of firms using external finance is more responsive to a given change in their borrowing rate than that of firms which are funded by internal capital alone. This would be consistent with the idea that credit constraints and decisions to take on new debt limit the extent to which changes in average borrowing costs reflect changes in the marginal cost of capital.

For some firms we also have data on initial capital stocks from company accounts and so re-specify the dependent variable as $\frac{\Delta Invest_t}{K_{t-1}}$ as a robustness check.

4. Data

4.1 Data description

This section outlines the main data sources used in the paper. To estimate the impact of higher interest rates on investment and the extent to which such impacts are driven by a credit channel of transmission, we use data from the Decision Maker Panel (DMP) survey: a large and representative survey of UK firms with more than 10 employees that are randomly sampled from the Companies House business register. Firms are invited to take part in the survey by a recruitment team based at the University of Nottingham (For more details on survey methodology see Bunn et al. (2024)).[8] The DMP is a monthly online survey. It was launched in late 2016, and is jointly organised by the Bank of England, University of Nottingham and King's College London. On average it receives around 2,500 responses each month (Figure B1) with an active response rate of around 50%. The survey has a rotating three-panel structure with each member randomised on entry into one of the panels. As a result each panel is given one-third of the questions in any given month, so over a quarter a firm will rotate through all questions (but may not respond to all).

As well as the regular questions on historical and expected sales, prices, employment and investment, the survey also includes special questions which focus on ad-hoc issues and policy topics. Between November 2023 and January 2024, firms were asked a series of questions regarding the impact of higher interest rates on their investment as well as a set of questions concerning how investment is funded.[9] Specifically the questions we employ in this analysis are:

1. Holding other factors constant, what is your best estimate of the impact of changes in interest rates since the end of 2021 on the [capital expenditures/employment/sales] of your business in 2023 Q3?

2. Holding other factors constant, what is your best estimate of the expected impact of changes in interest rates since the end of 2021 on the [capital expenditures/employment/sales] of your business in 2024 Q3?

3. How does your business typically finance its capital expenditure?

4. What is the approximate average annualised interest rate on the interest-bearing borrowing that your business has, both now and at the end of 2021?

[8] https://decisionmakerpanel.co.uk

[9] Firms were prompted to consider both the change in the cost of their existing and new borrowing, as well as the impacts on their deposit income.

2,289 firms responded to the question concerning the impact of higher rates on their investment, and on how they fund their capital expenditure. These firms account for 3% of total UK private sector jobs and 5% of total UK business investment. [10]

Figures B2 & B3 show the format of the questions concerning the impact of interest rates on investment and on sales, including the clarifying notes that are provided to firms when they answer. For both questions firms are first asked to consider the direction of the impact on the variable of interest (Panel A). Once this has been selected their answers are used to populate the follow on question in Panel B which asks them to provide an assessment of the size of these impacts. Figure B4 provides a summary of how firms responded to the question of the directional impact that higher interest rates since 2021 have had on their sales and investment. Figure B6 shows the distribution of reported declines in sales and investment among firms who reported that higher interest rates had reduced these variables. Around 10% of firms reported they had lowered investment by at least 50% due to higher interest rates, whereas for both sales and employment most firms reported smaller declines of less that 15%.

The questions concerning rate impacts provide us with a timely measure of the marginal change in investment at the firm level in response to higher interest rates (purged of issues around distance from desired capital), as well as providing a measure of the perceived demand impacts from higher interest rates which can be used to control for shifts in the investment demand curve. Additionally, asking firms about how they ordinarily finance investment provides a more direct measure of their position on the stylised supply curve in Figure 1, and is not reliant on correlations between firm characteristics and financial risk.

4.2 Summary statistics

Table 1 summarises the average reported impacts of increases in interest rates between December 2021 and August 2023, and the funding characteristics of our panel of firms before evaluating the evidence for the model predictions. Over this period, Bank Rate, the interest rate set by the Bank of England's Monetary Policy Committee rose from 0.1% to 5.25%. The upper panel, shows the mean reported fall in investment by 2023 Q3, relative to rates having stayed constant, was 7.1% (6.1% unweighted).[11] The middle panel shows that firms also reported a fall of around 4% in sales, on average. Additionally, the third panel shows that around 12% of firms in the sample reported using external finance only to fund their investment, 30-38% used internal funds only (depending on how data are weighted) and about 50% a mix of the two.Firms with no borrowing were not required to

[10] These two sets of questions were in the same panel.

[11] To be clear this refers to an estimate of the impact of higher interest rates as a percentage change in investment, not in investment scaled by capital.

answer this question. Finally, 1,146 firms gave an estimate of the actual change in their borrowing rates between the end of 2021 and Autumn 2023. The average increase was 3.1 percentage points, compared to a 5.15 percentage point rise in the Bank of England base rate.

Table 1: Summary statistics

Measure	Mean (weighted)	Mean (unweighted)	Firms
Impact of interest rates on capex 2023 Q3,%	-7.1%	-6.1%	2,289
Impact of interest rates on sales 2023 Q3,%	-3.9%	-4.7%	2,289
Impact of interest rates on expected sales 2024 Q3, %	-3.4%	-3.7%	2,289
Proportion of firms using external finance only	12%	11%	2,289
Proportion of firms using internal finance only	38%	30%	
Proportion of firms using both internal and external finance	46%	52%	
Proportion of firms who do not usually invest	4%	7%	
Reported change in borrowing rates	3.1%	3.1%	1,146

Source: Authors' calculations based on the DMP. Based on the questions "holding other factors constant, what is your best estimate of the impact of changes in interest rates since the end of 2021 on [capital expenditures/sales/employment] of your business in 2023 Q3 and expected in 2024 Q3?". Proportion of firms using each form of financing for investment was based on the question "How does your businesses typically finance its capital expenditure?". Firms are able to select multiple options from internal cashflow/cash reserves, bank borrowing, bond finance, equity finance and other (which they must specify). The reported impacts of interest rates on capex, sales and expected sales have been winsorised at the 5th and 95th percentiles.

4.3 Data quality

A potential challenge to this approach of using survey data is that it requires the answers that firms provide to the survey questions to be of high quality. Respondents may fail to remember the correct values of the variables they are being asked to provide or struggle to estimate the marginal effect of higher rates, resulting in inaccurate responses. Bunn et al. (2024) demonstrates that in general the DMP data match both accounts data that firms eventually file, as well as offering tracking aggregate series. Here we focus on evaluating the quality of the key data used in this paper.

The interest rates that firms report paying on their borrowing in the DMP survey closely track official statistics. Figure B7 in the appendix provides a time series of the average annualised interest rate on borrowing provided by firms in the DMP (considering both

the weighted and unweighted mean), relative to the official statistics of the aggregate sterling-weighted interest rate on all loans to private non-financial corporations. The small absolute deviations between the two series suggests firms accurately report their financial costs, on average.

In this setting, where firms are being asked to estimate the marginal impact of higher interest rates relative to a counterfactual in which interest rates did not increase, there may be added issues given question complexity: firms may not be able to reliably conceived a hypothetical economy where rates have not risen and the resultant investment or employment decisions.

Figures B8 and B9 demonstrate firms that reported higher interest rates as having reduced their investment plans relative to a counterfactual world in which interest rates did not increase, reported lower overall investment growth in a separate survey question, relative to firms who reported no impact. This true both unconditionally and when controlling for industry and time fixed effects (and so firm responses over time appear internally consistent).

Additionally, the total reported marginal impacts of higher interest rates on investment are consistent with findings in the wider economic literature on monetary transmission. Several studies provide estimates of the impact of monetary policy on investment: Cloyne et al. (2023) find that a 25bps monetary policy shock leads to the investment rate falling by around 0.4 percentage points (investment rate defined as investment relative to capital stock). The paper also shows at an aggregate level that a 25bps shock to interest rates reduces business investment by between 0.6% and 0.8% in the national accounts data.[12]. If we assume that the 500bps increase in interest rates would have a similar causal impact as that identified using monetary policy shocks, the estimates from Cloyne et al. (2023) are consistent with a large decrease in aggregate investment of 12% - 16% using the national accounts estimates as an upper bound. Other work suggests smaller impacts, for example results from Albuquerque et al. (2025) imply a reduction in investment of around -6% for a monetary policy shock of 500bps. The reports of firms in the DMP are, on average, within a reasonable range of estimates found in the literature.

[12]Comparing these with our estimate is not completely straightforward given that these impacts are identified using monetary policy shocks while we are asking firms about the marginal impact of all interest rate changes over this period (both systematic and idiosyncratic, and across the interest rates firms borrow and receive). Moreover, measures of monetary shocks over this period which use high-frequency surprises suggest the UK saw more expansionary shocks than contractionary shocks over this period (see for example the monetary policy shock series developed in Braun et al. (2025))

5. Results

5.1 Main results

We now consider evidence for each prediction identified from the model in Figure 1 in turn.

Prediction 1: Firms using external finance face a higher cost of funds than those using internal finance

The model in Figure 1 generates the result that firms which use external finance for investment should face a higher cost of funds.

We begin by looking at some simple bi-variate correlations and relationships in Table 2. In Table 2, we show the reported level of capital costs. As it shows, those using internal funds only report an average cost of capital of 6.4%. That cost goes up to 6.7% and 7.4% for those using respectively, a mix of external and internal financing, and external finance alone. This then supports the static cross-sectional pattern in Figure 1, with firms using external finance facing a higher cost of funds.

Table 2: Reported borrowing costs by how firms finance investment

Financing investment	Borrowing rate (3m to Jan 24)	Δ_{24-21} Borrowing rate
External finance only	7.38%	3.27%
Internal & external finance	6.72%	3.08%
Internal finance only	6.41%	3.13%
Does not invest	6.38%	2.24%
Total	6.79%	3.14%

Source: Authors' calculations based on the DMP.

To provide further evidence for these cross-sectional predictions we present a series of regression results in Table 3 on the reported borrowing rate of firms. This exercise uses a longer time series of data on borrowing rates that the firms have reported since November 2022 (and how the level has changed relative to 2021), rather than solely the interest rate reported in the three months to January 2024. Using industry and time fixed effects to control for industry characteristics which may impact a firm's riskiness and thus their borrowing rate, as well as changes in the macroeconomic climate more generally, we find that how a firm funds its investment is a significant factor which leads to higher borrowing rates: firms using external finance to fund investment paid 1 percentage point higher interest rates, on average. Furthermore, this remains the case when controlling for firm sales growth and expected sales growth (a factor which may also determine credit

worthiness). This provides stronger evidence that firms using external finance face a higher cost of borrowing and that the first prediction of the model in Figure 1 holds.

Table 3: Regression of reported borrowing costs by how firms finance investment

	Borrowing rate		Δ_{X-21} Borrowing rate	
	(1)	(2)	(3)	(4)
𝟙 External finance only	1.02***	1.01***	0.28**	0.22*
𝟙 External & internal finance	0.538***	0.553***	0.22**	0.19*
Industry FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Sales controls	N	Y	N	Y
Observations	3,955	3,742	1,553	1,462
R^2	0.12	0.13	0.19	0.19

Note: * p<0.1; ** p<0.05; *** p<0.01. Sales controls are current and expected annual sales growth. The time period of the regression on changes in the borrowing rate since 2021 ranges from November 2022 to January 2024.

Prediction 2: Firms using external finance will face a larger increase in their cost of funds for a given increase in baseline interest rates than firms using internal finance

The model of the credit channel outlined showed that as baseline interest rates are increased the upward sloping section of the supply curve for firms using external finance should steepen, leading to a larger increase in the cost of funds for these firms.

The second column of Table 2 outlines the summary evidence on time series changes. The reported change in the borrowing rate between 2021 and the three months to January 2024 for those using only internal funds is 3.1%. A similar number is seen for those using a mix of internal and external funds, but those using external finance alone have a higher change in their borrowing rate of 3.3%. This is suggestive of the the time series prediction in Figure 1, but recall again that these reported numbers are themselves a noisy measure of the rise in the shadow cost of capital if firms did not undertake fresh borrowing in similar proportions, and these are merely correlations.

To get stronger evidence of this second prediction, we supplement this evidence with more robust regressions in Table 3 controlling for industry and time fixed effects, as well as sales controls. We find stronger evidence that the reported change in the borrowing rate since 2021 for firms using external finance was larger than for those firms relying solely on internal funds in columns 3 and 4. In particular we find that the changes in borrowing rates were 0.28ppt higher for firms using external finance solely and 0.22ppt higher for firms using a mix of external and internal funding for their investment, relative to firms reliant solely on internally generated cash. This further validates the second prediction

of the model, since the increase in policy rates seen over this period has been somewhat amplified for firms that use external sources of finance.

Prediction 3: Firms using external finance to fund investment will reduce investment by a larger amount relative to firms using internal finance for a given increase in baseline interest rates

Having established evidence that firms using external finance are subject higher borrowing costs, and see changes in the baseline interest rate amplified relative to firms using solely internal finance, we now test the extent to which investment responds to changes in interest rates.

Table 4 sets out the results of the analysis based on equation 1. The dependent variable is $\Delta ln(I)$ - namely the percentage impact from higher interest rates that firms report in the survey. In all columns, apart from column 4, we control for demand changes by including the reported impacts of higher interest rates on firm sales in 2023 Q3 and 2024 Q3 in the regression.

Column 1 shows the simple impact of external/internal finance by inserting dummies: "External finance only" is a dummy variable taking the value one if the firm reports that it is entirely reliant on external capital to fund investment. "External and internal finance" is likewise a dummy variable taking the value one if the firm is reliant on a mix of external capital and internally generated cash flow. The omitted category is financing internally only (we dropped the very small number of firms who reported investing very infrequently).

The dummies on the financing arrangements in column 1 indicate some support for the model. The results show that firms using only external finance cut their investment by 8.5 percentage points more than those who invest using internal cashflow only, and that firm that use a mix of internal and external finance reduced investment by 6.7 percentage points more than internal funders. These two coefficients are not statistically significantly different from each other (Prob $>$ F $=$ 0.1911) at conventional significance levels but are statistically significantly different from the omitted category namely using internal finance only.

As mentioned previously, firms are not only asked whether they are using external finance, but also about the change in the borrowing rate that they have actually experienced. This detail is useful since according to the simple model in Figure 1 the impacts of the credit channel should be mediated by a larger change in marginal borrowing rate for firms using external finance. Column 2 replaces the dummy of internal/external finance by reported changes in the borrowing rate. The change in the borrowing rate has a negative impact as expected. However, when retaining the indicator variables for how a firm is financed alongside the change in the reported borrowing rate (not shown in here)

Table 4: Regression table on reported impact of higher interest rates on capital expenditure

	Capex impact 23Q3				
	(1)	(2)	(3)	(4)	(5) No sales impacts
Impact on sales 23Q3	0.448***	0.409***	0.399***	0.406***	
	(0.058)	(0.061)	(0.061)	(0.061)	
Impact on sales 23Q4	0.135**	0.151**	0.149**	0.149*	
	(0.059)	(0.061)	(0.061)	(0.061)	
𝟙 External finance only	-8.453***		-3.485**		-2.951
	(1.223)		(1.716)		(2.167)
𝟙 External & internal finance	-6.697***		-4.667***		-3.043**
	(0.691)		(0.989)		(1.230)
𝟙 Any external finance				-4.390***	
				(0.874)	
Δ Borrowing rate		-1.908***			
		(0.235)			
Δ Borrowing rate			-1.971***		-1.579*
# 𝟙 External finance only			(0.639)		(0.942)
Δ Borrowing rate			-0.783**		-1.064**
# 𝟙 External & internal finance			(0.343)		(0.506)
Δ Borrowing rate				-1.085***	
# 𝟙 Any external finance				(0.305)	
Constant	-0.647**	-1.683***	-0.802***	-0.772***	-0.983***
	(0.277)	(0.278)	(0.276)	(0.276)	(0.231)
Observations	2,132	1,932	1,932	1,932	915
R^2	0.163	0.149	0.165	0.162	0.089

Note: * p<0.1; ** p<0.05; *** p<0.01

the negative coefficients on the use of external finance and a mix of both internal and external finance remain significant and of a similar magnitude. That funding status has explanatory power in addition to the change in firm's reported average borrowing costs points to the potential that this measure of change in borrowing costs does not capture the change in marginal funds.[13]

[13]Reported borrowing costs might be less accurate measure of marginal borrowing costs if firms who are unable to access external capital do not report higher borrowing costs since they cease to borrow. This issue is explored in Table A3 which looks at reported borrowing costs according to whether firms report being "financially constrained" or not. Firms were asked whether their capital expenditures were "wholly or partly constrained by the following factors" which were "access to external capital, the cost of external capital or access to internal capital" and could select multiple as constraining their investment. We see that firms reporting different constraints tend to report facing similar borrowing costs and similar changes. This is evidence that reported rises in borrowing costs might be a selected sample of only those who actually borrowed.

In Column 3 of Table 4 we extend the analysis interacting how firms fund investment with the change in the borrowing rate. The coefficient on the change in borrowing rate for those using only external finance is consistently larger in absolute magnitude than those using a combination of external and internal finance. The large negative coefficient reflects firms that use solely external finance to fund investment cutting their investment back by more for each percentage point increase in the average interest rate they pay on borrowing than those who rely on internal funds. This pattern is consistent with a story of financial constraints as limiting the amount of capital firms reliant on external finance are able to raise, simultaneously limiting the observed change in their borrowing rate but leading to large declines in investment. Column 4 shows this relationship continues to hold when the funding source variable is reduced to a binary dummy taking the value 1 if a firm uses any external finance.

We can also visualise this result using the binned scatterplot in Figure 2. The red and blue lines show the marginal impact on changes in investment of changes in borrowing rates for those firms using respectively (red) a mix of internal and external finance and (blue) external finance only. The fact that the blue line is steeper illustrates that a given change in borrowing rate has a higher absolute impact on the adjustment to investment that firms make if they are using solely borrowing to fund their investment. These results suggest that relying solely on changes in the average borrowing rate firms face to attempt to capture the full extent of the credit channel may be problematic - potentially reflecting a reason that some studies in the literature find weak impacts.

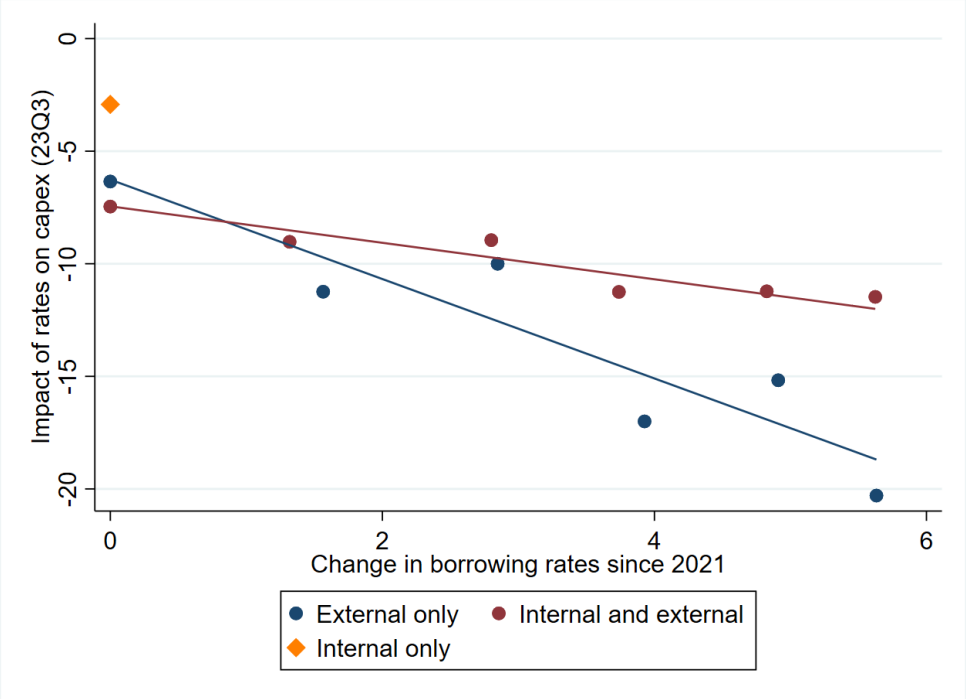

Figure 2: Change in reported borrowing rates between 2024 and 2021 and reported impact of higher rates on capital expenditures, by funding source.

To further control the extent to which the interest sensitivity of the demand firm's

face are driving results, in Column 5 we restrict the sample further to those firms who reported no impact on their sales from the rise in interest rates. Once again, the same pattern emerges, namely higher (in absolute value) investment impact for a given change in borrowing costs for those using external finance to fund investment.

In the Appendix Table A2 we also present an alternative set of results where the dependent variable is an approximation of the change in investment relative to capital $\Delta ln(\frac{I}{K_{t-1}})$.This approximation is calculated by using 2023 investment and total asset balance sheet data for the firms from Bureau van Dijk and assuming that investment levels recorded in firm accounts would be larger by the percentage impact firms report in the DMP if interest rates has not been raised. We then scale this higher investment level by the total capital stock reported in firm accounts and calculate the percentage point difference between this counterfactual higher investment-to-capital ratio and that reported in firm accounts. The noise these assumptions introduce is one reason for why we find less clean results in this exercise. The results are qualitatively the same: a more negative response of investment by those financing by borrowing only relative to those financing by solely internally generated funds (the omitted category), and a larger reduction in investment from firms who use any external finance relative to those firms who solely use internal finance for each percentage point increase in borrowing rates (column 4).

5.2 Economic significance

We have shown the statistical significance of the credit channel. What of its economic significance? Our results show that the credit channel accounts for about a quarter of the total impact of higher interest rates on investment: reflecting both a bigger increase in the cost of capital for firms using external finance and these firms also cutting investment by more for a given increase in the cost of capital. Overall firms that use only borrowing to fund investment reported that their investment declined between 2021 and 2023 by 18.3% as a result of higher interest rates, while those using internal funds reported their investment fell by 3.4%. The regression in column 3 suggests that around 40% of this difference (6.4%) can be explained by the credit channel – namely by the terms which interact the change in borrowing rate with the source of funding firms use to invest. This is shown in Figure 3 which decomposes the reported impact of higher rates on firms by the channels represented by the regression results in column 3 of Table 6.[14] When considering the total impact that firms report higher interest rates have had on their investment, our proxy for the credit channel suggests its contributed just under one-quarter of this 7% decline.

[14]This is constructed by multiplying the coefficients in Table 6 column 3 by the population-weighted average of firm responses to produce an aggregate measure of the importance of each effect. Here the credit channel is defined solely as the impact mediated by changes in the borrowing cost, but a more broad definition would also include the impact of finance status.

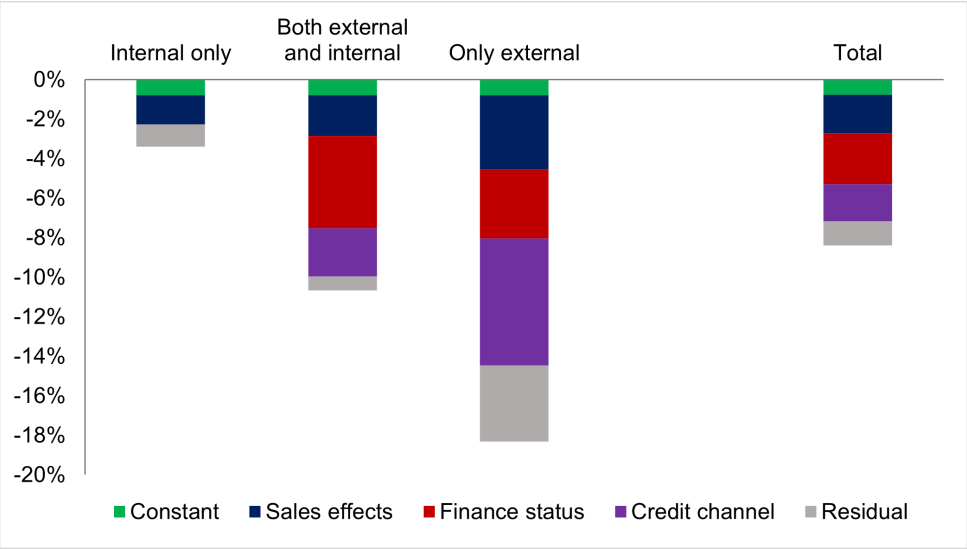

Figure 3: Contributions to impact of higher interest rates on capital expenditure in 2023 Q3. This figure is constructed using the estimated coefficients in column 3 of Table 6.

This finding of an economically significant credit channel effect appears to contrast with those found in Durante et al. (2022) which shows that the durability of the industry a firm operates in is predictive of larger and more persistent cuts in investment due to to monetary policy shocks than firm age (which serves as a proxy of credit channels). The importance of durability is interpreted in the paper as reflecting demand impacts of higher interest rates. However, durability may also be capturing financial channels too if lenders are more likely to restrain credit or tighten standards to firms which operate in cyclical sectors. If this is the case these findings may easier reconciled. Our novel approach may also help to uncover effects that are hard to estimate by allowing us to control for firm level sales impacts.

Comparing these findings with the implied elasticity of capital demand to the user cost of capital found in the broader literature is not straightforward due to the wide variety of methodological approaches, different investment data (i.e. types of investment or capital stock data), and differing types of elasticity (partial vs full) calculated across the literature. Moreover, as we only observe the cost of borrowing for firms in our sample, the majority of which are not publicly traded, calculating an estimates of average user cost is non-trivial. Our estimates are therefore best seen as shedding light on the cross-sectional differences between firm adjustment based on differences in financing and are complementary to the administrative data based estimates.[15]

[15]Firm level estimates from Cummins et al. (1994) which use tax reforms to estimate long run user-cost elasticities for plant and equipment suggest find these are 0.66. With a market-sector average user-cost of 30% in the UK, our estimates would imply a user-cost elasticity of investment of -0.5 or user-cost elasticity investment scaled to capital of -0.1. Cummins et al. (1994) point out small user cost elasticities in the literature may be due to perceived temporary changes in user costs which have small investment implications. Our setting likely involves a more significant and persistent change in user costs given the scale of the rise in interest rates and the exceptionally low starting point of this hiking cycle.

5.3 Additional results

In the wider literature on the credit channel firm size is often used as a proxy for firms who are reliant on external capital, or are more sensitive to the external finance premium. To evaluate the quality of this proxy for our dataset, Table 5 looks at financing patterns by firm size. The table suggests that the smallest firms are significantly less likely to use external finance to fund investment and - shown in the final row - are less likely to conduct investment in general relative to larger firms. Therefore, smaller firms in general are more likely to be located on the flat part of the credit supply curve. This could either reflect the investment preferences of smaller firms or could be the result of small firms being unable to access credit and therefore investing using internally generated cashflow due to this. In either case this suggests that firm size is unlikely to capture the pattern of the credit channel of monetary policy.

Table 5: How firms finance investment by firm size

Financing investment	10-49 emp	50-99 emp	100-249 emp	250+ emp
External finance only	9.3%	12.4%	11.6%	13.6%
Internal & external finance	25.2%	30.1%	41.7%	43.1%
Internal finance only	55.5%	52.9%	42.8%	42.1%
Does not invest	10.0%	4.7%	3.9%	1.1%

Source: Authors' calculations based on the DMP.

Table 6 studies the data on reported borrowing rates, not by how firms finance their investment, as in Table 1, but by size. Firms of between 10 and 49 employees face borrowing costs around 40 basis points higher than firms with over 250 employees (first column). The second column shows changes. If anything the increase in borrowing rates over this time has been slightly higher for larger firms. If the larger firms are more likely to seek external finance this could explain the seeming evidence against the theory that larger firms are less affected by borrowing constraints. However, studies in the wider literature which focus on size as a potential proxy for exposure to the external finance premium are in reality considering larger firms than those with fewer than 100 employees.

Table 6: Reported borrowing costs by firm size

Firm size	Borrowing rate now	Δ_{Now-21} Borrowing rate
10 - 49 employees	7.10%	2.99%
50 - 99 employees	6.97%	3.07%
100 - 249 employees	6.67%	3.15%
250 + employees	6.71%	3.19%
Total	6.79%	3.14%

Source: Authors' calculations based on the DMP.

In Table 7 we use the regression framework just outlined to explore size and other

common proxies used in the literature to study the credit channel. Our purpose here is to study whether the external finance premium effect operates in firms with different creditworthiness captured by these commonly used proxies.

We first consider if firm size is a good proxy for the credit channel. Smaller firms reported reducing capital expenditures by more than larger firms (-8.2% vs. -7.8%). If this difference were largely the result of the credit channel we would expect financing status and borrowing rates to have a stronger impact on capital expenditures for smaller firms than for larger firms. The results in Table 7 suggest that what drives differences in investment responses to higher interest rates for both small and large firms is the use of external relative to internal finance, with both regressions having similarly sized negative and significant coefficients on the interaction between the change in reported borrowing costs and the indicator variable for whether firms are funded solely by external finance.

However, the table also shows that for firms that ordinarily use a mixture of external and internal finance small firms report reducing investment by more for a given change in reported borrowing costs relative to large firms. This supports the idea that some small firms may face a greater steepening of their credit curve when interest rates rise. For firms that specifically use a mix of internal and external (which represent a plurality of firms) firm size is likely a suitable proxy for capturing credit channel impacts. However, the evidence overall suggests that firm size alone is a mixed proxy for capturing credit channel effects.

Other proxies appear to be more useful. One proxy of access to credit is firm age. Overall younger firms (those incorporated less than 20 years ago) report cutting investment by more than older firms (-9.1% vs. -6.9%). In Columns 3 & 4 we compare firms older and younger firms. These results demonstrate that younger firms using external finance respond significantly and with a greater magnitude to higher borrowing rates than older firms. As shown in Table A1, a larger proportion of young firms report using external finance to fund investment than older firms. It is also likely that younger firms are more reliant on bank borrowing relative to alternative sources of external finance, given their shorter track records, and as such face credit conditions which are more sensitive to the macroeconomic environment and the policy context. These results suggest that difference between young and old firms is driven by differences in the responsiveness of their investment to borrowing costs and their financing status - consistent with age being a good proxy of credit channel effects.

One potential indicator of a firm having limited liquidity and therefore facing a higher external finance premium is whether a firm pays a dividend. If a firm pays a dividend it can reduce payouts in the face of a cost shock and so may not need to adjust investment as strongly to a rise in interest rates. Firms who pay a dividend, however, report cutting investment by more than those who do not (-8.9% vs. -7.1%). Column 5 & 6 we use

Table 7: Regression table on reported impact of higher rates on capital expenditures, sample splits by different proxies of access/cost of credit

Capex impact 23Q3				
	Size		Age	
	(1) <100 employees	(2) >100 employees	(3) <20 yrs old	(4) >20 yrs old
Impact of higher rates on sales 23Q3	0.381***	0.418***	0.369***	0.424***
	(0.072)	(0.110)	(0.085)	(0.086)
Impact of higher rates on sales 23Q4	0.198***	0.018	0.170**	0.137
	(0.071)	(0.117)	(0.083)	(0.089)
𝟙 External finance only	-4.084	-2.537	-5.211**	-1.393
	(2.487)	(2.285)	(2.381)	(2.368)
𝟙 External & internal finance	-5.481***	-3.508***	-5.204***	-3.993***
	(1.518)	(1.242)	(1.400)	(1.389)
Δ Borrowing rate	-1.733**	-2.439**	-2.194***	-1.689*
# 𝟙 External finance only	(0.833)	(0.999)	(0.847)	(0.954)
Δ Borrowing rate	-1.244**	-0.424	-0.712	-0.888*
# 𝟙 External & internal finance	(0.569)	(0.379)	(0.495)	(0.480)
Constant	-0.542	-1.461***	-1.002**	-0.594
	(0.331)	(0.489)	(0.413)	(0.368)
Observations	1,197	731	968	964
R^2	0.194	0.130	0.171	0.163

Capex impact 23Q3				
	Dividend		Leverage	
	(5) No dividend	(6) Pays dividend	(7) Bottom quartile	(8) Top quartile
Impact of higher rates on sales 23Q3	0.269***	0.501***	0.315**	0.360***
	(0.101)	(0.127)	(0.133)	(0.118)
Impact of higher rates on sales 23Q4	0.162	0.036	0.086	0.145
	(0.107)	(0.142)	(0.121)	(0.124)
𝟙 External finance only	-2.399	-2.541	-3.576	-4.048
	(2.261)	(2.979)	(3.538)	(3.399)
𝟙 External & internal finance	-5.504***	-5.457***	-4.577*	-3.079**
	(1.456)	(1.998)	(2.582)	(1.765)
Δ Borrowing rate	-1.867**	-1.833	-2.950*	-2.068*
# 𝟙 External finance only	(0.928)	(1.274)	(1.729)	(1.146)
Δ Borrowing rate	-0.434	-0.487	-0.283	-1.137**
# 𝟙 External & internal finance	(0.513)	(0.582)	(1.186)	(0.567)
Constant	-0.986**	-0.710	-1.006**	-2.173**
	(0.398)	(0.635)	(0.425)	(0.744)
Observations	797	451	505	472
R^2	0.125	0.172	0.130	0.127

Note: *** p<0.01, ** p<0.05, * p<0.1

whether or not firms paid a dividend in 2021 to split the sample of firms and re-estimate the regression on these two groups. We find similar sensitivity to increased borrowing costs for firms that do not pay a dividend - indicating that dividend paying status may be a poor proxy of credit channel effects.

Finally Columns 7 & 8 explore the how these impacts vary with leverage. More highly levered firms will be considered riskier for lenders as the moral hazard is more acute for these firms. Due to the fact that these firms will have a lower net worth their lending may also be harder to collateralise. The most levered quartile of firms cut their investment by 11.3% relative to a smaller cut of 3.1% for firms in the least levered quartile. We also find statistically stronger effects for firms with higher leverage, and these firms cut back their

investment by more in response to increases in their reported borrowing rate, particularly for those firms that use a mix of internal and external finance.

6. Conclusions

This paper outlines novel evidence from a large firm survey for the existence of a credit channel of monetary policy. Using a special set of questions in the Decision Maker Panel (DMP) concerning both how firms' capital expenditures and sales have been impacted by higher interest rates, as well as how firms ordinarily finance investment and the cost of borrowing they face, we validate three predictions of a simple model of the credit channel. Firstly, firms using external finance report a higher cost of capital than those using internal funds; secondly that firms using external finance see a larger rise in their cost of borrowing for a given increase in the baseline interest rate than those using internal funds; and finally that firms reliant on external financing for investment report reducing investment by more than the internally funded firms when interest rates rise. Our analysis suggests that the credit channel could account for just under a quarter of the total impact of monetary policy on firm investment. We also find evidence that firm age rather than firm size may be a better proxy for capturing the credit channel.

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Appendix

A. Tables

Table A1: How firms finance investment by firm age, dividend paying status & leverage quartile

Financing investment	<20yrs	>=20yrs	:	No dividend	Pays dividend
External finance only	12.26%	12.38%	:	11.84%	13.92%
Internal & external finance	41.85%	38.26%	:	35.54%	42.79%
Internal finance only	40.59%	51.33%	:	49.36%	42.16%
Does not invest	5.30%	2.26%	:	3.26%	1.14%

Financing investment	1 (Least levered)	2	3	4 (Most levered)
External finance only	5.45%	8.11%	15.50%	16.08%
Internal & external finance	22.66%	31.29%	39.63%	48.08%
Internal finance only	64.98%	56.93%	42.37%	32.73%
Does not invest	6.91%	3.68%	2.50%	3.12%

Source: Authors' calculations based on the DMP.

Table A2: Regression table on reported impact of higher interest rates on capital expenditure scaled by capital

	$\Delta(I/K)$						
	(1)	(2)	(3)	(4)	(5) No sales impacts	(6) <100 employees	(7) >100 employees
Impact on sales 23Q3	0.008*	0.004	0.0.003	0.004		0.003	0.007
	(0.004)	(0.004)	(0.004)	(0.004)		(0.005)	(0.006)
Impact on sales 23Q4	0.012**	0.012***	0.012***	0.012***		0.012**	0.011
	(0.005)	(0.004)	(0.004)	(0.004)		(0.005)	(0.007)
𝟙 External finance only	-0.400**		-0.198*		-0.087	-0.225*	-0.092
	(0.105)		(0.115)		(0.134)	(0.128)	(0.194)
𝟙 External and internal finance	-0.332***		-0.214***		-0.188**	-0.298***	-0.073
	(0.055)		(0.069)		(0.082)	(0.100)	(0.100)
𝟙 Any external finance				-0.210***			
				(0.061)			
Δ Borrowing rate		-0.092***					
		(0.017)					
Δ Borrowing rate			-0.071		-0.091	-0.005	-0.165*
# 𝟙 External finance only			(0.049)		(0.082)	(0.041)	(0.098)
Δ Borrowing rate			-0.047**		-0.035	-0.048	-0.049*
# 𝟙 External & internal finance			(0.022)		(0.024)	(0.033)	(0.028)
Δ Borrowing rate				-0.053**			
# 𝟙 Any external finance				(0.021)			
Constant	-0.066***	-0.123***	-0.081***	-0.081***	0.071***	-0.039	-0.169***
	(0.024)	(0.022)	(0.023)	(0.023)	(0.022)	(0.024)	(0.049)
Observations	1,649	1,515	1,515	1,515	733	930	582
R-squared	0.058	0.052	0.059	0.059	0.042	0.087	0.050

Note: * p<0.1; ** p<0.05; *** p<0.01. The dependent variable is calculated using 2021 accounts data on total assets and investment from Bureau van Dijk.

Table A3: Borrowing costs by whether firms report being financially constrained

	Internal constraint		External availability constraint		External cost constraint	
	No	Yes	No	Yes	No	Yes
Borrowing rate now	6.76%	6.67%	6.64%	6.82%	6.49%	6.89%
Change in borrowing rate	3.20%	3.00%	3.14%	3.04%	2.93%	3.23%

Source: Authors' calculations based on the DMP. Firms were asked whether their capital expenditure was constrained by access to internal finance, access to external finance or by the cost of external finance. They could answer positively to any and all of these.

B. Figures

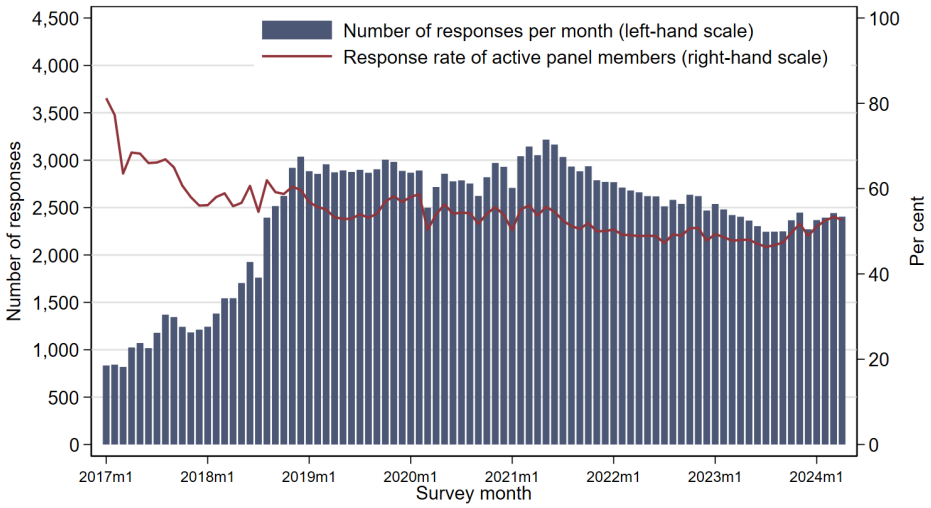
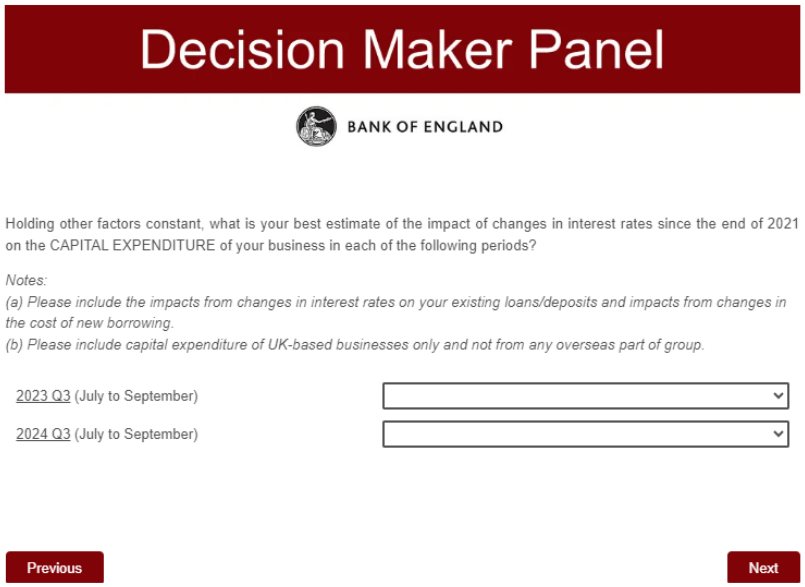
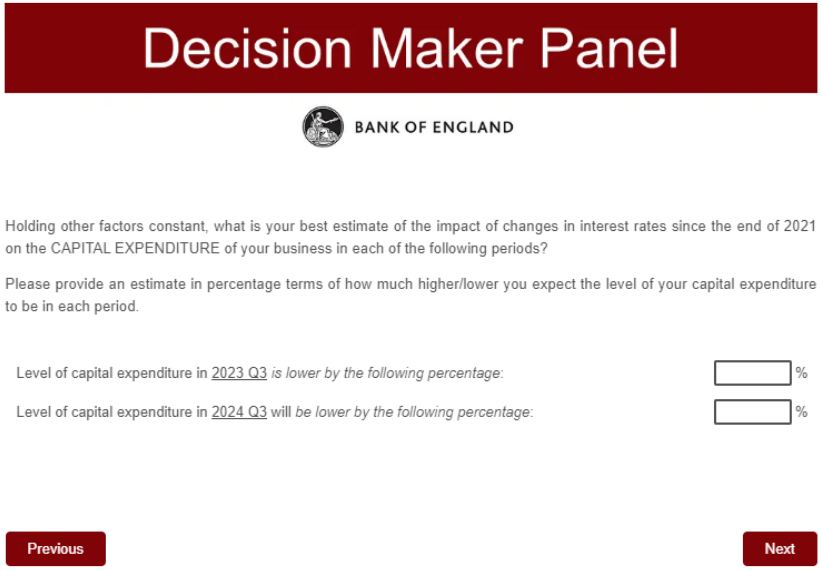


Figure B1: DMP response rate. The response rate of active panel members is calculated as the percentage of panel members who had completed at least one survey over the past 12 months who has responded to the survey in a given month.



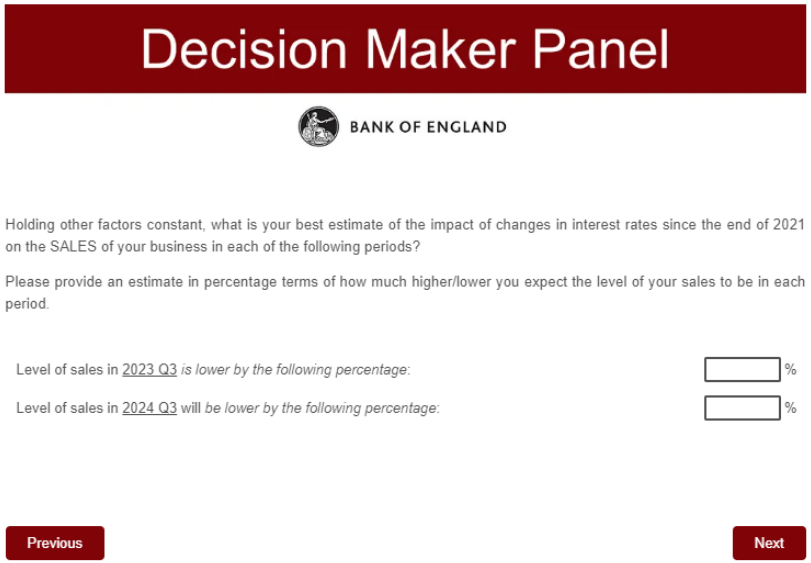
(a) Panel A: Question on direction of interest rate impact



(b) Panel B: Question on size of interest rate impact

Figure B2: Format of question on current and expected impact of higher interest rates on capital expenditures

(a) Panel A: Question on direction of interest rate impact



(b) Panel B: Question on size of interest rate impact

Figure B3: Format of question on current and expected impact of higher interest rates on firm sales

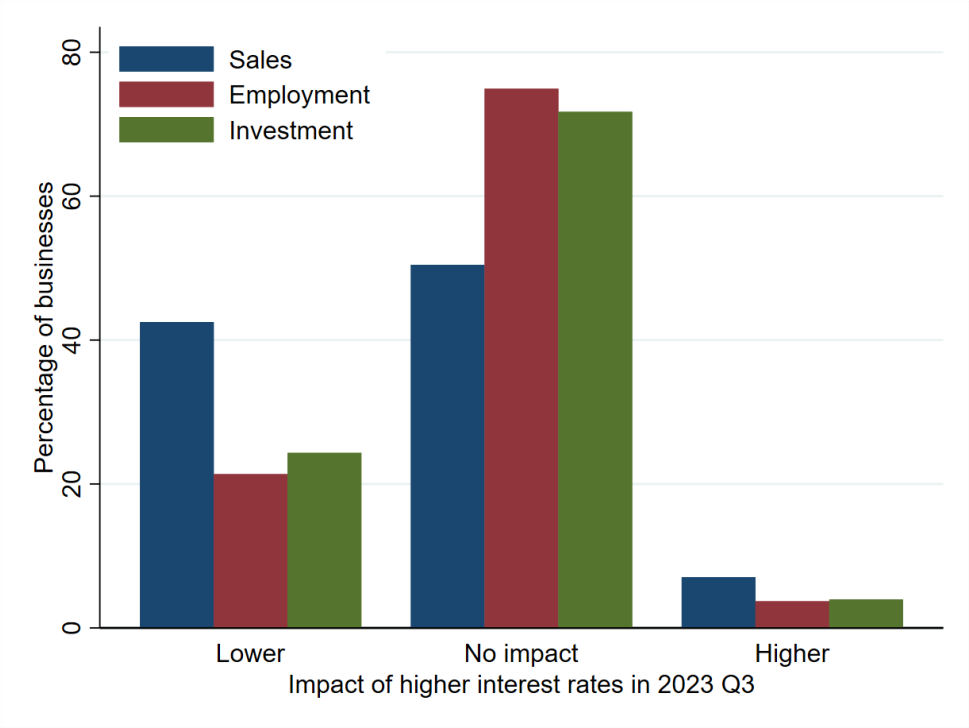


Figure B4: Proportion of firms reporting each directional impact of higher interest rates on sales, employment and investment, in 2023 Q3. Firms responses are weighted by industry and size to provide figures representative of the total market economy.

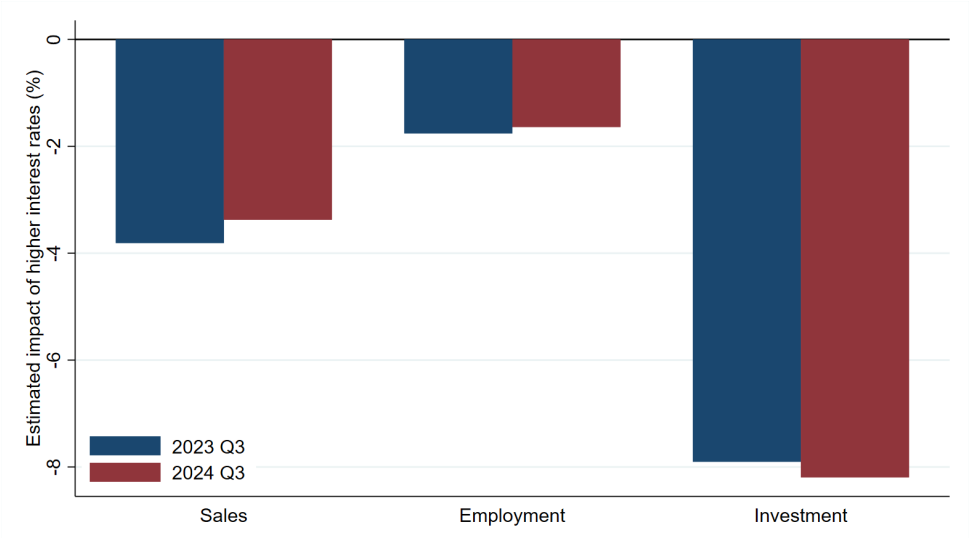


Figure B5: Average reported impacts of higher interest rates on sales, employment and investment, in 2023 Q3 and expected for 2024 Q3. Firms responses are weighted by industry and size to provide figures relevant to the total market economy impact.

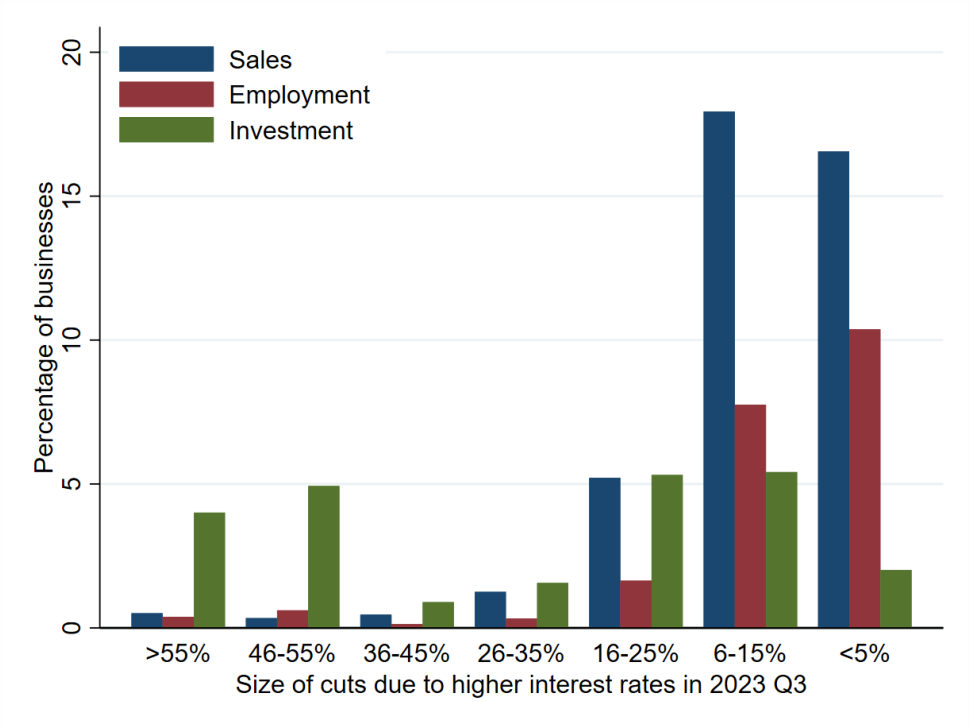


Figure B6: Distribution of reported impacts of higher interest rates on sales, employment and investment, in 2023 Q3. Firms responses are weighted by industry and size to provide figures relevant to the total market economy impact.

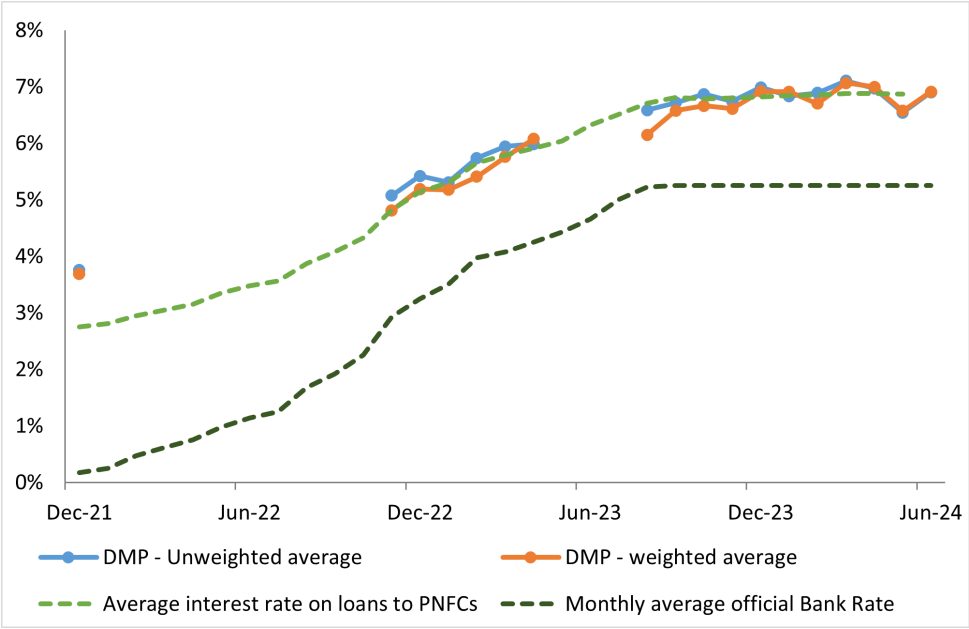


Figure B7: Industry-size weighted mean and unweighted mean reported average annualised interest rate on interest-bearing borrowing in the DMP, and sterling weighted average interest rate on all PNFC borrowing, non-seasonally adjusted.

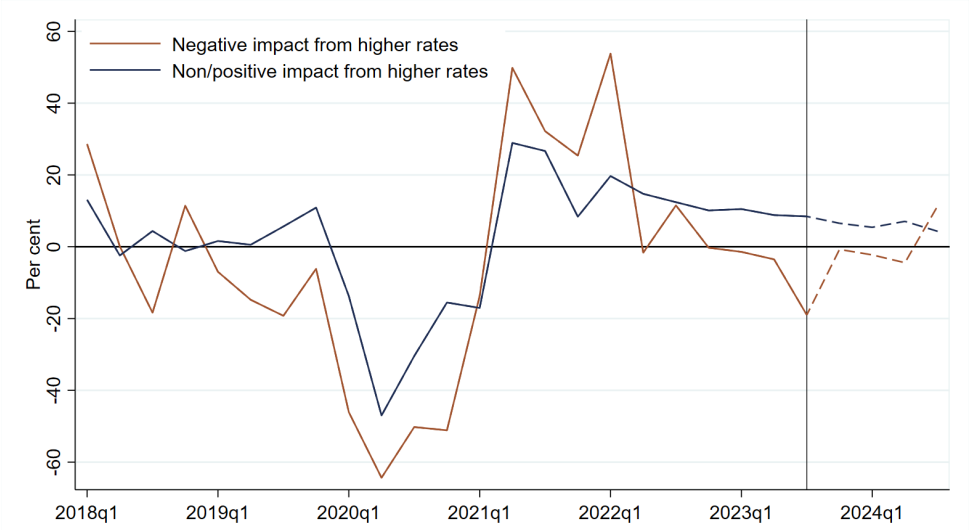


Figure B8: Reported DHS growth rate in capital expenditures by direction of interest rate impact on capital expenditures. The vertical line marks 2023 Q3, the dashed lines reflect firm expectations for the year ahead. Values are weighted by industry and size.

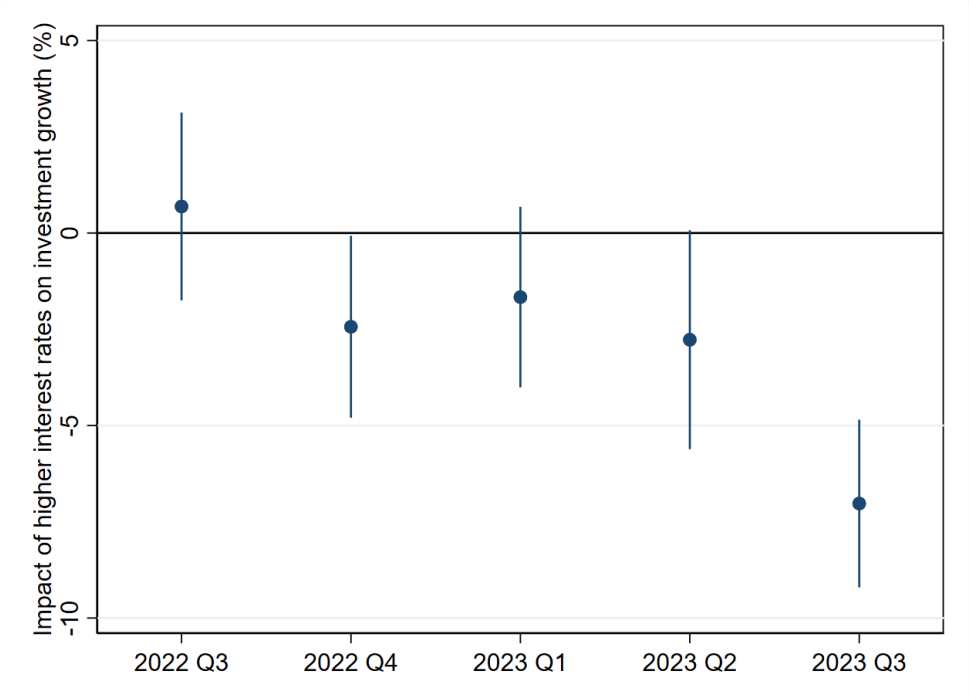


Figure B9: Plot of the coefficients on a regression of the reported impact of interest rates on firm investment, on reported capex growth controlling for time fixed-effects, time fixed-effects and the impact of Covid-19 on firm demand