Online Appendix for "Debt Maturity Heterogeneity and Investment Responses to Monetary Policy" by Minjie Deng and Min Fang (Not for Publication)

A Data Construction and Statistics

A.1 Compustat Variable Construction

We have briefly described the constructions of the key variables. In this appendix, we provide detailed information on how all variables are constructed and our justifications for our data choices. The database is Compustat's North America Fundamentals Quarterly.

Investment: Investment is defined as the ratio of quarterly capital expenditures (*capxy*) to the lag of quarterly property, plant and equipment (*ppentq*). As the capital expenditures (*capxy*) is a cumulative value within a fiscal year, we take differences between quarters except for the first fiscal quarter. The exact variable is $i_{jt} = capxy_{jt}/ppentq_{jt-1}$. This measure is considered more accurate because it suffers less from mismeasurement problems or firm-specific depreciation rate issues. Other measures usually use the difference between *ppentq* observations, adjust them with price index, back out the capital level, and then take the log-difference of the capital levels. This approach assumes the same depreciation rate for all firms as well as the same price index for all firms, which could be problematic. However, the capital expenditures (*capxy*) is a direct measure of how much "money" within that period a firm actually spent within a period to form property, plant and equipment (*ppentq*), hence neither inflation rate nor depreciation rates need to be considered.

Maturity: We define the debt maturity structure m_{jt} as the ratio of debt maturing in longer than 1 year (*dlttq*) to total debt (*dlcq+dlttq*).

Borrowing: Changes in total debt (Δ *(dlcq+dlttq)*) over total debt (*dlcq+dlttq*), which can be decomposed as long-term debt borrowing and short-term debt borrowing. Long-term debt borrowing is defined as changes in long-term debt (Δ*dlttq*) over debt (*dlcq+dlttq*). Short-term debt borrowing is defined as changes in short-term debt (Δ*dlcq*) over debt (*dlcq+dlttq*).

Leverage: The definition of leverage is quite standard: as debt-to-assets ratio using debt maturing in one year plus debt maturing in longer than one year (*dlcq+dlttq*) over total asset (*atq*). This measures the debt level of a firm quarterly.

Distance-to-Default: We construct the distance-to-default measure as in Gilchrist and Zakrajšek (2012) and Blanco and Navarro (2016). The variable is defined as $dd \equiv \frac{log(V/D)+(\mu_V-0.5\sigma_V^2)}{\sigma_V}$, where V denotes the total value of the firm, μ_V the annual expected return on V, σ_V the annual volatility of the firm's value, and D firm debt. The iteration method to construct dd for each firm at each quarter is outlined as in Ottonello and Winberry (2020) Online Appendix (additional datasets required: CRSP and Federal Reserve Board of Governors H.15 Selected Interest Rates release).

Age: We construct age for each firm as their current quarter of operation minus their date (quarter) of incorporation (additional datasets required: Datastream WorldScope Fundamentals).

Liquidity: We construct liquidity as the ratio of cash and short-term investments ($cheq$) to total assets (atq).

Control Variables: The firm-level control variables follow classic literature: a size measure (total assets atq), cash holdings $cheq$, revenue $revtq$, sales $saleq$, sales growth rate $\Delta saleq$ divided by $saleq$, profitability $oibdpq$ divided by atq, earnings volatility averaged over five quarters $\frac{1}{5} * \frac{niq}{atq}$, and net equity issuance $\Delta(lseq - ltq) - \Delta req$.

A.2 Sample Selection

Our sample selection criteria approach follows Almeida et al. (2012). We show more details here than in the paper for completeness. First, we drop observations with mismatched fiscal quarters. Some firms use a fiscal quarter which is not in line with calendar quarters, i.e., a firm may have their second fiscal quarter as (Mar, Apr, May) as opposed to the calendar quarter of (Apr, May, Jun). Matching a firm such as this one with the monetary shocks, which are set at calendar quarters, cannot be done cleanly. Second, we disregard observations from financial sector firms (SICs 6000-6999), non-profit organizations and governmental enterprises (SICs 8000s 9000s), as well as utilities (SICs 4900-4999). This is because firms in these categories behave very differently compared to other production firms.

The remaining parts are standard. We drop firms with missing or negative sales, firms with more than 100% sales or asset growth in a quarter, firms with either cash holdings, capital expenditures, or property, plant and equipment larger than total assets, and firms with potentially mis-measured debt structures (debt greater than total assets or components greater than total long-term debt). These selections are effectively trying to rule out extreme observations which could emerge when firms are entering bankruptcy. We also drop firms with very small size or a very low long-term debt ratio as in Almeida et al. (2012). Details of the sample selection process are in Table 1.

Table 1: Sample Selection

Compustat North America Quarterly, 1990-2008	**604,019**
Drop firms with:	
Fiscal quarter miss-match	-112,626
SIC 8000s & 9000s (NGO & Government Entrepreneurs)	-33,254
SIC 6000-6999 (Financial Firms)	-150,989
SIC 4900-4999 (Utility Firms)	-27,356
Growth of Assets > 100% in a quarter	-56,235
Missing Sales	-1,599
Sales < 0	-180
Growth of Sales > 100% in a quarter	-22,290
Cash is greater than Assets	-490
Property, Plant, and Equipment > Total Assets	-837
Total Assets (ATQ) < 10	-42,001
Missing Short-term/Long-term Debt	-9,864
Total Debt > Total Assets	-4,992
All firms	**141,306**

A.3 Summary Statistics

Summary Statistics for the Firm-level Sample: Table 2 summarizes the statistics of key covariates. The sample displays substantial heterogeneity in leverage, distance-to-default, firm age, liquidity, total assets, and cash holdings. Table 3 shows the correlations between maturity and all other key control variables.

Table 2:
Key Statistics for Firm-level Covariates

Statistics	Leverage	distance-to-default	Age	Liquidity	Total Assets	Cash Holdings
Observation	141,265	113,843	95,876	141,265	141,265	141,265
Mean	0.35	4.81	98	0.09	2544	149
Median	0.32	4.13	60	0.10	341	60
Std	0.19	3.95	110	0.14	10009	752
Max	0.95	40.23	625	0.99	479921	54987
75%	0.46	6.93	129	0.11	1353	60
25%	0.21	1.96	27	0.01	78	2.1
Min	0.06	-4.36	0	-0.05	10	-14

Notes: The data is from Compustat Quarterly 1990-2008. Leverage is measured as total debt over total asset, distance-to-default is measured as in Gilchrist and Zakrajšek (2012), age is measured as current quarter minus date (quarter) of incorporation, liquidity is measured as cash over total asset. Total assets and cash holdings are directly reported.

Summary Statistics for Alternative Monetary Shocks: Table 4 summarizes the statistics of

Table 3:
CORRELATION OF MATURITY WITH KEY COVARIATES

	Maturity	Leverage	Distance-to-default	Age	Liquidity	Total Assets	Cash Holdings
Maturity	1.0000						
Leverage	0.0690	1.0000					
Distance-to-default	0.0894	-0.4039	1.0000				
Age	-0.0596	-0.1375	0.2535	1.0000			
Liquidity	0.0794	-0.0998	-0.0151	-0.1390	1.0000		
Total Assets	-0.0436	-0.0453	0.1879	0.1466	-0.0674	1.0000	
Cash Holdings	-0.0310	-0.0642	0.1792	0.1283	0.1077	0.6583	1.0000

Notes: The data is from Compustat Quarterly 1990-2008. Maturity is measured as long-term debt over total debt. Leverage is measured as total debt over total asset, distance-to-default is measured as in Gilchrist and Zakrajšek (2012), age is measured as current quarter minus date (quarter) of incorporation, liquidity is measured as cash over total asset. Total assets and cash holdings are directly reported. All pairwise correlations are significant at p value < 0.0001, and therefore are not reported for each individual pair.

our measures of alternative monetary shocks including the smoothed measure as in Ottonello and Winberry (2020) and the measure excluding central bank information effects as in Jarociński and Karadi (2020). Table 5 shows the correlation between the different measures of monetary policy shocks.

Table 4:
STATISTICS ON ALTERNATIVE MONETARY POLICY SHOCKS

Statistics	$\Delta_{ow}^{m,tight}$	$\Delta_{ow}^{m,wide}$	Δ_{jk}^{m}
Observation	75	75	76
Mean	-0.0491	-0.0476	-0.0149
Median	-0.0163	-0.0134	0.0017
Std	0.1050	0.1087	0.0816
Max	0.2374	0.2331	0.1940
Min	-0.4350	0.0.4831	-0.3071

Note: $\Delta_{ow}^{m,tight}$ denotes $\Delta^{m,30}$ smoothly aggregated to a quarterly series as in Ottonello and Winberry (2020), and $\Delta_{ow}^{m,wide}$ denotes $\Delta^{m,60}$ similarly aggregated. $\Delta_{jk}^{m,tight}$ denotes the monetary policy shock excluding central bank information effects as in Jarociński and Karadi (2020).

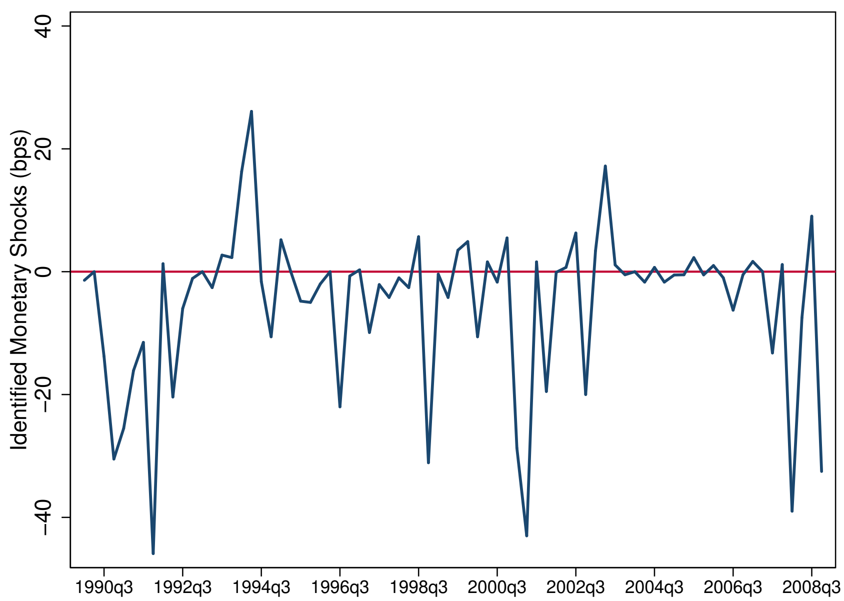
Time Series of the Main Measure of Monetary Shocks: Figure 1 shows the quarterly aggregated high-frequency identified monetary policy shocks (30mins window). Surprises of monetary expansions are large in recessions during the beginning of the 1990s, the internet crisis in 2001, and the Great Recession in 2007.

Table 5:
CORRELATION OF MONETARY POLICY SHOCKS

	$\Delta^{m,tight}$	$\Delta^{m,wide}$	$\Delta^{m,tight}_{ow}$	$\Delta^{m,wide}_{ow}$	Δ^{m}_{jk}
$\Delta^{m,tight}$	1.0000				
$\Delta^{m,wide}$	0.9851	1.0000			
$\Delta^{m,tight}_{ow}$	0.6592	0.6799	1.0000		
$\Delta^{m,wide}_{ow}$	0.6425	0.6770	0.9900	1.0000	
Δ^{m}_{jk}	0.5233	0.5501	0.4345	0.4337	1.0000

Notes: $\Delta^{m,tight}$ denotes $\Delta^{m,30}$ aggregated to a quarterly series as in Wong (2016), and $\Delta^{m,wide}$ denotes $\Delta^{m,60}$ similarly aggregated. $\Delta^{m,tight}_{ow}$ denotes $\Delta^{m,30}$ smoothly aggregated to a quarterly series as in Ottonello and Winberry (2020), and $\Delta^{m,wide}_{ow}$ denotes $\Delta^{m,60}$ similarly aggregated. $\Delta^{m,tight}_{jk}$ denotes the monetary policy shock excluding central bank information effects as in Jarociński and Karadi (2020).All pairwise correlations are significant at p value=0.001, and therefore are not reported for each individual pair.

Figure 1:
TIME SERIES OF IDENTIFIED MONETARY POLICY SHOCKS



Notes: This figure shows the quarterly aggregated high-frequency identified monetary policy shocks (30mins window). Surprises of monetary expansions are large in recessions during the beginning of the 1990s, the internet crisis in 2001, and the Great Recession in 2007.

B Robustness Checks for Main Results

B.1 Robustness Check regarding Monetary Policy Shocks

Monetary shocks within-60 mins window In Table 6, we carry out a robustness check using an alternative measure of monetary policy shocks which is based on aggregating the shocks derived from observing 60 minute windows around FOMC meetings. The point estimates are in general very stable in terms of significance, signs, and magnitudes compared with the baseline estimation in Table 3 in the paper.

Table 6:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY,
USING SHOCKS WITH 60 MINS WINDOW

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.183**	0.184**	—	—	0.212**	0.000
	(0.075)	(0.075)	(.)	(.)	(0.086)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-0.509***	-0.606***	-0.691***	-0.568***	-0.694***
		(0.175)	(0.175)	(0.194)	(0.206)	(0.196)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			-0.270		0.338	0.452
			(0.183)		(0.362)	(0.361)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.075***	0.056**	0.082***
				(0.026)	(0.027)	(0.029)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.365	0.365	0.373	0.368	0.360	0.368
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right)\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}^1$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Monetary shocks with smoothed aggregation In Table 7, we show a robustness check using an alternative measure of monetary policy shocks which is based on smoothed aggregation

Table 7:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY, USING SMOOTHED MONETARY POLICY SHOCKS

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.332***	0.332***	—	—	0.373***	0.000
	(0.108)	(0.109)	(.)	(.)	(0.131)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-0.647**	-0.854***	-1.053***	-0.828***	-1.060***
		(0.256)	(0.183)	(0.261)	(0.280)	(0.260)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			-0.266		0.908*	1.049**
			(0.360)		(0.461)	(0.465)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.142***	0.113**	0.157***
				(0.045)	(0.043)	(0.047)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.366	0.366	0.373	0.368	0.361	0.368
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right) \Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}^2$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

following Ottonello and Winberry (2020). We use a moving average of the shocks weighted by the number of days in the quarter after the shock, which allows us to weight the shocks by the time that firms have had to react to them. Formally, the monetary policy shock in quarter q is given by:

$$x_q^m = \sum_{t \in J(q)} \omega^a(t) x_t^m + \sum_{t \in J(q-1)} \omega^b(t) x_t^m \tag{1}$$

where $\omega^a(t) = \frac{\tau_q^n(t) - \tau_q^d(t)}{\tau_q^n(t)}$, $\omega^b(t) = \frac{\tau_q^d(t)}{\tau_q^n(t)}$, $\tau_q^d(t)$ denotes the day of the monetary policy announcement in the quarter, $\tau_q^n(t)$ is the number of days in the monetary policy announcement quarter, and $J(q)$ denotes the set of periods t contained in quarter q. The point estimates of average investment responses are quite stable in terms of significance, signs, and magnitudes. The only noticeable change is the slight drop in significance of leverage interacting with monetary policy shocks.

Monetary shocks controlling for the information channel In Table 8, we show a robustness check using an alternative measure of monetary policy shocks which excluded the potential central bank information (CBI) channel following Jarociński and Karadi (2020). The result shows that our results are not driven by this information channel of monetary policy.

Table 8:
Heterogeneous Responses of Investment to Monetary Policy, using monetary policy shocks net of CBI channel

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.239*	0.240*	—	—	0.288*	0.000
	(0.131)	(0.131)	(.)	(.)	(0.147)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-0.485*	-0.463*	-0.564*	-0.554*	-0.565*
		(0.267)	(0.271)	(0.330)	(0.309)	(0.334)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			-0.800**		-0.008	0.113
			(0.376)		(0.594)	(0.674)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.099**	0.050	0.101*
				(0.049)	(0.051)	(0.057)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.365	0.365	0.373	0.367	0.360	0.367
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right)\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}^3$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

B.2 Robustness Checks regarding Firm Characteristics

Not demeaned financial positions In Table 9, we show the investment responses considering the not demeaned firms' financial positions. These results are qualitatively consistent with our main results in the sense that firms with more long-term debt and shorter distance-to-default are less responsive to monetary shocks.

Table 9:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY, USING NOT DEMEANED FINANCIAL POSITIONS

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.185**	0.187**	—	—	-0.102	—
	(0.075)	(0.075)	(.)	(.)	(0.111)	(.)
$\Delta_t^m \times mat_{j,t-1}$		-0.302**	-0.331***	-0.398***	-0.370**	-0.432***
		(0.143)	(0.114)	(0.140)	(0.157)	(0.142)
$\Delta_t^m \times lev_{j,t-1}$			-0.297*		0.344*	0.454**
			(0.165)		(0.195)	(0.203)
$\Delta_t^m \times dd_{j,t-1}$				0.069***	0.066***	0.078***
				(0.019)	(0.022)	(0.021)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.365	0.365	0.373	0.368	0.360	0.368
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' X_{jt-1}\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}^4$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Permanent components of financial positions In Table 10, we show the investment responses considering the permanent components of firms' financial positions. The permanent components are defined as mean maturity $\bar{X}_j = \sum_{t=1}^{T_j} X_{j,t}/T_j$ over a firm's life cycle throughout the sample. The semi-elasticities of investment in terms of the permanent components of maturity are not significant. This suggests that the heterogeneous responses by maturity are potentially coming from the transitory components.

Table 10:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY, PERMANENT COMPONENTS OF FINANCIAL POSITIONS

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.180**	0.180**	—	—	-0.067	—
	(0.080)	(0.080)	(.)	(.)	(0.136)	(.)
$\Delta_t^m \times m\bar{a}t_{j,t}$		-0.052	-0.002	-0.093	-0.196	-0.116
		(0.215)	(0.229)	(0.247)	(0.247)	(0.263)
$\Delta_t^m \times le\bar{v}_{j,t}$			-0.333		0.194	0.137
			(0.200)		(0.273)	(0.274)
$\Delta_t^m \times d\bar{d}_{j,t}$				0.040**	0.054***	0.043**
				(0.017)	(0.019)	(0.020)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.365	0.365	0.373	0.368	0.360	0.368
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta'}\bar{X}_{jt}\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, $\bar{X}_{jt}$ is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including $\bar{X}_{jt}$, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta'}$ to the average effect $\boldsymbol{\alpha}^5$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Covariates in financial positions In Table 11, we examine the heterogeneous effects considering the interactions of monetary policy shocks with other covariates reflecting financial constraints. We capture several different aspects of financial constraints. First, as we already show in Table 3 in the paper, firms with higher leverage or shorter distance-to-default are less responsive to monetary shocks, consistent with recent work by Ottonello and Winberry (2020). Second, firms with fewer liquid assets reduce investment relative to others in response to monetary shocks, consistent with Jeenas (2018). And finally, younger firms are more responsive relative to others in response to monetary shocks, consistent with Cloyne et al. (2018). We also find that larger firms are more responsive in investment relative to smaller firms, however, since Compustat firms are already the largest firms in the economy, this finding may not applicable to firms of all sizes.

Table 11:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY, CONTROLLING FOR FINANCIAL CONSTRAINTS MEASURES

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$	-0.663***	-0.748***	-0.823***	-0.510**	-0.617***	-0.808***
	(0.184)	(0.201)	(0.199)	(0.218)	(0.184)	(0.229)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$	-0.319*					0.471
	(0.187)					(0.414)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$		0.082***				0.061**
		(0.028)				(0.026)
$\Delta_t^m \times \left(liq_{j,t-1} - \mathbb{E}_j[liq_{j,t}]\right)$			4.588***			2.935***
			(1.030)			(0.883)
$\Delta_t^m \times age_{j,t-1}$				-0.001**		-0.001**
				(0.000)		(0.000)
$\Delta_t^m \times size_{j,t-1}$					7.205*	7.972*
					(3.950)	(4.347)
N	104737	88648	104737	72892	104737	66700
adj. R^2	0.373	0.368	0.366	0.361	0.365	0.372
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
time FE	Yes	Yes	Yes	Yes	Yes	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right) \Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, distance-to-default dd_{jt-1}, liquidity liq_{jt-1}, size $size_{jt-1}$, and age age_{jt-1}. For size $size_{jt-1}$ and age age_{jt-1}, we replace $\boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right) \Delta_t^m$ with $\boldsymbol{\beta}' X_{jt-1} \Delta_t^m$. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Dynamic panel regression controlling for past investment In Table 12, we examine the heterogeneous effects by estimating the dynamic panel regressions controlling for past firm-level investment. The heterogeneous responses are still significant. However, since investment is persistent, the average effects of monetary policy shocks are not significant anymore.

Table 12:
HETEROGENEOUS RESPONSES OF INVESTMENT TO MONETARY POLICY,
CONTROLLING FOR LAGGED FIRM-LEVEL INVESTMENT

i_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.039	0.039	0.000	0.000	0.054	0.000
	(0.040)	(0.041)	(.)	(.)	(0.047)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-0.506**	-0.590**	-0.616***	-0.524**	-0.616***
		(0.206)	(0.224)	(0.209)	(0.202)	(0.209)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			-0.126		-0.086	-0.033
			(0.229)		(0.319)	(0.326)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.042**	0.032*	0.041*
				(0.020)	(0.019)	(0.023)
L.inv	0.259***	0.259***	0.256***	0.257***	0.260***	0.257***
	(0.010)	(0.010)	(0.017)	(0.011)	(0.011)	(0.011)
L2.inv	0.104***	0.104***	0.101***	0.103***	0.107***	0.103***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
L3.inv	0.035***	0.035***	0.032***	0.026***	0.029***	0.026***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
L4.inv	0.075***	0.075***	0.072***	0.070***	0.074***	0.070***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
N	83912	83912	83912	71867	71867	71867
adj. R^2	0.466	0.466	0.468	0.464	0.462	0.464
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

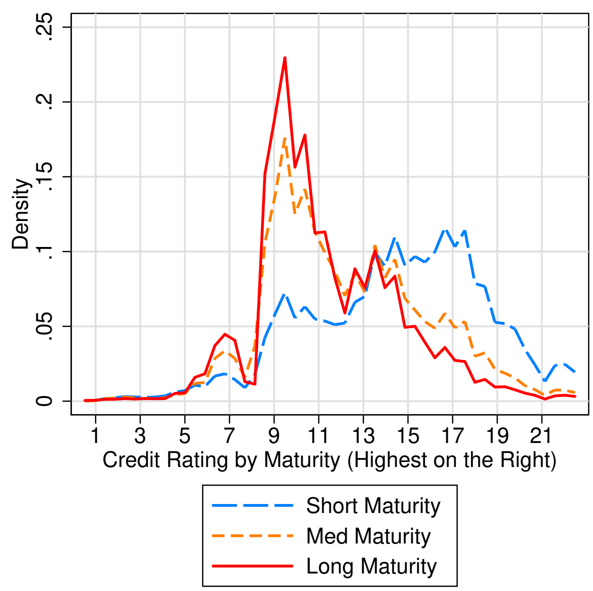
Notes: This table reports the results from estimating $i_{jt} = \boldsymbol{\alpha}\Delta_t^m + \sum_{l=1}^4 \gamma_l i_{jt-l} + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right) \Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where i_{jt} is the firm-level investment rate which builds into capital at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}^6$, we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

C Additional Empirical Results

C.1 Additional Empirical Results on Credit Rating

Credit rating distribution over maturity In Figure 2, we show additional results by credit rating and maturity. Maturity is equally divided into *Low*, *Medium*, and *High* three groups. A higher number on the x-axis indicates a better credit rating, thus a lower default risk. Number 22 corresponds to a credit rating of AAA+ and number 1 corresponds to a credit rating of SD (Selective Default). The plot shows that the distribution of firms with shorter maturity is skewed and peaks at higher credit ratings then other others.

Figure 2:
Credit Rating Distribution over Maturity



Notes: This figure shows the relationships between maturity and credit rating. Maturity is equally divided into *Low*, *Medium*, and *High* three groups. A higher number on the x-axis indicates a better credit rating, thus a lower default risk. 22 corresponds to a credit rating of AAA+ and 1 corresponds to a credit rating of SD (Selective Default).

Debt heterogeneity and credit ratings In Table 13, We show that there are negative relationships between credit rating and maturity after controlling for leverage, distance-to-default and all other firm-level characteristics as in baseline specification (2) in the paper.

Table 13:
DEBT HETEROGENEITY AND CREDIT RATINGS

Credit Rating	(1)	(2)	(3)	(4)
$mat_{j,t}$	-0.87***			-1.52***
	(-3.25)			(-8.44)
$lev_{j,t}$		-3.81***		-3.22***
		(-12.73)		(-10.45)
$dd_{j,t}$			0.10***	0.06***
			(9.59)	(7.95)
N	38774	38774	32374	32374
R^2	0.062	0.125	0.097	0.156
adj. R^2	0.062	0.124	0.097	0.155
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes

Notes: This table reports the results of the following specification: Credit $\text{Rating}_{jt} = \beta_0' X_{jt} + \gamma_z' Z_{jt} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$, where Credit Ratings are from Grade AAA+ (Grade 1) to Grade Selective Default (Grade 22) and a higher number means a higher default risk. X_{jt} includes both leverage and maturity, Z_{jt} is a vector of firm-level controls, γ_j, γ_{qs}, and γ_t are firm fixed effects, quarter-sector fixed effects, and time fixed effects. t statistics in parentheses. Significance level: * p<0.1, ** p<0.05, *** p<0.01

C.2 Additional Empirical Results on Borrowing Responses

We present here the additional results on how firm borrowing behavior responds to monetary policy shocks given their debt maturity. The empirical specification is the same as the baseline specification equation (2) in the paper, except for we replace the dependent variables with Δb_{jt} (changes in debt).

Total borrowing In Table 14, we report the results from estimating regression equation (??) with the dependent variable being firm-level borrowing Δb_{jt}. We find that an expansionary monetary policy shock boosts firms' borrowing, but there is no significant evidence for heterogeneous responses for firms with different maturities.

Long-term debt borrowing In Table 15, we report the results from estimating regression equation (2) in the paper with the dependent variable being firm-level long-term debt borrowing Δb_{jt}^L. We find that an expansionary monetary policy shock boosts firms' long-term debt borrowing, but firms with more long-term debt significantly lowered their long-term debt borrowing in response to monetary expansions. Also, firms with a longer distance-to-default increase their long-term debt borrowing in response to monetary expansions. Finally, after controlling for distance-to-default, firms with higher leverage increase their long-term debt borrowing in response to monetary expansions.

Table 14:
HETEROGENEOUS RESPONSES OF TOTAL BORROWING TO MONETARY POLICY

Δb_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.482*	0.484*	—	—	0.632*	—
	(0.271)	(0.271)	(.)	(.)	(0.323)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-1.335	-1.101	-1.117	-1.263	-1.174
		(1.338)	(1.619)	(1.719)	(1.714)	(1.735)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			7.230*		10.568***	10.326***
			(4.045)		(3.449)	(3.487)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.209	0.315***	0.362***
				(0.151)	(0.118)	(0.137)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.063	0.063	0.065	0.065	0.063	0.065
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $\Delta b_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right)\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where Δb_{jt} is the firm-level borrowing rate which builds into debt at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}$[7], we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Short-term debt borrowing In Table 16, we report the results from estimating regression equation (2) in the paper with the dependent variable being firm-level short-term debt borrowing Δb_{jt}^S. We find that an expansionary monetary policy shock does not boost firms' short-term debt borrowing, but firms with higher leverage significantly increase their short-term debt borrowing in response to monetary expansions.

Table 15:
HETEROGENEOUS RESPONSES OF LONG-TERM DEBT BORROWING TO MONETARY POLICY

Δb_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.389*	0.395*	—	—	0.560**	—
	(0.223)	(0.224)	(.)	(.)	(0.268)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		-4.137**	-3.948	-4.280**	-4.444**	-4.321**
		(2.059)	(2.364)	(2.122)	(2.037)	(2.114)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			4.491		7.661**	7.432**
			(3.968)		(2.982)	(3.002)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				0.247*	0.324***	0.357***
				(0.144)	(0.111)	(0.133)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.057	0.057	0.058	0.058	0.057	0.058
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $\Delta b_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta}' \left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right)\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where Δb_{jt} is the firm-level borrowing rate which builds into debt at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta}'$ to the average effect $\boldsymbol{\alpha}$[8], we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

Table 16:
HETEROGENEOUS RESPONSES OF SHORT-TERM DEBT BORROWING TO MONETARY POLICY

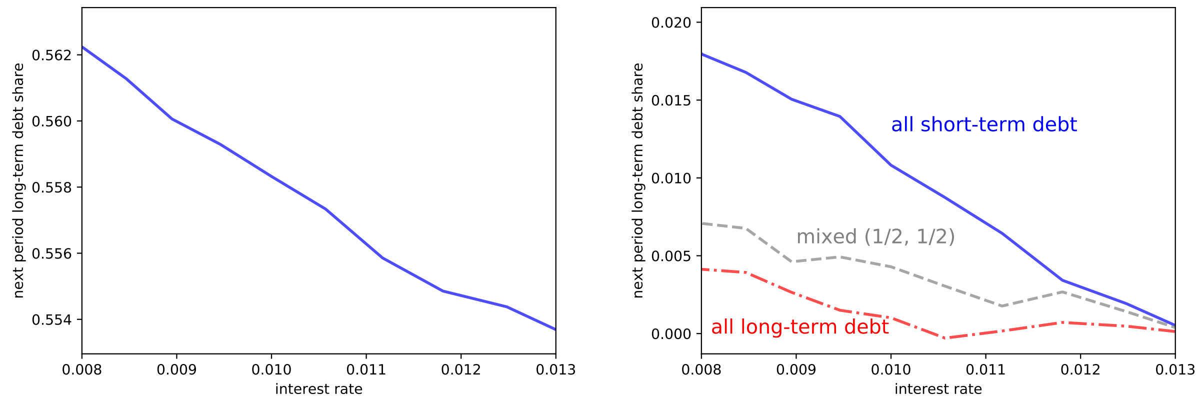
Δb_{jt}	(1)	(2)	(3)	(4)	(5)	(6)
Δ_t^m	0.093	0.089	—	—	0.072	—
	(0.111)	(0.112)	(.)	(.)	(0.116)	(.)
$\Delta_t^m \times \left(mat_{j,t-1} - \mathbb{E}_j[mat_{j,t}]\right)$		2.802	2.847	3.163	3.181	3.147
		(1.714)	(1.776)	(2.027)	(2.025)	(2.035)
$\Delta_t^m \times \left(lev_{j,t-1} - \mathbb{E}_j[lev_{j,t}]\right)$			2.739***		2.907**	2.894**
			(0.704)		(1.180)	(1.221)
$\Delta_t^m \times \left(dd_{j,t-1} - \mathbb{E}_j[dd_{j,t}]\right)$				-0.038	-0.010	0.005
				(0.034)	(0.036)	(0.039)
N	104737	104737	104737	88648	88648	88648
adj. R^2	0.101	0.101	0.103	0.102	0.100	0.102
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Sector-Seasonality FE	Yes	Yes	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	—	—	Yes	—
Time FE	No	No	Yes	Yes	No	Yes
Time-Firm Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table reports the results from estimating $\Delta b_{jt} = \boldsymbol{\alpha}\Delta_t^m + \boldsymbol{\beta'}\left(X_{jt-1} - \mathbb{E}_j[X_{jt}]\right)\Delta_t^m + \gamma_z' Z_{jt-1} + \gamma_a' Agg_{t-1} + \gamma_j + \gamma_{qs} + \gamma_t + \epsilon_{jt}$ where Δb_{jt} is the firm-level borrowing rate which builds into debt at quarter $t+1$, Δ_t^m is the monetary policy shock occurring at quarter t, X_{jt-1} is a vector capturing firm j's financial positions at quarter $t-1$, including lagged maturity m_{jt-1}, leverage l_{jt-1}, and distance-to-default dd_{jt-1}. Z_{jt-1} is a vector of lagged firm-level controls, including X_{jt-1}, total assets, cash holdings, revenue, sales, sales growth, profits, earnings volatility, and net equity issuance. Agg_{t-1} is a vector of aggregate controls, including the VIX index, GDP growth, unemployment rate, and inflation. γ_j and γ_{qs} are firm fixed effects and quarter-sector seasonality fixed effects, respectively. And finally, γ_t are time fixed effects to absorb all aggregate shocks. Since controlling for γ_t completely absorbs the variations in $\boldsymbol{\alpha}\Delta_t^m$, in order to compare the heterogeneous effects in $\boldsymbol{\beta'}$ to the average effect $\boldsymbol{\alpha}$[9], we shut down the time fixed effects in some regressions. The error term ϵ_{jt} is two-way clustered at both the firm level and quarterly time level. The sign "—" means estimations not available. Significance level: * p<0.1, ** p<0.05, *** p<0.01

D Theoretical Appendix

D.1 Additional Theoretical Results

Figure 3:
HETEROGENEOUS BORROWING RESPONSES TO MONETARY POLICY



(a) Average maturity response (b) Heterogeneous maturity response

Notes: Panel (a) plots the decision rules for next period long-term debt share with respect to the interest rate. Panel (b) plots for different debt maturity levels. To compare, we normalize each series by its own value when the interest rate is at the grid maximum. The solid blue line plots for firms with only short-term debt, the dash-dotted red line plots for firms with only long-term debt, and the dashed gray line is firms with half short-term debt and half long-term debt.

D.2 Computational Methods

This appendix describes the algorithm for computing the model. We compute the transformed model as discussed in Section 3.5 in the paper. We first discretize the shock processes and state variables. We then solve the model via value function iteration. We discretize the AR(1) processes for the z and r shocks respectively using 11 equally spaced grid points with Tauchen's method. For the bonds B we use a grid with 100 equally spaced points on $B \in [0, 2]$, and 10 equally spaced points on long-term debt share $f \in [0, 1]$. For capital we use a grid with 100 equally spaced points on $k \in [0.5, 4.5]$. We have tested with different numbers of grid points and the results are robust. The firm makes borrowing (total debt, long-term debt share) and investment decisions B', f' and k' for the next period. We restrict these choice variables to be on the grid. Rather than value function iteration until convergence, and then updating the price and then repeating, we update the bond price at every value function iteration step. This approach is faster and the two different procedures deliver very similar results.

Here is a more detailed description of our algorithm:

1. Create grids for capital k, total debt B, and long-term debt share f; Create grids and discretize the Markov processes for productivity z and interest rate r.

2. Guess the value function $V_0(z, k, r, B, f)$, price function for short-term debt $q_{S0}(z, k, r, B, f)$ and the price function for long-term debt $q_{L0}(z, k, r, B, f)$.

3. Update the value of continuing operations $V_c(z, k, r, B, f)$.

4. Compare $V_c(z, k, r, B, f)$ and 0, update the default rule, price functions $q_S(z, k, r, B, f)$ and $q_L(z, k, r, B, f)$, and the value function of firm $V(z, k, r, B, f)$.

5. Check the distance $dist_v$ between the updated and prior value functions, and the distance $dist_q$ between the updated price function for long-term debt and the ones from last iteration. If either of the distances is larger than the tolerance 5e-5, then go back to 3. Otherwise, stop.

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