Credit and Liquidity Policies during Large Crises

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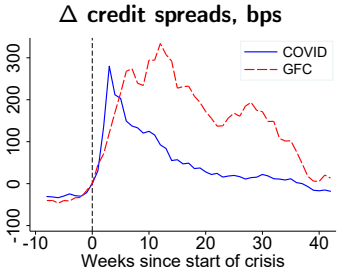
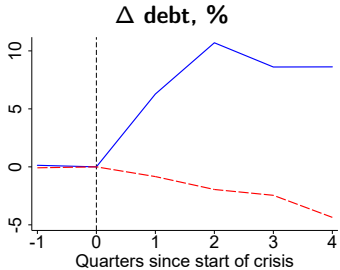
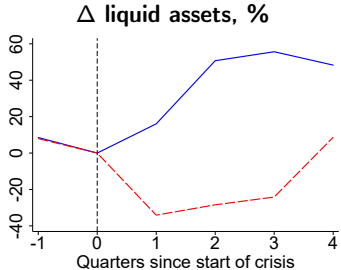
Debt and liquid assets during large crises



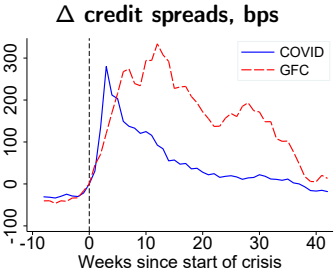


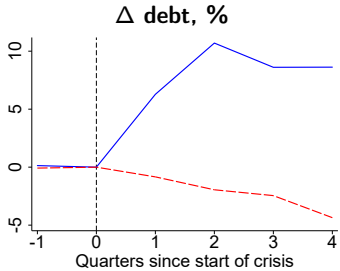


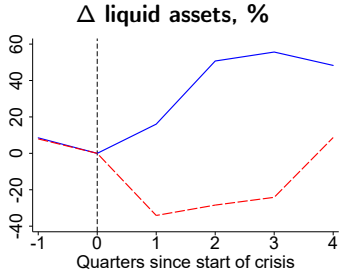
Aggregate data

- **GFC**: negative comovement between (i) credit spreads and (ii) debt and liquid assets
- **COVID-19**: positive comovement between (i) credit spreads and (ii) debt and liquid assets

Debt and liquid assets during large crises







Cross-section

- Leverage is an important determinant of credit spreads both during GFC and COVID
- Liquidity matters during COVID: Firms with more liquid assets had lower increase in spreads

Credit and liquidity policies during large crises

Model

- Investment & balance sheet: defaultable debt, liquid assets, and costly short-term loans
- Ex-ante heterogeneous firms: differ in leverage & liquidity needs

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Large crises

- Real+financial: positive comovement between (i) investment and (ii) debt, liquid assets (GFC)
- Liquidity: negative comovement between (i) investment and (ii) debt, liquid assets (COVID)
- Aggregate shocks are typically unobservable, but credit spreads are available at daily frequency
  - Cross-sectional elasticities can help identify the source of the underlying aggregate shock

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Policies

- Credit policies (e.g. CCF): Reduce credit spreads, little effect on bankruptcy
- Liquidity policies (e.g. PPP): Reduce defaults, little effect on credit spreads
- Liquidity policies are a bad idea if there is no liquidity shock

Empirical Analysis

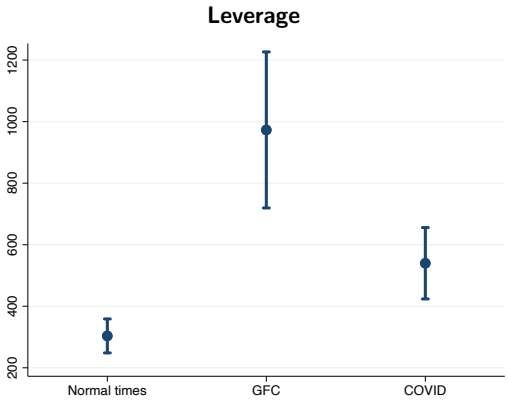
Is there any systematic relationship between firm financials and financing conditions?

- Maturity-matched corporate bond spreads, following Gilchrist & Zakrajsek (2012)
- $\sim$ 40k firm-quarter observations, June 2002 to December 2020 ▷ Details
- Estimate

$$\text{credit spreads}_{f,t} = \alpha_t + \gamma_f + \underbrace{\beta_{E(t)}\, \text{liq}_{f,t-4}}_{\text{liquid assets}} + \underbrace{\gamma_{E(t)}\, \text{lev}_{f,t-4}}_{\text{leverage}} + \Phi X_{f,t} + \varepsilon_{f,t}$$

- $E(t)$: quarter t is "normal", GFC (2008:Q2 - 2009:Q2) or COVID-19 (2020:Q1 - 2020:Q2)
- $X_{f,t}$ includes other firm-time controls (size, etc.)

Spreads and firm level characteristics ▷ Regressions



- Leverage: important determinant of credit spreads both during GFC and COVID

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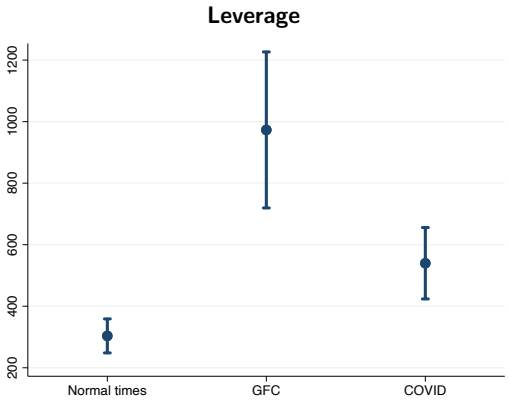
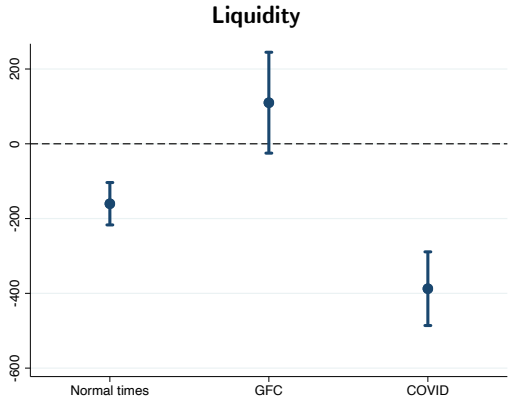




- Leverage: important determinant of credit spreads both during GFC and COVID
- Liquidity matters during COVID: firms with higher liquidity had lower increase in spreads

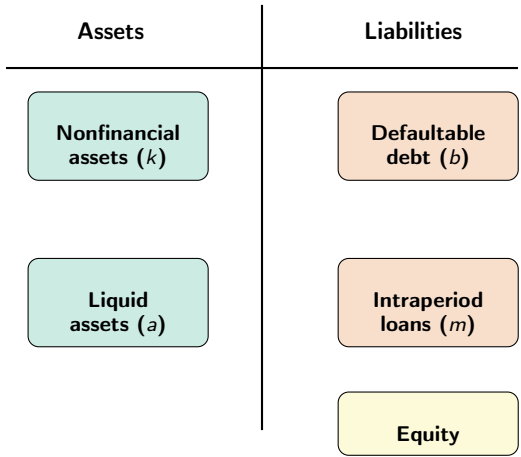
A macro-financial model with liquidity shocks

A macro-financial model with liquidity shocks

Model of investment with a rich balance sheet: ▷ Environment

- Defaultable debt: 1-period bonds, priced by risk-neutral investors (Eaton & Gersovitz '82)
- Liquidity needs
  - Firm subject to negative liquidity shocks (e.g., working capital needs)
  - Liquid assets: Dominated in rate of return, but useful to satisfy liquidity needs
  - Can access costly intraperiod loans to satisfy liquidity needs
- Costly equity issuance

Firm's balance sheet



Liquidity constraint

- Liquidity shocks: ω is iid distributed

$$\omega = \begin{cases} \overline{\omega} & \text{w.p. } p(\overline{\omega}) \\ 0 & \text{otherwise} \end{cases}$$

- Firms need to finance working capital ωk
  - e.g., trade credit or supply chain disruptions, Boissay et al. (2020) Baqaee and Farhi (2020)
- Can use liquid assets a, and/or take an intraperiod loan m'

$$\omega k \leq a + m'$$

- Intraperiod loans are costly, interest rate $r \exp(s_m m')$

Default

- Firm draws iid extreme-value preference shocks $\varepsilon^P, \varepsilon^D$ (Dvorkin et al., 2021)

$$\mathcal{V}(k, b, a) = \mathbb{E}_{\varepsilon^P, \varepsilon^D, \omega}\left[\max\left\{V(k, b, a, \omega) + \varepsilon^P, V^D(k, b, a, \omega) + \varepsilon^D\right\}\right]$$

- Normalize $V^D = 0$
- $\varepsilon^P - \varepsilon^D$ follows mean-zero logistic distribution with scale κ. Pay probability:

$$\mathcal{P}(k, b, a) = \mathbb{E}_{\omega}\left[\frac{\exp[V(k, b, a, \omega)/\kappa]}{1 + \exp[V(k, b, a, \omega)/\kappa]}\right]$$

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- Bond price: Risk-neutral lenders + frictions:

$$q\left(k', b', a'\right) = (1 + \chi)\frac{\mathcal{P}\left(k', b', a'\right)}{1 + r}$$

$\chi > 0$ summarizes frictions in debt markets (e.g., the benefits of debt financing due to tax shield)

Firm's problem

$$V(k,b,a,\omega) = \max_{k',b',a',m' \geq 0} div \overbrace{- \frac{\rho}{2} \max\{-div, 0\}^2}^{\text{costly equity issuance}} + \beta \, \mathcal{V}(k',b',a')$$

$$\text{flow dividend} : div = \pi(k) \underbrace{+(1-\delta)k - k' - \frac{\psi}{2}\left(\frac{k'-k}{k}\right)^2}_{\text{capital}} \overbrace{-b + q\left(k',b',a'\right) b'}^{\text{debt}}$$

$$\underbrace{-m' \; r \exp(s_m m')}_{\text{intraperiod loan}} \overbrace{+a - q^a a'}^{\text{liquid assets}}$$

$$\text{static profit} : \pi(k) = \max_{\ell} z^{1-\nu} k^{\alpha} \ell^{\nu} - w\ell$$

$$\text{liq. constraint} : \omega k \leq a + m'$$

$$\text{bond price} : q\left(k',b',a'\right) = (1+\chi)\frac{\mathcal{P}\left(k',b',a'\right)}{1+r}$$

Externally calibrated parameters

Parameter	Value	Description
Production		
α	0.2550	Capital share, Gilchrist et al. (2014)
ν	0.5950	Labor share, Gilchrist et al. (2014)
δ	0.0963	Depreciation rate, Gilchrist et al. (2014)
ψ	0.4550	Capital adjustment, Cooper and Haltiwanger (2006)
w	1.0000	Wage, normalization
z	1.0000	TFP, normalization
ρ	3.0000	Zero equity issuance in SS
p_ω	0.5000	Probability of liquidity shock
Prices		
β	0.9500	Discount factor
r	$1/\beta - 1$	Interest rate
q^a	1.0000	Price of liquid assets
s_m	25.0000	Slope of intra-period borrowing cost

Internally calibrated parameters with ex-ante heterogeneity

4 types of firms (Compustat data): high/low leverage (45% or 20%) and liquidity (11% or 1.5%)

- Liquidity risk $\omega \rightarrow$ liquid asset holdings
- Frictions in debt markets $\chi \rightarrow$ leverage
- Extreme-value shocks, scale $\kappa \rightarrow$ credit spreads

Firm type	**Model Parameter**			**Model Moment**		
	debt preference (χ)	liquidity needs ($\bar{\omega}$)	idiosyncratic risk (κ)	Leverage	Liquid assets	Credit spreads
High lev & high liq	0.0146	0.1880	0.3480	0.4504	0.1101	166
Low lev & high liq	0.0049	0.1892	0.3249	0.2004	0.1101	166
High lev & low liq	0.0139	0.0721	0.3645	0.4501	0.0150	166
Low lev & low liq	0.0045	0.0723	0.3415	0.2003	0.0151	166

Untargeted moments

	Data		Model
	2007Q2	2019Q4	
Spread of intraperiod loans, %	3.00	3.25	3.77
Income to assets, %	13.40	11.10	14.82
Debt to income, %	2.21	3.24	2.25
Default rate, %	3.00	3.00	2.47

Notes: Spread of intraperiod loans corresponds to the bank prime loan rate. Income to assets and debt to Income is from Compustat. Default rate from Moody's investors service, 2015.

Large macro-financial crises

Large macro-financial crises

Large crises

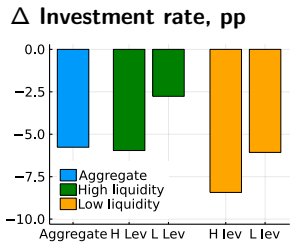
- Large, unexpected, and transitory shocks with persistence $1 - \zeta$
- Real, financial, and/or liquidity shocks
- Evaluate aggregate and cross-sectional responses
- Benchmark targets for shocks
  1. 5% drop in GDP (real shock, z)
  2. 300 bps rise in credit spreads (financial shock, χ)
  3. 25% rise in liquid assets (liquidity shock, ω)

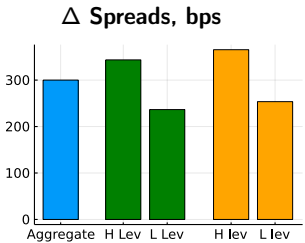
Aggregate responses

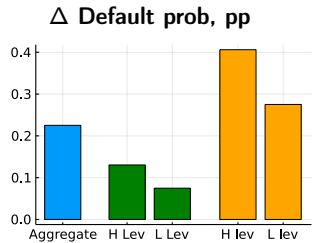
	Variation wrt SS
Spreads, bps	300.01
GDP, percent	-5.00
Liquid assets, percent	25.02
Debt owed, percent	18.51
Investment rate, pp	-5.77
Default prob., pp	0.23

- Negative comovement between (i) investment and (ii) debt and liquid assets

Cross-sectional responses



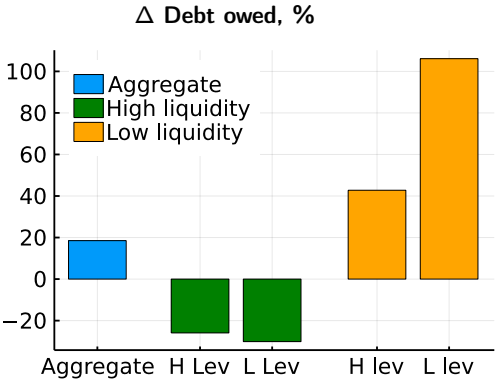


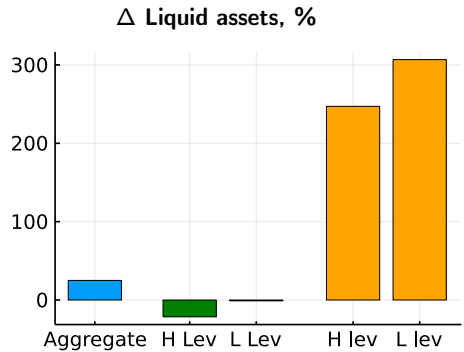


Worse outcomes for firms with:

- high leverage
- low liquid assets

Cross-sectional responses





- Firms with low liquid assets: increase liabilities and liquid assets
- Firms with high liquid assets do the opposite

The effects of liquidity shocks

	Model		Data	
	Benchmark	No Liquidity	COVID-19	GFC
Aggregate				
Spreads, bps	300.01	282.33		
GDP, percent	-5.00	-5.00		
Liquid assets, percent	25.02	-27.87		
Debt owed, percent	18.51	-65.21		
Investment rate, pp	-5.77	-3.97		
Default prob., pp	0.23	0.06		
Cross-section				
Elasticity of spreads wrt leverage	437.67	413.67	539.74	972.98
Elasticity of spreads wrt liquidity	-205.74	64.85	-387.54	109.93
Elasticity of inv. rate wrt leverage	-0.03	-0.03	-0.018	-0.013
Elasticity of inv. rate wrt liquidity	0.08	0.00	0.022	0.008

- COVID-19: Benchmark (liquidity + financial + real) while GFC: No Liquidity (financial + real)

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▷ No Financial, No Real

Credit and liquidity policies

Credit and liquidity policies

Credit Policies

1. **Corporate Credit Facilities (CCF)**: purchases debt securities at subsidized prices χ^{CCF}

$$q^{CCF}(k', b', a') = (1 + \chi + \chi^{CCF}) \frac{\mathcal{P}(k', b', a')}{1 + r}$$

2. **Credit Guarantees**: commits to repay the lender a fraction ϕ^{CG} of principal in case of default

$$q^{CG}(k', b', a') = (1 + \chi) \frac{\mathcal{P}(k', b', a')}{1 + r} + \phi^{CG} \frac{1 - \mathcal{P}(k', b', a')}{1 + r}$$

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Liquidity Policies

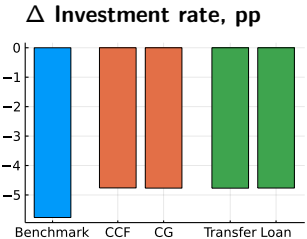
1. **Transfers**: lump-sum transfers τ, increase *dividends*, and help with liquidity constraint

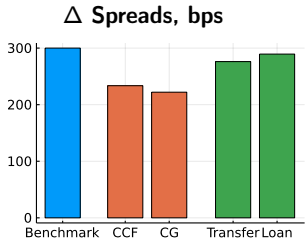
$$\omega k \leq a + m' + \tau$$

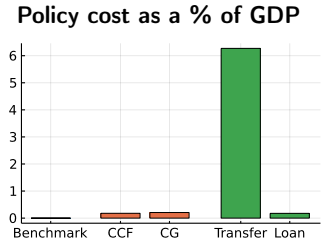
2. **Subsidized Loans**: direct loans L with liability $(1 + r)L$ at $t + 1$, also helps with liquidity constraint

$$\omega k \leq a + m' + L$$

Credit and liquidity policies in a crisis

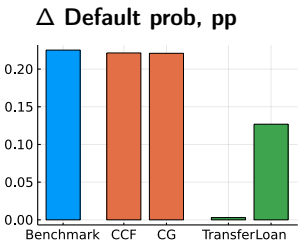


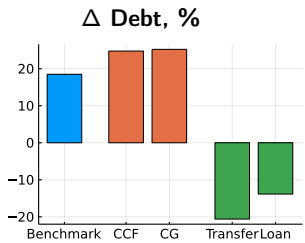


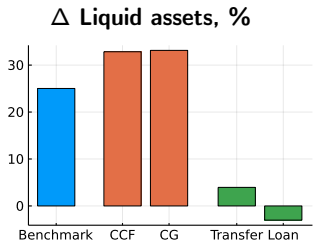


- Calibrate all policies so they increase the investment rate by 1 pp
- Credit policies are more effective in reducing spreads
- Liquidity policies can be very expensive. Loans seems *better* than transfers.

Credit and liquidity policies in a crisis

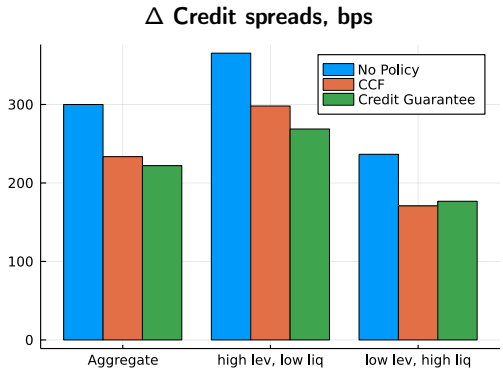






- Liquidity policies are more effective in reducing default
- Credit policies: increase in debt and liquid assets
- Liquidity policies: reduction in debt and liquid assets

Cross-sectional effects of credit policies: Riskier vs safer firms



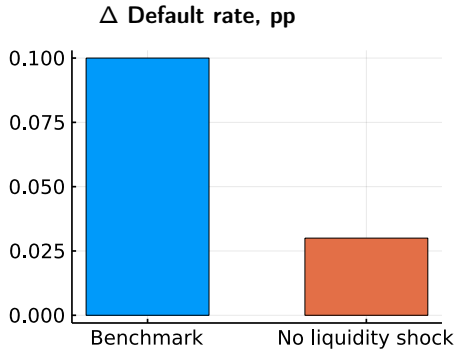
- Credit policies:

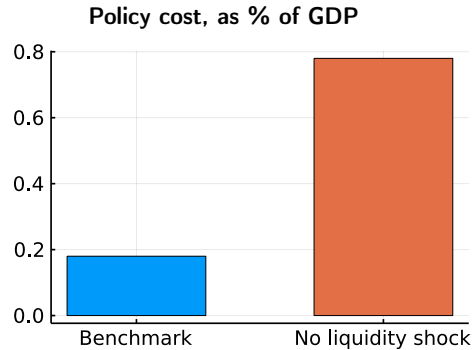
$$q^{CCF} = (1 + \chi + \chi^{CCF})\frac{\mathcal{P}}{1+r}$$

$$q^{CG} = (1 + \chi)\frac{\mathcal{P}}{1+r} + \phi^{CG}\frac{1-\mathcal{P}}{1+r}$$

- CCF $\rightarrow$ subsidy to safer firms (low lev, high liq)
- CG $\rightarrow$ subsidy to riskier firms (high lev, low liq)

Do loans prevent default when there is no liquidity shock?





Without liquidity shock:

- Smaller effect on reducing default
- Loans become very costly

Subsidized loans are a bad idea if there is no liquidity shock

Conclusions

Empirical analysis of credit spreads and firm financials during two large crises

- Aggregate debt and liquid assets moved in opposite directions during the last two crises
- **GFC** key variable: leverage
- **COVID** key variable: liquid assets

Quantitative model calibrated to match firm distribution of liquidity and leverage

- Liquidity shocks essential to explain data during COVID
- Credit policies effective in reducing spreads
- Liquidity policies effective in reducing default
- Different policies effective against different types of shocks

Cross-sectional data provides useful information about the nature of underlying shock

APPENDIX

Literature

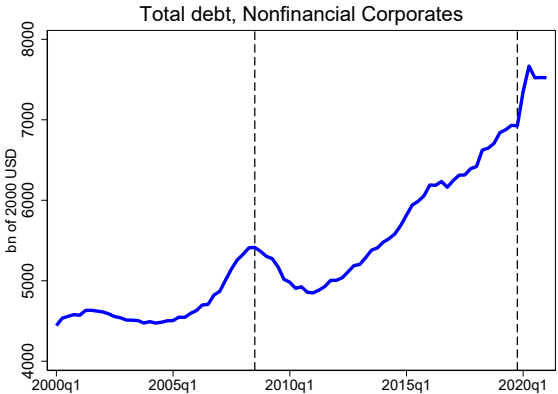
- **Role of firm heterogeneity in the response to shocks**: Kudlyak & Sanchez '17; Ottonello & Winberry '20; Jeenas '19
  New: Large crisis, and/or liquid assets

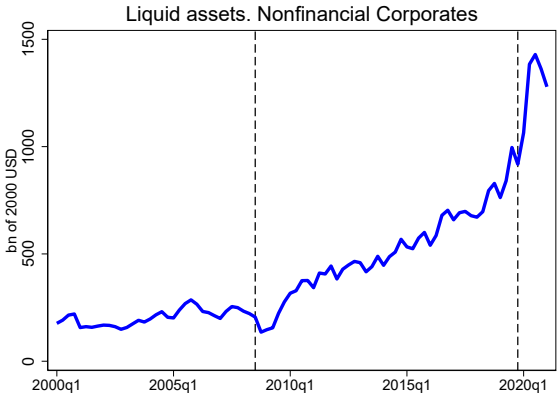
- **Credit Spreads during COVID-19**: Kargar et al. '20; Boyarchenko et al. '20; Gilchrist et al. '20
  New: Cross-sectional analysis with Compustat data

- **Policy and firm heterogeneity during COVID-19**: Crouzet & Gourio '20; Elenev et al. '20; Tourré & Crouzet '21
  New: Liquidity policies

Empirics

Debt and liquid assets ▷ Back





Source: Financial Accounts of the United States, FRB

Data ▷ Back

Variable	Mean	SD	Min	Median	Max
Number of bonds per firm/week	4.59	9.28	1.00	2.00	425.00
Market value of issue ($ mil)	524.34	553.59	1.80	400.00	15000.00
Maturity at issue (years)	10.34	7.23	1.00	9.67	30.00
Coupon (pct.)	5.58	2.21	0.00	5.62	19.00
Credit Spread (basis points)	249.51	324.83	5.00	145.69	3499.93
Nominal yield (basis points)	565.18	442.40	17.55	483.16	10434.36
Number of observations	3,451,219				
Number of bonds	21,091				
Number of firms	2,131				
Callable (pct)	0.73				

- Bond yields sourced from TRACE, bond characteristics from Mergent FISD
- Sample selection: fixed- and zero-coupon bonds issued by US corporates, amount at issuance $>$ $ 1 M, maturity at issuance between 1 and 30 years

Spreads, liquid assets and leverage ▷ Back

	$s_{f,t}$	inv rate$_{f,t}$
Leverage		
Normal	303.609***	-0.015***
	(27.669)	(0.002)
GFC	972.985***	-0.013***
	(127.077)	(0.003)
COVID	539.741***	-0.018***
	(58.122)	(0.002)
Liquidity		
Normal	-160.309***	0.008***
	(28.415)	(0.002)
GFC	109.933	0.008*
	(67.620)	(0.004)
COVID	-387.543***	0.022***
	(49.373)	(0.005)
N	39211	37352
R2	0.69	0.36

	$+1\sigma$ leverage	$+1\sigma$ liquid assets
Normal	54 bps	-18 bps
GFC	174 bps	12 bps
COVID	96 bps	-43 bps

Coefficient tests

$$y_{f,t} = \alpha_t + \gamma_f + \beta_{E(t)}\, \text{liq}_{f,t-r} + \gamma_{E(t)}\, \text{lev}_{f,t-r} + \Phi X_{f,t} + \varepsilon_{f,t}$$

Coefficient equality tests:

$$\beta_{\text{Normal}} = \beta_{\text{GFC}}, \beta_{\text{Normal}} = \beta_{\text{COVID}}$$
$$\gamma_{\text{Normal}} = \gamma_{\text{GFC}}, \gamma_{\text{Normal}} = \gamma_{\text{COVID}}$$

	Credit Spreads	Investment Rate
Leverage		
GFC	0.00	0.31
COVID	0.00	0.14
Liquidity		
GFC	0.00	0.87
COVID	0.00	0.00

Model

Environment & technology ▷ Back

- Time is discrete and infinite, $t = 0, 1, \ldots$
- Finite set of firm types, $i = 1, \ldots, N$ with mass $\lambda_i, \sum_{i=1}^{N} \lambda_i = 1$
- Firms produce according to a DRS production function that employs capital and labor

$$y = z^{1-\nu} k^{\alpha} \ell^{\nu}, \alpha + \nu < 1$$

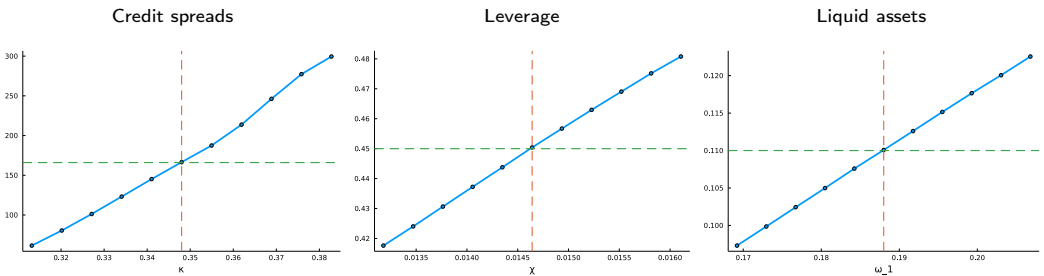
- Investment in capital is subject to convex adjustment costs

$$\mathcal{A}^{K}(k', k) = \frac{\psi}{2} \left(\frac{k' - k}{k} \right)^{2} k$$

- Firms have constant productivity z, subject to two iid shocks:
  1. **Default Shocks** ε, "preference" shocks that follow Extreme Value distribution
  2. **Liquidity Shocks** ω, follow a binomial distribution, $\omega = \omega_i$ w.p. p_ω, zero otherwise
- State variables:

$$s = \left(\underbrace{k}_{\text{capital}}, \overbrace{b}^{\text{debt}}, \underbrace{a}_{\text{liq. assets}}, \overbrace{\omega}^{\text{liq shock}}, \underbrace{\varepsilon}_{\text{pref shock}} \right)$$

Identification ▷ Back



Crisis: Cross-section

	Aggregate	Hi Lev, Hi Liq	Lo lev, Hi liq	Hi Lev, Lo Liq	Lo Lev, Lo Liq
Spreads, bps	300.01	343.52	236.56	365.44	253.61
GDP, percent	-5.00	-5.00	-5.00	-5.00	-5.00
Liquid assets, percent	25.02	-21.45	-1.07	247.15	306.76
Debt owed, percent	18.51	-25.92	-30.11	42.77	106.11
investment rate, pp	-5.77	-5.96	-2.77	-8.43	-6.07
Prob. Default, pp	0.23	0.13	0.07	0.41	0.28

Crisis: Decomposition ▷ Back

	Benchmark	No Liquidity	No Financial	No Real
Spreads, bps	300.01	282.33	21.15	294.78
GDP, percent	-5.00	-5.00	-5.00	0.00
Liquid assets, percent	25.02	-27.87	59.22	26.72
Debt owed, percent	18.51	-65.21	67.15	16.42
investment rate, pp	-5.77	-3.97	-1.40	-5.30
Prob. Default, pp	0.23	0.06	0.20	0.18
Elasticity of spreads wrt leverage	437.67	413.67	25.73	430.71
Elasticity of spreads wrt liquidity	-205.74	64.85	-252.88	-200.16
Elasticity of investment wrt leverage	-2.77	-3.05	-0.02	-2.70
Elasticity of investment wrt liquidity	7.59	-0.10	4.56	7.45

Crisis: Policies

Variation wrt SS	(1) No Policy	(2) CCF	(3) Credit Guarantee	(4) Transfer	(5) Loan
Spreads, bps	300.01	233.52	222.08	276.13	289.42
GDP, percent	-5	-5	-5	-5	-5
Liquid assets, percent	25.02	32.86	33.14	3.96	-3.03
Debt owed, percent	18.51	24.79	25.25	-20.62	-13.86
Investment rate, pp	-5.77	-4.76	-4.77	-4.77	-4.76
Profit, percent	-112.08	-108.65	-107.71	-105.41	-102.7
Prob. Default, pp	0.23	0.22	0.22	0.00	0.13
Cost of policy over GDP, pp	0	0.18	0.21	6.27	0.18
Elasticity of spreads wrt leverage	437.67	432.67	313.06	405.22	422.05
Elasticity of spreads wrt liquidity	-205.74	-201.99	-146.1	-93.9	-70.83
Elasticity of inv. rate wrt leverage	-2.77	-2.34	-2.01	-3.12	-3.5
Elasticity of inv. rate wrt liquidity	7.59	6.72	6.71	5.38	5.96