The Firm Balance Sheet Channel of Uncertainty Shocks

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This Paper

- Spikes in aggregates uncertainty are followed by large output drops.
- Understanding the transmission mechanism of uncertainty shocks is key to explaining its real impact and to the design of stabilization policies.
- **Key idea:** heightened uncertainty motivates firms to deleverage and build up liquid assets, thereby leading to capital investment cut.
- New Empirical Patterns + New Quantitative Model + Policy Implications

Empirical Patterns

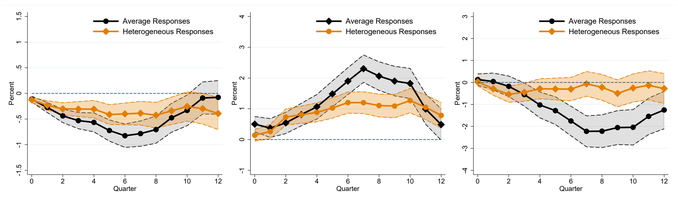
Two Key Empirical Patterns:

1. The spikes in aggregate uncertainty are followed by physical capital drop, liquidity buildup, and deleveraging.
2. Drop in physical capital and buildup of liquidity are more *pronounced* among ex-ante more indebted firms.

1. Baseline Panel Local Projection:

Baseline Local Projection: Firm-Level Responses to 1 S.D. Growth in Macro Uncertainty Index

(a) Physical capital (b) Liquid assets holding (c) Outstanding debt



$$\underbrace{\Delta_h \log(y_{i,t+h})}_{\text{Cumulative growth}} = \alpha_{i,h} + \alpha_{fq,h} + \Big(\underbrace{\boldsymbol{\beta_h}}_{\text{Average}} + \underbrace{\boldsymbol{\gamma_h}}_{\text{Heterogeneous}} \text{Indebtedness}_{i,t-1} \Big) \cdot \underbrace{\Delta \log \sigma_t}_{\text{Uncertainty Shock}}$$

$$+\eta_h \text{Indebtedness}_{i,t-1} + \Gamma_h' \underbrace{\mathsf{Z}_{i,t-1}}_{\text{Firm controls}} + \sum_{l=0}^{4} \Lambda_{l,h}' \underbrace{\mathsf{Y}_{t-l}}_{\text{Macro controls}} + \mu_{i,t+h}$$

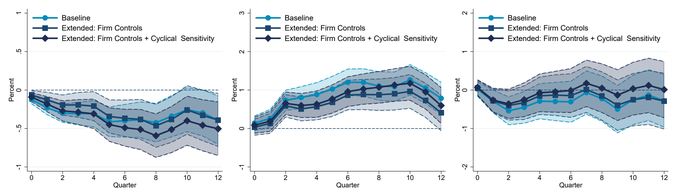
$$\forall i, h = 0, 1, 2, 3, ..., 12$$

- Firm panel: COMPUSTAT non-financial firms (1990q1-2019q4)
- Indebtedness: (Outstanding Debt - Liquid Assets)/ Total Assets
- $\Delta \log \sigma_t$: Changes in Macro Uncertainty Index by Jurado et al. (2015)
- $\mathsf{Z}_{i,t-1}$: Indebtedness/Tobin's Q/Firm Size/Sales Growth/Cash Flows
- Y_t: Real GDP Growth/Federal Funds Rate/Credit Spreads/Inflation Rate

2. Extended Panel Local Projection:

Extended Local Projection: Heterogeneous Responses by Firm indebtedness

(a) Physical capital (b) Liquid assets holding (c) Outstanding debt



$$\Delta_h \log(y_{i,t+h}) = \alpha_{i,h} + \alpha_{fq,h} + \alpha_{s,t,h} + \underbrace{\gamma_h \text{Indebtedness}_{i,t-1} \cdot \Delta \log \sigma_t}_{\text{Heterogeneous responses}} + \beta_h \text{Indebtedness}_{i,t-} \quad (1)$$

$$+ \underbrace{\boldsymbol{\Psi_h'} \mathsf{Z}_{i,t-1} \cdot \Delta \log \sigma_t + \Gamma_h' \mathsf{Z}_{i,t-1}}_{\text{Firm controls}} + \underbrace{\eta_h \text{Indebtedness}_{i,t-1} \cdot \Delta \log GDP_t}_{\text{Cyclical sensitivity}} + \mu_{i,t+h}$$

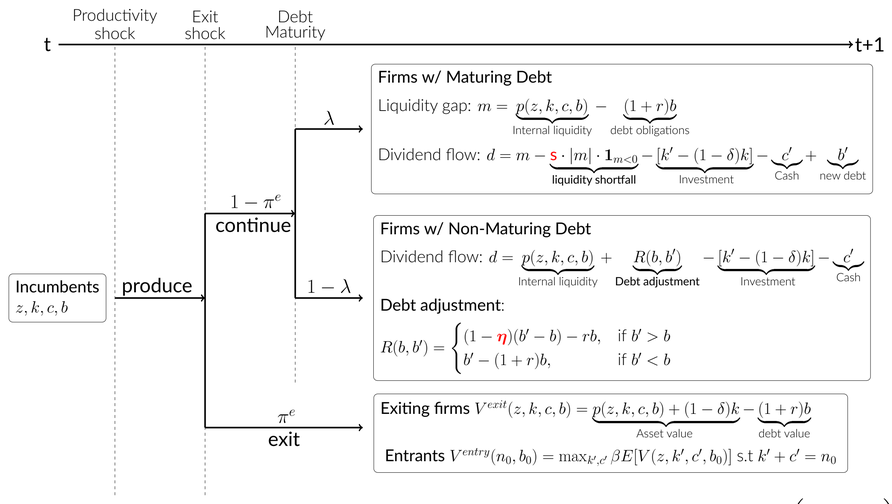
$$\forall i, h = 0, 1, 2, 3, ..., 12$$

- Empirical results are robust to a wide set of controls and specifications.
- Event study using the 9/11 terrorist attacks suggests similar patterns.

A Heterogeneous-Firm Model with Financial Frictions

- I embed firms' portfolio choice between physical capital and liquid assets into a heterogeneous-firm model with borrowing constraints.
- Frictions in financial markets and costly liquidity shortfalls for debt repayments motivate firms to hold liquid assets for future investment opportunities and for future debt repayment.

$$\underbrace{p(z,k,c,b)}_{\text{Internal Liquidity}} = \underbrace{(1-\tau)\pi(z,k)}_{\text{After-tax profits}} + \underbrace{[1+(1-\tau)r]c}_{\text{cash holding}} + \underbrace{\tau(rb+\delta k)}_{\text{Tax rebates}}$$



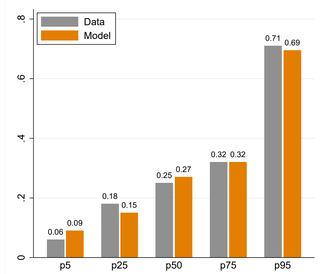
[Borrowing constraint]: $(1+r)b' \leq \theta(1-\delta)k', 0 < \theta < 1$ [Equity issuance costs]: $\Phi(d) = \mathbf{1}_{d<0} \cdot \left(\kappa_0 + \frac{\kappa_1}{2} d^2\right)$

Model Validation

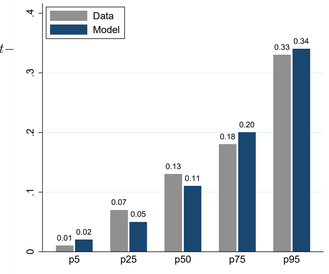
1.Empirically-consistent heterogeneity in firm balance sheets

Cross-Sectional Moments: Data versus Model

(a) Leverage ratio



(b) Cash ratio



2. Generating empirically-consistent dynamic investment/financing behavior

- Both in the data and in the model, high indebtedness is associated with low capital investment/high cash growth/low debt growth.

Firm Characteristics and Firm Behavior: Data Versus Model

$\Delta \ln y_{i,t+1}$	$\Delta\text{Capital}_{i,t+1}$		$\Delta\text{Cash}_{i,t+1}$		$\Delta\text{Debt}_{i,t+1}$	
	Data	Model	Data	Model	Data	Model
$\text{Indebtedness}_{i,t}$	-0.023***	-0.027***	0.122***	0.110***	-0.080***	-0.060***
	(0.001)	(0.000)	(0.003)	(0.001)	(0.003)	(0.001)
Tobin's $Q_{i,t}$	0.022***	0.056***	0.038***	0.008***	0.013***	0.033***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.000)
$\text{Firm Size}_{i,t}$	-0.003***	-0.012***	-0.043***	-0.051***	-0.015***	-0.044***
	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)
Firm FE	✓	–	✓	–	✓	–
Sector-Quarter FE	✓	–	✓	–	✓	–
R^2	0.098	0.784	0.055	0.045	0.054	0.144

- In both data and in the model, firms use cash holding and debt to fund capital investment when a growth opportunity realizes.

Firm Responses to Idiosyncratic Productivity Growth: Data versus Model

	Data			Model		
$\Delta \ln y_{i,t+1}$:	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$
$\Delta \ln \text{TFP}_{i,t}$	0.27***	-0.15***	0.26***	0.849***	-0.955***	0.381***
	(0.001)	(0.005)	(0.003)	(0.002)	(0.021)	(0.012)
Firm Controls	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	–	–	–
Sector-Quarter FE	✓	✓	✓	–	–	–
R^2	0.176	0.080	0.084	0.896	0.112	0.171

Model-implied Firm-level Transmission of Uncertainty Shocks

- The economy is at the steady state and unexpectedly receives a jump in the dispersion of idiosyncratic productivity (mean-preserving spread) that reverts back to steady-state level according to $\sigma_{t+1} = 0.5\ \sigma_t$.
- Baseline model reproduces both average responses across firms and heterogeneous response driven by firm indebtedness.

$\Delta \ln y_{i,t+1} \times 100$:	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$
$\Delta \log \sigma_{t+1}$	-0.326***	-0.214***	0.585***	0.753***	-0.491***	-0.193***
	(0.013)	(0.016)	(0.023)	(0.026)	(0.060)	(0.069)
$\Delta \log \sigma_{t+1} \times \text{Indebtedness}_{i,t}$		-0.280***		0.257***		0.086
		(0.025)		(0.039)		(0.103)
R-Squared	0.796	0.796	0.069	0.069	0.158	0.158
$\text{Firm Controls}_{i,t}$	✓	✓	✓	✓	✓	✓
$\Delta \log \sigma_{t+1} \times \text{Z}_{i,t}$	–	✓	–	✓	–	✓

Decomposing the Mechanism: Role of Model Ingredients

Uncertainty shocks create both larger downside risk and greater upside opportunity.

1. Model w/o liquidity penalty $\Longrightarrow$ no concern for downside risk $\Longrightarrow$ no deleveraging
2. Model w/o debt issuance frictions $\Longrightarrow$ no concern for upside opportunity $\Longrightarrow$ cash drops

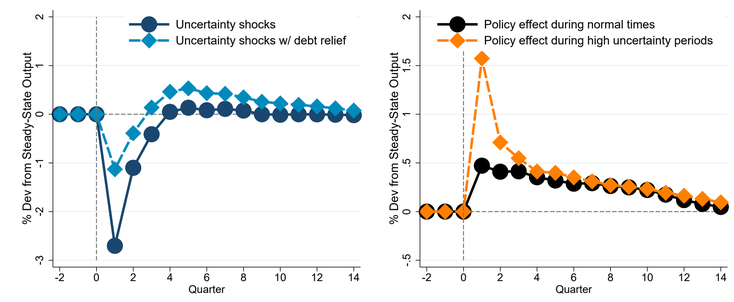
	(A) Model w/o liquidity penalty			(B) Model w/o debt issuance frictions		
$\Delta \ln y_{i,t+1} \times 100$:	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$	$\Delta\text{Capital}_{i,t+1}$	$\Delta\text{Cash}_{i,t+1}$	$\Delta\text{Debt}_{i,t+1}$
$\Delta \log \sigma_{t+1}$	0.033**	0.239***	-0.018	-0.389***	-2.426***	-5.447***
	(0.016)	(0.008)	(0.022)	(0.017)	(0.158)	(0.152)
$\text{Firm Controls}_{i,t}$	✓	✓	✓	✓	✓	✓
R^2	0.727	0.084	0.589	0.716	0.059	0.086

Novel Policy Implication

- **Strong state-dependent effects:** debt relief programs that can stimulate aggregate output by 0.5% during normal times drive up aggregate output by 1.5% during uncertainty-driven recessions.
- **The working of policy:** debt relief programs mitigate both deleveraging and liquidity buildup in response to uncertainty shocks.

Uncertainty-Driven Recessions and Credit Interventions

(a) Output Responses to Uncertainty shocks (b) Output Responses to debt relief



Conclusions

- A **novel** transmission mechanism of uncertainty shocks that works through firm balance sheets.
- The **first** model that reproduces joint capital/cash/debt dynamics following uncertainty shocks.
- Shed **new** light on stabilization policies during uncertainty-driven recessions.