

# Financial and Uncertainty Shocks

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# Alternative Drivers of Economic Fluctuations

*The shocks that produced the recession were primarily associated with **financial disruptions** and **heightened uncertainty***

Stock and Watson (2012)

Depth and duration of **financial crisis**

⇒ several challenges for standard business cycle models

New strands of literature arose proposing alternative shocks

- ① **Financial shocks** - Khan and Thomas (2013) JPE
- ② **Uncertainty shocks** - Bloom (2009) ECMA

# Theoretical Definitions

**Financial Shocks.** Unanticipated innovations to financial conditions orthogonal to other economic disturbances.

$$F_t = g(s_t^Y, s_t^U) + s_t^F$$

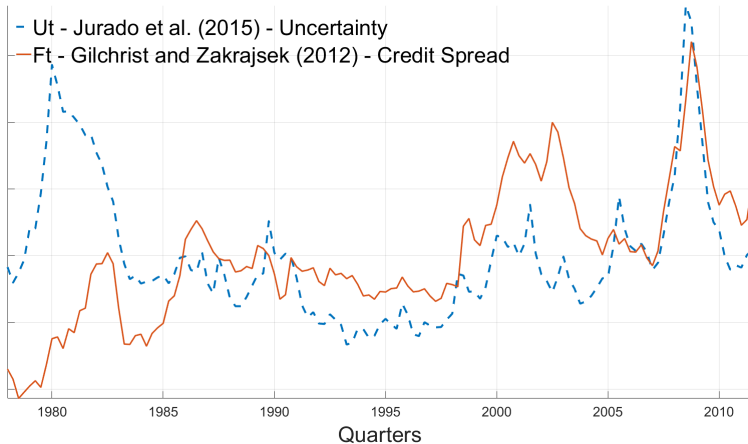
*E.g. new banking regulation, banks' balance sheet deterioration, changes in lenders' risk management, ...*

**Uncertainty Shocks.** Innovations to the forecast error variance of aggregate variables orthogonal to other economic disturbances.

$$U_t = h(s_t^Y, s_t^F) + s_t^U$$

*E.g. political tension, terrorist attack, sectoral growth opportunities, ...*

# Empirical Proxies for Financial Conditions and Uncertainty



# Motivation: Empirical Challenge in Structural VAR

Empirically distinguishing between financial and uncertainty shocks is difficult

⇒ financial distress is empirically associated with larger volatility

Within a SVAR framework, this correlation significantly complicates identification of both shocks

❶ Implausible **zero-contemporaneous restrictions**

⇒ Both  $F_t$  and  $U_t$  are fast moving

❷ Unavailable instruments for **sign restrictions**

⇒ Current theoretical models predict same qualitative effects on both prices and quantities

# My contribution

I want to take a step back and show evidence and theory that financial and uncertainty shocks are **qualitative different**.

In particular,

- ① **Corporate cash holdings** respond differently to financial and uncertainty shocks.  
⇒ Identification assumption
- ② I provide a **new econometric tool** to simultaneously identify two structural shocks when an internal instrument is available.  
⇒ Generalized Penalty Function Approach

1. **Cash Holdings**
2. Model
3. Empirical Strategy
4. Results
5. Conclusions

# Corporate Cash Holdings

**Cash and Cash Equivalents** refer to assets a business holds as ready cash

- Coffer as petty cash
- Bank accounts
- Certificates of deposits

U.S. large firms have cash equal to about 15% of total assets.

It is a **stock variable**,

$$Cash_t = Cash_{t-1} + NY_t + \delta K_t - I_t + B_t - D_t.$$



## Cash and Financial Frictions

⇒ Cash is a substitute for external finance

*Kaplan and Zingales (1997); Almeida, et al. (2004); Campello et al. (2010); Campello et al. (2011).*

## Cash and Uncertainty

⇒ Cash is positively associated with uncertainty shocks

*Han and Qiu (2007); Baum et al. (2008); Bloom et al. (2018); Alfaro et al. (2018).*

# Aggregate Evidence

Aggregate quarterly cash (CHEQ) and assets (ATQ) using **Compustat** from 1961 to 2018.

Remove seasonality using 7-term Henderson filter on aggregate cash and aggregate assets and obtain **Cash2Assets**.

	$\Delta\text{GDP}$	U	F
<i>Correlations</i>			
U	-0.48***		
F	-0.36***	0.22***	
C2A	-0.06	0.43***	-0.37***

1. Cash Holdings
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# Model - General Setup

- **Three-period partial equilibrium** model
- Firm **maximizes** sum of **dividends**
  - Discount factor  $\beta$  is one
- **Choice variables** are
  - **Investments**  $i_0$  and  $i_1$  in period 0 and 1
  - Amount to **borrow**  $b_0$  and  $b_1$  in period 0 and 1
  - **Cash**  $c$  in period 0 to be carried in period 1
- Feature **financial frictions** in the form of risk premium
- **Gross returns**  $g(\cdot)$  happen in the last period for both investments

# Model - Analytical Setup

Period 0      $d_0 = y_0 + b_0 - i_0 - c$

Period 1      $d_1 = y_1 + b_1 - i_1 + c$ ,     where  $y_1 \sim F(y_0, \sigma^2)$

Period 2      $d_2 = g(i_0) - b_0(1 + r_0) + g(i_1) - b_1(1 + r_1)$

$$\max_{\{b_t, i_t, c\}_{t=0,1}} \mathbb{E} \left[ d_0 + d_1 + d_2 \middle| F \right]$$

$$\text{subject to } r_0 = \frac{1}{2}\alpha_0 b_0 \text{ and } r_1 = \frac{1}{2}\alpha_1 b_1$$

$$d_t \geq 0, \quad t = 0, 1, 2$$

Financial shock:  $\uparrow \alpha_0$      vs     Uncertainty shock:  $\uparrow \sigma^2$

## Solution

Assuming that firm needs external finance in equilibrium, model implies:

- $i_0 = y_0 + b_0 - c$ ,
- $i_1 = y_1 + b_1 + c$ ,

and first order conditions are

$$b_0 : g'(y_0 + b_0^* - c^*) = \underbrace{1 + \alpha_0 b_0^*}_{\text{Marginal Cost of } i_0}$$

$$b_1 : \mathbb{E} \left[ g'(y_1 + b_1^* + c^*) \right] = \underbrace{1 + \alpha_1 b_1^*}_{\text{Marginal Cost of } i_1}$$

$$c : \underbrace{\mathbb{E} \left[ g'(y_1 + b_1^* + c^*) \right]}_{\text{Expected Marginal Return of } i_1} = \underbrace{g'(y_0 + b_0^* - c^*)}_{\text{Marginal Return of } i_0}$$

# Comparative Statics

$$b_0 : g'(y_0 + b_0^* - c^*) = \underbrace{1 + \alpha_0 b_0^*}_{\text{Marginal Cost of } i_0}$$

$$b_1 : \mathbb{E} \left[ g'(y_1 + b_1^* + c^*) \right] = \underbrace{1 + \alpha_1 b_1^*}_{\text{Marginal Cost of } i_1}$$

$$c : \underbrace{\mathbb{E} \left[ g'(y_1 + b_1^* + c^*) \right]}_{\text{Expected Marginal Return of } i_1} = \underbrace{g'(y_0 + b_0^* - c^*)}_{\text{Marginal Return of } i_0}$$

**Uncertainty shock:**  $y_1 \sim Q$  which is mean-preserving spread in  $F$

$$\Rightarrow c^*(\alpha_0, Q) > c^*(\alpha_0, F) \text{ as long as } g'''(\cdot) > 0$$

**Financial shock:**  $\alpha_0^f > \alpha_0$  which is an exogenous increase in  $r_0$

$$\Rightarrow c^*(\alpha_0^f, F) < c^*(\alpha_0, F)$$

1. Cash Reserves
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# Empirical Analysis

Given the reduced-form system  $X_t = BX_{t-1} + \iota_t$  where

$$X_t = \begin{bmatrix} U_t \\ F_t \\ GDP_t \\ C_t \\ I_t \\ H_t \\ C2A_t \\ GDPDef_t \end{bmatrix}$$

Dataset ranges from 1978q1 to 2015q3.

# Sequential Penalty Function Approach

## Uncertainty Shock

$$\begin{array}{ll} \max_{\gamma_U} & \underbrace{e_U A_0 \gamma_U}_{\text{Impact on U}} + \delta \underbrace{e_C A_0 \gamma_U}_{\text{Impact on Cash}} \\ \text{subject to} & \delta \geq 0 \quad \text{and} \quad \underbrace{\gamma_U \gamma'_U = 1}_{\text{Normalization}} \end{array}$$

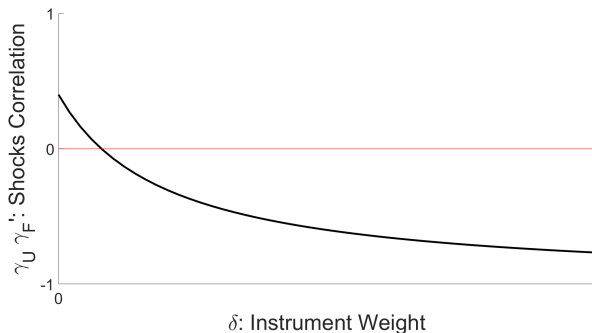
## Financial Shock

$$\begin{array}{ll} \max_{\gamma_F} & \underbrace{e_F A_0 \gamma_F}_{\text{Impact on F}} - \delta \underbrace{e_C A_0 \gamma_F}_{\text{Impact on Cash}} \\ \text{subject to} & \delta \geq 0, \quad \underbrace{\gamma_F \gamma'_F = 1}_{\text{Normalization}}, \quad \text{and} \quad \underbrace{\gamma_U \gamma'_F = 0}_{\text{Orthogonality with U shock}} \end{array}$$

# A Novel Approach

I suggest a **general approach** where  $\delta$  is treated as an endogenous parameter chosen by the data.

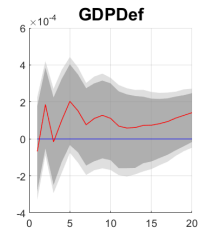
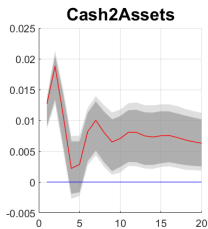
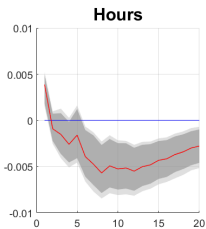
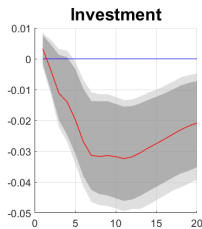
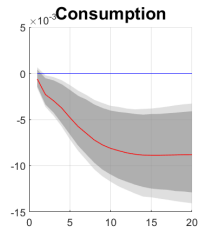
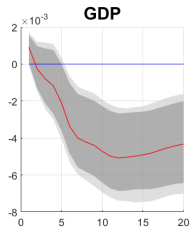
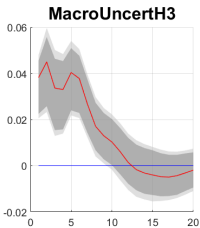
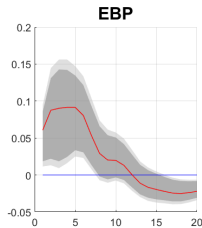
⇒ Given the problem above, set  $\delta$  such that  $\gamma_U \gamma_F' = 0$



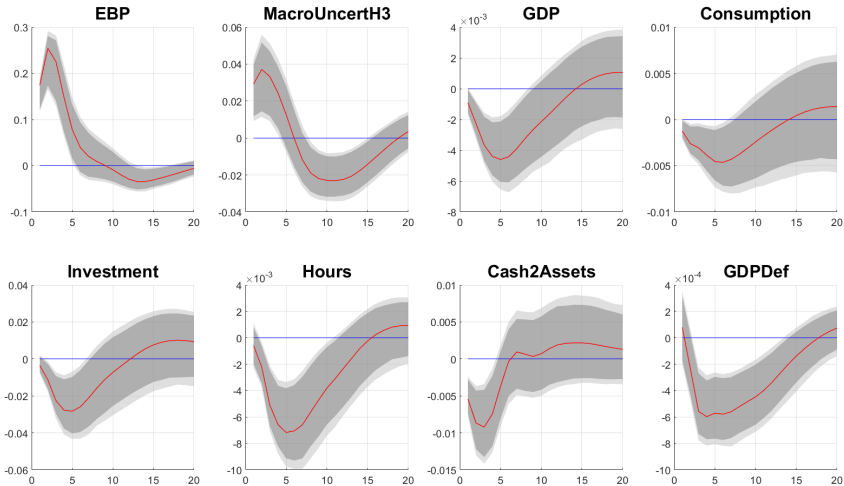
**Intuition.** Weight of the internal instrument should be large enough such that  $\gamma_U \gamma_F' = 0$  endogenously holds.

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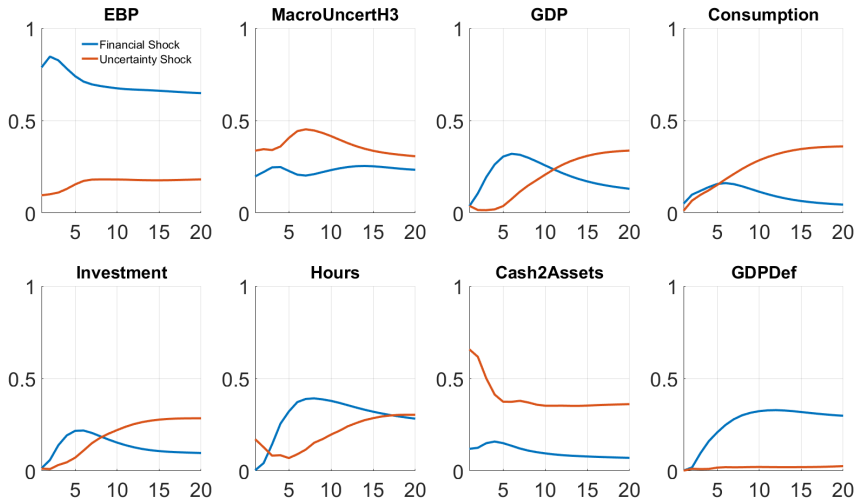
# Uncertainty Shock



# Financial Shock



# Variance Explained



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# Conclusions

- **Cash reserves** as an internal instrument to simultaneously identify financial and uncertainty shocks.
- An **econometric tool** to overcome known SVAR shortcomings
  - ⇒ Tests using simulated data confirm the reliability of the procedure. See **Appendix A**.
- Empirical results confirm the **relevance** and **exogeneity** of both shocks.
  - ⇒ Correlations with external shocks is available in **Appendix B**.
- **Financial shocks** have larger effects in the **short run** while **uncertainty shocks** have a more **persistent** effect.

# Next Steps

## ① Empirical evidence in favor of my identification assumption

- Using **Quarterly Financial Report** data to show that my results are mostly driven by small firms
- Merging **Compustat** and **TRACE** to show firm-level evidence of the differential response of cash

$$\frac{Cash_{it}}{Assets_{it}} = \underbrace{\beta^U}_{(+)} U_{it} + \underbrace{\beta^F}_{(-)} F_{it} + \beta^X X_{it} + \delta_i + \lambda_t + \varepsilon_{it}$$

## ② Design and analyze a **dynamic GE model**

- to show my identification assumption survives to GE effects
- to test whether GPFA can recover both shocks

## Appendix A - Simulated Data and Generalized PFA

Consider the following structural model,

- $U_t = B_{UU}U_{t-1} + B_{UF}F_{t-1} + B_{UC}C_{t-1} + A_{UU}s_t^U + A_{UF}s_t^F$
- $F_t = B_{FU}U_{t-1} + B_{FF}F_{t-1} + B_{FC}C_{t-1} + A_{FU}s_t^U + A_{FF}s_t^F$
- $C_t = B_{CU}U_{t-1} - B_{CF}F_{t-1} + B_{CC}C_{t-1} + A_{CU}s_t^U - A_{CF}s_t^F$

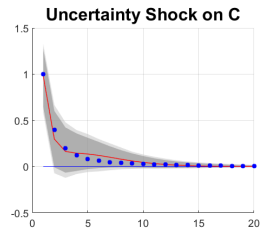
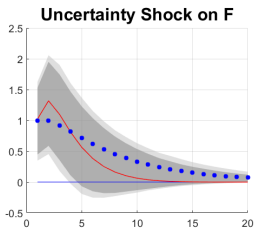
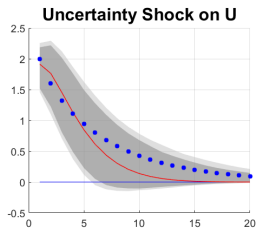
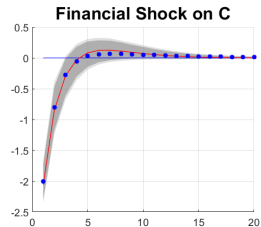
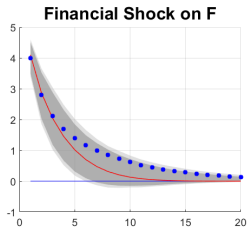
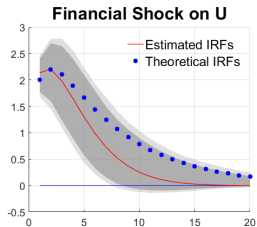
where  $s_t^U \sim N(0, \sigma_U^2)$ ,  $s_t^F \sim N(0, \sigma_F^2)$  and  $s_t^U \perp s_t^F$ .

Objective is to estimate structural parameters

- using only  $X_t = [U_t, F_t, C_t]$ , and
- only knowing that  $A_{ji} \geq 0$  for  $j, i = \{U, F, C\}$ .

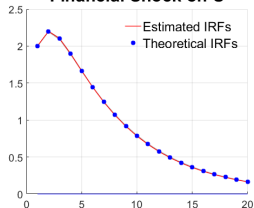
$\Rightarrow$  apply GPFA to test reliability of the econometric tool

# Appendix A - Small Sample Performance ( $T = 100$ )

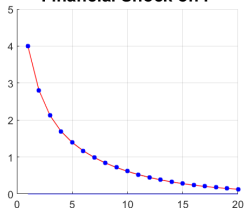


# Appendix A - Large Sample Performance ( $T = 100000$ )

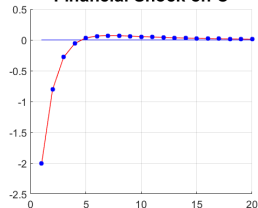
**Financial Shock on U**



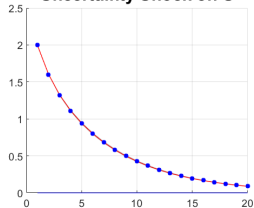
**Financial Shock on F**



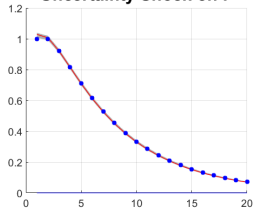
**Financial Shock on C**



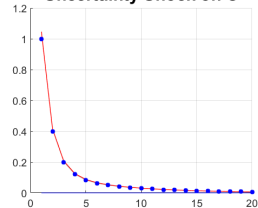
**Uncertainty Shock on U**



**Uncertainty Shock on F**



**Uncertainty Shock on C**



## Appendix B - Correlations with Other External Shocks

	Uncertainty Shocks	Financial Shocks
<i>External Shocks</i>		
BZP Military News	−0.10 (0.24)	0.08 (0.31)
Ramey Military news	0.07 (0.44)	0.02 (0.82)
LWY Exp. Tax	0.03 (0.74)	0.15 (0.11)
RRMR Unexp. Tax	−0.13 (0.16)	0.05 (0.59)
RRMR Exp. Tax	−0.08 (0.36)	0.03 (0.76)
AdjTFP AR(1)	0.08 (0.31)	−0.14 (0.11)
RR Mon. Policy	−0.13 (0.18)	−0.04 (0.70)