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Asymmetric Effects of Monetary Policy on Firms

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Asymmetric Effects of Monetary Policy on Firms*

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Abstract

This paper documents firm-level evidence on the asymmetric effects of monetary policy in the US. Focusing on the 1980q3-2019q4 period, I find that monetary tightenings show larger effects on firms' employment and sales than monetary easings. In comparison, investment rate does not generate significant asymmetry in response to sign-dependent monetary policy shocks. I interpret these findings in the context of downward nominal wage rigidity and investment irreversibility channels. Furthermore, I exploit cross-sectional variation and show that employment of small, non-dividend payer, low credit rating and young firms displays larger contractions in response to a monetary tightening.

JEL Codes: E52, E24, E61

Keywords: monetary policy, asymmetric effects, employment

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1. Introduction

The literature on monetary transmission has extensively documented the asymmetric effects of monetary policy at the aggregate level. However, the sign-dependent effects of monetary policy at the disaggregate level remain relatively underexplored. In this paper, I examine whether there is asymmetry in firms' response to sign-dependent monetary innovations and whether the magnitude of asymmetric effects of monetary policy differs for firms with alternative financial characteristics.

In recent years, the literature has proposed various mechanisms such as financial frictions and downward wage rigidity to model the asymmetric effects of monetary policy.[1] According to the financial frictions literature, a monetary tightening (i.e., an increase in interest rates) may result in weaker firm and bank balance sheets and lower expected future value of collateral assets, which in turn leads to more binding borrowing constraints on firms that are at the very margin.[2] The main idea is that during monetary tightenings, credit constraints tend to bind, leading to larger effects on financially constrained firms. This type of amplification during contractions can be associated with banks engaging in credit rationing or incorporating higher risk premium into the financial contracts of high-risk firms to mitigate adverse selection and moral hazard problems.[3] In contrast, during monetary expansions, borrowing constraints tend to relax, weakening the amplification mechanism.

Studying the role of financial frictions in the context of monetary asymmetry requires (i) time-series identified, sign-dependent monetary policy innovations and (ii) an indicator capturing the variation of financial constraints at the micro level. To do this, I first follow Gertler and Karadi (2015), Cloyne et al. (2022), Gurkaynak et al. (2005) and Nakamura and Steinsson (2018a) and exploit high-frequency surprises in interest rate futures contracts within a

[1] A non-exhaustive list of papers include Lin (2020), Barnichon et al. (2017), Kandil (1995), Gorodnichenko and Weber (2016) and Guerrieri and Iacoviello (2017).

[2] Gertler and Gilchrist (1994), Bernanke and Gertler (1989), Kiyotaki and Moore (1997) and Calomiris and Hubbard (1990) show that in an environment with capital market imperfections, borrowers' balance sheet conditions may play a significant role in access to credit.

[3] See the literature on credit channels and market imperfections: Gertler and Karadi (2015), Bordo et al. (2016), Bayoumi and Melander (2008), Aron et al. (2012), Jiménez et al. (2012) and Ciccarelli et al. (2015). Bernanke and Gertler (1990) and Calomiris and Hubbard (1990) study the reallocation of credit in downturns from low net worth to high net worth borrowers. In addition, Barnichon et al. (2017) argue that banks may change the overall pass-through of interest rate changes in an asymmetric way depending on the sign of the monetary policy intervention.

30-minute window around policy announcement. Then, I use these monetary policy shocks to instrument the increases (or decreases) in the one-year government bond yields depending on the sign of movement in that particular quarter. I also utilize quarterly Compustat firm-level data offering comprehensive balance sheet information from 1980q3 to 2019q4. This dataset allows me to explore a wide group of financial constraint proxies and examine whether firms with certain financial characteristics exhibit distinct responses to sign-dependent monetary policy changes.

This paper makes two contributions to the literature. First, the results of this paper present comprehensive firm-level evidence on the asymmetric effects of monetary policy in the US. By analyzing 39 years of micro-data, I show that monetary tightenings are more effective than monetary easings on firms' employment and sales. These findings are consistent with the downward nominal wage rigidity channel (Abbritti and Fahr, 2013; Jo and Zubairy, 2022) and the literature highlighting matching frictions in the labor market (Garibaldi, 1997). As wages are rigid downward and upward flexible, a monetary tightening produces larger effects on employment than a monetary easing. In addition, monetary accommodations may be less effective on employment creation due to hiring costs and slower job-finding rates caused by existing matching frictions in the labor market.

In comparison, I find that investment rate does not generate significant asymmetry in response to sign-dependent monetary policy shocks. These findings are interpreted within the context of the extensive literature on the firm-specificity of assets and investment irreversibility (Pindyck, 1990; Bertola and Caballero, 1994; Abel and Eberly, 1996; Bloom, 2009; Kermani and Ma, 2022). Since capital has firm-level specificity, firms may have limited benefit from selling capital during monetary policy tightenings. In contrast, labor is relatively less firm-specific, making it easier for firms to adjust following a monetary tightening.

Second, this paper tests the role of common financial constraint proxies used in the literature and provides evidence that sign-dependent effects of monetary policy may differ based on firm characteristics. My findings confirm significant heterogeneity using firm size, dividend status, credit ratings and age, corroborating earlier works on financial constraints. I also document that most of these amplifications are seen in employment responses to monetary tightenings, which is once again consistent with less flexible investment dynamics of firms. The heterogeneous effects on sales are also limited, likely because sales are influenced by various factors such as demand conditions, product pricing and market structures, all of which can play significant roles in determining sales outcomes.

This paper contributes to the literature studying the asymmetric effects of monetary policy. Analyzing sign-dependent money supply shocks in the US from 1951 to 1987, Cover (1992) documents that negative money supply shocks affect output and positive money supply shocks do not.[4] Using data from 1954q3 to 2002q4, Lo and Piger (2005) find a policy contraction to be more effective than a policy stimulus. Using aggregate data from 1989:8 to 2007:7, Angrist et al. (2018) show that monetary tightenings have more pronounced effects than monetary expansions on inflation, industrial production and unemployment in the US. Last, using inflation and output data from 1969:1-2002:4, Tenreyro and Thwaites (2016) show that monetary tightenings have a bigger impact on output—but not on inflation– than monetary expansions. A common feature of this literature is to focus on aggregate time-series data to study the sign-dependent effects of monetary policy. In contrast, I focus on providing firm-level evidence on the asymmetric effects of monetary policy, which, unlike earlier findings, allows for a rich analysis of transmission mechanisms in the context of monetary asymmetries. My empirical strategy allows for testing a variety of firm characteristics and can determine whether asymmetric effects of monetary policy differ based on underlying firm characteristics.

There are several recent studies using micro-level data and exploring sign-dependent monetary innovations. Using Compustat sample from 1990-2007, Ottonello and Winberry (2020) explore the interaction of sign-dependent monetary policy shocks with leverage dynamics and find that high leverage firms respond less to monetary *expansions*.[5] Focusing on the 1995-2021 period, Perez-Orive and Timmer (2022) show that financial constraints - proxied by firms' distance to default - increase the responsiveness of firm investment, net corporate debt issuance

[4]Similar to Cover (1992), de Long et al. (1988) and Thoma (1994) find that negative monetary policy shocks to have a greater effect on real GNP and industrial output, respectively. In contrast, Weise (1999), using data from 1960q2 to 1995q2, finds no evidence to support the differential effectiveness of positive and negative shocks. Note that most of the earlier studies work with money-based indicators of monetary policy rather than interest rate-based measures.

[5]Their estimates change sign and turn insignificant for contractionary shocks, which is consistent with the financial frictions channel as noted in Perez-Orive and Timmer (2023).

and employment to a monetary policy tightening. In contrast, they show that constrained and unconstrained firms respond similarly to accommodative monetary policy shocks. The main deviation of this paper from these studies is its larger sample period (1980-2019) and broader focus on various financial proxies as opposed to exploring one particular measure in the context of sign-dependent monetary policy changes.

This paper also contributes to the literature studying the heterogeneity of monetary policy on firm-level data. These papers provide evidence on how financial and non-financial factors like balance sheet conditions (Gertler and Gilchrist, 1994; Ottonello and Winberry, 2020; Kudlyak and Sánchez, 2017), dividend payments (Fazzari et al., 1988; Farre-Mensa and Ljungqvist, 2016), firm age-dividend (Cloyne et al., 2022), liquidity conditions (Jeenas, 2019; Fazzari et al., 1988; Kashyap et al., 1994; Gilchrist and Himmelberg, 1995) and collateral assets (Bahaj et al., 2020) play a role in the transmission of monetary policy. Although these studies investigate a wide variety of monetary policy transmission mechanisms, a common feature in them is to form a direct link between firm finance and the transmission of monetary policy. I contribute to the literature by exploring alternative financial proxies in the context of monetary asymmetries and examining if firms with certain financial characteristics display alternative responses to sign-dependent monetary policy.

There is also a literature studying how the effectiveness of monetary policy depends on the state of the economy (Thoma, 1994; Weise, 1999; Garcia R. and Schaller H., 2002; Lo and Piger, 2005; Peersman and Smets, 2009).[6] Although this literature is mainly interested in sensitivity to the interest rate at different points in business cycles, some interesting studies explore the sign-dependence *jointly* with size and business cycle-related effects. Among these, Ravn and Sola (2004) analyze the *size* and direction of monetary policy shocks jointly and conclude that *small* contractionary monetary policy shocks have real effects on output.[7] In addition, Tenreyro and Thwaites (2016) explore the asymmetric effects of monetary policy depending on the state of the business cycle and document that there is little difference between

[6]For example, Garcia R. and Schaller H. (2002) find asymmetry in the effects of monetary policy, with stronger effects during recessions than during expansions. Using data from 1969q1 to 2002q4, Tenreyro and Thwaites (2016) show that the effects of monetary policy are less powerful in recessions for durables expenditure and business investment.

[7]Note that Ravn and Sola (2004) find asymmetric effects only on the estimates using the federal funds rate.

the distributions of shocks in booms and recessions. Hence, the two sets of asymmetries in monetary effectiveness (sign-dependence and regime dependence) co-exist.

The rest of the paper is organized as follows. In Section (2), I discuss firm-level data and monetary policy shocks. In Section (3), I present the empirical strategy and the main results. I also discuss the robustness checks and heterogeneity of the findings. Section (4) concludes.

2. Dataset

This section describes the datasets used in the paper. I first present the Compustat firm-level database, discuss the construction of the main variables and present descriptive statistics. Next, I discuss the monetary policy shocks used in the paper and illustrate their basic properties. A detailed description of sources, definitions and the sample selection is provided in Appendix A.

2.1. Firm-Level Variables

This paper uses the quarterly Compustat North America database on the universe of publicly traded C-corporations, which offers high-quality information on the balance sheet and income statement components of active and inactive publicly held companies. The total sample covers the period between 1980q3 and 2019q4 and consists of observations from 14,209 firms. I take 1980q3 as the starting date since the monetary policy shocks start then. The sample ends in 2019q4 before the Covid-19 pandemic. The main variables of interest are the number of employees (*emp*), investment rate ($\frac{i_{j,t}}{k_{j,t-1}}$), defined as the capital expenditures of firm j in period t relative to the level of physical capital stock in the last period, sales (*saleq*), book value of total assets (*atq*), liquidity ratio and leverage (total debt divided by the book value of total assets).[8]

Using Compustat data in this paper is advantageous for several reasons. First, Compustat is a long enough panel to study within-firm variation, enabling the analysis of 39 years of quarterly firm-level data where the average firm is observed for about 13 years. Second, Compustat has a rich cross-sectional dimension that allows me to test alternative hypotheses and conduct

[8] The liquidity ratio is calculated as the share of cash and short-term investments (*cheq*) to total assets. Total debt is calculated as the sum of debt in current liabilities (*dlcq*) and long-term debt (*dlttq*). I provide further details on sample selection and data construction in Appendix A.

heterogeneity analysis. Finally, it is a high-frequency dataset that permits the analysis of monetary policy at a quarterly frequency. One limitation of using Compustat data is that despite the good coverage across different-sized firms, the data may disproportionately feature large companies and therefore may underrepresent small firms. In addition, Compustat estimates represent the behavior of publicly traded C-corporations.[9]

2.2. Summary Statistics

Table 7 presents the summary statistics of key variables of interest in the firm-level data for the period 1980q3–2019q4. The sample contains 735,197 firm-by-quarter observations from 14,209 firms. Since the sample consists of public firms, the median real assets is $147.5 million and the median real sales is $38.1 million. The investment rate ($i_{j,t}/k_{j,t-1}$) is, on average, 7.6 percent with a standard deviation of 10.6. The median number of employees in the sample is 745 and the average number of employees is 7,568. The average leverage ratio is 32.6 percent and the average liquidity rate is 17.5 percent. The right-skewed size distribution of firms motivates using log variables in regressions.

2.3. Monetary Policy Shocks

A common challenge in identifying monetary policy surprises is the concern of endogeneity. Since interest rate movements can both react to prevailing economic conditions and influence them, it is challenging to isolate the causes and effects of monetary policy innovations.[10] To address this, I identify the exogenous movements in monetary policy by using the external instrument VAR approach of Gertler and Karadi (2015), developed by Stock and Watson (2012) and Mertens and Ravn (2013). Gertler and Karadi (2015) use high-frequency surprises on interest rate futures around Federal Open Market Committee (FOMC) meetings as external instruments in VARs to identify the effects of monetary policy shocks.

Following the high-frequency identification literature (Kuttner, 2001; Gurkaynak et al., 2005; Nakamura and Steinsson, 2018a), the main identifying assumption of Gertler and Karadi

[9]Since private firms often have harder financial constraints, the estimates incorporating financial proxies in Compustat should be taken as a lower bound.

[10]See Nakamura and Steinsson (2018b) for a review of the literature on the causal estimation of monetary policy.

(2015) is that they measure the surprises in the futures rate within the 30-minute window of an FOMC meeting. The tight window deals with the endogeneity problem and helps identify monetary surprises that are due to purely exogenous policy shifts. Hence, any surprise movements in fed funds futures during this time period are contemporaneously exogenous to within-period movements in both economic and financial variables (Gertler and Karadi (2015)), leading to consistent estimates of monetary innovations.[11]

Similar to Gertler and Karadi (2015), I first estimate a monthly VAR using a one-year government bond rate, log industrial production, log consumer price index, Gilchrist and Zakrajšek (2012) excess bond premium, employment rate and debt to GDP.[12] The reduced form of the proxy VAR is given by

$$\mathbf{Y_t} = \sum_{j=1}^{J} \mathbf{B_j} \mathbf{Y_{t-j}} + \mathbf{u_t} \tag{1}$$

where $u_t = \mathbf{S}\epsilon_t$ is the reduced-form shock and $\mathbf{S}$ is the structural impact matrix that maps latent structural shocks into reduced-form shocks. Data on fed funds futures are available from 1991 and the VAR data spans 1979m6 to 2019m12. An advantage of the proxy VAR approach is that VAR can be estimated over a much longer period than the instrument available (Cloyne et al., 2022). Next, following Cloyne et al. (2022), I extract the latent monetary policy shocks from the implied residuals of their SVAR-IV by inverting the structural VAR impact matrix.[13] This yields a time series of monetary policy innovations from 1980m6 to 2019m12. I aggregate these innovations from monthly to quarterly frequency by summing. Appendix Figure A.1 plots the implied monetary policy structural shocks employed in the empirical section.

[11] As discussed in Gertler and Karadi (2015), within a period, policy shifts may not only affect financial variables but also be responding to them. By using daily data of surprise movements in fed funds future around a tight window, the high-frequency identification (HFI) approach addresses the simultaneity issue.

[12] The VAR is estimated using 12 lags. Similar to Gertler and Karadi (2015), I use shocks to instrument changes in the one-year Treasury rate. This is advantageous as movements in the one-year rate not only incorporate surprises in the current funds rate but also shift in expectations about the future path of the funds rate through forward guidance.

[13] Using $u_t = \mathbf{S}\epsilon_t$, we can write $E(u_t u_t') = E(\mathbf{S}\epsilon_t \epsilon_t' \mathbf{S}')$, where $E(u_t u_t') \equiv \Sigma$. $\Sigma = E(\mathbf{SS}')$ requires $\mathbf{S}$ to be identified as the Cholesky factor of Σ. Since $u_t = \mathbf{S}\epsilon_t$, $\mathbf{S}^{-1} u_t = \epsilon_t$ would yield the latent shocks.

3. Empirical Framework

This section provides the empirical framework that explores the asymmetric effects of monetary policy in the micro-data. I first study the responses of three sets of variables: the number of employees, investment rate and real sales to sign-dependent effects of monetary policy. I then provide robustness checks of the baseline results using various specifications and controls. Last, I test the sign-dependent effects of monetary policy for firms with various financial characteristics and explore the role of alternative financial constraint proxies.

3.1. Micro Estimates on the Asymmetric Effects of Monetary Policy

I first estimate the asymmetric effects of monetary policy shocks using local projection instrumental variable (LP-IV) (Jordà et al., 2015) approach. The estimation closely follows Tenreyro and Thwaites (2016) and Cloyne et al. (2022) specifications:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h} \tag{2}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks following Gertler and Karadi (2015).

The monetary policy shocks instrument the increases (or decreases) in the one-year government bond yields depending on the sign of movements in that particular quarter's one-year Treasury rate. That is, I pin down the increases and decreases in the one-year Treasury rate for each quarter and instrument them with the monetary innovations that occurred in these quarters. This approach applies the sign restriction *only* to the movements of the one-year Treasury rate and not to the monetary policy instruments. The reason is that monetary policy shocks reflect deviations from pre-FOMC meeting expectations of financial markets; hence, its sign is not informative about whether the monetary policy is contractionary or expansionary.[14] For this reason, I only use the sign restriction on the one-year Treasury rate and use the instrument that occurred *on* these dates.

[14] I thank Professor Òscar Jordà for this valuable suggestion.

There are three main dependent variables: number of employees, investment rate and real sales.[15] The dependent variable is defined as the cumulative difference to interpret the parameters as impulse responses. β_h^+ captures the effect of a 25 basis point *increase* in interest rate across different horizons and β_h^- captures the impact of a 25 basis point *decrease* in interest rate across different horizons. The estimation horizon is 20 quarters.

Firm fixed effects, α_j^h, soak up permanent differences across firms and allow me to explore within-firm variation. Standard errors are two-way clustered by firm and quarter (calendar), where serial correlation adjustment is set to 16 quarters using Driscoll and Kraay (1998)'s methodology. This is a standard method to account for serial correlation at the firm level and through time.[16] To prevent the results from being driven by outliers, I trim the sample by 1 percent on both ends based on the investment rate, employment growth and debt-to-equity ratio. I also trim the top 1 percent of the debt-to-asset ratio.[17] Firms with observations less than 20 quarters are dropped as the impulse responses are estimated using at least five years of consecutive data. Lastly, since I test the implications of an aggregate shock on micro-data, the analysis does not suffer from reverse causality, which would imply that firm-level variables affect aggregate shocks.

3.2. Baseline Results

This section presents the impulse responses using specification (2). First, I provide the baseline results of the dependent variables employment, investment rate, and sales, followed by a discussion of the findings. Finally, I compare the firm-level findings to macroeconomic studies using aggregate data sources.

Employment

Figure 1 plots the impulse response of number of employees for a monetary tightening (β_h^+) and monetary easing (β_h^-), respectively. The shaded areas display 90 percent confidence intervals and the policy rate is scaled such that the shock changes the one-year policy rate by 25 basis

[15] Since employment is reported annually in Compustat, I linearly interpolate the within-year movements of the number of employees by firm. In addition, investment estimations use the 1986q1-2019q4 window as Compustat investment in the pre-1986 window is sparsely populated.

[16] See Cloyne et al. (2022) and Bahaj et al. (2020).

[17] See Appendix A for the sample selection procedure.

points on impact. The first column of Figure 1 (Figure 1a) shows that firms lower the number of employees gradually for about two years after a monetary policy tightening. The peak effect is –1.1 percent and occurs about ten quarters after the shock. The tightening effect is significant from quarter 5 to quarter 13. In contrast, Figure 1b shows that a monetary expansion increases employment by a maximum of 0.3 percent and the effect is insignificant across the horizon.

Next, I present a formal asymmetry test for the hypothesis that positive and negative monetary policy shocks have asymmetric effects on firm-level employment. I test the following hypothesis:

$$H_0 : \beta^+ = -\beta^-$$

$$H_1 : \beta^+ \neq -\beta^-$$

using horizon ten estimates as they are the half-life of the dynamic estimation window.[18] The test results reject the null hypothesis that positive and negative monetary policy changes have similar effects on firms' employment ($p = 0.08$). This suggests statistically significant asymmetry in the effects of monetary easings and tightenings on firm-level employment.

A number of papers provide evidence that is consistent with these findings. For example, Garibaldi (1997) shows a monetary tightening easily transmits into higher job destruction, yet expansionary monetary policy produces smaller effects on job creation due to hiring costs and slower job finding rate caused by existing matching frictions in the labor market. This result is also consistent with the downward nominal wage rigidity channel (Abbritti and Fahr, 2013; Jo and Zubairy, 2022). As wages are rigid downward and upward flexible, a monetary tightening produces larger effects on employment than a monetary easing. For example, Jackson and Kurt (2023) show that a 25 bp monetary tightening leads to a 1.1 percent drop in employment, whereas a 25 bp monetary easing leads to a 0.5 percent increase in employment, emphasizing that the effects vary across sectors. Similarly, using Compustat data from 1995 to 2021, Perez-Orive and Timmer (2022) report that a one standard deviation surprise tightening reduces employment by 1.2 percent and a one standard deviation expansionary shock increases

[18] Since the coefficient signs are in opposite directions, this requires the null hypothesis to test the magnitude differences across positive and negative monetary policy using $H_0 : \beta^+ = -\beta^-$. I thank the referees for this valuable suggestion.

employment by 0.3, which also aligns with my estimates.[19]

Investment Rate

This exercise follows Cloyne et al. (2022) and Chaney et al. (2012) and re-estimates specification (2) using investment *rate*, which allows comparisons of investment decisions of firms with different levels of capital. Figure 2 shows that following a 25 basis point monetary tightening, the investment rate has a –0.7 percentage point (pp) peak response occurring 11 quarters after the shock. Investment starts dropping after quarter four and the effect dies off about 14 quarters after the monetary shock. On the other hand, monetary expansions have much weaker (0.3 pp) effects that are not statistically significant across the horizon.

Repeating the asymmetry test using investment rate estimates suggests that the difference in response to a monetary tightening and easing is not statistically significant ($p = 0.20$).[20] There are several factors that could explain the lack of asymmetry in the investment response. First, Lanteri (2018) documents that capital has a firm-level specificity; hence, it may be underpriced when the firms try to sell the used capital in the secondary market during contractionary times. In addition, the demand side may be weaker during bad times; both of these could make discarding capital less profitable. Relatedly, Kermani and Ma (2022), Bertola and Caballero (1994), Pindyck (1990), among others, document high asset specificity being associated with less disinvestment and investment irreversibility. In contrast, labor is relatively less firm-specific, making it easier for firms to adjust following a monetary tightening.

In addition, earlier studies like Elsas et al. (2014) document that Compustat firms finance 67% of their capital expenditures with externally raised funds, which reflects higher leverage patterns and higher presence of financial frictions on investment decisions. As investment requirements exceed the available internal funds, the financial constraints may hinder investment adjustments more than employment adjustments. In contrast, since labor adjustments could be accommodated with internal funds (retained earnings), labor may be easier to adjust at the firm level.

[19] Perez-Orive and Timmer (2022) estimates are broadly consistent with this paper. However, they report both estimates to be insignificant, which is likely a shortcoming of the limited time span of the study.

[20] For reference, impulse responses for alternative investment measures are provided in Online Appendix Figure C.11.

Overall, the dynamics of these responses are consistent with Cloyne et al. (2022) who document a 0.5 pp decrease in investment *rate* between the second and third year after a 25 bp monetary policy shock without any sign-split. Similarly, using Compustat data from 1995-2021 and alternative monetary policy shocks, Perez-Orive and Timmer (2022) find that monetary policy tightenings have stronger effects on *investment*, documenting a 2.8 percent cumulative drop in investment after two years. In contrast, expansionary shocks do not generate a response of investment that is statistically different from 0, which is consistent with this paper as well.

Sales

In addition to employment and investment rate responses, I also present the effects of monetary easings and tightenings on firms' sales. Figure 3 shows that firms experience a decline in sales for about three years following a monetary policy tightening, which is consistent with the employment responses. The peak effect is –2.9 percent, and it occurs about 13 quarters after the shock. The effect is significant from quarter 4 to quarter 16, and sales start to recover about three years after the shock. In contrast, a monetary expansion increases sales by about 1 percent at maximum. Overall, the impact on sales is smaller and less significant for monetary easings than monetary tightenings. In line with the employment results, the sales response to monetary tightenings and easings is also statistically different ($p = 0.05$).[21]

Comparison to the aggregate literature

These firm-level estimates line up with the earlier literature studying sign-dependent monetary policy changes in the aggregate economy. Among these, Angrist et al. (2018) find monetary expansions to be less stimulative on output and inflation, suggesting a -1.7 percent drop in industrial production two years following a 25 bp *increase* in the target funds rate. In contrast, their estimates suggest that the term rates are not as sensitive to monetary easings, resulting in a -0.17 percent (insignificant) decline in industrial production following a negative 25 bp change in the target funds rate. Similarly, Barnichon et al. (2017), using data from 1959 through 2007, find strong evidence of an asymmetric response in unemployment depending on the direction of the monetary change. They estimate that an increase in the federal funds rate of 0.7 pp results

[21] The impulse responses for employment, investment and sales using pooled monetary policy shocks are also provided in Online Appendix Figure B.7.

in an increase in unemployment of 0.15 pp. On the other hand, a 0.7 pp decrease in the federal funds rate produces only a 0.04 pp (insignificant) decrease in unemployment. This implies that monetary tightenings have significantly stronger effects on unemployment than monetary easings, which is also consistent with this paper. While establishing comparisons with aggregate studies is not straightforward due to disparities in data, time spans, and methodologies, Online Appendix D provides a comprehensive comparison of estimates derived from alternative studies, employing both aggregate and micro-data resources.

In the following sections, I (i) confirm the robustness of these results across a range of specifications and (ii) disaggregate the sign-dependent effects across firms with different financial characteristics. This exercise will help disentangle the role of financial frictions within the asymmetric effects of monetary policy.

3.3. Robustness

In this section, I show that the main results on sign-dependent effects of monetary policy are robust to a range of alternative specifications. In particular, I explore if the main findings are robust to (i) adding firm-level and aggregate control variables, (ii) having a more restrictive sample, (iii) sub-sample analysis across sectors, (iv) alternative monetary policy shocks and (v) business cycle effects.

First, I incorporate real asset growth, total debt growth, and log real GDP growth as control variables to the estimation. Firm-level controls help control for differences in cross-sectional characteristics across firms, and aggregate controls help capture the dynamics of the aggregate economy. Control variables are added up to 4 lags. Online Appendix Figure B.2 shows the results that mirror the baseline findings: adding new control variables to the specifications does not change the asymmetric results. Online Appendix Figure B.3 also plots the results that control for the lags of the dependent variable in addition to the above controls. The results are remarkably similar to the baseline findings. I also trim the sample with more restrictive criteria and re-estimate the baseline specification. In addition to the baseline trim, I trim the sample based on firms' sales growth.[22] Online Appendix Figure B.4 shows that the results are very

[22] In particular, I trim the top and bottom 1 percent of sales growth. All the trimming is done by year.

similar to the baseline impulse response functions.

Next, I consider whether my estimates are driven by a particular sector in the sample. To do this, I focus on the two largest sectors in my sample: manufacturing and services. The manufacturing sector comprises 48 percent of the sample and the service sector comprises 18 percent. I also form a third group consisting of companies belonging to all remaining sectors.[23] Online Appendix Table B.2 shows the responses to a sign-dependent monetary policy for manufacturing, service and other sector firms. The estimates show that sign-dependent effects are visible across all major sectors.[24]

Next, I conduct a further robustness check using alternative monetary policy shocks. I use extended Romer and Romer (2004) shocks in Wieland and Yang (2020) to instrument sign-dependent changes in one-year treasury rate. Online Appendix Table B.3 displays the responses at horizon 10 estimates using the new monetary policy shocks. The estimates correctly capture the signs of monetary easing and tightening. However, due to the restricted time span of Romer and Romer (2004) shocks, the estimates do not reveal significant asymmetry.

Next, I consider how these results interact with business cycle dynamics. I do this by modifying the baseline estimation as follows:

$$\begin{aligned} y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \gamma_h^{+,+} \, max[0, \Delta R_t] \Delta GDP_{j,t}^+ + \gamma_h^{+,-} \, max[0, \Delta R_t] \Delta GDP_{j,t}^- \\ + \beta_h^- \, min[0, \Delta R_t] + \gamma_h^{-,+} \, min[0, \Delta R_t] \Delta GDP_{j,t}^+ + \gamma_h^{-,-} \, max[0, \Delta R_t] \Delta GDP_{j,t}^- \\ + \rho_t^+ \Delta GDP_{j,t}^+ + \rho_t^- \Delta GDP_{j,t}^- + \Omega'(L) \, Z_{j,t-1} + \epsilon_{j,t+h}, \end{aligned} \tag{3}$$

where positive and negative monetary shocks interact with changes in GDP occurring on NBER business cycle dates. In this specification, $\gamma_h^{+,+}$ ($\gamma_h^{-,+}$) captures the effect of a monetary tightening (easing) accompanied by positive GDP growth. Similarly, $\gamma_h^{+,-}$ ($\gamma_h^{-,-}$) captures the effect of a monetary tightening (easing) accompanied by negative GDP growth.

Online Appendix Table B.4 shows the responses of the dependent variables using specification (3) where baseline impulse responses of specification (2) are also provided for easy

[23] The largest sectors in the final group consist of construction (7 percent), transportation and communications services (13 percent) and wholesale trade (11 percent).

[24] In terms of statistical testing, the asymmetries in employment, investment and sales are predominantly in the manufacturing sector. However, employment responses in the remaining sectors also show statistically significant asymmetry in responses to monetary tightenings and easings.

comparison of estimates. The table reports very similar baseline effects of monetary tightenings and easings for all variables. The results also show insignificant the business cycle interaction coefficients for employment and investment. Only for sales, the table reports that monetary tightenings may not contract the economy during economic booms ($\gamma^{+,+}$), which may be possible due to strong demand effects during economic booms. The lack of contraction in output could also be associated with expanding fiscal policy in high growth periods (Tenreyro and Thwaites, 2016).[25]

In addition to these dynamics, Online Appendix Table B.5 estimates the role of size-dependency of monetary innovations by splitting the monetary policy changes by size. A large (small) monetary policy shock is a shock that is accompanied by a change in the one-year Treasury rate of more (less) than 0.5 points. Consistent with menu cost models, I find large monetary policy shocks to be neutral because firms find it optimal to adjust nominal prices, whereas *small* shocks generate larger real effects as firms choose not to adjust their prices. Although splitting the shocks by size results in larger standard errors, these results align with Ravn and Sola (2004), who focus on U.S. aggregate data from 1960-1995 and find that only small negative monetary policy shocks have real effects.

Last, Online Table B.6 re-estimates the baseline results by splitting the sample into two subparts: 1980-1998 and 1999-2019. Although this exercise restricts the time-series dimension, the results are comparable to the baseline and show that the later part of the sample reports higher estimates than the earlier part.[26]

3.4. Heterogeneity Analysis

This section examines the heterogeneity of the main findings and explores the role of financial frictions in the context of monetary asymmetries. Assessing the role of financial frictions requires identifying firms that are "financially constrained." Since financial constraints are not directly observable, the empirical macroeconomics literature has used indirect measures as

[25]Using 1969:I–2002:IV sample of shocks, Tenreyro and Thwaites (2016) also attempts to test the sign and cycle asymmetries jointly; however, they report insignificant results due to low precision and lost degrees of freedom.

[26]Similarly, Online Appendix Figure B.6 excludes the zero lower bound period (2008-2013) and reports similar results to the baseline findings.

proxies of financial constraints.[27] This section studies a broad group of these proxies and tests whether firms with these characteristics show larger sensitivity to sign-dependent effects of monetary policy.

I study the role of firm heterogeneity by interacting positive and negative monetary policy shocks with firm characteristics in a semi-parametric way as in Cloyne et al. (2022). The specification is characterised as follows:

$$\Delta y_{j,t+h} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+}\, max[0, \Delta R_t]\; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-}\, min[0, \Delta R_t]\; I[N_{j,t-1} \in g] + \epsilon_{j,t+h} \tag{4}$$

where $\Delta y_{j,t+h} = y_{j,t+h} - y_{j,t-1}$ is the change in the independent variable between the end of quarter t+h and the end of quarter t-1. Horizon is h = 0, 1,..., H, τ is linear time trend, α_j^h is firm-level fixed effects, and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. I is an indicator function that takes a value of 1 if the firm falls in a particular group g in the period preceding the monetary policy shock. β_g^+ and β_g^- capture the responses of firms in a particular group g. The benefit of this approach is that it does not impose the restrictive assumption of linearity and generates separate slopes for different groups (Cloyne et al., 2022). It also allows to work with finer groups with multiple characteristics.

Firm size

Earlier contributions in Bernanke et al. (1996), Oliner and Rudebusch (1996) and Gertler and Gilchrist (1994) propose firm size as a proxy for access to credit markets. According to the financial accelerator literature, the effects of changes in the financial conditions of firms close to the margin would be much larger than the firms above the standard requirements, i.e., less constrained. Table 1 Panel A estimates specification (4) and shows the dynamic responses of firm-level employment to monetary policy for small and large firms. The small versus large binning is done using terciles of real asset distribution by year. Specifically, small firms have the lowest tercile of the real asset distribution by year, and large firms have the highest tercile of the real asset distribution by year.

[27] See Cloyne et al. (2022) for a discussion of these alternative proxies in the literature.

Comparing the responses in Table 1 Panel A suggests that small firms reduce employment by about 1.4 percent ten quarters after a monetary tightening. In contrast, employment of large firms drops only by 0.65 percent. The difference between small and large firms' responses to monetary tightenings is statistically significant ($p = 0.05$).[28] On the other hand, the results comparing monetary expansions suggest that large and small firms respond to monetary expansions with comparable magnitudes ($p = 0.55$). These results corroborate the financial accelerator view: following a monetary tightening *small* firms show greater downturns than large firms.

Next, Table 1 Panel B shows the impulse responses of investment rate to monetary policy shocks across small and large firms. Investment rate drops by 0.79 (0.55) pp for small (large) firms ten quarters following a 25 bps monetary tightening. Unlike employment, the difference between the groups is not significant for monetary tightenings ($p = 0.28$), which may again be related to the firm-specific nature of capital and investment irreversibility discussed in the baseline results.[29]

Similarly, Table 1 Panel C shows the sales responses for small and large firms. Similar to investment, both small and large firms' sales drop at comparable magnitudes after monetary tightening, with no significant difference across groups.[30] This suggests that despite the heterogeneity captured in firm inputs, various other factors such as demand conditions, product prices and market structure may also be relevant to understand sales effects.

Dividend

Following Fazzari et al. (1988), Farre-Mensa and Ljungqvist (2016) and Cloyne et al. (2022), I also test the role of firms' dividend issuance via specification (4). In the face of negative shocks, dividend-paying firms can reduce the payouts, whereas the non-dividend payers would likely require external finance and be subject to a larger wedge between internal and external funding costs (Cloyne et al., 2022). To test this, I divide the firms into two groups: firms that do not pay dividends and firms that do. Table 2 Panel A shows that the firms that do not pay

[28] Furthermore, testing $H_0 : \beta^+ + \beta^- = 0$ suggests that asymmetry is only significant for employment of small firms ($p = 0.04$).

[29] The differences across groups for monetary easings are also not significant ($p = 0.90$).

[30] The difference across groups for monetary easings is also not significant ($p = 0.45$).

dividends have a near 1.9 percent drop in employment ten quarters following a 25 bp monetary tightening. In contrast, the response to a monetary tightening is around -1 percent for firms that pay positive dividends. The responses of the two groups are statistically different, supporting the financial accelerator view with dividend payments serving as an indicator of firms' financial conditions.[31]

Similar to employment, the investment results in Table 2 Panel B show that the investment rate of non-dividend payer firms drops by 0.74 pp in response to a monetary tightening. In contrast, the positive dividend-payer firms have a 0.54 pp drop following a monetary tightening. This is broadly consistent with Cloyne et al. (2022) and Fazzari et al. (1988), who similarly find that the investment of non-dividend payers are more sensitive than high-dividend payers. However, the splitting of monetary policy shocks shows that this difference is not as pronounced in investment as in employment and is statistically insignificant.[32] Similar to investment, sales results also point to no significant asymmetry depending on the dividend payments of firms ($p = 0.64$), which once again may be attributed to various factors such as firms' pricing behavior, demand sensitivity and market structure.

Leverage

Monetary policy can also generate heterogeneous effects depending on a firm's leverage. Table 3 estimates specification (4) using leverage groups where firms are separated into high versus low leverage groups using top and bottom tercile of leverage distribution by year. Specifically, high leverage firms have the highest tercile of leverage distribution and low leverage firms have the lowest tercile of leverage distribution by year. Table 3 Panel A shows that firms with low leverage experience a 1.4 percent drop in employment ten quarters after a monetary tightening. This effect is 0.8 percent for firms with high leverage, yet the difference in the response of the two groups is not statistically significant ($p = 0.24$). The employment responses to a monetary expansion are also not significantly different across alternative leverage groups ($p = 0.30$).

Similar to employment, investment and sales responses reveal slightly larger responses for low-leverage firms. However, no significant heterogeneity is found based on firms' leverage

[31] The increase in employment in response to monetary policy easing is also higher for non-dividend payer firms. However, this difference is not statistically significant ($p = 0.37$).

[32] The p-value is 0.35 for monetary tightenings and 0.83 for monetary easings.

conditions.[33] These results are broadly consistent with Ottonello and Winberry (2020) who explores the interaction of sign-dependent monetary policy shocks with leverage dynamics and finds that *low* leverage firms respond more to monetary expansions. Although the results agree on the direction of the heterogeneity, analyzing investment *rate* over a longer time span yields insignificant estimates.[34]

These findings suggest that leverage, as a financial contraint proxy, does not reveal significant heterogeneity in the responses to monetary tightenings or easings. This result is not surprising compared to the existing literature on leverage dynamics. For example, Ozdagli (2018) shows that the median leverage of financially *constrained* firms is less than half of financially unconstrained firms.[35] Similarly, in Online Appendix Figure C.8, I plot the share of credit ratings for firms in alternative leverage quartiles in Compustat.[36] These summary statistics show that firms with the lowest debt rates have a higher share of low credit rating firms, which aligns with earlier discussions on the endogenous nature of leverage (Hadlock and Pierce, 2010; Cloyne et al., 2022).

Liquidity

Following Kashyap et al. (1994) and Jeenas (2019), I also analyze the responses of firms with different levels of cash holdings. High (low) liquidity firms have the highest (lowest) tercile of liquidity distribution by year. According to Table 4, only low liquidity firms reveal significant contractions in employment and investment. These findings are broadly consistent with Jeenas (2019) who shows that low cash holdings predict a stronger contraction of capital and Bates

[33] I test the difference between high and low-leverage firms' responses to monetary tightenings and find p-values of 0.45 and 0.61 for investment and sales, respectively. Similarly, I find no significant difference in high and low-leverage firms' investment responses to monetary easings ($p = 0.61$). I only find that low-leverage firms experience larger *sales* increases following monetary easings ($p = 0.06$). Since there are no significant differences in the firms' factors of production, I attribute this particular finding to various other factors affecting sales, such as firms' pricing behavior, market structure the firm operates in, etc.

[34] Ottonello and Winberry (2020) also note that since they focus on a limited time-series (1990-2007), they have very few shocks in their sample, yielding large standard errors.

[35] In addition, Lakdawala and Moreland (2021) analyzes the financial crisis of 2007-2009 and finds that the investment of firms with high leverage was less responsive to monetary policy shocks in the pre-crisis period but has become more responsive since the crisis. This further highlights the endogenous nature of leverage. On the other hand, recent work by Ippolito et al. (2017) studies the floating rate channel and finds that firms that use more bank debt and do not hedge against it display a stronger sensitivity of their stock price, cash holdings, sales, inventory and fixed capital investment to monetary policy. Unfortunately, Compustat data does not provide information on floating vs fixed-rate debt, making it unsuitable to test this particular leverage channel.

[36] High-rating firms hold ratings $A+$, A , $A-$, $B+$ or B. Low-rating firms hold ratings $B-$, C or D. This is a small sample exercise, as credit ratings observations are only available for half of the Compustat sample.

et al. (2009) who document that firms with high cash holdings hedge against future borrowing constraints hence may be financially less constrained. However, the statistical test between low and high liquidity firms suggests that the responses to *sign-dependent* monetary policy shocks are not statistically significant for all three dependent variables.

These findings are consistent with Hadlock and Pierce (2010) and Cloyne et al. (2022), who discuss endogeneity issues regarding using liquidity as a proxy for financial conditions. To understand the relation between liquidity and financial well-being in the Compustat sample, Online Appendix Table C.9 plots the share of high vs low-credit rating firms together with liquidity quartiles.[37] The table shows that 50% of high liquidity firms are low credit rating firms, which may be due to low rating firms choosing to stay more liquid due to tighter borrowing constraints they face. Although this is a limited sample size evidence, the summary statistics support the earlier findings that liquidity as a proxy of financial constraints may suffer from endogeneity.

Credit Ratings

I also test sign-dependent effects on firms with high vs low credit rating groups. The sample size in this estimation is about half of the previous estimates due to missing observations in Compustat credit ratings. High-rating firms hold ratings $A+, A$, $A-$, $B+$ or B. Low-rating firms hold ratings $B-$, C or D.[38] Table 5 shows that employment of firms with *low* credit ratings respond significantly more to monetary tightenings than high credit rating firms ($p = 0.03$).[39] The effects on investment rate and sales are also statistically significant, with p-values of 0.05 and 0.02, respectively.[40] This suggests firms with more severe financial constraints respond more to monetary tightenings, which is consistent with the financial accelerator framework. These results are also consistent with Perez-Orive and Timmer (2023), which looks at firms' *distance to default* and finds a 1.8 percent drop in employment of distressed firms in response to one standard deviation tightening shock. In addition, Perez-Orive and Timmer (2023) finds

[37] High-rating firms hold ratings $A+, A$, $A-$, $B+$ or B. Low-rating firms hold ratings $B-$, C or D. This is a small sample exercise, as credit ratings observations are only available for half of the Compustat sample.

[38] This split yields 36% of the sample as high credit rating and 64% of the sample as low credit rating firms.

[39] The response to monetary easings is similar across groups with a p-value of 0.17.

[40] Similarly, sales response suggests that *low* rating firms experience a significantly larger increase in sales following a monetary easing ($p = 0.06$). The investment response to monetary easings is also similar across different credit rating groups.

one standard deviation tightening shock generates a 3.7 percent drop in *investment* of financially distressed firms one year after the shock. In contrast, they report that the capital stock of healthy firms is statistically insignificant, which is consistent with my findings using *credit ratings* as well.

Firm Age

Last, firms earlier in their life cycle may also be more likely to face financial constraints, as they lack stable cash flow and strong credit ratings (Haltiwanger et al., 2013; Davis and Haltiwanger, 2019), and are subject to a higher degree of idiosyncratic risk (Gertler and Gilchrist, 1994). Table 6 presents the responses of young and old firms where young (old) firms are defined as firms with less (more) than 20 years since incorporation.[41]

Table 6 documents that employment of *young* firms drops more significantly than old firms following a monetary tightening ($p = 0.06$). This result is coherent with Cloyne et al. (2022), who shows that young firms are more sensitive to monetary policy as they are more likely to face financial constraints early in their life cycle. On investment, Table 6 Panel B also documents larger drops in the investment of young firms. However, this difference is not statistically significant ($p = 0.20$), which may be a shortcoming of the age sample size.[42] Similar to investment, sales results, shown in Panel C, are also statistically insignificant ($p = 0.57$), which once again may be attributed to various other demand and market-related factors affecting firm sales. The responses to monetary easings across different age groups are also not significantly different for all dependent variables.

Overall, these results document larger *employment* responses to monetary tightenings for small, non-dividend payer, low credit ratings and young firms. I also show that investment and sales of low credit rating firms contract significantly more than high credit rating firms in response to a monetary tightening. These findings suggest that much of the earlier evidence on heterogeneity aligns more with monetary tightenings than easings. Furthermore, the results

[41] The age variable is constructed using CRSP and Jay Ritter databases. See further details on data sources in Appendix A.

[42] The age variable in Cloyne et al. (2022) is constructed using Worldscope, Jay Ritter and Center for Research in Security Prices (CRSP) databases. This paper only has access to the CRSP and Jay Ritter database, which results in a smaller sample size than Cloyne et al. (2022) age variable. The differences in the *age* sample size may account for the difference between these results and Cloyne et al. (2022).

show no heterogeneity based on firms' leverage and liquidity conditions, suggesting that leverage and liquidity dynamics may not be straightforward proxies of firms' financial conditions. The heterogeneity along size, age, dividend and credit rating dimensions can be reconciled with the financial accelerator channel.[43]

4. Conclusion

This paper documents how exogenous monetary policy shocks generate strong asymmetric effects using detailed firm-level data. Specifically, I study firm-level employment, investment and sales responses to monetary policy changes, allowing the effects to vary based on the sign of monetary policy.

The main results of this paper are summarized as follows. First, monetary policy shocks generate fairly asymmetric effects on the firms depending on the direction of the monetary action. In particular, I show that positive monetary policy shocks are more effective than negative monetary innovations on firms' employment and sales. These results are consistent with the downward nominal wage rigidity channel and the literature highlighting matching frictions in the labor market. In addition, the investment rate shows less pronounced and insignificant asymmetry in response to sign-dependent monetary policy shocks. I interpret this in the context of the firm-specificity of capital and investment irreversibility.

Second, I trace alternative proxies on financial frictions and find considerable heterogeneity in firms' responses to sign-dependent monetary innovations. My results confirm significant heterogeneity using firm size, dividend status, credit ratings and age, corroborating earlier works on financial constraints. In contrast, I found no heterogeneity based on firms' leverage and liquidity conditions, suggesting that leverage and liquidity dynamics may not be straightforward proxies of financial conditions. I also document that most of these amplifications are seen in employment responses to monetary tightenings, which is once again consistent with less flexible investment dynamics of firms.

The results of this paper are particularly important for two reasons. First, this study provides a comprehensive analysis of the asymmetric effects of monetary policy within firm-level data in

[43] In addition to single group analyses, Online Appendix Section C discusses heterogeneity results exploring firm groups jointly.

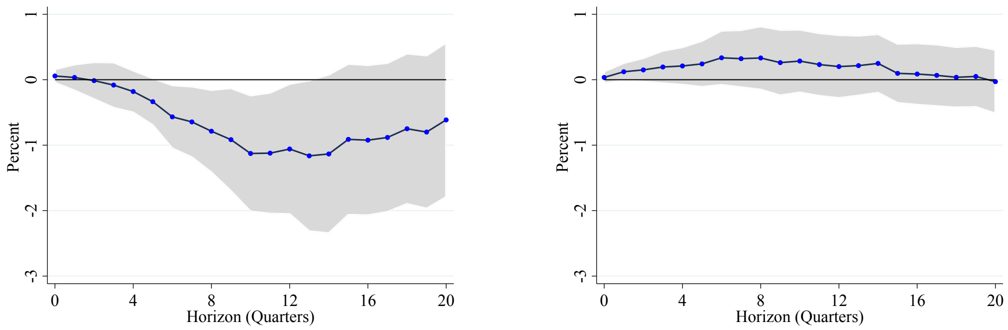
the US. This is quite different than the earlier approaches adopted in the monetary transmission literature that mainly use aggregate data to test monetary asymmetries. Second, the results highlight the role of firm heterogeneity on monetary asymmetries, which may be an important input for future modeling efforts. Overall, these findings provide a practical rule of thumb and contribute to our understanding of the scope of monetary policy when asymmetric effects are present.

5. Figures

5.1. Main Results

Figure 1: ASYMMETRIC EFFECTS OF MONETARY POLICY ON LOG EMPLOYEES

(a) Monetary Tightening (β_h^+) (b) Monetary Easing (β_h^-)



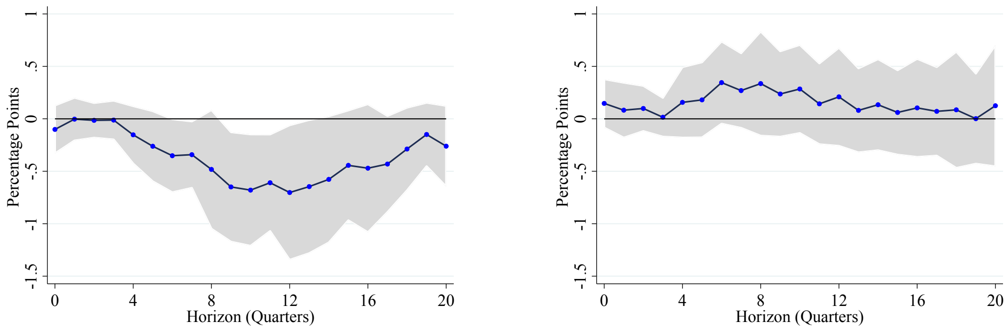
Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks following Gertler and Karadi (2015). The shaded areas show 90 percent confidence intervals.

Figure 2: ASYMMETRIC EFFECTS OF MONETARY POLICY ON INVESTMENT RATE

(a) Monetary Tightening (β_h^+) (b) Monetary Easing (β_h^-)



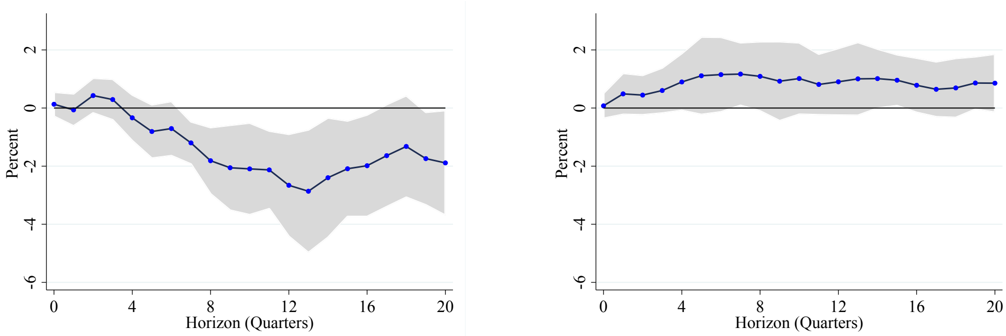
Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks following Gertler and Karadi (2015). The shaded areas show 90 percent confidence intervals.

Figure 3: ASYMMETRIC EFFECTS OF MONETARY POLICY ON LOG REAL SALES

(a) Monetary Tightening (β_h^+) (b) Monetary Easing (β_h^-)



Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks following Gertler and Karadi (2015). The shaded areas show 90 percent confidence intervals.

6. Tables

Table 1: ASYMMETRIC EFFECTS OF MONETARY POLICY BY SIZE

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small size	β^+	0.06	-0.20	-1.17***	-1.39**	-1.15**	-0.90
		(-0.05, 0.16)	(-0.66 , 0.26)	(-1.85 , -0.48)	(-2.32 , -0.46)	(-2.10 , -0.21)	(-1.89 , 0.09)
	β^-	0.05	0.14	0.40	0.13	-0.03	-0.23
		(-0.03, 0.13)	(-0.20 , 0.48)	(-0.09 , 0.90)	(-0.34 , 0.60)	(-0.53 , 0.46)	(-0.86 , 0.41)
Large size	β^+	0.08	0.02	-0.27	-0.65	-0.75	-0.70
		(-0.03, 0.19)	(-0.23 , 0.27)	(-0.72 , 0.19)	(-1.31 , 0.00)	(-1.60 , 0.10)	(-1.46 , 0.06)
	β^-	-0.02	0.18	0.23	0.33	0.39	0.34
		(-0.13, 0.10)	(-0.08 , 0.45)	(-0.24 , 0.70)	(-0.21 , 0.87)	(-0.18 , 0.95)	(-0.21 , 0.89)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small size	β^+	-0.02	-0.06	-0.35	-0.79**	-0.56	-0.25
		(-0.24, 0.21)	(-0.39 , 0.28)	(-1.02 , 0.33)	(-1.44 , -0.15)	(-1.20 , 0.09)	(-0.84 , 0.34)
	β^-	0.04	-0.01	0.21	0.31	0.00	-0.10
		(-0.22, 0.30)	(-0.63 , 0.61)	(-0.57 , 0.99)	(-0.23 , 0.86)	(-0.62 , 0.62)	(-0.73 , 0.53)
Large size	β^+	-0.14	-0.14	-0.45	-0.55**	-0.65*	-0.57
		(-0.46, 0.18)	(-0.48 , 0.20)	(-0.95 , 0.04)	(-0.99 , -0.12)	(-1.22 , -0.08)	(-1.22 , 0.09)
	β^-	0.18	0.23	0.42*	0.33	0.35	0.31
		(-0.07, 0.44)	(-0.06 , 0.52)	(0.05 , 0.80)	(-0.02 , 0.69)	(-0.08 , 0.78)	(-0.07 , 0.69)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small size	β^+	0.44	0.20	-1.09	-1.56**	-1.57	-0.44
		(-0.11, 0.99)	(-0.89 , 1.29)	(-2.20 , 0.02)	(-2.82 , -0.30)	(-3.35 , 0.21)	(-2.26 , 1.39)
	β^-	0.03	0.65	0.73	0.65	0.13	0.30
		(-0.56, 0.62)	(-0.25 , 1.55)	(-0.20 , 1.65)	(-0.36 , 1.65)	(-0.78 , 1.05)	(-0.38 , 0.97)
Large size	β^+	-0.09	-0.75	-2.22**	-2.29*	-3.61***	-2.89***
		(-0.63, 0.45)	(-1.71 , 0.22)	(-3.66 , -0.78)	(-4.34 , -0.25)	(-5.67 , -1.55)	(-4.55 , -1.22)
	β^-	-0.02	0.89	1.26	1.23	1.45	1.16
		(-0.51, 0.47)	(-0.21 , 1.99)	(-0.25 , 2.78)	(-0.48 , 2.93)	(-0.20 , 3.10)	(-0.34 , 2.67)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. The small versus large binning is done using terciles of real asset distribution by year. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^+ \, max[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^- \, min[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 2: ASYMMETRIC EFFECTS OF MONETARY POLICY BY DIVIDEND STATUS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Non-dividend	β^+	0.09	-0.14	-1.30*	-1.89**	-1.83*	-1.72
payer		(-0.04, 0.22)	(-0.73 , 0.45)	(-2.42 , -0.18)	(-3.41 , -0.36)	(-3.56 , -0.10)	(-3.55 , 0.10)
	β^-	0.05	0.39	0.80	0.53	0.33	-0.05
		(-0.15, 0.24)	(-0.16 , 0.93)	(-0.13 , 1.73)	(-0.45 , 1.50)	(-0.61 , 1.27)	(-1.05 , 0.95)
Positive div	β^+	0.09*	-0.26	-0.68*	-0.97*	-0.99*	-0.73
		(0.00, 0.18)	(-0.54 , 0.02)	(-1.31 , -0.05)	(-1.82 , -0.12)	(-1.91 , -0.08)	(-1.64 , 0.17)
	β^-	-0.07	0.27	0.24	0.21	0.21	-0.06
		(-0.21, 0.06)	(-0.07 , 0.61)	(-0.38 , 0.86)	(-0.52 , 0.94)	(-0.57 , 0.99)	(-0.89 , 0.77)

Panel B. Investment

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Non-dividend	β^+	-0.07	-0.15	-0.53	-0.74*	-0.76*	-0.50
payer		(-0.27, 0.14)	(-0.47 , 0.18)	(-1.18 , 0.13)	(-1.38 , -0.11)	(-1.52 , -0.00)	(-1.18 , 0.19)
	β^-	0.15	0.14	0.34	0.26	0.16	0.06
		(-0.09, 0.39)	(-0.29 , 0.58)	(-0.26 , 0.94)	(-0.24 , 0.76)	(-0.38 , 0.71)	(-0.48 , 0.61)
Positive div	β^+	-0.14	-0.13	-0.35	-0.54**	-0.55*	-0.38
		(-0.42, 0.13)	(-0.45 , 0.18)	(-0.79 , 0.09)	(-0.93 , -0.15)	(-1.03 , -0.06)	(-0.92 , 0.16)
	β^-	0.11	0.15	0.28	0.30	0.26	0.17
		(-0.13, 0.35)	(-0.11 , 0.42)	(-0.07 , 0.63)	(-0.00 , 0.60)	(-0.13 , 0.65)	(-0.19 , 0.52)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Non-dividend	β^+	0.12	-0.46	-2.18*	-2.95**	-3.13*	-2.56
payer		(-0.83, 1.07)	(-1.71 , 0.79)	(-4.18 , -0.19)	(-5.07 , -0.82)	(-6.08 , -0.18)	(-5.57 , 0.44)
	β^-	0.38	2.05*	2.41**	1.99*	1.69*	1.17
		(-0.78, 1.54)	(0.32 , 3.77)	(0.73 , 4.08)	(0.20 , 3.77)	(0.20 , 3.17)	(-0.44 , 2.77)
Positive div	β^+	0.65	-0.51	-2.07*	-2.67**	-3.02*	-2.10
		(-0.10, 1.39)	(-1.63 , 0.61)	(-4.00 , -0.13)	(-4.69 , -0.65)	(-5.75 , -0.29)	(-4.54 , 0.35)
	β^-	-0.74**	0.49	1.28	1.21	0.97	0.64
		(-1.36, -0.13)	(-0.73 , 1.71)	(-0.53 , 3.09)	(-0.74 , 3.17)	(-1.03 , 2.97)	(-1.27 , 2.55)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Firms are divided into two groups: firms that do not pay dividends and firms that do. Each panel is estimated separately. The confidence intervals are provided in parentheses. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+} \, max[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-} \, min[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3: ASYMMETRIC EFFECTS OF MONETARY POLICY BY LEVERAGE

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low leverage	β^+	0.09	-0.22	-0.91**	-1.37**	-1.18*	-1.07
		(-0.05, 0.23)	(-0.67 , 0.22)	(-1.56 , -0.26)	(-2.37 , -0.38)	(-2.27 , -0.09)	(-2.35 , 0.22)
	β^-	0.05	0.33	0.48	0.45	0.07	-0.06
		(-0.07, 0.18)	(-0.03 , 0.68)	(-0.17 , 1.13)	(-0.19 , 1.09)	(-0.54 , 0.67)	(-0.76 , 0.63)
High leverage	β^+	0.02	-0.18	-0.49	-0.84	-0.76	-0.61
		(-0.07, 0.11)	(-0.56 , 0.20)	(-1.30 , 0.31)	(-1.68 , 0.00)	(-1.72 , 0.19)	(-1.67 , 0.45)
	β^-	0.03	0.11	0.18	0.17	0.21	0.05
		(-0.05, 0.10)	(-0.14 , 0.36)	(-0.23 , 0.58)	(-0.23 , 0.57)	(-0.24 , 0.67)	(-0.39 , 0.48)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low leverage	β^+	0.06	-0.05	-0.40	-0.73*	-0.73	-0.50
		(-0.20, 0.33)	(-0.42 , 0.33)	(-1.16 , 0.36)	(-1.45 , -0.01)	(-1.58 , 0.11)	(-1.25 , 0.25)
	β^-	0.10	0.25	0.40	0.32	0.20	0.17
		(-0.21, 0.41)	(-0.25 , 0.75)	(-0.25 , 1.06)	(-0.25 , 0.89)	(-0.42 , 0.81)	(-0.46 , 0.79)
High leverage	β^+	-0.06	-0.07	-0.39	-0.55*	-0.61	-0.36
		(-0.32, 0.21)	(-0.34 , 0.19)	(-0.89 , 0.10)	(-1.07 , -0.02)	(-1.23 , 0.00)	(-0.87 , 0.16)
	β^-	0.12	0.05	0.25	0.21	0.17	-0.00
		(-0.12, 0.35)	(-0.21 , 0.32)	(-0.14 , 0.63)	(-0.10 , 0.51)	(-0.16 , 0.50)	(-0.33 , 0.33)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low leverage	β^+	0.29	0.29	-1.16*	-2.08***	-1.74	-1.29
		(-0.53, 1.10)	(-0.91 , 1.49)	(-2.29 , -0.03)	(-3.38 , -0.78)	(-3.64 , 0.16)	(-3.25 , 0.67)
	β^-	0.29	1.48*	1.64*	1.46*	0.84	1.02
		(-0.48, 1.07)	(0.07 , 2.89)	(0.19 , 3.08)	(0.09 , 2.83)	(-0.24 , 1.93)	(-0.00 , 2.04)
High leverage	β^+	0.16	-0.36	-1.64**	-1.66	-2.66***	-2.05**
		(-0.21, 0.52)	(-1.08 , 0.37)	(-2.75 , -0.54)	(-3.44 , 0.12)	(-4.17 , -1.15)	(-3.55 , -0.55)
	β^-	-0.01	0.48	0.64	0.45	0.70	0.61
		(-0.40, 0.38)	(-0.37 , 1.33)	(-0.41 , 1.69)	(-0.66 , 1.56)	(-0.53 , 1.93)	(-0.51 , 1.73)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. High (low) leverage firms have the highest (lowest) tercile of leverage distribution by year. The confidence intervals are provided in parentheses. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+} \, max[0, \Delta R_t] \, I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-} \, min[0, \Delta R_t] \, I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: ASYMMETRIC EFFECTS OF MONETARY POLICY BY LIQUIDITY

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low liquidity	β^+	0.02	-0.30**	-0.83***	-1.04***	-0.99**	-0.53
		(-0.07, 0.11)	(-0.55 , -0.05)	(-1.33 , -0.33)	(-1.69 , -0.39)	(-1.73 , -0.24)	(-1.29 , 0.23)
	β^-	0.01	0.16	0.24	0.24	0.23	0.04
		(-0.05, 0.08)	(-0.04 , 0.37)	(-0.11 , 0.59)	(-0.14 , 0.61)	(-0.15 , 0.62)	(-0.30 , 0.39)
High liquidity	β^+	0.12	0.06	-0.63	-1.10	-1.05	-1.00
		(-0.04, 0.28)	(-0.48 , 0.60)	(-1.39 , 0.12)	(-2.23 , 0.03)	(-2.36 , 0.26)	(-2.44 , 0.44)
	β^-	0.05	0.10	0.13	-0.00	-0.18	-0.35
		(-0.10, 0.20)	(-0.32 , 0.52)	(-0.59 , 0.85)	(-0.71 , 0.71)	(-0.88 , 0.52)	(-1.20 , 0.51)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low liquidity	β^+	-0.01	-0.04	-0.33	-0.43**	-0.36	-0.24
		(-0.21, 0.18)	(-0.24 , 0.16)	(-0.68 , 0.02)	(-0.78 , -0.09)	(-0.73 , 0.02)	(-0.65 , 0.18)
	β^-	0.05	0.04	0.20	0.13	0.01	-0.01
		(-0.15, 0.24)	(-0.15 , 0.23)	(-0.08 , 0.48)	(-0.09 , 0.36)	(-0.26 , 0.27)	(-0.25 , 0.22)
High liquidity	β^+	-0.07	-0.19	-0.46	-0.79	-0.91	-0.63
		(-0.35, 0.22)	(-0.64 , 0.26)	(-1.34 , 0.42)	(-1.61 , 0.03)	(-1.85 , 0.04)	(-1.38 , 0.13)
	β^-	0.18	0.32	0.49	0.38	0.38	0.28
		(-0.10, 0.47)	(-0.26 , 0.89)	(-0.30 , 1.29)	(-0.26 , 1.03)	(-0.35 , 1.12)	(-0.40 , 0.95)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low liquidity	β^+	0.06	-0.54	-1.96***	-1.82*	-2.66***	-1.97**
		(-0.42, 0.53)	(-1.21 , 0.14)	(-3.06 , -0.85)	(-3.55 , -0.09)	(-4.14 , -1.18)	(-3.36 , -0.58)
	β^-	-0.07	0.42	0.62	0.55	0.65	0.46
		(-0.49, 0.36)	(-0.37 , 1.20)	(-0.45 , 1.68)	(-0.56 , 1.67)	(-0.50 , 1.80)	(-0.51 , 1.43)
High liquidity	β^+	0.30	0.44	-1.18	-1.84*	-2.01*	-1.19
		(-0.46, 1.06)	(-0.91 , 1.79)	(-2.44 , 0.09)	(-3.39 , -0.28)	(-4.02 , -0.00)	(-3.24 , 0.86)
	β^-	0.38	1.72*	1.42	1.09	0.79	0.61
		(-0.52, 1.28)	(0.13 , 3.30)	(-0.05 , 2.90)	(-0.36 , 2.55)	(-0.24 , 1.82)	(-0.45 , 1.67)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. High (low) liquidity firms have the highest (lowest) tercile of liquidity distribution by year. The confidence intervals are provided in parentheses. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+} \, max[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-} \, min[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: ASYMMETRIC EFFECTS OF MONETARY POLICY BY CREDIT RATINGS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low rating	β^+	0.09	-0.31	-1.70**	-2.52**	-2.65**	-2.67**
		(-0.06, 0.25)	(-0.90 , 0.28)	(-2.91 , -0.48)	(-4.25 , -0.80)	(-4.61 , -0.70)	(-4.74 , -0.61)
	β^-	0.08	0.45	0.79	0.62	0.63	0.41
		(-0.11, 0.27)	(-0.05 , 0.94)	(-0.13 , 1.71)	(-0.30 , 1.55)	(-0.31 , 1.57)	(-0.50 , 1.33)
High rating	β^+	0.05	-0.15	-0.53	-0.76	-0.91	-0.65
		(-0.04, 0.15)	(-0.44 , 0.14)	(-1.19 , 0.13)	(-1.53 , 0.02)	(-1.95 , 0.12)	(-1.75 , 0.46)
	β^-	-0.01	0.17	0.11	0.08	0.09	-0.02
		(-0.14, 0.11)	(-0.15 , 0.50)	(-0.46 , 0.68)	(-0.55 , 0.72)	(-0.56 , 0.74)	(-0.77 , 0.74)

Panel B. Investment

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low rating	β^+	-0.08	-0.01	-0.58	-0.84*	-0.92*	-0.59
		(-0.33, 0.17)	(-0.36 , 0.34)	(-1.34 , 0.18)	(-1.60 , -0.07)	(-1.79 , -0.05)	(-1.40 , 0.23)
	β^-	0.23*	0.20	0.45	0.34	0.23	0.09
		(0.01, 0.44)	(-0.26 , 0.66)	(-0.17 , 1.07)	(-0.23 , 0.91)	(-0.33 , 0.80)	(-0.47 , 0.65)
High rating	β^+	-0.05	-0.07	-0.45	-0.47	-0.62	-0.50
		(-0.27, 0.17)	(-0.42 , 0.28)	(-0.94 , 0.05)	(-0.98 , 0.03)	(-1.25 , 0.01)	(-1.16 , 0.16)
	β^-	0.06	0.15	0.32	0.21	0.24	0.17
		(-0.20, 0.33)	(-0.12 , 0.42)	(-0.10 , 0.74)	(-0.22 , 0.65)	(-0.21 , 0.69)	(-0.30 , 0.63)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Low rating	β^+	-0.25	-0.70	-2.96**	-3.84***	-4.29**	-3.86**
		(-1.26, 0.76)	(-2.07 , 0.66)	(-5.02 , -0.91)	(-6.11 , -1.56)	(-7.46 , -1.13)	(-7.00 , -0.72)
	β^-	0.66	2.33**	2.73**	2.30**	2.12**	1.76*
		(-0.38, 1.69)	(0.67 , 4.00)	(0.73 , 4.73)	(0.42 , 4.18)	(0.43 , 3.81)	(0.22 , 3.30)
High rating	β^+	0.07	-0.68	-2.08***	-2.18**	-3.07***	-2.31***
		(-0.29, 0.43)	(-1.40 , 0.04)	(-3.36 , -0.80)	(-3.89 , -0.47)	(-4.81 , -1.34)	(-3.69 , -0.93)
	β^-	-0.05	0.92*	0.97	0.78	1.02	0.75
		(-0.42, 0.33)	(0.07 , 1.77)	(-0.11 , 2.05)	(-0.52 , 2.09)	(-0.05 , 2.08)	(-0.24 , 1.74)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. High credit ratings cover firms with rating $A+, A$, $A-$, $B+$ and B, and low credit ratings cover firms with ratings $B-$, C and D. Each panel is estimated separately. The confidence intervals are provided in parentheses. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+} \, max[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-} \, min[0, \Delta R_t] \; I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: ASYMMETRIC EFFECTS OF MONETARY POLICY BY FIRM AGE

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Young firms	β^+	0.05	-0.31	-1.75**	-2.91**	-3.19**	-3.18**
		(-0.29, 0.40)	(-1.24 , 0.63)	(-3.21 , -0.29)	(-4.87 , -0.94)	(-5.59 , -0.80)	(-5.67 , -0.70)
	β^-	0.08	0.25	0.36	0.21	-0.02	-0.33
		(-0.19, 0.36)	(-0.60 , 1.09)	(-1.14 , 1.86)	(-1.29 , 1.71)	(-1.58 , 1.54)	(-2.07 , 1.41)
Old firms	β^+	0.11	-0.41	-1.29*	-1.71**	-1.88*	-1.47
		(-0.09, 0.30)	(-0.95 , 0.14)	(-2.48 , -0.09)	(-3.05 , -0.37)	(-3.70 , -0.07)	(-3.06 , 0.11)
	β^-	-0.08	0.38	0.44	0.31	-0.02	0.10
		(-0.38, 0.23)	(-0.28 , 1.04)	(-0.83 , 1.72)	(-1.06 , 1.67)	(-1.50 , 1.45)	(-1.39 , 1.59)

Panel B. Investment

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Young firms	β^+	-0.10	-0.08	-0.65	-0.79*	-0.94	-0.74
		(-0.33, 0.13)	(-0.59 , 0.43)	(-1.58 , 0.29)	(-1.56 , -0.02)	(-1.95 , 0.08)	(-1.58 , 0.09)
	β^-	0.10	0.04	0.20	0.01	-0.02	-0.10
		(-0.27, 0.46)	(-0.57 , 0.65)	(-0.55 , 0.95)	(-0.67 , 0.70)	(-0.63 , 0.59)	(-0.66 , 0.46)
Old firms	β^+	-0.00	-0.19	-0.45*	-0.43*	-0.62	-0.67*
		(-0.16, 0.15)	(-0.44 , 0.06)	(-0.90 , -0.01)	(-0.81 , -0.04)	(-1.26 , 0.01)	(-1.28 , -0.05)
	β^-	-0.00	0.11	0.36	0.09	0.17	0.21
		(-0.19, 0.19)	(-0.09 , 0.32)	(-0.08 , 0.79)	(-0.38 , 0.56)	(-0.32 , 0.65)	(-0.26 , 0.68)

Panel C. Log Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Young firms	β^+	-0.51	0.82	-2.73**	-4.10***	-4.53**	-3.28
		(-1.24, 0.22)	(-0.93 , 2.58)	(-4.92 , -0.53)	(-6.43 , -1.77)	(-7.85 , -1.21)	(-6.64 , 0.08)
	β^-	0.82	2.12*	2.28	2.59*	1.75	1.61
		(-0.30, 1.94)	(0.12 , 4.13)	(-0.39 , 4.94)	(0.23 , 4.94)	(-0.30 , 3.80)	(-0.84 , 4.06)
Old firms	β^+	-0.13	-0.32	-2.55	-3.50*	-4.43*	-3.86*
		(-1.50, 1.24)	(-2.05 , 1.41)	(-5.87 , 0.76)	(-6.92 , -0.08)	(-8.85 , -0.01)	(-7.60 , -0.12)
	β^-	0.52	1.94**	3.12*	2.83	2.23	2.08
		(-0.59, 1.63)	(0.34 , 3.54)	(0.36 , 5.88)	(-0.23 , 5.89)	(-0.29 , 4.74)	(-0.23 , 4.40)

Notes: The first (second) row in each panel shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Young (old) firms are firms with less (more) than 20 years since incorporation. Each panel is estimated separately. The confidence intervals are provided in parentheses. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \sum_{g=1}^{G} \beta_{h,g}^{+}\, max[0, \Delta R_t]\; I[N_{j,t-1} \in g] + \sum_{g=1}^{G} \beta_{h,g}^{-}\, min[0, \Delta R_t]\; I[N_{j,t-1} \in g] + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7: Descriptive Statistics

	Obs #	Bottom 5%	Median	Average	Top 5%	Std deviation
Employees	656966	7	745	7,568	31,304	36535.5
Investment Rate	599163	0.0	4.4	7.6	26	10.6
Real Sale	733986	0.0	38.1	483.2	1884.5	2522
Real Asset	735197	2	147.5	2406.4	9472.1	13750
Debt Asset Ratio	731218	0.0	22.7	32.6	79.8	77.2
Liquidity Ratio	734904	0.2	7.1	17.5	73.1	24

Notes: The table reports descriptive statistics on the main variables used in the paper. Employment data is the number of employees extracted from annual data and linearly interpolated across quarters within the year. Investment rate is the capital expenditures of a firm in period t relative to the level of physical capital stock in the last period. Real sale is variable *saleq* and real asset is the book value of total assets, *atq*, where both series are deflated with Price Index detailed in Appendix A. Debt to Asset Ratio is the ratio of short and long-term debt to total assets. The liquidity ratio is the ratio of cash and short-term investments (*cheq*) to total assets. Real asset and real sale are reported in millions of dollars. See Appendix A for detailed data descriptions.

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For Online Publication

ONLINE APPENDIX

Asymmetric Effects of Monetary Policy on Firms

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A. Data appendix

A.1. Variable definitions

Firm level variables I use quarterly Compustat firm-level from 1980q3 to 2019q4. Compustat provides high-quality information on the balance sheet and income statement components of publicly traded C corporations in North America. Detailed variable definitions of Compustat can be accessed through Wharton Research Data Services for the United States.

Table A.1 provides the variable names and respective codes in Compustat. Leverage is the ratio of short and long-term debt to total assets. The liquidity ratio is the ratio of cash and short-term investments (*cheq*) to total assets. The dividend variable is used as an indicator of whether the firm has paid cash dividends in the previous year. *aqcq* represents the cash outflow or funds used to the acquisition of a company. Employment data is pulled from yearly data and linearly interpolated across quarters within the year. All nominal variables in level are deflated using the aggregate GVA deflator. The age variable is constructed using the Center for Research in Security Prices (CRSP) and Jay Ritter databases.[44] Investment estimations use 1986q1-2019q4 window as Compustat investment in the pre-1986 window is sparsely populated.

Table A.1: VARIABLE DEFINITIONS

Variable	Compustat variable
Leverage	$(dlcq + dlttq) * 100/atq$
Liquidity ratio	$cheq * 100/atq$
Employees	emp
Investment rate	$capxq/L.ppentq$
Total Assets (Book value)	atq
Debt-to-Equity ratio	$(dlcq + dlttq) * 100/ceqq$
Sales	$saleq$
Dividend	dvq
Acquisitions	$aqcq/atq$
S&P Quality Ranking	$spcsrc$

Sample Restrictions I drop firms in finance, insurance, real estate and public administration sectors. Following Ottonello and Winberry (2020), I also exclude firms with acquisitions accounting for more than 5 percent of total assets. I drop firms that have been in the panel for less than 5 years. The baseline trimming excludes firms with top and bottom 1 percent of the investment rate, debt-to-equity ratio and employment growth. I also trim the top 1 percent of the leverage ratio. Trimming is done by year. I also drop observations with negative debt-to-asset ratio, liquidity ratio, investment rate and sale.

Macro Time Series Data The one-year risk-free rate is the 1-Year Treasury Constant Maturity Rate (Monthly, Not Seasonally Adjusted) from FRED series GS1. The excess bond premium is complied by Gilchrist and Zakrajšek (2012), EBP_OA, available at author's website.[45] The employment rate is available at FRED as the seasonally adjusted employment rate of all persons aged 15:64 in the United

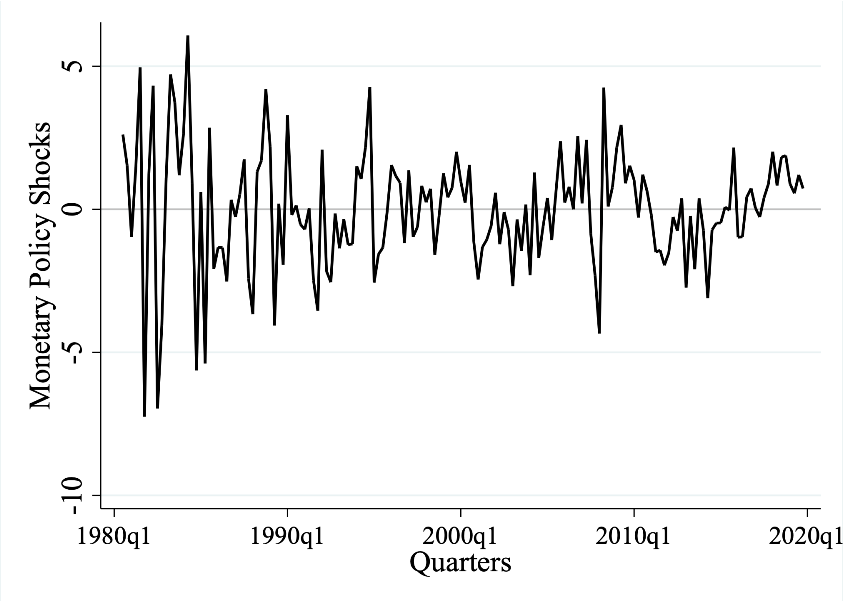
[44] Jay Ritter dataset is publicly provided here: `https://site.warrington.ufl.edu/ritter/files/founding-dates.pdf`

[45] The data was accessed in February 2022.

States (LREM64TTUSM156S). CPI is the seasonally adjusted consumer prices index computed for total items in the United States by FRED (CPALTT01USM661S). Debt to GDP is provided by macro trends, available here. PPI is the producer prices index computed for total items in the United States by FRED (PPIACO). The GVA (gross value added) deflator series (B358RG3Q086SBEA) is the Price Index (Business : Nonfarm) from FRED.

A.2. Time-series of monetary policy shocks

Figure A.1: TIME-SERIES OF MONETARY POLICY SHOCKS (1980Q3-2019Q4)

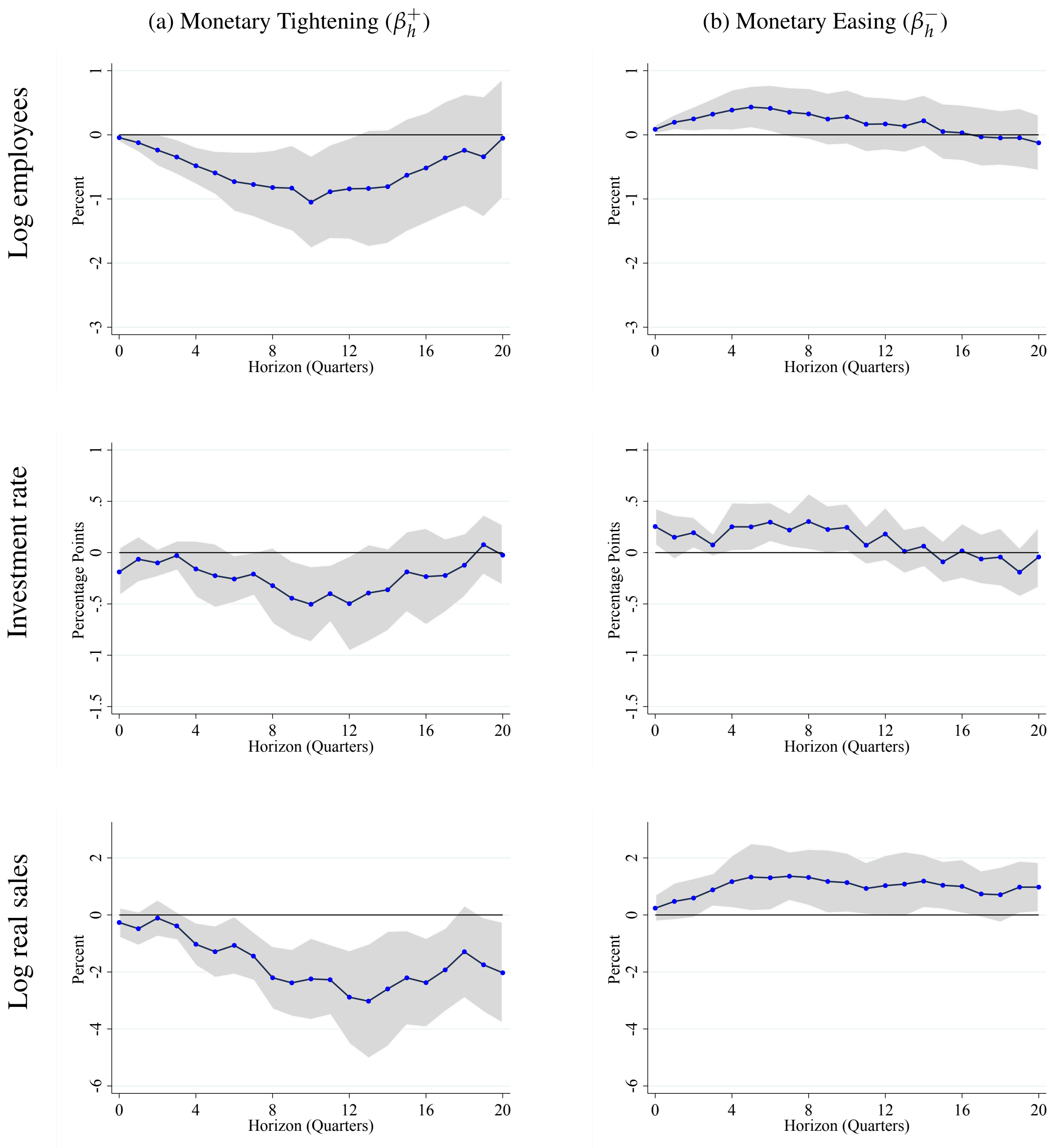


Notes: The figure plots implied monetary policy shocks derived from Gertler and Karadi (2015)'s structural VAR impact matrix. See the text in section 2 for details.

B. Robustness

B.1. Additional controls

Figure B.2: ASYMMETRIC EFFECTS OF MONETARY POLICY WITH ADDITIONAL CONTROLS



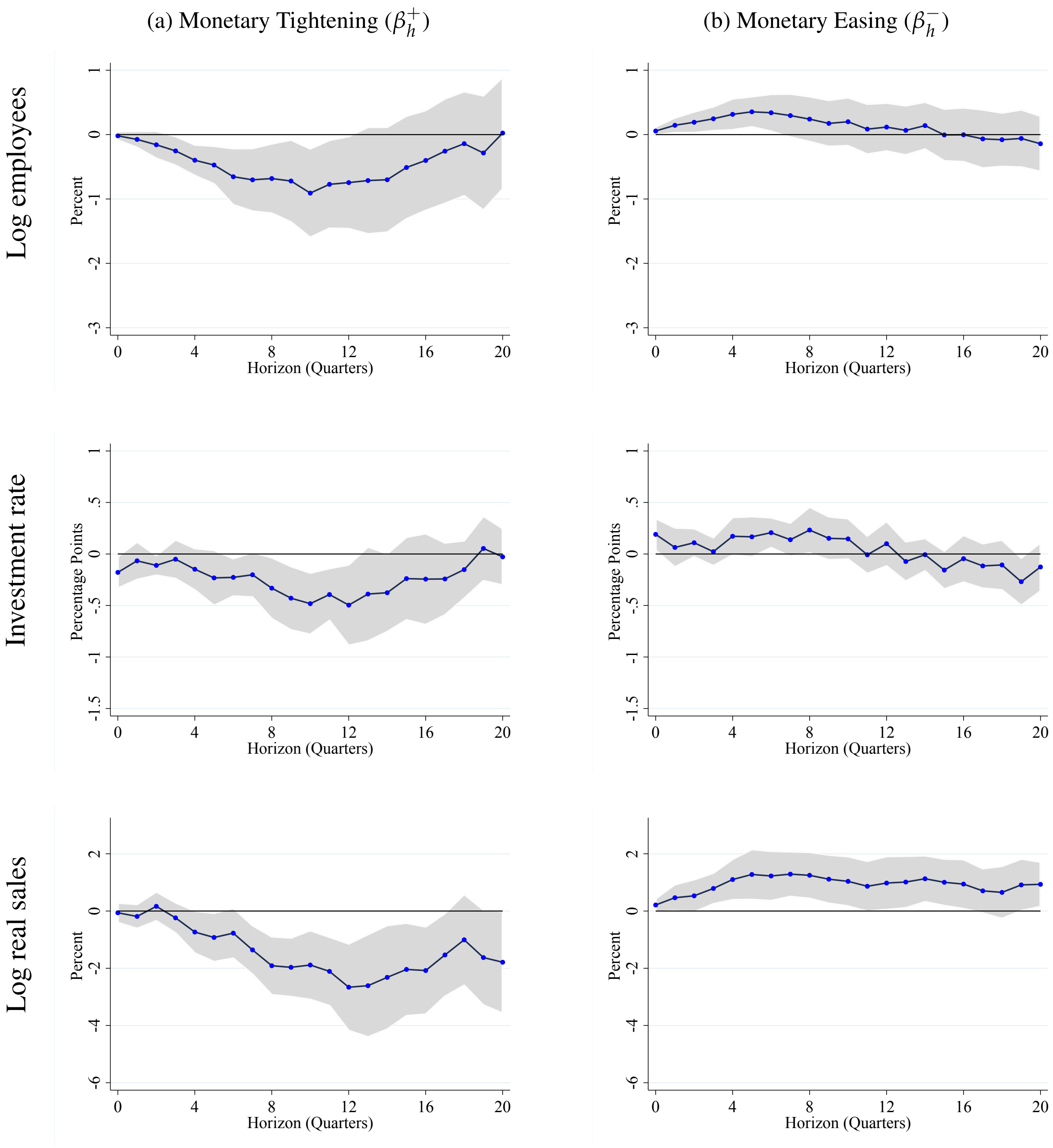
Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each row is estimated separately using the specification:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \Omega'(L) \, Z_{j,t-1} + \epsilon_{j,t+h} \qquad (1)$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. Control variables are real asset growth, total debt growth and log real GDP growth. The shaded areas show 90 percent confidence intervals.

B.2. Controlling for lags of dependent variable

Figure B.3: EFFECTS OF MONETARY POLICY CONTROLLING FOR LAGS OF DEPENDENT VARIABLE



Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each row is estimated separately using the specification:

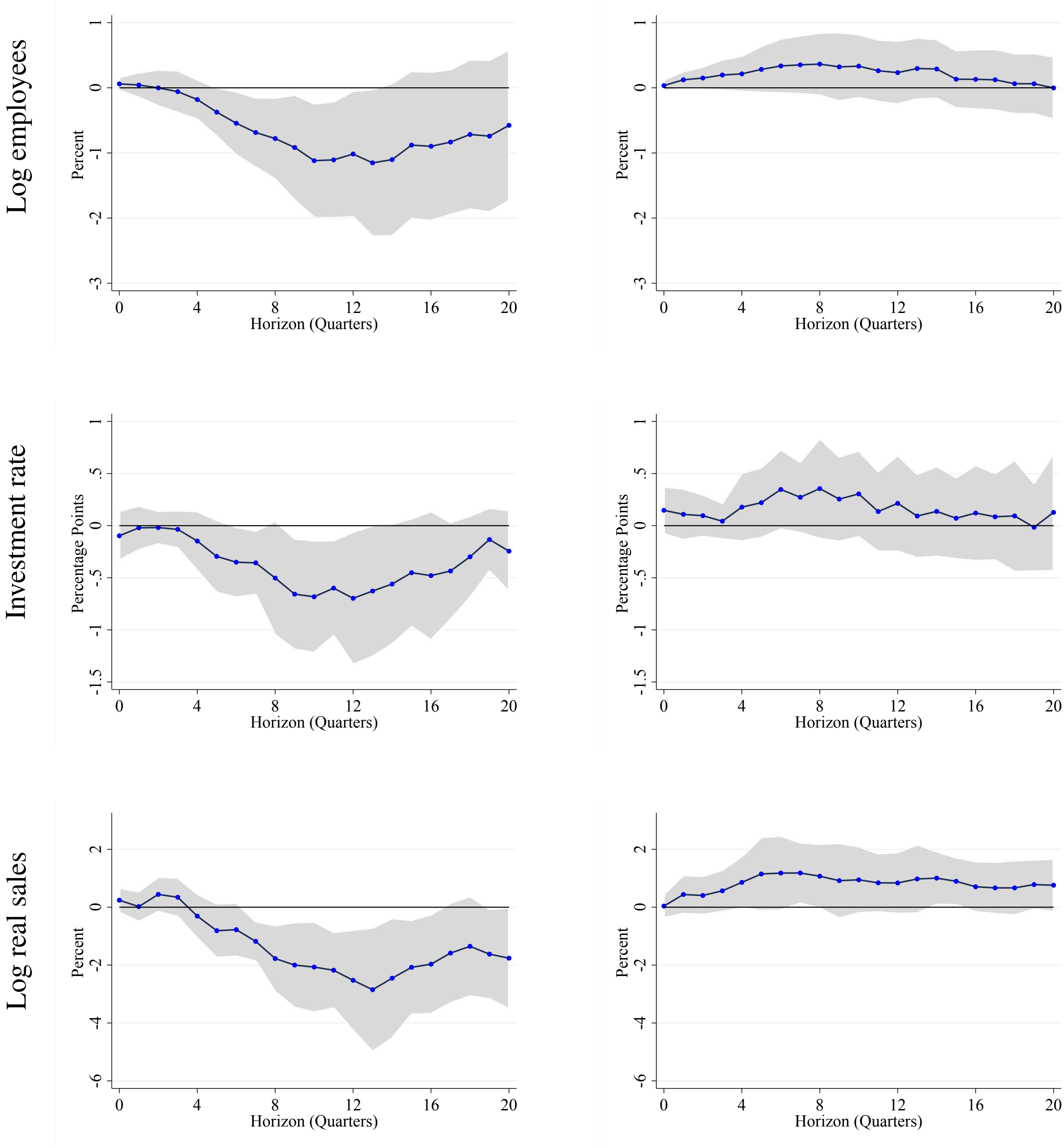
$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \Omega'(L)\, Z_{j,t-1} + \epsilon_{j,t+h} \qquad (2)$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. Control variables are real asset growth, total debt growth, log real GDP growth and lags of dependent variable. The shaded areas show 90 percent confidence intervals.

B.3. Extended sample trim

Figure B.4: ASYMMETRIC EFFECTS OF MONETARY POLICY WITH EXTENDED SAMPLE TRIM

(a) Monetary Tightening (β_h^+) (b) Monetary Easing (β_h^-)



Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each row is estimated separately using the specification:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h} \tag{3}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. The shaded areas show 90 percent confidence intervals. The sample is further trimmed based on the top and bottom 1 percent of sales growth. The trimming is done by year.

B.4. Sector heterogeneity

Table B.2: ASYMMETRIC EFFECTS OF MONETARY POLICY BY SECTOR

	Manufacturing		Services		Other Sectors	
	Tightening (β^{+})	Easing (β^{-})	Tightening (β^{+})	Easing (β^{-})	Tightening (β^{+})	Easing (β^{-})
Employees	-1.17*	0.17	-1.40	0.58	-0.94**	0.31
(Percent)	(-2.16, -0.17)	(-0.38, 0.73)	(-3.15, 0.36)	(-0.28, 1.44)	(-1.56, 0.32)	(-0.09, 0.72)
Investment	-0.56**	0.24	-1.19*	0.57	-0.61*	0.20
(Pp)	(-1.02, -0.09)	(-0.21, 0.68)	(-2.31, -0.08)	(-0.09, 1.24)	(-1.02, -0.19)	(-0.16, 0.57)
Sales	-2.49**	1.22	-1.58*	0.96	-1.69	0.74
(Percent)	(-4.15, -0.84)	(-0.00, 2.45)	(-2.95, -0.21)	(-0.24, 2.17)	(-3.75, 0.37)	(-0.92, 2.41)

Notes: The columns show the responses to a monetary policy shock that changes the one-year Treasury rate by 25 basis points on impact. Each sector is estimated separately using the specification:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. Horizon 10 estimates are provided with 90 percent confidence intervals in parentheses. Manufacturing and services consist of 48 and 18 percent of the sample, respectively. The largest sectors in the remaining group consist of construction (7 percent), transportation and communications services (13 percent) and wholesale trade (11 percent).

B.5. Romer and Romer (2004) monetary policy shocks

Table B.3: ASYMMETRIC EFFECTS OF MONETARY POLICY USING ROMER AND ROMER (2004) SHOCKS

	Monetary Tightening (β^+)	Monetary Easing (β^-)
Employees	-0.94*	0.70***
(Percent)	(-1.83, -0.05)	(0.30, 1.09)
Investment Rate	-0.75***	0.39**
(pp)	(-1.22, -0.28)	(0.07, 0.70)
Sales	-2.02 ***	1.68***
(Percent)	(-3.14, -0.90)	(0.97, 2.39)

Notes: The second (third) column shows the responses to a monetary policy shock that increases (decrease) the one-year Treasury rate by 25 basis points on impact. Each row is estimated separately using the specification:

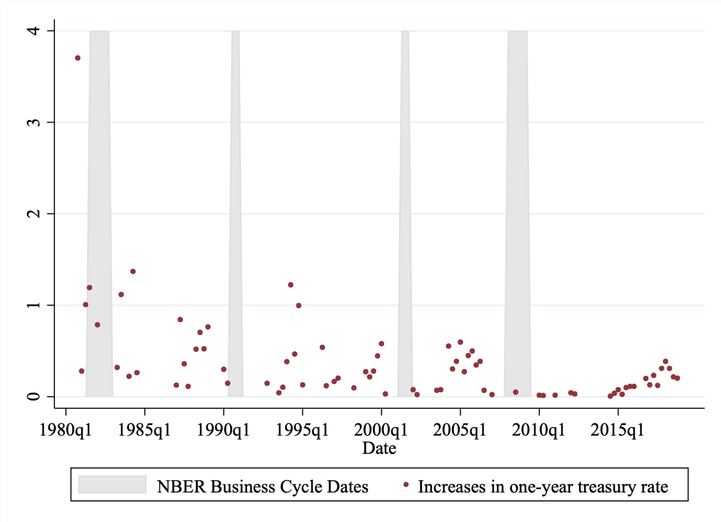
$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. Horizon 10 estimates are provided with 90 percent confidence intervals in parentheses. The specification uses extended Romer shocks following Romer and Romer (2004) and Wieland and Yang (2020). The sample period covers 1974-2007 as the quarterly firm-level data is sparse prior to 1974, and Wieland and Yang (2020) shocks end in 2007. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

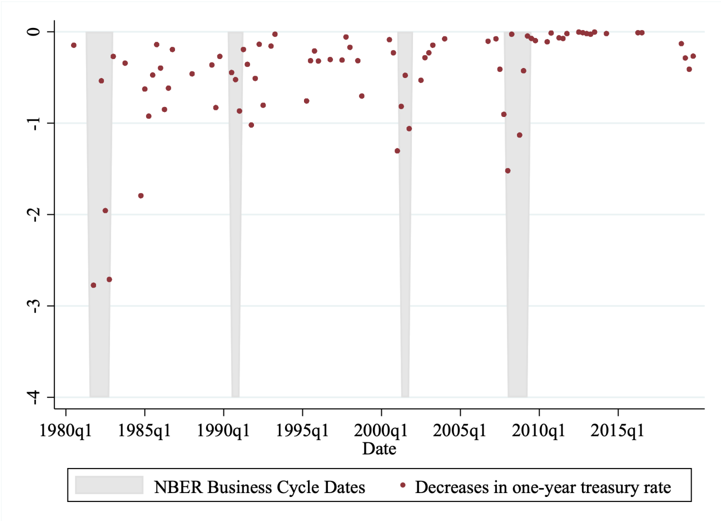
B.6. Business cycle interactions

Figure B.5: CHANGES IN ONE-YEAR TREASURY RATES ACROSS BUSINESS CYCLE

(a) INCREASES IN ONE-YEAR TREASURY RATE



(b) DECREASES IN ONE-YEAR TREASURY RATE



Notes: This figure plots the increases and decreases in the one-year Treasury rate together with NBER business cycle dates. The positive and negative changes in the one-year Treasury rate are instrumented with the monetary innovations that occurred in these quarters. In panel (a), the mean increase in the one-year treasury rate is 0.172 for the periods outside of the business cycle and 0.065 for the periods during the business cycle. In panel (b), the mean change in one-year treasury rate is -0.161 for the periods outside of the business cycle and -0.804 for the periods during the business cycle, which suggest that larger monetary easings may have occurred during business cycles.

Table B.4: ASYMMETRIC EFFECTS OF MONETARY POLICY AND BUSINESS CYCLE

	$\beta^{+}_{Baseline}$	β^{+}	$\gamma^{+,+}$	$\gamma^{+,-}$	$\beta^{-}_{Baseline}$	β^{-}	$\gamma^{-,+}$	$\gamma^{-,-}$
Employees	-1.13**	-1.22**	1.63	-0.00	0.29	0.24	8.48	-1.18
(Percent)	(0.54)	(0.56)	(3.92)	(2.81)	(0.29)	(0.42)	(6.01)	(1.85)
Investment	-0.66***	-0.63***	0.23	1.11	0.13	0.01	0.65	-1.11
Rate (Pp)	(0.20)	(0.22)	(1.23)	(0.85)	(0.16)	(0.21)	(2.10)	(0.81)
Sales	-2.09**	-2.28**	4.64*	1.01	1.02	1.19	0.12	-0.17
(Percent)	(0.96)	(1.04)	(2.77)	(4.58)	(0.75)	(0.95)	(5.99)	(2.37)

Notes: The table shows the responses of the dependent variables at horizon 10. The estimation follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \gamma_h^{+,+} \, max[0, \Delta R_t] \Delta GDP^+_{j,t} + \gamma_h^{+,-} \, max[0, \Delta R_t] \Delta GDP^-_{j,t}$$
$$+ \beta_h^- \, min[0, \Delta R_t] + \gamma_h^{-,+} \, min[0, \Delta R_t] \Delta GDP^+_{j,t} + \gamma_h^{-,-} \, max[0, \Delta R_t] \Delta GDP^-_{j,t}$$
$$+ \rho_t^+ \Delta GDP^+_{j,t} + \rho_t^- \Delta GDP^-_{j,t} + \Omega'(L) \, Z_{j,t-1} + \epsilon_{\, j,t+h},$$

where positive and negative monetary shocks interact with changes in GDP occurring on NBER business cycle dates. These dates identify the peaks and troughs that frame economic recessions and expansions. The second and sixth column reports baseline impulse responses using specification (2) for easy comparison of estimates. Horizon 10 estimates are provided with standard errors in parentheses. This estimation is very data-demanding; hence, it was performed using the entire 1980-2019 time span for all three dependent variables. In order to continue utilizing the full time span for all variables, I fill in the missing investment observations in the pre-1984 window, where the share of missing observations is higher. I fill the missing investment observations using the capital accumulation equation: $I_t = K_t - (1-\delta)K_{t-1}$ where K_t is the firm's capital stock (Property, Plant and Equipment, *ppentq*) and δ is sector-level depreciation rates via Fraumeni (1997). These only account for about 6 percent of total observations and result in new estimates similar to the baseline estimates provided in Section 3.2.

B.7. Size and sign dependent effects of monetary policy

Table B.5: SIZE AND SIGN DEPENDENT EFFECTS OF MONETARY POLICY

	Monetary Tightening		Monetary Easing	
	β^{+}_{large}	β^{+}_{small}	β^{-}_{large}	β^{-}_{small}
Employees	-0.55	-3.60	0.37	-0.99
(Percent)	(-2.28, 1.19)	(-7.52, 0.32)	(-0.50, 1.24)	(-11.24, 9.27)
Investment Rate	-0.46	-1.54**	0.36**	0.36
(Pp)	(-0.99, 0.06)	(-2.58, -0.49)	(0.07, 0.66)	(-1.24, 1.97)
Sales	-2.12	-6.40*	1.27	4.68
(Percent)	(-4.86, 0.62)	(-12.30, -0.50)	(-0.24, 2.77)	(-9.75, 19.11)

Notes: The table shows the responses to a monetary policy shock where a large (small) monetary policy shock is a shock that is accompanied by a change in the one-year Treasury rate of more (less) than 0.5 points. The estimations follow the specification:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^{+,L}\, \Delta R_t^{+,L} + \beta_h^{+,S}\, \Delta R_t^{+,S} + \beta_h^{-,L}\, \Delta R_t^{-,L} + \beta_h^{-,S}\, \Delta R_t^{-,S} + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects. $\Delta R^{+,L}$ captures large increases in the one-year government bond yield instrumented with the monetary policy shocks. $\Delta R^{+,S}$ captures small increases in the one-year government bond yield instrumented with the monetary policy shocks. $\Delta R^{-,S}$ captures small decreases in the one-year government bond yield instrumented with the monetary policy shocks. $\Delta R^{-,L}$ captures large decreases in the one-year government bond yield instrumented with the monetary policy shocks. Horizon 10 estimates are provided with 90 percent confidence intervals in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B.8. Sub-sample analysis

Table B.6: ASYMMETRIC EFFECTS OF MONETARY POLICY BY SUB-SAMPLE

	1980-1998		1999-2019	
	Monetary Tightening (β^{+})	Monetary Easing (β^{-})	Monetary Tightening (β^{+})	Monetary Easing (β^{-})
Employees	-1.02	0.24	-4.30*	-0.05
(Percent)	(-2.08, 0.04)	(-0.20, 0.67)	(-7.87, -0.73)	(-1.59, 1.49)
Investment	-0.70***	0.21	-1.47**	0.45
Rate (Pp)	(-1.01, 0.39)	(-0.18, 0.60)	(-2.64, -0.31)	(-0.15, 1.06)
Sales	-1.32	0.16	-4.85	1.93
(Percent)	(-3.74, 1.10)	(-0.73,1.04)	(-10.35, 0.65)	(-1.21, 5.07)

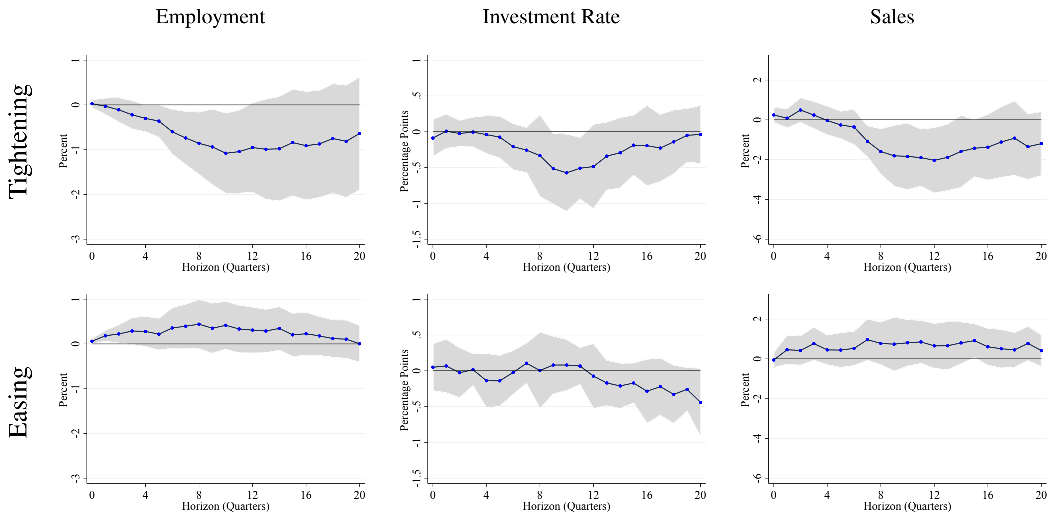
Notes: The table shows the responses to a monetary policy shock that changes the one-year Treasury rate by 25 basis points on impact. The second and third columns show the responses from the 1980-1998 interval, and the fourth and fifth columns show the responses from the 1999-2019 interval. The estimations follow the specification:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. Horizon 10 estimates are provided with 90 percent confidence intervals in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B.9. Excluding zero lower bound period

Figure B.6: ASYMMETRIC EFFECTS OF MONETARY POLICY EXCLUDING ZERO LOWER BOUND PERIOD



Notes: The top (bottom) rows in each panel show the impulse response function following a 25bp increase (decrease) in the one year interest rate. The estimation follows the specification:

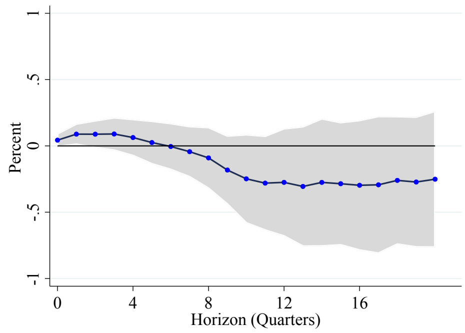
$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h} \quad (4)$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. The shaded areas show 90 percent confidence intervals. Estimation excludes the zero lower bound period (2008-2013).

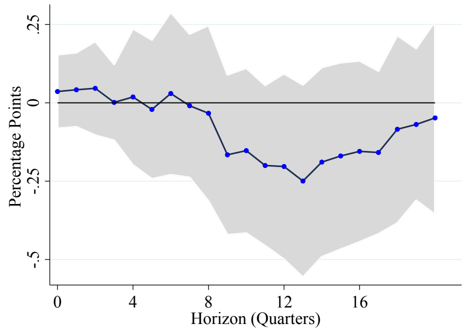
B.10. Baseline effects using pooled monetary innovations

Figure B.7: IMPULSE RESPONSES TO MONETARY POLICY SHOCKS USING ALL SHOCKS

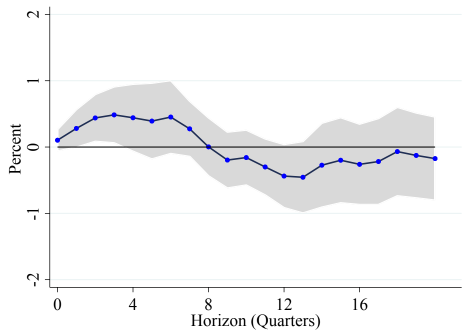
Panel A. Log Employees



Panel B. Investment Rate



Panel C. Log Real Sales



Notes: This figure plots the impulse responses using pooled monetary policy innovations. The estimation follows:

$$y_{j,t+h} - y_{j,t-1} = \alpha_j^h + \beta_h \, \Delta R_t + \epsilon_{j,t+h},$$

where horizon is h = 0, 1,..., H, τ is a linear time trend, α_j^h is firm-level fixed effects and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks. The shaded areas show 90 percent confidence intervals.

C. Further heterogeneity results

Cross-group analysis

The heterogeneity results of this paper document larger responses to monetary tightenings on firms with small size, non-dividend paying status, low credit ratings and relatively young age. However, it is possible that these proxies may be correlated with each other. In this section, I look at finer firm groups to determine if some of these characteristics are of second order for monetary tightenings and easings.

A. Firm Size and Dividend

This section analyzes size and dividend dimensions jointly by exploring four categories of firms: small non-dividend payer, large non-dividend payer, small positive-dividend payer and large positive-dividend payer firms. Individual group definitions follow the earlier descriptions in Section 3.4. The results for all independent variables are provided in Online Appendix Table C.7.

Online Appendix Table C.7 suggests that within large firms, firms that do not pay dividends drop employment and investment more significantly than the group that pays positive dividends.[46] This aligns with the financial accelerator view: as monetary tightening makes credit constraints bind, this may result in larger effects on firms that rely more on internal finance and hold more retained earnings. However, this difference is not statistically significant for small firms. Similarly, within positive dividend payers, small firms drops employment and investment more significantly than large firms.[47] However, the size difference is not statistically significant for non-dividend payers.

For sales, the results show that small positive dividend payer firms experience a larger decline in sales ($p = 0.05$) than small non-dividend payer firms. These suggest that various other factors, such as demand conditions, product pricing and market structures, may be important to understand the effects on sales.

B. Firm Size and Credit Rating

This section analyzes size and credit rating dimensions jointly by exploring four categories of firms: small firms with high credit ratings, large firms with high credit ratings, small firms with low credit ratings and large firms with low credit ratings. Individual group definitions follow the earlier descriptions in Section 3.4. The sample size in this estimation is about half of the previous estimates due to missing observations in Compustat credit ratings. The results for all independent variables are provided in Online Appendix Table C.8.

Online Appendix Table C.8 shows that low credit rating firms contract significantly more than high credit rating firms. This result holds for both employment and investment response of small and large firms, which is consistent with Perez-Orive and Timmer (2023).[48] Among high credit firms, I also find that small and large firms' investment responses to monetary tightenings are significantly different ($p = 0.04$). On sales, I find that conditional on size, low credit rating firms respond more to monetary

[46] In this test, p-values are 0.04 and 0.01 for employment and investment, respectively.

[47] In this test, p-values are 0.08 and 0.04 for employment and investment, respectively.

[48] In this test, p-values for employment of small and large firms are 0.03 and 0.02, respectively. Similarly, p-values for investment of small and large firms are 0.002 and 0.033, respectively.

tightenings and easings than high credit rating firms. This lines up with financial friction channels where financially constrained firms (proxied by credit ratings) are more sensitive to monetary policy shocks.

C. Dividends and Age

This section analyzes dividend and age dimensions jointly by exploring four categories of firms: non-dividend payer young firms, positive-dividend payer young firms, non-dividend payer old firms and positive-dividend payer old firms. Individual group definitions follow the earlier descriptions in Section 3.4. The results for all independent variables are provided in Online Appendix Table C.9.

Analyzing employment and sales responses suggests that following a monetary tightening non-dividend paying *young* firms respond significantly more than non-dividend paying old firms. These results, however, is not statistically significant for investment *rate*, which may be due to the limited sample size of the age variable. Overall, the employment results are consistent with Cloyne et al. (2022) and Davis and Haltiwanger (2019), which argue that firms earlier in their life cycle may be more likely to face financial constraints, hence may contract more than old firms following monetary tightenings.

D. Size and Age

This section analyzes size and age dimensions jointly by exploring four categories of firms: young and small firms, young and large firms, old and small firms and old and large firms, where the groups follow the earlier descriptions in Section 3.4. The results for all independent variables are provided in Online Appendix Table C.10. Analyzing employment and sales responses of all categories suggests no significant difference based on firm size conditional on age. Similarly, I find no significant difference in employment and sales based on firm age, conditional on size. Last, following a monetary tightening, young-small firms show the highest drop (-1.3 pp) in investment as compared to small-old firms (-0.3 pp). Although this is consistent with Cloyne et al. (2022) findings, the sample size limitations in age likely results the difference in the responses to be not statistically significant (p=0.15).

E. Dividends and Credit Ratings

This section analyzes dividend and credit rating dimensions jointly by exploring four categories of firms: non-dividend payer firms with high credit ratings, positive-dividend payer firms with high credit ratings, non-dividend payer firms with low credit ratings and positive-dividend payer firms with low credit ratings. Individual group definitions follow the earlier descriptions in Section 3.4. The results for all independent variables are provided in Online Appendix Table C.11.

Online Appendix Table C.11 shows that employment of non-dividend payer high-rating firms contracts significantly more than positive-dividend payer high-rating firms ($p = 0.05$). In addition, among the positive-dividend payer firms, I document larger drops in employment for low-credit rating firms. These results are once again consistent with the earlier findings that not paying dividends and having low credit ratings are plausible proxies of firms' financial constraints.

For investment results, I find that within firms that do not pay dividends, low-rating firms respond significantly more to monetary tightenings than high-rating firms ($p = 0.08$), which is consistent with Perez-Orive and Timmer (2023). In addition, conditional on a firm paying positive dividends, low credit rating firms' investment and sales are more sensitive to monetary tightenings and easings than high credit rating firms, which suggests that monetary policy can effectively tighten and ease the financial conditions of these firms. Similarly, I find that conditional on paying no dividends, low credit rating firms experience a larger sales growth than high credit rating firms following a monetary easing.[49]

[49] Since both credit rating and age observations have sizable missing observations, I do not perform joint analysis on credit rating and firm age.

C.1. Results by size and dividend groups

Table C.7: ASYMMETRIC EFFECTS OF MONETARY POLICY BY SIZE AND DIVIDENDS GROUPS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - Small	β^+	0.07	0.19	-1.13*	-1.36*	-1.20	-1.12
		(-0.05, 0.19)	(-0.48 , 0.86)	(-2.16 , -0.10)	(-2.71 , -0.01)	(-2.68 , 0.28)	(-2.61 , 0.37)
	β^-	0.03	-0.01	0.72	0.02	-0.15	-0.51
		(-0.11, 0.18)	(-0.65 , 0.63)	(-0.03 , 1.47)	(-0.93 , 0.97)	(-1.14 , 0.85)	(-1.57 , 0.55)
No dividends - Large	β^+	0.22**	-0.08	-1.25*	-2.02**	-2.58**	-2.82***
		(0.04, 0.40)	(-0.66 , 0.51)	(-2.40 , -0.10)	(-3.54 , -0.51)	(-4.38 , -0.79)	(-4.43 , -1.21)
	β^-	0.01	0.77**	0.77	0.92	1.09	0.88
		(-0.24, 0.26)	(0.21 , 1.33)	(-0.31 , 1.85)	(-0.30 , 2.14)	(-0.13 , 2.30)	(-0.44 , 2.19)
Positive dividends - Small	β^+	0.12	-1.09**	-1.67**	-2.46**	-1.65	-0.40
		(-0.09, 0.32)	(-1.85 , -0.33)	(-2.76 , -0.58)	(-4.18 , -0.73)	(-3.75 , 0.45)	(-2.22 , 1.42)
	β^-	-0.21*	-0.07	-0.08	-0.19	0.01	-0.83
		(-0.40, -0.02)	(-0.79 , 0.64)	(-1.36 , 1.21)	(-1.58 , 1.19)	(-1.62 , 1.64)	(-2.13 , 0.46)
Positive dividends - Large	β^+	0.11*	-0.12	-0.50	-0.80*	-0.85*	-0.81**
		(0.01, 0.21)	(-0.37 , 0.13)	(-1.04 , 0.04)	(-1.53 , -0.07)	(-1.60 , -0.10)	(-1.48 , -0.14)
	β^-	-0.08	0.27	0.30	0.31	0.37	0.22
		(-0.21, 0.05)	(-0.05 , 0.60)	(-0.33 , 0.92)	(-0.42 , 1.04)	(-0.33 , 1.06)	(-0.50 , 0.94)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - Small	β^+	0.04	-0.14	-0.38	-0.95**	-0.72	-0.41
		(-0.23, 0.31)	(-0.53 , 0.26)	(-1.18 , 0.42)	(-1.74 , -0.17)	(-1.49 , 0.06)	(-1.07 , 0.24)
	β^-	0.04	0.08	0.29	0.49	0.05	0.05
		(-0.25, 0.32)	(-0.59 , 0.76)	(-0.57 , 1.16)	(-0.16 , 1.14)	(-0.64 , 0.74)	(-0.66 , 0.76)
No dividends - Large	β^+	-0.18	-0.20	-0.66**	-0.78**	-0.83**	-0.71
		(-0.43, 0.07)	(-0.62 , 0.23)	(-1.20 , -0.13)	(-1.31 , -0.24)	(-1.47 , -0.19)	(-1.46 , 0.04)
	β^-	0.21	0.24	0.43*	0.29	0.25	0.17
		(-0.04, 0.46)	(-0.08 , 0.57)	(0.04 , 0.83)	(-0.05 , 0.64)	(-0.14 , 0.63)	(-0.21 , 0.55)
Positive dividends - Small	β^+	-0.28	0.01	-0.38	-1.17**	-0.61	-0.09
		(-0.64, 0.08)	(-0.46 , 0.48)	(-1.40 , 0.64)	(-2.05 , -0.29)	(-1.33 , 0.11)	(-0.62 , 0.45)
	β^-	-0.14	0.39	0.38	0.66	0.14	0.04
		(-0.61, 0.32)	(-0.15 , 0.93)	(-0.42 , 1.18)	(-0.19 , 1.51)	(-0.67 , 0.95)	(-0.43 , 0.51)
Positive dividends - Large	β^+	-0.10	-0.11	-0.31	-0.40*	-0.48	-0.36
		(-0.40, 0.19)	(-0.43 , 0.22)	(-0.74 , 0.11)	(-0.77 , -0.04)	(-0.99 , 0.03)	(-0.90 , 0.19)
	β^-	0.13	0.15	0.29	0.26	0.28	0.20
		(-0.14, 0.39)	(-0.15 , 0.44)	(-0.05 , 0.63)	(-0.01 , 0.52)	(-0.13 , 0.68)	(-0.15 , 0.54)

Panel C. Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - Small	β^+	0.35	-0.65	-2.01**	-2.33**	-1.96	-1.66
		(-0.55, 1.25)	(-2.14 , 0.83)	(-3.56 , -0.45)	(-4.00 , -0.67)	(-4.17 , 0.24)	(-4.23 , 0.91)
	β^-	0.44	1.94*	2.54***	1.66	1.24*	0.86
		(-0.86, 1.74)	(0.08 , 3.80)	(1.22 , 3.87)	(-0.13 , 3.44)	(0.08 , 2.39)	(-0.53 , 2.25)
No dividends - Large	β^+	-0.17	-0.19	-2.96*	-3.89**	-4.85**	-4.29**
		(-1.31, 0.97)	(-1.89 , 1.50)	(-5.59 , -0.32)	(-6.92 , -0.85)	(-8.83 , -0.86)	(-7.46 , -1.13)
	β^-	0.48	1.96*	2.33*	2.43*	2.43**	1.89
		(-0.75, 1.71)	(0.17 , 3.76)	(0.09 , 4.57)	(0.18 , 4.68)	(0.46 , 4.41)	(-0.14 , 3.91)
Positive dividends - Small	β^+	-0.30	-0.87	-1.83*	-4.34***	-4.96**	-0.42
		(-1.55, 0.95)	(-3.55 , 1.82)	(-3.51 , -0.15)	(-6.11 , -2.56)	(-8.98 , -0.93)	(-2.72 , 1.88)
	β^-	-0.26	-0.38	0.30	1.75	1.38	-0.07
		(-1.78, 1.25)	(-2.11 , 1.36)	(-1.84 , 2.45)	(-0.54 , 4.04)	(-1.28 , 4.04)	(-2.46 , 2.33)
Positive dividends - Large	β^+	0.76*	-0.53	-1.84	-2.62*	-2.97*	-2.11
		(0.03, 1.49)	(-1.75 , 0.70)	(-3.81 , 0.12)	(-4.89 , -0.35)	(-5.69 , -0.24)	(-4.54 , 0.32)
	β^-	-0.84*	0.53	1.05	1.14	0.78	0.50
		(-1.60, -0.09)	(-0.82 , 1.89)	(-0.94 , 3.03)	(-0.88 , 3.16)	(-1.30 , 2.86)	(-1.46 , 2.47)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (4). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C.2. Results by size and credit rating groups

Table C.8: ASYMMETRIC EFFECTS OF MONETARY POLICY BY SIZE AND CREDIT RATING GROUPS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
High rating - Small	β^+	-0.08	-0.25	-0.27	-0.07	-0.70	0.49
		(-0.27, 0.11)	(-1.06 , 0.57)	(-1.32 , 0.78)	(-1.22 , 1.07)	(-1.59 , 0.19)	(-0.63 , 1.62)
	β^-	0.12*	0.26	-0.19	-0.32	-0.23	-0.61
		(0.00, 0.25)	(-0.30 , 0.83)	(-0.94 , 0.55)	(-0.89 , 0.25)	(-0.80 , 0.35)	(-1.43 , 0.20)
High rating - Large	β^+	0.08	-0.12	-0.52	-0.89**	-1.14**	-1.17**
		(-0.02, 0.19)	(-0.40 , 0.15)	(-1.06 , 0.01)	(-1.61 , -0.17)	(-2.07 , -0.22)	(-2.05 , -0.29)
	β^-	-0.03	0.24	0.23	0.30	0.44	0.39
		(-0.17, 0.10)	(-0.06 , 0.54)	(-0.36 , 0.83)	(-0.39 , 0.99)	(-0.26 , 1.14)	(-0.41 , 1.18)
Low rating - Small	β^+	0.06	-0.23	-2.37**	-3.12**	-2.93**	-3.00**
		(-0.12, 0.25)	(-1.11 , 0.64)	(-4.00 , -0.75)	(-5.20 , -1.04)	(-5.11 , -0.76)	(-5.34 , -0.66)
	β^-	0.06	-0.07	0.39	-0.13	-0.24	-0.52
		(-0.15, 0.26)	(-0.73 , 0.58)	(-0.33 , 1.12)	(-1.12 , 0.87)	(-1.19 , 0.71)	(-1.67 , 0.63)
Low rating - Large	β^+	0.09	-0.54*	-1.77***	-2.48***	-2.87***	-3.06***
		(-0.08, 0.25)	(-1.07 , -0.01)	(-2.82 , -0.73)	(-3.90 , -1.06)	(-4.54 , -1.20)	(-4.66 , -1.47)
	β^-	0.08	0.75**	1.33	1.43	1.54	1.63
		(-0.11, 0.26)	(0.13 , 1.38)	(-0.01 , 2.67)	(-0.09 , 2.94)	(-0.12 , 3.21)	(-0.07 , 3.33)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
High rating - Small	β^+	0.37	0.80***	0.09	0.21	-0.45	-0.10
		(-0.02, 0.76)	(0.42 , 1.18)	(-0.38 , 0.56)	(-0.48 , 0.90)	(-1.09 , 0.20)	(-0.43 , 0.24)
	β^-	-0.72**	-0.45	-0.24	-0.24	-0.05	-0.41
		(-1.21, -0.24)	(-0.93 , 0.04)	(-0.86 , 0.39)	(-1.00 , 0.53)	(-0.62 , 0.52)	(-1.12 , 0.31)
High rating - Large	β^+	-0.07	-0.06	-0.41	-0.48*	-0.59*	-0.52
		(-0.34, 0.21)	(-0.40 , 0.27)	(-0.90 , 0.07)	(-0.95 , -0.01)	(-1.15 , -0.03)	(-1.21 , 0.18)
	β^-	0.16	0.18	0.39	0.31	0.31	0.29
		(-0.12, 0.44)	(-0.14 , 0.50)	(-0.01 , 0.78)	(-0.04 , 0.67)	(-0.13 , 0.76)	(-0.13 , 0.72)
Low rating - Small	β^+	0.06	0.09	-0.47	-1.03	-0.87	-0.47
		(-0.31, 0.42)	(-0.41 , 0.59)	(-1.50 , 0.55)	(-2.07 , 0.01)	(-1.81 , 0.07)	(-1.31 , 0.36)
	β^-	0.20	0.19	0.53	0.54	0.11	0.09
		(-0.01, 0.41)	(-0.60 , 0.98)	(-0.45 , 1.51)	(-0.28 , 1.36)	(-0.73 , 0.96)	(-0.70 , 0.89)
Low rating - Large	β^+	-0.29*	-0.15	-0.66**	-0.75**	-0.84**	-0.66
		(-0.57, -0.02)	(-0.47 , 0.17)	(-1.17 , -0.15)	(-1.26 , -0.24)	(-1.52 , -0.15)	(-1.42 , 0.11)
	β^-	0.29*	0.28	0.46*	0.38*	0.33	0.18
		(0.01, 0.57)	(-0.04 , 0.60)	(0.05 , 0.87)	(0.01 , 0.75)	(-0.13 , 0.78)	(-0.18 , 0.55)

Panel C. Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
High rating - Small	β^+	0.33	0.60	0.37	0.97	-0.95	-0.02
		(-0.70, 1.35)	(-0.69 , 1.89)	(-1.19 , 1.93)	(-0.55 , 2.50)	(-2.64 , 0.74)	(-1.41 , 1.36)
	β^-	-0.41	-0.09	-0.57	-0.90	-0.10	-0.40
		(-1.12, 0.30)	(-0.80 , 0.62)	(-1.48 , 0.34)	(-1.86 , 0.05)	(-0.93 , 0.74)	(-1.34 , 0.53)
High rating - Large	β^+	-0.04	-0.79	-2.31**	-2.58**	-3.42***	-2.79***
		(-0.61, 0.52)	(-1.69 , 0.12)	(-3.84 , -0.77)	(-4.57 , -0.58)	(-5.54 , -1.30)	(-4.41 , -1.18)
	β^-	0.03	1.04*	1.17	1.10	1.22	1.09
		(-0.45, 0.51)	(0.04 , 2.05)	(-0.17 , 2.51)	(-0.39 , 2.60)	(-0.22 , 2.65)	(-0.27 , 2.44)
Low rating - Small	β^+	0.10	-0.62	-2.12**	-2.85**	-2.55*	-2.47
		(-0.77, 0.97)	(-2.38 , 1.14)	(-3.68 , -0.55)	(-4.83 , -0.87)	(-4.97 , -0.12)	(-5.48 , 0.54)
	β^-	0.74	2.05**	1.74*	1.44*	0.50	0.23
		(-0.27, 1.75)	(0.39 , 3.71)	(0.24 , 3.23)	(0.15 , 2.73)	(-0.56 , 1.55)	(-1.31 , 1.76)
Low rating - Large	β^+	-0.18	-0.97	-4.00**	-5.33***	-6.44**	-5.41**
		(-1.15, 0.78)	(-2.66 , 0.72)	(-6.85 , -1.14)	(-8.48 , -2.17)	(-10.53 , -2.35)	(-8.98 , -1.85)
	β^-	0.53	2.37*	3.40*	3.32*	3.56*	3.27
		(-0.61, 1.67)	(0.34 , 4.41)	(0.41 , 6.38)	(0.16 , 6.47)	(0.08 , 7.04)	(-0.03 , 6.57)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (4). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C.3. Results by dividend and age groups

Table C.9: ASYMMETRIC EFFECTS OF MONETARY POLICY BY DIVIDEND AND AGE GROUPS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividend - Young	β^+	0.12	-0.03	-1.81*	-3.10**	-3.63*	-3.28*
		(-0.22, 0.46)	(-0.96 , 0.90)	(-3.57 , -0.04)	(-5.47 , -0.72)	(-6.74 , -0.52)	(-6.54 , -0.02)
	β^-	0.13	0.22	0.56	0.21	0.03	-0.55
		(-0.17, 0.43)	(-0.72 , 1.15)	(-1.05 , 2.16)	(-1.45 , 1.87)	(-1.74 , 1.81)	(-2.48 , 1.37)
No dividends - Old	β^+	0.10	-0.21	-1.16	-1.62	-1.85	-1.08
		(-0.12, 0.31)	(-1.02 , 0.61)	(-2.81 , 0.50)	(-3.27 , 0.02)	(-4.20 , 0.50)	(-3.32 , 1.16)
	β^-	0.02	0.69*	0.97	0.56	0.25	-0.13
		(-0.31, 0.35)	(0.02 , 1.36)	(-0.31 , 2.25)	(-0.82 , 1.93)	(-1.25 , 1.75)	(-1.65 , 1.40)
Positive dividends - Young	β^+	0.06	-0.89	-2.24*	-2.40*	-2.17	-2.68**
		(-0.28, 0.41)	(-2.40 , 0.62)	(-4.24 , -0.24)	(-4.48 , -0.33)	(-4.42 , 0.08)	(-4.85 , -0.51)
	β^-	-0.32	0.13	-0.58	-0.48	-0.91	0.21
		(-0.67, 0.03)	(-0.88 , 1.14)	(-2.02 , 0.85)	(-2.08 , 1.11)	(-2.69 , 0.86)	(-1.84 , 2.26)
Positive dividends - Old	β^+	0.16	-0.87**	-1.82**	-2.21**	-2.82**	-2.90***
		(-0.06, 0.39)	(-1.45 , -0.29)	(-2.99 , -0.65)	(-3.81 , -0.61)	(-4.89 , -0.74)	(-4.57 , -1.24)
	β^-	-0.34	0.21	0.07	0.05	-0.36	0.45
		(-0.72, 0.05)	(-0.59 , 1.02)	(-1.60 , 1.74)	(-2.00 , 2.09)	(-2.60 , 1.87)	(-2.04 , 2.93)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - Young	β^+	-0.17	-0.13	-0.68	-0.79	-0.96	-0.84*
		(-0.42, 0.08)	(-0.70 , 0.45)	(-1.69 , 0.33)	(-1.60 , 0.03)	(-2.06 , 0.15)	(-1.67 , -0.00)
	β^-	0.05	0.01	0.16	-0.08	-0.09	-0.16
		(-0.37, 0.46)	(-0.65 , 0.67)	(-0.64 , 0.96)	(-0.80 , 0.65)	(-0.74 , 0.56)	(-0.74 , 0.42)
No dividends - Old	β^+	0.07	-0.08	-0.55**	-0.38	-0.63	-0.82**
		(-0.13, 0.26)	(-0.45 , 0.28)	(-1.00 , -0.10)	(-0.78 , 0.02)	(-1.32 , 0.07)	(-1.46 , -0.18)
	β^-	-0.05	0.07	0.41	0.03	0.12	0.23
		(-0.24, 0.14)	(-0.18 , 0.31)	(-0.01 , 0.84)	(-0.43 , 0.48)	(-0.33 , 0.58)	(-0.25 , 0.71)
Positive dividends - Young	β^+	0.21	0.54*	-0.10	-0.54*	-0.46	-0.03
		(-0.26, 0.68)	(0.06 , 1.02)	(-0.62 , 0.41)	(-1.05 , -0.03)	(-0.97 , 0.06)	(-0.93 , 0.87)
	β^-	0.29	-0.07	0.27	0.47	0.24	0.05
		(-0.22, 0.80)	(-0.82 , 0.69)	(-0.37 , 0.91)	(-0.28 , 1.23)	(-0.49 , 0.96)	(-0.78 , 0.88)
Positive dividends - Old	β^+	-0.14	-0.36*	-0.24	-0.41**	-0.52**	-0.22
		(-0.52, 0.24)	(-0.67 , -0.06)	(-0.59 , 0.11)	(-0.69 , -0.13)	(-0.93 , -0.11)	(-0.75 , 0.32)
	β^-	0.07	0.19	0.28	0.23	0.28	0.19
		(-0.21, 0.34)	(-0.14 , 0.53)	(-0.15 , 0.71)	(-0.25 , 0.72)	(-0.24 , 0.80)	(-0.20 , 0.58)

Panel C. Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - Young	β^+	-0.65	0.61	-3.35**	-5.11***	-5.44**	-4.34*
		(-1.44, 0.15)	(-1.43 , 2.65)	(-6.11 , -0.59)	(-8.21 , -2.00)	(-9.42 , -1.47)	(-8.51 , -0.18)
	β^-	1.31*	3.20**	3.69*	3.61**	2.83*	2.42
		(0.11, 2.51)	(0.97 , 5.42)	(0.57 , 6.81)	(0.73 , 6.49)	(0.38 , 5.28)	(-0.53 , 5.38)
No dividends - Old	β^+	-0.33	0.00	-2.25	-3.43	-4.21	-3.29
		(-2.07, 1.41)	(-1.58 , 1.58)	(-6.14 , 1.65)	(-7.51 , 0.65)	(-9.71 , 1.30)	(-7.57 , 0.98)
	β^-	1.12	2.70**	4.13**	3.47*	2.58*	2.14*
		(-0.32, 2.57)	(0.92 , 4.48)	(1.07 , 7.19)	(0.21 , 6.72)	(0.16 , 5.00)	(0.07 , 4.20)
Positive dividends - Young	β^+	-0.43	-1.92	-4.51**	-4.75**	-6.01**	-4.74*
		(-2.16, 1.29)	(-4.19 , 0.34)	(-8.11 , -0.91)	(-8.40 , -1.10)	(-10.54 , -1.49)	(-8.77 , -0.72)
	β^-	-0.83	1.74	1.43	1.56	0.80	0.84
		(-2.58, 0.92)	(-0.99 , 4.47)	(-1.63 , 4.50)	(-1.98 , 5.10)	(-2.68 , 4.27)	(-2.98 , 4.66)
Positiv e dividends - Old	β^+	-0.20	-1.30	-3.57	-3.26**	-5.57*	-4.48
		(-2.16, 1.76)	(-4.17 , 1.57)	(-7.39 , 0.25)	(-5.89 , -0.63)	(-10.47 , -0.68)	(-9.40 , 0.45)
	β^-	-0.31	1.42	2.82	2.61	2.31	2.36
		(-1.65, 1.02)	(-0.28 , 3.11)	(-0.73 , 6.37)	(-1.59 , 6.81)	(-1.87 , 6.49)	(-2.15 , 6.88)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (4). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C.4. Results by size and age groups

Table C.10: Asymmetric Effects of Monetary Policy by Size and Age Groups

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small - Young	β^+	0.07	0.09	-1.78	-3.61*	-4.16*	-3.84*
		(-0.47, 0.60)	(-1.65 , 1.83)	(-3.66 , 0.10)	(-6.85 , -0.37)	(-7.81 , -0.51)	(-7.64 , -0.04)
	β^-	0.09	-0.44	-0.62	-1.38	-1.76	-1.41
		(-0.22, 0.40)	(-1.38 , 0.50)	(-2.07 , 0.84)	(-3.34 , 0.57)	(-4.19 , 0.67)	(-3.46 , 0.64)
Small - Old	β^+	0.58	1.82	-0.20	-1.53	-0.37	-0.74
		(-0.08, 1.24)	(-1.03 , 4.66)	(-3.90 , 3.49)	(-5.57 , 2.51)	(-4.37 , 3.62)	(-4.28 , 2.81)
	β^-	-0.24	0.15	1.32	0.75	-1.20	-0.59
		(-0.56, 0.08)	(-1.36 , 1.67)	(-0.69 , 3.32)	(-0.55 , 2.06)	(-3.29 , 0.89)	(-2.92 , 1.74)
Large - Young	β^+	0.22**	-0.51	-2.46*	-2.70*	-3.12*	-3.27*
		(0.04, 0.39)	(-1.53 , 0.50)	(-4.54 , -0.37)	(-5.14 , -0.26)	(-5.89 , -0.34)	(-6.21 , -0.33)
	β^-	-0.02	0.58	0.73	0.65	0.63	0.10
		(-0.27, 0.23)	(-0.34 , 1.49)	(-0.62 , 2.08)	(-0.71 , 2.01)	(-0.79 , 2.05)	(-1.82 , 2.01)
Large - Old	β^+	0.20*	-0.23	-1.06**	-1.77***	-2.38**	-1.99**
		(0.01, 0.40)	(-0.66 , 0.19)	(-1.88 , -0.23)	(-2.80 , -0.73)	(-4.00 , -0.76)	(-3.45 , -0.53)
	β^-	-0.09	0.37	0.08	0.15	0.13	0.32
		(-0.35, 0.17)	(-0.26 , 1.01)	(-1.22 , 1.38)	(-1.32 , 1.62)	(-1.32 , 1.58)	(-1.25 , 1.88)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small - Young	β^+	-0.45	-0.28	-1.27	-1.30	-1.17	-1.47**
		(-0.92, 0.01)	(-0.87 , 0.31)	(-2.85 , 0.32)	(-2.71 , 0.11)	(-2.55 , 0.20)	(-2.47 , -0.46)
	β^-	-0.04	-0.16	0.40	-0.04	-0.31	-0.10
		(-0.53, 0.45)	(-0.86 , 0.53)	(-0.80 , 1.59)	(-0.91 , 0.82)	(-1.12 , 0.51)	(-0.79 , 0.59)
Small - Old	β^+	0.51*	0.23	-0.59	-0.31	-0.58**	-0.88
		(0.02, 1.00)	(-1.43 , 1.89)	(-1.64 , 0.46)	(-1.02 , 0.39)	(-0.97 , -0.19)	(-2.10 , 0.34)
	β^-	-0.90***	-0.45	0.28	-0.19	-0.69	-0.36
		(-1.14, -0.67)	(-1.40 , 0.50)	(-0.35 , 0.91)	(-0.87 , 0.49)	(-1.59 , 0.21)	(-2.14 , 1.43)
Large - Young	β^+	0.07	0.10	-0.42	-0.66**	-0.72*	-0.46
		(-0.21, 0.35)	(-0.38 , 0.57)	(-0.93 , 0.09)	(-1.19 , -0.14)	(-1.35 , -0.08)	(-1.23 , 0.31)
	β^-	-0.00	-0.04	0.16	0.17	0.03	0.04
		(-0.31, 0.31)	(-0.56 , 0.48)	(-0.31 , 0.64)	(-0.30 , 0.65)	(-0.44 , 0.50)	(-0.42 , 0.49)
Large - Old	β^+	-0.20	-0.41*	-0.83***	-0.67**	-0.98***	-0.78**
		(-0.48, 0.08)	(-0.77 , -0.05)	(-1.35 , -0.30)	(-1.18 , -0.16)	(-1.55 , -0.40)	(-1.43 , -0.13)
	β^-	0.24	0.23	0.53*	0.31	0.44	0.39
		(-0.04, 0.52)	(-0.15 , 0.61)	(0.07 , 0.98)	(-0.12 , 0.73)	(-0.11 , 0.99)	(-0.04 , 0.81)

Panel C. Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Small - Young	β^+	-0.94	4.10**	2.11	-0.08	-0.37	-2.56
		(-3.07, 1.19)	(1.11 , 7.09)	(-1.12 , 5.34)	(-3.46 , 3.30)	(-3.09 , 2.35)	(-8.63 , 3.51)
	β^-	0.79	0.14	-0.26	1.70	-0.16	1.64
		(-0.92, 2.51)	(-2.93 , 3.21)	(-3.78 , 3.26)	(-1.86 , 5.26)	(-2.85 , 2.52)	(-1.93 , 5.22)
Small - Old	β^+	1.52	0.27	-0.29	-4.15	-4.31	-4.20
		(-0.78, 3.82)	(-2.32 , 2.86)	(-7.79 , 7.21)	(-11.71 , 3.40)	(-10.42 , 1.81)	(-8.61 , 0.22)
	β^-	2.07*	3.71**	5.64*	5.76*	2.57	2.91
		(0.31, 3.83)	(0.79 , 6.63)	(0.83 , 10.45)	(0.50 , 11.01)	(-1.61 , 6.75)	(-1.67 , 7.48)
Large - Young	β^+	-0.46	-0.46	-4.36*	-5.26*	-5.65*	-3.75
		(-2.28, 1.37)	(-2.88 , 1.95)	(-8.40 , -0.32)	(-10.28 , -0.24)	(-11.16 , -0.15)	(-8.09 , 0.59)
	β^-	1.00	2.96**	3.31*	3.32*	2.81	2.72
		(-0.70, 2.70)	(0.74 , 5.17)	(0.30 , 6.32)	(0.08 , 6.56)	(-0.08 , 5.70)	(-0.18 , 5.63)
Large - Old	β^+	-0.43	-1.05	-2.80	-4.21**	-5.54**	-4.58**
		(-1.88, 1.02)	(-2.92 , 0.83)	(-5.86 , 0.26)	(-7.50 , -0.91)	(-9.59 , -1.49)	(-8.20 , -0.95)
	β^-	0.54	2.20**	2.83	2.26	2.30	2.20
		(-0.64, 1.71)	(0.41 , 3.99)	(-0.02 , 5.67)	(-0.99 , 5.51)	(-0.48 , 5.08)	(-0.70 , 5.10)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (4). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C.5. Results by dividend and credit rating groups

Table C.11: ASYMMETRIC EFFECTS OF MONETARY POLICY BY DIVIDEND AND CREDIT RATING GROUPS

Panel A. Log Employees

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - High rating	β^+	0.05	-0.19	-1.05	-1.74**	-1.80	-1.45
		(-0.11, 0.20)	(-0.77 , 0.39)	(-2.22 , 0.13)	(-3.13 , -0.35)	(-3.66 , 0.06)	(-3.21 , 0.31)
	β^-	0.01	0.41	0.11	0.13	-0.06	-0.74
		(-0.26, 0.28)	(-0.35 , 1.16)	(-1.26 , 1.49)	(-1.35 , 1.61)	(-1.66 , 1.53)	(-2.62 , 1.14)
No dividends - Low rating	β^+	0.18	0.02	-1.56	-2.73*	-2.79	-2.92
		(-0.03, 0.38)	(-0.88 , 0.92)	(-3.39 , 0.26)	(-5.26 , -0.20)	(-5.70 , 0.12)	(-5.97 , 0.14)
	β^-	0.08	0.44	0.99	0.64	0.57	0.23
		(-0.19, 0.35)	(-0.26 , 1.14)	(-0.24 , 2.22)	(-0.68 , 1.96)	(-0.69 , 1.83)	(-1.09 , 1.54)
Positive dividend - High rating	β^+	0.12*	-0.20	-0.67*	-0.83	-1.11*	-0.75
		(0.01, 0.23)	(-0.46 , 0.07)	(-1.28 , -0.05)	(-1.69 , 0.02)	(-2.14 , -0.08)	(-1.67 , 0.17)
	β^-	-0.13	0.14	0.05	-0.12	-0.05	-0.22
		(-0.30, 0.05)	(-0.28 , 0.56)	(-0.70 , 0.80)	(-1.00 , 0.75)	(-0.89 , 0.80)	(-1.21 , 0.77)
Positive dividend - Low rating	β^+	0.05	-0.69**	-1.46**	-2.06**	-2.29**	-1.72**
		(-0.09, 0.19)	(-1.20 , -0.18)	(-2.46 , -0.45)	(-3.60 , -0.53)	(-3.97 , -0.62)	(-3.13 , -0.31)
	β^-	0.00	0.75**	0.90	0.95	0.83	0.48
		(-0.21, 0.21)	(0.27 , 1.22)	(-0.15 , 1.96)	(-0.33 , 2.24)	(-0.56 , 2.23)	(-0.84 , 1.80)

Panel B. Investment Rate

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - High rating	β^+	0.02	-0.00	-0.66*	-0.52	-0.76	-0.57
		(-0.22, 0.27)	(-0.35 , 0.34)	(-1.22 , -0.10)	(-1.16 , 0.12)	(-1.54 , 0.03)	(-1.26 , 0.12)
	β^-	0.06	0.14	0.44	0.21	0.28	0.14
		(-0.24, 0.37)	(-0.20 , 0.48)	(-0.14 , 1.01)	(-0.37 , 0.80)	(-0.32 , 0.87)	(-0.44 , 0.72)
No dividends - Low rating	β^+	-0.03	0.00	-0.59	-0.86	-1.01*	-0.63
		(-0.29, 0.23)	(-0.42 , 0.42)	(-1.46 , 0.29)	(-1.74 , 0.01)	(-2.01 , -0.02)	(-1.54 , 0.29)
	β^-	0.24*	0.23	0.45	0.31	0.20	0.07
		(0.01, 0.47)	(-0.28 , 0.73)	(-0.22 , 1.11)	(-0.31 , 0.93)	(-0.40 , 0.80)	(-0.52 , 0.66)
Positive dividends - High rating	β^+	-0.10	-0.11	-0.28	-0.43	-0.49	-0.42
		(-0.48, 0.28)	(-0.53 , 0.31)	(-0.77 , 0.20)	(-0.88 , 0.03)	(-1.06 , 0.07)	(-1.07 , 0.23)
	β^-	0.07	0.17	0.24	0.22	0.22	0.19
		(-0.19, 0.33)	(-0.12 , 0.45)	(-0.08 , 0.57)	(-0.10 , 0.53)	(-0.15 , 0.60)	(-0.20 , 0.57)
Positive dividends - Low rating	β^+	-0.17	-0.07	-0.51**	-0.75***	-0.66**	-0.48
		(-0.37, 0.02)	(-0.35 , 0.20)	(-0.90 , -0.11)	(-1.17 , -0.33)	(-1.18 , -0.14)	(-1.01 , 0.06)
	β^-	0.12	0.13	0.41	0.44**	0.31	0.19
		(-0.10, 0.33)	(-0.16 , 0.41)	(-0.02 , 0.83)	(0.07 , 0.81)	(-0.09 , 0.70)	(-0.18 , 0.55)

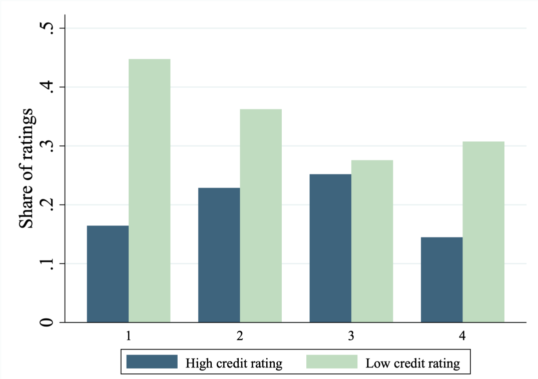
Panel C. Sales

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
No dividends - High rating	β^+	0.17	-0.41	-2.30	-3.30*	-3.75*	-3.03*
		(-0.79, 1.12)	(-1.77 , 0.95)	(-4.97 , 0.37)	(-6.12 , -0.48)	(-6.99 , -0.51)	(-5.59 , -0.48)
	β^-	0.03	1.50*	1.50	1.71	1.12	0.78
		(-1.12, 1.17)	(0.12 , 2.88)	(-0.41 , 3.41)	(-0.30 , 3.72)	(-0.51 , 2.76)	(-1.00 , 2.56)
No dividends - Low rating	β^+	-0.49	-0.49	-2.44	-3.66*	-3.80	-3.86
		(-1.77, 0.79)	(-2.24 , 1.26)	(-5.07 , 0.18)	(-6.76 , -0.56)	(-7.92 , 0.31)	(-8.14 , 0.41)
	β^-	1.22	3.54***	3.72***	2.87**	2.76***	1.95*
		(-0.03, 2.48)	(1.64 , 5.44)	(1.53 , 5.91)	(0.72 , 5.03)	(1.17 , 4.35)	(0.11 , 3.78)
Positive dividends - High rating	β^+	0.74**	-0.57	-1.70	-2.12*	-2.62	-1.57
		(0.19, 1.30)	(-1.62 , 0.49)	(-3.57 , 0.18)	(-4.16 , -0.07)	(-5.26 , 0.03)	(-3.82 , 0.67)
	β^-	-0.65*	0.82	0.92	0.71	0.56	0.04
		(-1.30, -0.01)	(-0.37 , 2.02)	(-0.74 , 2.59)	(-1.09 , 2.51)	(-1.03 , 2.16)	(-1.62 , 1.69)
Positive dividends - Low rating	β^+	0.17	-0.60	-3.55*	-4.55**	-5.13**	-4.17*
		(-0.91, 1.25)	(-2.21 , 1.02)	(-6.58 , -0.52)	(-7.68 , -1.43)	(-9.26 , -0.99)	(-7.88 , -0.47)
	β^-	-0.20	1.39	3.40*	3.06	3.02	2.79
		(-1.39, 0.99)	(-0.38 , 3.16)	(0.35 , 6.45)	(-0.47 , 6.60)	(-0.52 , 6.57)	(-0.65 , 6.22)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (4). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

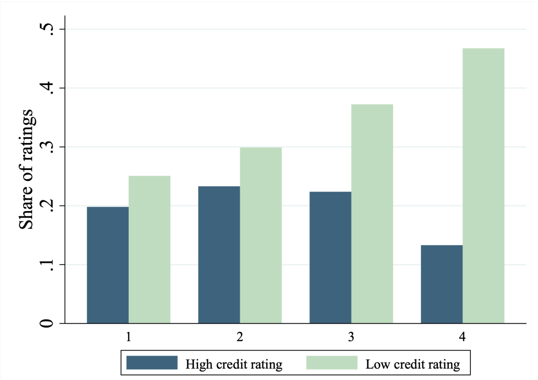
C.6. Supplementary figures

Figure C.8: CREDIT RATINGS ACROSS ALTERNATIVE FIRM LEVERAGE QUARTILES



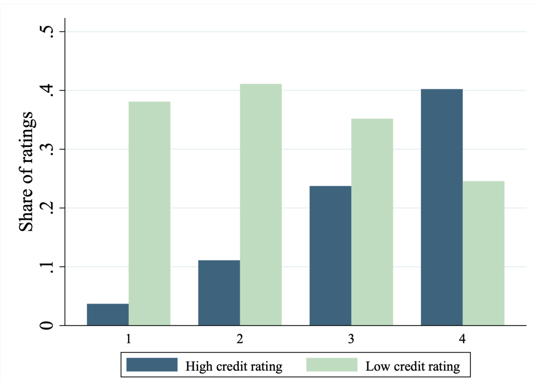
Notes: Credit ratings are generated using the S&P Quality Rating of the firms (*spcsrc*). High credit ratings cover firms with ratings $A+$, A , $A-$, $B+$ and B, and low credit ratings cover firms with ratings $B-$, C and D. Leverage quartiles are displayed on the x-axis, where 1 is the lowest leverage quartile, and 4 is the highest leverage quartile.

Figure C.9: CREDIT RATINGS ACROSS ALTERNATIVE FIRM LIQUIDITY QUARTILES



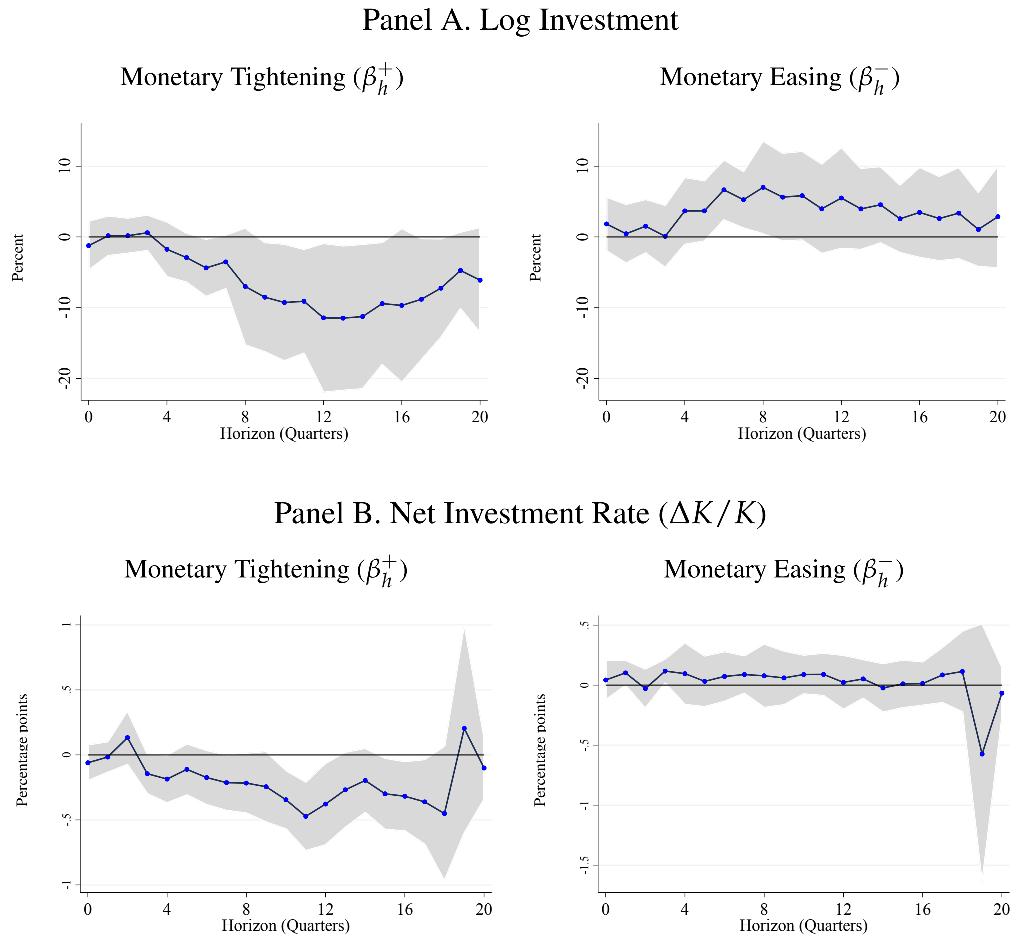
Notes: Credit ratings are generated using the S&P Quality Rating of the firms (*spcsrc*). High credit ratings cover firms with ratings $A+$, A , $A-$, $B+$ and B, and low credit ratings cover firms with ratings $B-$, C and D. Liquidity quartiles are displayed on the x-axis, where 1 is the lowest liquidity quartile, and 4 is the highest liquidity quartile.

Figure C.10: CREDIT RATINGS ACROSS ALTERNATIVE FIRM SIZE QUARTILES



Notes: Credit ratings are generated using the S&P Quality Rating of the firms (*spcsrc*). High credit ratings cover firms with ratings $A+$, A , $A-$, $B+$ and B, and low credit ratings cover firms with ratings $B-$, C and D. Size quartiles are displayed on the x-axis, where 1 is the lowest asset quartile, and 4 is the highest asset quartile.

Figure C.11: Asymmetric effects of monetary policy using alternative investment measures



Notes: The first (second) column shows the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. The dependent variables are cumulative change in log investment (capital expenditures) and net investment rate, respectively. The estimation is as follows:

$$y_{j,t+h} - y_{j,t-1} = \tau t + \alpha_j^h + \beta_h^+ \, max[0, \Delta R_t] + \beta_h^- \, min[0, \Delta R_t] + \epsilon_{j,t+h}$$

where horizon is h = 0, 1,..., H and ΔR is the change in the one-year government bond yield instrumented with the monetary policy shocks following Gertler and Karadi (2015). The shaded areas show 90 percent confidence intervals.

Table C.12: Asymmetric Effects of Monetary Policy

		h_0	h_4	h_8	h_{10}	h_{12}	h_{16}
Log Employees	β^+	0.06	-0.18	-0.79**	-1.13**	-1.06*	-0.92
		(-0.05, 0.16)	(-0.50 , 0.14)	(-1.42 , -0.15)	(-2.02 , -0.23)	(-2.06 , -0.06)	(-2.08 , 0.23)
	β^-	0.04	0.21	0.33	0.29	0.20	0.09
		(-0.06, 0.13)	(-0.08 , 0.50)	(-0.16 , 0.82)	(-0.20 , 0.77)	(-0.28 , 0.69)	(-0.39 , 0.56)
Investment Rate	β^+	-0.10	-0.15	-0.48	-0.68**	-0.70*	-0.47
		(-0.33, 0.13)	(-0.43 , 0.12)	(-1.05 , 0.09)	(-1.22 , -0.14)	(-1.35 , -0.05)	(-1.09 , 0.15)
	β^-	0.15	0.16	0.34	0.28	0.21	0.10
		(-0.09, 0.38)	(-0.18 , 0.50)	(-0.17 , 0.84)	(-0.14 , 0.71)	(-0.26 , 0.68)	(-0.37 , 0.58)
Log Sales	β^+	0.13	-0.34	-1.81**	-2.09**	-2.66**	-1.98*
		(-0.29, 0.56)	(-1.14 , 0.46)	(-2.97 , -0.66)	(-3.69 , -0.50)	(-4.43 , -0.88)	(-3.75 , -0.22)
	β^-	0.08	0.90	1.09	1.02	0.90	0.78
		(-0.36, 0.52)	(-0.10 , 1.89)	(-0.12 , 2.30)	(-0.23 , 2.26)	(-0.26 , 2.07)	(-0.16 , 1.73)

Notes: The first (second) rows show the impulse response to a monetary policy shock that increases (decreases) the one-year Treasury rate by 25 basis points on impact. Each panel is estimated separately using specification (2). Specifically, the panels report the point estimates provided in Figures (1) - (3). 90 percent confidence intervals are provided in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

D. Comparisons to the aggregate literature

In terms of magnitudes, it is not straightforward to establish comparisons with aggregate studies due to differences in data, time span and methodologies.

First, most of the previous literature estimating the impact of interest rates on aggregate variables uses larger estimation periods. For example, Barnichon et al. (2017) focus on the 1955- 2007 time period and find that a 0.7 pp increase in the federal funds rate results in a 0.15 pp increase in the unemployment rate. To put it in comparable units, a 0.25 pp increase in the federal funds rate results in approximately a 0.05 pp increase in the unemployment rate. In contrast, using data from August 1989 to July 2007, Angrist et al. (2018) find 25 basis points (0.25 pp) increase in target funds rate generate a 0.3 pp increase in the unemployment rate two years after the policy. The variations in these estimations could arise from differences in methodology or the broader time span covered by Barnichon et al. (2017).[50] Given the better sample overlap, I proceed with Angrist et al. (2018) estimate of a 0.3 pp increase in the unemployment rate for a quick calculation. Assuming there are 10 million unemployed individuals within a total labor force of 150 million, this yields an unemployment rate of about 6.67 percent. A 0.3 pp increase would lead to a new unemployment rate of 6.97 percent, suggesting that approximately 450,000 more people would be unemployed following a 25 basis points monetary tightening.

In comparison, the Compustat estimates in horizon 8 suggest a 0.8 percent decline in employment in response to a monetary tightening. If we assume a total employed population of 100 million, this projection indicates approximately 800,000 individuals being laid off. The differences between the 800,000 job loss in this study and the 450,000 unemployment estimate in Angrist et al. (2018) could be attributed to various factors like sample characteristics, duration of analysis, and methodological differences. First, it is important to note that the Compustat estimates pertain specifically to public firms, which predominantly consist of larger firms. As shown in Haltiwanger (2012), small businesses contribute much to job creation. Hence, the -0.8 percent estimate may differ for private firms, which is important for reaching an overall projection for the economy. Secondly, drawing direct comparisons with studies focusing on different aggregate variables can be challenging. For example, these calculations assume a fixed labor force, an assumption relevant for aligning projections concerning both employment levels and the unemployment rate. These complexities underscore the need for cautious interpretation when reconciling estimates across diverse economic indicators.

Finally, Angrist et al. (2018) find 25 bp increase in target funds rate generates a -1.7 percent decline in industrial production two years after the policy. To facilitate a comparative analysis of these estimates, I conduct a back-of-the-envelope growth-accounting exercise. I assume a capital share of 0.3 percent and compute the following:

$$\Delta log(Y) = \Delta log(A) + \alpha \Delta log(K) + (1 - \alpha) \Delta log(L)$$

$$-1.73 = \Delta log(A) + 0.3 * (-3.89) + 0.7 * (-0.8)$$

leveraging capital stock estimates from Ottonello and Winberry (2020), paired with the employment

[50] For instance, Barnichon et al. (2017) may capture the rising participation of women in the labor force in the early part of their sample.

estimates from this study.[51] Abstracting from the effects on TFP, the projected change in industrial production amounts to approximately -1.73 percent, aligning reasonably well with the estimation provided by Angrist et al. (2018) using aggregate data.

[51] Ottonello and Winberry (2020) reports that a one standard deviation monetary shock (9 basis points) causes a 1.4 percent decline in the stock of capital. Consequently, a 25 basis points monetary innovation would generate a 3.89 percent change in capital stock.