

Crossing the Credit Channel: Credit Spreads and Firm Heterogeneity*

Gareth Anderson
IMF

Ambrogio Cesa-Bianchi
Bank of England, CEPR, and CfM

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*The views expressed in this paper are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, IMF management, or the Bank of England.

Motivation

- ▶ What do **firm-level funding costs** and **firm balance sheets** tell us about the transmission mechanism of monetary policy?
- ▶ Two open questions:
 - [1] Are financially constrained firms more responsive to monetary policy than unconstrained firms?
[Ottonello and Winberry (2020); Cloyne et al (2018); Jeenas (2018)]
 - [2] Are the differences driven by frictions in the corporate or financial intermediation sector?
[Bernanke, Gertler, & Gilchrist (1999); Gertler-Karadi-Kiyotaki (2010,2011)]
- ▶ Policy relevance: state dependence of monetary policy, design of unconventional policies...

This paper & Contribution

Leverage, age,
liquid assets, ...



- ▶ **Existing evidence:** response of relatively more constrained firms to monetary policy

- * Focus on quantities (e.g. investment) at quarterly (or lower) frequency

- ▶ **This paper's empirical innovation:**

- [1] Construct a daily bond-level data set

- [2] Study the high frequency effects of monetary policy on firms' credit spreads

- [3] Decompose effects into expected default and risk premium components

⇒ More testable implications, more credible identification, more precise estimates

What we do, what we find

▶ Daily frequency firm-level event study

- * Monetary policy hike leads to an aggregate increase in credit spreads
- * Effect is larger for firms with high leverage
- * Risk premium component accounts for most of the effect

▶ Simple theoretical framework

- * Heterogeneity and financial frictions on both firms and financial intermediaries
- * Crucial role for financial intermediation sector in monetary transmission

► **Credit view of monetary policy and financial accelerator**

[Bernanke and Blinder (1992); Bernanke and Gertler (1989); Bernanke and Gertler (1995); Kashyap, Lamont and Stein (1994); Gertler and Gilchrist (1994); Kashyap and Stein (1995); Bernanke, Gertler, and Gilchrist (1999); Kashyap and Stein (2000), Gertler and Kiyotaki (2010); Gertler and Karadi (2011); Gertler and Karadi (2015); Drechsel (2018); Chen and Ma (2019); Greenwald (2019)]

► **Heterogeneous impact of monetary policy across firms**

- * Focus on quantities: Ottonello and Winberry (2020); Crouzet and Mehrotra (2020); Cloyne, Ferreira, Fromel, Surico (2018); Bahaj, Foulis, Pinter, Surico (2018); Jeenas (2018)
- * Focus on stock prices: Ippolito, Ozdagli and Perez-Orive (2018); Ozdagli (2018); Gurkaynak, Karasoy, Lee (2019)
- * Focus on credit spreads (and quantities): [This paper](#)

Data & Sources

Bond-level data

- ▶ Bond data from ICE BoAML (Global Index System)

- * Corporate bonds traded in the secondary market at *daily* frequency
- * Investment grade and high yield

- ▶ **Credit spread:** main variable of interest

- [1] *Duration matching:* Synthetic risk-free security that replicates the cash flows of the bond
- [2] *Option adjustment:* Adjustment for call optionality embedded in bonds

OAS Details

Summary Statistics

Bond-level data

▶ Sample period and coverage:

- * Sample period: August 1999 – Nov 2017
- * Focus on non-financial, senior, unsecured bonds, issued in USD
- * Flow of new issuance (in 2014): 495 bn USD (~ 70% of the market)

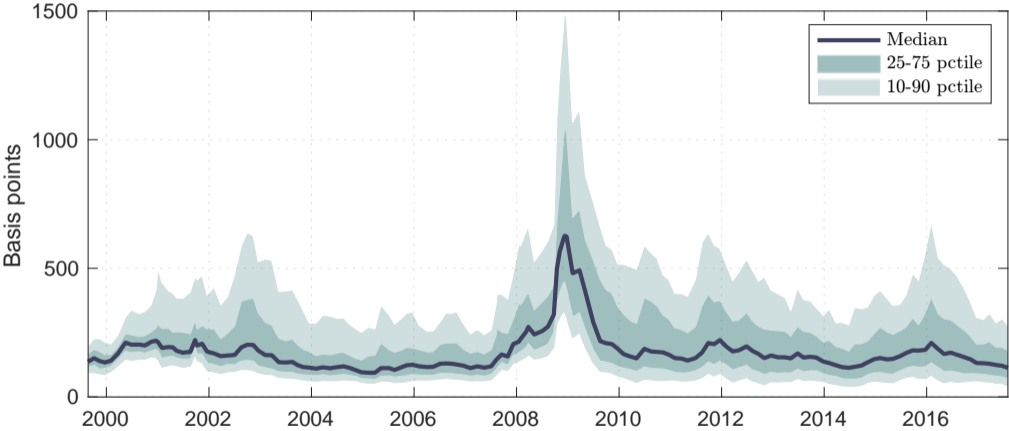
▶ Data treatment:

- * Drop if amount issued < 1 M\$
- * Drop if maturity < 1 and > 30 years
- * Drop if spread $> 3,500$ bps

▶ Firm-level information matched to bond data:

- * Quarterly balance sheet data from Compustat
- * Daily equity price data from CRSP

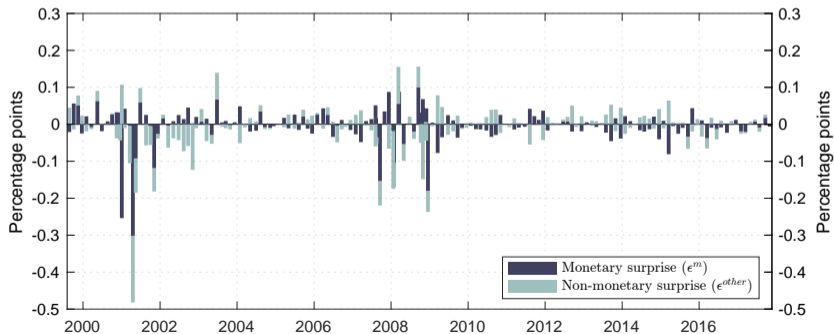
Corporate bond spreads



Monetary policy: High-frequency identification

- ▶ Surprises in fed fund futures (s_t^{FF4}) around FOMC announcements
- ▶ Decomposition of raw surprises into monetary and non-monetary news as in [Jarocinski and Karadi \(2020, AEJ:M\)](#):

$$s_t^{FF4} = \epsilon_t^m + \epsilon_t^{other}$$



Final event study data set

- ▶ Merge bond/firm information in an 'event study' data set around FOMC days (t)
- ▶ Resulting data set:
 - * Sample period: Jul 1999 – Nov 2017
 - * No. of FOMC announcements: 156
 - * No. of bonds: 9, 413
 - * No. of companies: 975
 - * No. of observations: 281, 330

Empirical Results

Approach: Event study panel OLS regressions

▶ **Dependent variable** ($\Delta CS_{ij,t}$)

- * Change in the spread of bond i , issued by firm j , around FOMC meeting t

▶ **Independent variable** (ϵ_t^m)

- * Monetary policy surprise

▶ **Interaction variable** ($\ell_{j,t-1}^{High}$)

- * Dummy variable =1 when firm j 's leverage in $t-1$ is above median leverage
- * Leverage is defined as $L_{jt} = (\text{Total Debt}_{jt}/\text{Assets}_{jt})$
- * Control for other proxies for financial constraints (age, size, credit ratings,...)

Leverage definition in Compustat

Heterogeneity in the data

Low Leverage (below median)

	Mean	SD	P25	Median	P75
Firm Total Assets (\$M)	56,427	70,788	11,208	30,277	67,243
Firm Age (years)	38	14	26	42	50
Firm Credit Rating			BBB2	BBB1	A2
Firm Hadlock-Pierce Constraint	-4.2	0.4	-4.5	-4.4	-4.0
Bond Spread (basis points)	177	159	88	136	207
Bond Amount Issued (\$M)	648	523	300	500	750
Total Observations	134,379				

High Leverage (above median)

	Mean	SD	P25	Median	P75
Firm Total Assets (\$M)	36,432	57,452	7,570	19,136	44,033
Firm Age (years)	33	16	18	34	49
Firm Credit Rating			BB2	BBB2	BBB1
Firm Hadlock-Pierce Constraint	-4.2	0.4	-4.5	-4.3	-3.8
Bond Spread (basis points)	267	249	113	190	336
Bond Amount Issued (\$M)	619	584	300	500	750
Total Observations	131,176				

Credit spread response to monetary policy

Average effect

- ▶ Average effect:

$$\Delta cs_{ij,t} = \alpha_i + \beta \epsilon_t^m + e_{ij,t}$$

- ▶ β : response of spreads to a 25 bps monetary surprise

Dep. Variable: spread (Δcs_{ij})	(1)	(2)	(3)
	Baseline	Low/High Leverage	Relative effect
MP surp. (ϵ^m)	27.68** (10.62)		26.84** (10.56)
MP surp. \times Low Lev. ($\epsilon^m \times l_j^{Low}$)		21.15*** (7.35)	
MP surp. \times High Lev. ($\epsilon^m \times l_j^{High}$)		31.54** (13.68)	11.09* (6.61)
Double clustering	Yes	Yes	Yes
Time-sector FE	No	No	Yes
R-squared	0.034	0.032	0.031
Observations	285,794	279,974	279,974

Credit spread response to monetary policy

Heterogeneity

- ▶ Leverage dummy:

$$\Delta cs_{ij,t} = \alpha_i + \beta_1 (\epsilon_t^m l_{j,t-1}^{Low}) + \beta_2 (\epsilon_t^m l_{j,t-1}^{High}) + e_{ij,t}$$

- ▶ β_1 and β_2 : response for firms high/low leverage firms

Dep. Variable: spread (Δcs_{ij})	(1)	(2)	(3)
	Baseline	Low/High Leverage	Relative effect
MP surp. (ϵ^m)	27.68** (10.62)		26.84** (10.56)
MP surp. \times Low Lev. ($\epsilon^m \times l_j^{Low}$)		21.15*** (7.35)	
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R-squared	0.034	0.032	0.031
Observations	285,794	279,974	279,974

Credit spread response to monetary policy

Heterogeneity

- ▶ Time-sector fixed effects:

$$\Delta cs_{ij,t} = \alpha_i + \alpha_{t,sct} + \gamma (\epsilon_t^m l_{j,t-1}^{High}) + \delta l_{j,t-1}^{High} + e_{ij,t}$$

- ▶ γ : relative response of high-leverage firm

Dep. Variable: spread (Δcs_{ij})	(1)	(2)	(3)
	Baseline	Low/High Leverage	Relative effect
MP surp. (ϵ^m)	27.68** (10.62)		
MP surp. \times Low Lev. ($\epsilon^m \times l_j^{Low}$)		21.15*** (7.35)	
MP surp. \times High Lev. ($\epsilon^m \times l_j^{High}$)		31.54** (13.68)	18.85** (9.26)
Double clustering	Yes	Yes	Yes
Time-sector FE	No	No	Yes
R-squared	0.034	0.032	0.031
Observations	285,794	279,974	279,974

Other determinants of financial constraints

- ▶ Double sort by other firms characteristics x:

$$\Delta CS_{ij,t} = \alpha_i + \beta_{sct,t} + \gamma \left(\epsilon_t^m \ell_{j,t-1}^{High} \right) + \delta \left(\epsilon_t^m x_{j,t-1}^{High} \right) + \Gamma W_{j,t-1} + e_{ij,t}$$

Dep. Variable: spread (ΔCS_{ij})	(1)	(2)	(3)	(4)
	Baseline	Size	Credit Rating	Time IPO
MP surp. x High Lev. ($\epsilon^m \times \ell_j^{High}$)	18.85** (9.26)	18.78** (9.22)	16.90** (8.28)	18.69** (9.09)
MP surp. x Size ($\epsilon^m \times x_j^{High}$)		-0.25 (7.39)		
MP surp. x Credit rating ($\epsilon^m \times x_j^{High}$)			-12.30 (8.06)	
MP surp. x Time IPO ($\epsilon^m \times x_j^{High}$)				-2.36 (5.09)
Double clustering	Yes	Yes	Yes	Yes
Time-sector FE	Yes	Yes	Yes	Yes
R-squared	0.308	0.309	0.310	0.308
Observations	279,603	279,603	277,288	279,603

Other determinants of financial constraints

- ▶ Double sort by other firms characteristics x :

$$\Delta CS_{ij,t} = \alpha_i + \beta_{sct,t} + \gamma \left(\epsilon_t^m \ell_{j,t-1}^{High} \right) + \delta \left(\epsilon_t^m x_{j,t-1}^{High} \right) + \Gamma W_{j,t-1} + e_{ij,t}$$

Dep. Variable: spread (ΔCS_{ij})	(1)	(2)	(3)	(4)
	Baseline	DD	Debt to Ebitda	Liquid Assets
MP surp. \times High Lev. ($\epsilon^m \times \ell_j^{High}$)	18.85** (9.26)	18.77** (8.95)	17.16** (8.78)	19.13** (9.57)
MP surp. \times DD ($\epsilon^m \times x_j^{High}$)		-3.27 (8.35)		
MP surp. \times Debt-Ebitda ($\epsilon^m \times x_j^{High}$)			16.44** (7.33)	
MP surp. \times Liquid Assets ($\epsilon^m \times x_j^{High}$)				3.77 (4.37)
Double clustering	Yes	Yes	Yes	Yes
Time-sector FE	Yes	Yes	Yes	Yes
R-squared	0.308	0.310	0.311	0.308
Observations	279,603	277,281	251,257	279,957

Robustness

- ▶ Response by quartile [Go](#)
- ▶ Add firm-level controls [Go](#)
- ▶ Control for permanent differences in leverage [Go](#)
- ▶ Instrumental variable specification [Go](#)
- ▶ Pre-crisis sample [Go](#)
- ▶ Raw monetary surprises [Go](#)
- ▶ Firm-level quantities (debt and investment) [Go](#)

Inspecting the mechanism

Default risk & Excess bond premium

A decomposition of credit spreads

- ▶ Response of credit spreads to monetary policy could reflect:
 - * Worsening of the quality of borrowers' balance sheets
[Kiyotaki & Moore (1997), Bernanke, Gertler, & Gilchrist (1999)]
 - * Deterioration in the health of financial intermediaries
[Gertler & Karadi (2011), Gertler & Kiyotaki (2010), He and Krishnamurthy (2013)]
- ▶ Gilchrist and Zakrajšek (2012) decompose credit spreads into:
 - [1] A component that captures firms' default risk
 - [2] A residual Excess Bond Premium (EBP) component
- ▶ EBP linked to effective risk-bearing capacity of financial intermediaries

Gilchrist and Zakrajšek (2012)'s decomposition

Overview of the approach

[1] Compute the 'distance to default' for each firm (DD_{jt}) [Merton (1974)]

[2] Regress bond spreads on DD_{jt} and other bond/firm-specific characteristics ($X_{ij,t}$ and $Z_{j,t}$):

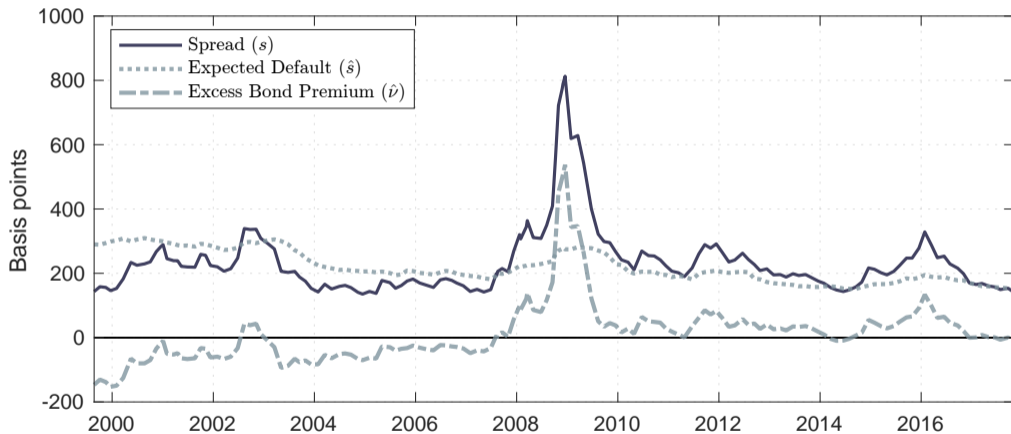
$$\log(1 + cs_{ij,t}) \equiv y_{ij,t} = \alpha_i + \beta DD_{jt} + \Gamma X_{ij,t} + \Lambda Z_{j,t} + \epsilon_{ij,t}$$

[3] Fitted variation $\hat{cs}_{ij,t} = \exp(\hat{y}_{ij,t} + \sigma/2)$ associated with default risk

[4] Residual variation $\hat{v}_{ij,t} = cs_{ij,t} - \hat{cs}_{ij,t}$ is the excess bond premium

Details

Gilchrist and Zakrajšek (2012)'s decomposition



Comparison with GZ

Monetary policy transmission: Default risk vs. EBP

Average effect

- Specification: $\Delta y_{ij,t} = \alpha_i + \beta \epsilon_t^m + e_{ij,t}$

	(1)	(2)	(3)
Dep. Variable:	Spread (Δcs)	Default Risk ($\Delta \hat{cs}$)	Exc. Bond Premium ($\Delta \hat{v}$)
MP surp. (ϵ^m)	27.68*** (10.62)	2.98 (1.81)	24.70** (10.30)
Double clustering	Yes	Yes	Yes
Time-sector FE	No	No	No
R-squared	0.034	0.030	0.033
Observations	285,794	285,794	285,794

- Transmission via $\hat{v}_{ij,t}$ is ~ 8 times larger than $\hat{cs}_{ij,t}$
- Monetary policy has a statistically significant impact only on $\hat{v}_{ij,t}$

Monetary policy transmission: Default risk vs. EBP

Heterogeneity

- Specification: $\Delta y_{ij,t} = \alpha_i + \beta_{sct,t} + \gamma(\epsilon_t^m \ell_{j,t-1}^{High}) + \delta \ell_{j,t-1}^{High} + e_{ij,t}$

	(1)	(2)	(3)
Dep. Variable:	Spread (Δcs)	Default Risk ($\Delta \hat{cs}$)	Exc. Bond Premium ($\Delta \hat{v}$)
MP surp. \times Lev. ($\epsilon^m \times \ell_j^{High}$)	18.85** (9.26)	0.30 (0.58)	18.56** (9.33)
Double clustering	Yes	Yes	Yes
Time-sector FE	Yes	Yes	Yes
R-squared	0.312	0.373	0.300
Observations	279,603	279,603	279,603

- Virtually all of the cross-sectional response is driven by $\hat{v}_{ij,t}$

Model & Interpretation

A model with heterogeneous borrowers and lenders

- ▶ Two islands of mass unity, risky (R) and safe (S)
- ▶ Each island populated with the following agents:
 - * A continuum of entrepreneurs of mass unity
 - * A financial intermediary
- ▶ Financial frictions
 - * Financial intermediary & Depositors → Moral hazard
Gertler-Karadi-Kiyotaki (2010,2011) [GKK]
- ▶ Key assumptions (departures GKK)
 - * Decreasing returns to scale technology for entrepreneurs
 - * Segmented financial markets (no intermediation across islands)

Balance sheets of agents on island i

► Entrepreneurs

- * Limited net worth N_i ($N_S > N_R$)
- * Default probability $p_S < p_R$
- * Limited liability

► Financial intermediary

- * Limited equity E_i (identical across islands)
- * Moral hazard (can steal a fraction of assets)

Entrepreneurs	
Assets	Liabilities
Capital, K_i	Loans, B_i
	Net worth, N_i

Financial Intermediary	
Assets	Liabilities
Loans, B_i	Deposits, D_i
	Equity, E_i

Entrepreneurs

- ▶ Entrepreneurs maximize expected profits subject to their balance sheet constraint:

$$\begin{aligned} \max_K \{ & zK^\alpha - R^B B \} \\ \text{s.t. } & K = N_j + B \end{aligned}$$

- ▶ Idiosyncratic productivity shock $\tilde{\omega}_j$
 - * Can take two values $\tilde{\omega}_j = \{0, \omega_j\}$ with probability p_j and $1 - p_j$
 - * When $\tilde{\omega}_j$ takes the low value, the entrepreneur loses everything and declares default
- ▶ Restriction on the idiosyncratic productivity shocks and their probabilities:

$$\omega_j(1 - p_j) = z,$$

where z is a non-random parameter known to all

Financial intermediary

- ▶ Financial intermediary chooses lending and deposits to maximize expected profits:

$$\max_{D,B} (1 - p_j)R^B B - R(B - E)$$

$$\text{s.t. } (1 - p_j)R^B B - R(B - E) \geq \theta(1 - p_j)R^B B$$

$$B = E + D$$

$$D \geq 0$$

- ▶ Difference relative to Gertler-Kiyotaki-Karadi formulation → Risk on asset side

Capital supply and demand schedules

- ▶ Solution to the intermediary's problem yields their supply schedule for credit to firms:

$$CS = \begin{cases} \frac{1}{1-p_j} & \text{if } N_j < K \leq N_j + \frac{E}{\theta} \\ \frac{1}{(1-p_j)(1-\theta)} \left(1 - \frac{E}{K-N_j}\right) & \text{if } K > N_j + \frac{E}{\theta} \end{cases}$$

- ▶ Solution to entrepreneurs' problem yields the capital demand schedule:

$$CS = \frac{\alpha z K^{\alpha-1}}{R}$$

Calibration

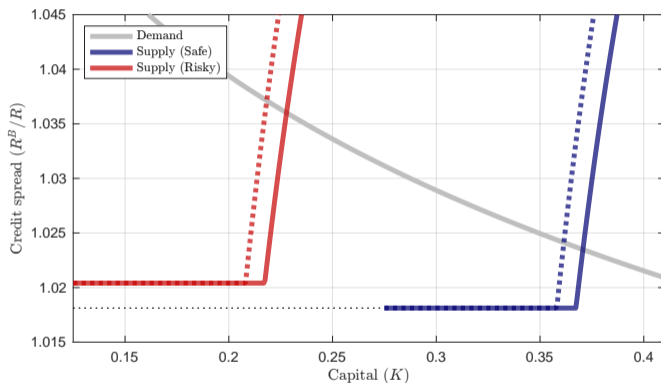
- ▶ Target moments of high- and low-leverage firms in manufacturing sector
- ▶ $p_S = 0.0178$, $p_R = 0.020$, $N_S = 0.275$, $N_R = 0.125$, $E = 0.012$, $\alpha = 0.975$, $z = 1.024$, $\theta = 0.13$

	Low Leverage		High Leverage	
	<i>Data</i>	<i>Model</i>	<i>Data</i>	<i>Model</i>
Leverage (Debt/Assets)	0.24	0.26	0.48	0.45
Credit spreads (bp)	230	228	351	353
Default risk (bp)	181	181	204	204
Excess bond premium (bp)	49	47	148	149

NOTE. The columns labelled *Data* report the average values of leverage, credit spreads, and their decomposition into expected default and excess bond premium for high-leverage and low-leverage firms in the 'Manufacturing sector' ($2000 \leq \text{sic} \leq 3999$) in our data set. The columns labelled *Model* report the values of the same variables computed from the theoretical model.

A monetary policy shock

- ▶ Exogenous fall in intermediaries' equity E of 10 percent



NOTE. Equilibrium in the capital market. On the horizontal axis is capital K and on the vertical axis is the credit spread CS . The gray line is the demand schedule, the red line is the supply schedule for the risky firm, the blue line is the supply schedule for the safe firm.

Conclusions

Some new facts... and implications

- ▶ Credit spreads:
 - * Increase in response to a policy tightening
 - * The more so, the higher the leverage of the firm
 - * Transmission driven by the excess bond premium

- ▶ **Implication #1** Importance of high frequency analysis
 - * Better identification and more precise estimation

Some new facts... and implications

- ▶ Credit spreads:
 - * Increase in response to a policy tightening
 - * The more so, the higher the leverage of the firm
 - * Transmission driven by the excess bond premium

- ▶ **Implication #2** Importance of heterogeneity and frictions in financial intermediation
 - * Crucial in shaping the transmission mechanism of monetary policy

Crossing the Credit Channel: Credit Spreads and Firm Heterogeneity*

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Appendix

[A1] Data

BAML Option Adjusted Spread: Details

- ▶ Option-adjusted spread is the number of basis points that the fair value government spot curve is shifted in order to match the present value of discounted cash flows to the bond's price
- ▶ For securities with embedded options (call, sink or put), a log normal short interest rate model is used to evaluate the present value of the securities potential cash flows. In this case, the OAS is equal to the number of basis points that the short interest rate tree must be shifted in order to match discounted cash flows to the bond's price
- ▶ Fair value government spot yield curves are derived from a universe of bond prices using government Index constituents
- ▶ More at <https://www.theice.com/market-data/indices/fixed-income-indices>

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Bond-level data: Summary statistics

	Mean	Std. Deviation	Minimum	Median	Maximum
No. of Bonds per Firm/Month	3.8	4.5	1.0	2.0	57.0
Effective Yield (%)	5.3	3.0	0.1	5.2	39.6
Spread (%)	2.6	2.7	0.1	1.7	35.0
Coupon (%)	6.2	1.8	0.0	6.3	15.0
Amount Issued (\$M)	570	478	25	450	15,000
Maturity at Issue (Years)	14.7	9.4	1.5	10.0	50.0
Time to Maturity (Years)	10.7	8.4	1.0	7.6	30.0
Effective Duration	6.7	3.8	0.0	5.9	19.3
Credit Rating (Composite)	-	-	D	BBB2	AAA
Callable (% of Observations)	51.4				

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Firm-level variables definition

- ▶ Leverage: Ratio of total debt ($d1cq + d1ttq$) to total assets (atq)
- ▶ Net leverage: Subtract current assets ($actq$) net of other current liabilities ($lctq$) from debt liabilities to total assets
 - * Current assets consists of cash and other assets expected to be realized in cash within the next 12 months
 - * Current liabilities are those due within one year
- ▶ Real Sales Growth: log-differences in sales ($saleq$) deflated using CPI
- ▶ Size: Log of total assets (atq)

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[A2] Monetary policy surprises

High frequency interest rate surprises: Monetary vs. Non-monetary decomposition

- ▶ High frequency interest rate surprises are possibly contaminated by a monetary policy 'signalling' component
 - * Can lead to a bias in the estimated effect of monetary policy
- ▶ Decompose s_t^i into monetary (ϵ_t^m) and non-monetary (ϵ_t^{other}) shocks with a simple sign restriction methodology [Jarocinski and Karadi (2020)].*

	Monetary shock	Non-monetary shock
Equity surprise (s_t^{eq})	-	+
Interest rate surprise (s_t^i)	+	+

[* For an alternative approach see [Miranda-Agrippino and Ricco \(2020\)](#).]

Monetary policy events: Unscheduled meetings

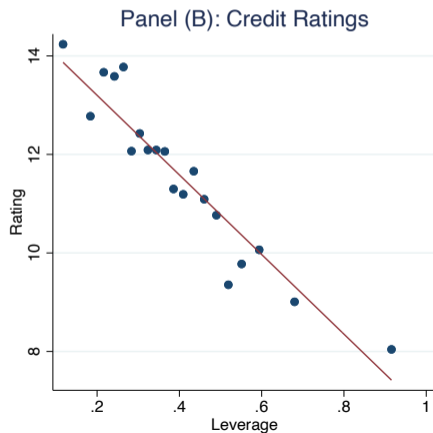
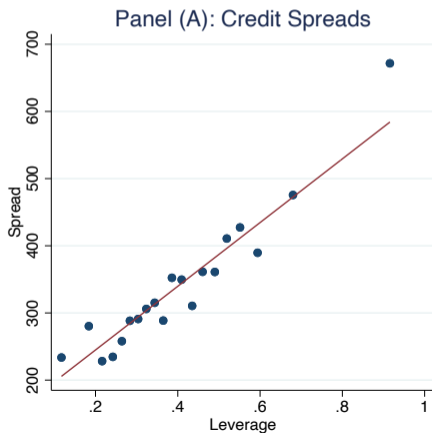
<i>Date</i>	<i>Announcement</i>
3rd January 2001	FOMC lowers federal funds rate by 50 basis points.
18th April 2001	FOMC lowers federal funds rate by 50 basis points.
10th August 2007	FOMC statement announcing provision of liquidity to facilitate orderly financial markets.
17th August 2007	FOMC statement on the deterioration of financial market conditions.
22nd January 2008	FOMC lowers federal funds rate by 75 basis points.
11th March 2008	FOMC increases and extends its swap lines with the ECB and Swiss National Bank.
8th October 2008	FOMC lowers federal funds rate by 50 basis points.
1st December 2008	Chairman Bernanke speech outlining the possibility of purchasing longer-term Treasury securities.

[More info on MP surprises](#)

[A3] Additional Stats

Leverage, Credit spreads, & Credit ratings

- ▶ In the data $\text{Corr}(\text{Lev}, \text{Cred.Spread}) > 0$, $\text{Corr}(\text{Lev}, \text{Cred.Rating}) < 0$
- ▶ Supportive of the fact that heterogeneity in the data is driven by differences in net worth N , rather than monitoring costs μ or idiosyncratic variance σ .



[A4] EBP

Distance to default: The Merton-KMV framework

- ▶ Use [Merton \(1974\)](#) model to calculate firm-specific distance to default measures (DD_{jt}) \Rightarrow Distance between the expected value of the firm and the default point.
 - * Value of the firm (V) follows a geometric Brownian motion
 - * Firm has just issued a discount bond (D) maturing in T periods
 - * Distance-to-default (1-year horizon):

$$DD_{jt} = \frac{\ln(V/D) + (\mu_V - 0.5\sigma_V^2)}{\sigma_V}$$

- ▶ Distance to default estimated using an iterative approach of the Merton-KMV Framework [[Bharath and Shumway \(2008\)](#)]

Decomposing credit spreads: Pricing equation

- ▶ Empirical credit spread model:

$$\log(1 + cs_{ij,t}) = \alpha_i + \beta DD_{jt} + \Gamma X_{ij,t} + \Lambda Z_{jt} + \epsilon_{ij,t}$$

	Spread
Distance to default	-0.0596*** (0.0002)
log(Age)	0.0145*** (0.0006)
Log(Issuance)	0.0016 (0.0010)
log(Duration)	0.2138*** (0.0011)
log(Coupon)	-0.2559*** (0.0020)
R-squared	0.7175
Observations	618,888

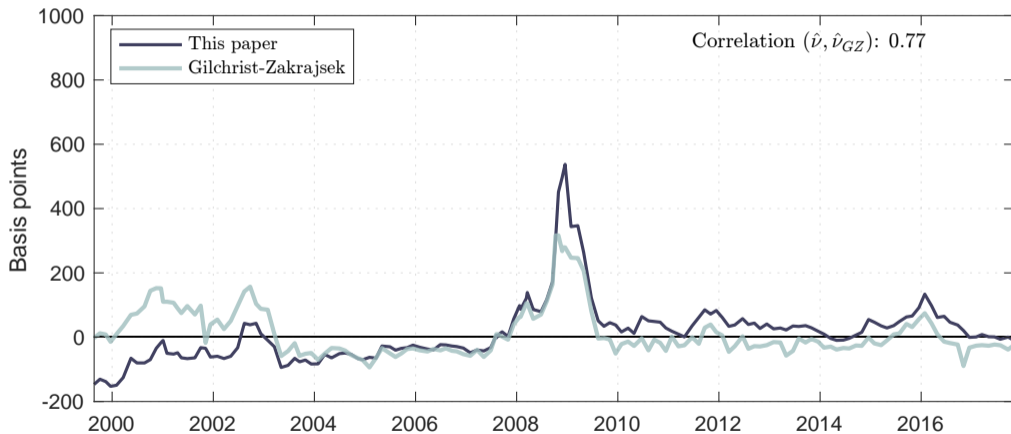
- ▶ Estimated by OLS with two-way clustered standard errors (firm and time) [\[Cameron et al \(2011\)\]](#).

Decomposing Corporate Bond Spreads

Comparison with GZ

- ▶ Some small differences relative to Gilchrist and Zakrajsek (2012)'s approach
- ▶ Callable option-adjustment
 - * *This paper*: adjustment is performed by BAML
 - * *GZ*: yield curve factors for callable bonds
- ▶ Sample period
 - * *This paper*: July 1999-March 2015
 - * *GZ*: January 1970 to December 2012
- ▶ Number of time observations
 - * *This paper*: Include bond spread observations on the day of monetary policy announcements, as well as the day before and 1 week after
 - * *GZ*: end of the month observations

Excess Bond Premium: Comparison with GZ



Default risk & Excess bond premium

- ▶ Larger coefficient on $\hat{\nu}_{ij,t}$ could simply reflect higher variance of excess bond premium ($\hat{\nu}_{ij,t}$) relative to expected default ($\hat{c}_{ij,t}$)
- ▶ Re-estimate same specifications after standardizing both series.

	(1)	(2)
Dep. Variable:	Default Risk, Standardized ($\Delta\hat{s}$)	Exc. Bond Premium, Standardized ($\Delta\hat{\nu}$)
MP surp. (ϵ^m)	0.49 (0.30)	0.72** (0.30)
Double clustering	Yes	Yes
Time-sector FE	No	No
R-squared	0.030	0.033
Observations	285,794	285,794

- ▶ Response of $\hat{\nu}_{ij,t}$ not statistically different from response of $\hat{c}_{ij,t}$

[A5] Event Study - Robustness

Robustness: By leverage quartiles

Dep. Variable: Δcs_{ij}	(1)	(2)	(3)
	Baseline	Leverage Interaction	Leverage quartile
MP surp. (ϵ^m)	27.68** (10.62)	26.84** (10.56)	
MP surp. \times Lev. ($\epsilon^m \times L_j$)		11.09* (6.61)	
MP surp. \times Lev. Q1 ($\epsilon^m \times l_j^1$)			19.73*** (6.43)
MP surp. \times Lev. Q2 ($\epsilon^m \times l_j^2$)			22.60** (9.03)
MP surp. \times Lev. Q3 ($\epsilon^m \times l_j^3$)			24.56** (9.96)
MP surp. \times Lev. Q4 ($\epsilon^m \times l_j^4$)			39.63** (18.56)
Double clustering	Yes	Yes	Yes
Time-sector FE	No	No	No
R-squared	0.034	0.030	0.031
Observations	285,794	285,794	279,974

Robustness: Other

Dep. Variable: Δcs_{ij}	(1)	(2)	(3)	(4)	(5)
	Time-sector FE	Controls	Within Leverage	IV	Pre-crisis
MP surp. \times High Lev. ($\epsilon^m \times \ell_j^{High}$)	18.85** (9.26)	19.12** (9.54)			18.64** (7.23)
MP surp. \times High Lev. ($\epsilon^m \times \tilde{\ell}_j^{High}$)			13.35* (7.64)		
1yr Rate \times High Lev. ($\epsilon^m \times \ell_j^{High}$)				18.05*** (1.40)	
Double clustering	Yes	Yes	Yes	Yes	Yes
Time-sector FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.308	0.303	0.308	-0.014	0.341
Observations	279,603	267,306	279,603	279,603	52,056

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The (confounding) role of non-monetary news

Average effect

- Specification:

$$\Delta cs_{ij,t} = \alpha_i + \beta \varepsilon_t + e_{ij,t}$$

Alternative surprises

- $\varepsilon_t \equiv$ raw interest rate (s_t^{FF4}), monetary (ε_t^m), and non-monetary (ε_t^{other}) surprises

Dep. Variable: Δcs_{ij}	(1)	(2)	(3)
Indep. Variable:	Interest rate surp. (ε^{FF4})	Monetary surp. (ε^m)	Non-monetary surp. (ε^{other})
Monetary surp. (ε^m)	10.29* (5.86)	27.68*** (10.62)	-24.73 (16.35)
Time-Sector FE	No	No	No
Double clustering	Yes	Yes	Yes
R-squared	0.034	0.030	0.032
Observations	281,330	281,330	281,330

The (confounding) role of non-monetary news

Heterogeneity

- Specification:

$$\Delta CS_{ij,t} = \alpha_i + \beta_{sct,t} + \gamma(\varepsilon_t \ell_{j,t-1}^{High}) + \delta \ell_{j,t-1}^{High} + e_{ij,t}$$

- $\varepsilon_t \equiv$ raw interest rate (ε_t^{FF4}), monetary (ε_t^m), and non-monetary (ε_t^{other}) surprises

Dep. Variable: ΔCS_{ij}	(1)	(2)	(3)
Indep. Variable:	Interest rate surp. (s^{FF4})	Monetary surp. (ε^m)	Non-monetary surp. (ε^{other})
MP surp. \times Lev. ($\varepsilon \times \ell_j^{High}$)	8.95* (5.34)	18.85** (9.26)	-10.94 (11.27)
Double clustering	Yes	Yes	Yes
Time-sector FE	Yes	Yes	Yes
R-squared	0.373	0.308	0.300
Observations	279,603	279,603	279,603

[A6] Local projections - Robustness

Persistent and real effects of monetary policy

- ▶ **Focus so far** High frequency response of credit spreads
 - * Better identification, more precise estimates
- ▶ Additional questions:
 - [1] Does monetary policy have persistent effects on firm-level quantities?
 - [2] Are the cross-sectional patterns consistent with the high frequency analysis?
- ▶ Business cycle frequency analysis (as in existing literature):
 - * Collect quarterly data on total debt and investment for firms in our data set
 - * Revisit the evidence using panel local projections

Panel local projections: Relative response of high-leverage firms

- ▶ Heterogeneous effect:

$$y_{j,\tau+h} - y_{j,\tau-1} = \alpha_j^h + \beta_{sct,\tau} + \gamma^h \left(\epsilon_{\tau}^m \ell_{j,\tau-1}^{High} \right) + \sum_{p=1}^P \Gamma_p W_{j,\tau-p} + e_{j,\tau+h}$$

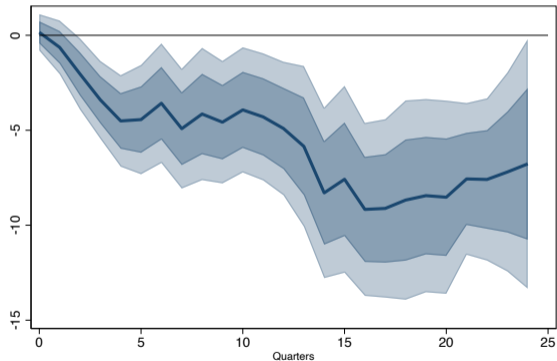
- * τ is a quarter
- * $y_{j\tau}$ is the independent variable of interest ($\ln(d_{j\tau})$ or $\ln(k_{j\tau})$)
- * ϵ_{τ}^m is the monetary policy surprise (average within the quarter).
- * $W_{j\tau}$ includes firm-level controls
- * Standard errors clustered two-way (firm-quarter)
- * γ^h is the relative impulse response for a firm in the high-leverage group

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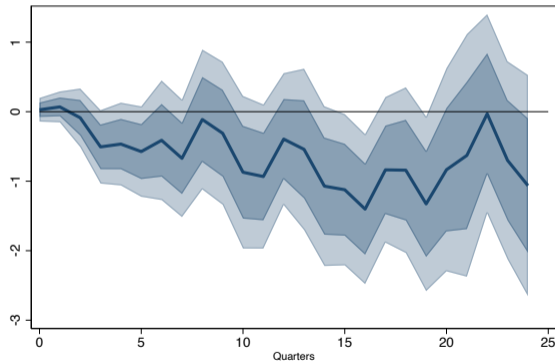
Relative response of high-leverage firms

- ▶ Larger contraction of **total debt** and **investment** for high-leverage firms

(A) Total debt: Relative



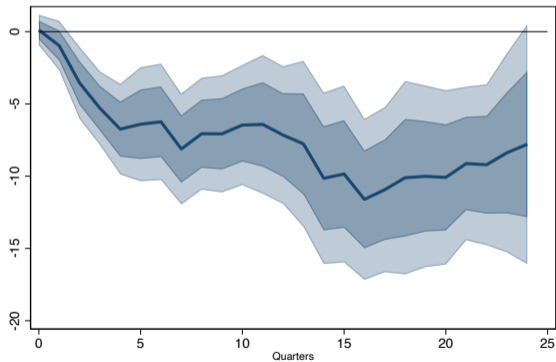
(B) Investment: Relative



Relative response of high-leverage firms: pre-crisis sample

► Robust to pre-crisis period

(A) Total debt: Relative



(B) Investment: Relative

