Financial and Uncertainty Shocks

Marco Brianti

October 2018

Boston College

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**

$\Rightarrow$ 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.

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

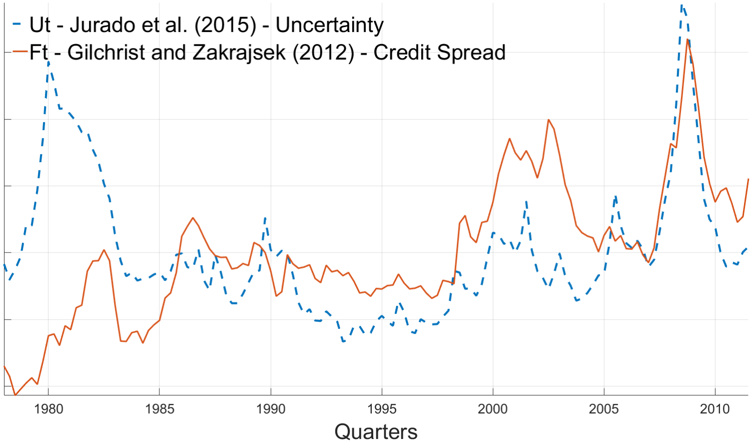
E.g. new banking regulation, banks' balance sheet deterioration, changes in lenders' risk management, . . .

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

$\Rightarrow$ financial distress is empirically associated with larger volatility

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

1. Implausible **zero-contemporaneous restrictions**
   - $\Rightarrow$ Both F_t and U_t are fast moving
2. Unavailable instruments for **sign restrictions**
   - $\Rightarrow$ 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.
   - $\Rightarrow$ Identification assumption
2. I provide a **new econometric tool** to simultaneously identify two structural shocks when an internal instrument is available.
   - $\Rightarrow$ Generalized Penalty Function Approach

Roadmap

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**,

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

Cross-Sectional Evidence

Cash and **Financial Frictions**

⇒ Cash is a substitute for external finance

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

	ΔGDP	U	F
Correlations			
U	-0.48^{***}		
F	-0.36^{***}	0.22^{***}	
C2A	-0.06	0.43^{***}	-0.37^{***}

Roadmap

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

Model - General Setup

- **Three-period partial equilibrium** model
- Firm **maximizes** sum of **dividends**
  - Discount factor β 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 $\quad d_0 = y_0 + b_0 - i_0 - c$

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

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

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

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

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

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

Solution

Firm needs external finance: $\mathbb{E}_0\left[g(y_t)\right] > 1$ for $t = 0, 1$

$$\Rightarrow\ d_t = 0 \quad \text{for} \quad t = 0, 1$$

which implies $i_0 = y_0 + b_0 - c$ and $i_1 = y_1 + b_1 + c$. Objective function is,

$$\max_{b_0, b_1, c}\ g\left(i_0\right) - b_0 - \frac{1}{2}\alpha_0 b_0^2 - y_0 + \mathbb{E}\left[g\left(i_1\right) - b_1 - \frac{1}{2}\alpha_1 b_1^2 - y_1 \middle| F\right]$$

First Order Conditions

$$\begin{aligned}
b_0 &: \ g'(y_0 + b_0^* - c^*) = 1 + \alpha_0 b_0^* \\
b_1 &: \ \mathbb{E}\left[g'(y_1 + b_1^* + c^*)\right] = 1 + \alpha_1 b_1^* \\
c &: \ \mathbb{E}\left[g'(y_1 + b_1^* + c^*)\right] = g'(y_0 + b_0^* - c^*)
\end{aligned}$$

Comparative Statics

Given the first order conditions,

$$
\begin{aligned}
b_0 &: \; g'(y_0 + b_0^* - c^*) = 1 + \alpha_0 b_0^* \\
b_1 &: \; \mathbb{E}\left[g'(y_1 + b_1^* + c^*)\right] = 1 + \alpha_1 b_1^* \\
c &: \; \mathbb{E}\left[g'(y_1 + b_1^* + c^*)\right] = g'(y_0 + b_0^* - c^*)
\end{aligned}
$$

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

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

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

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

Roadmap

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

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

$$\max_{\gamma_U} \quad \underbrace{e_U A_0 \gamma_U}_{\text{Impact on U}} \quad + \quad \delta \quad \underbrace{e_C A_0 \gamma_U}_{\text{Impact on Cash}}$$

$$\text{subject to} \quad \delta \geq 0 \quad \text{and} \quad \underbrace{\gamma_U \gamma_U' = 1}_{\text{Normalization}}$$

Financial Shock

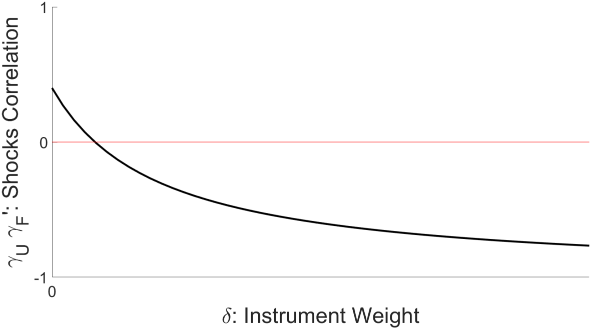
$$\max_{\gamma_F} \quad \underbrace{e_F A_0 \gamma_F}_{\text{Impact on F}} \quad - \quad \delta \quad \underbrace{e_C A_0 \gamma_F}_{\text{Impact on Cash}}$$

$$\text{subject to} \quad \delta \geq 0, \quad \underbrace{\gamma_F \gamma_F' = 1}_{\text{Normalization}}, \quad \text{and} \quad \underbrace{\gamma_U \gamma_F' = 0}_{\text{Orthogonality with U shock}}$$

A Novel Approach

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

$\Rightarrow$ Given the problem above, set δ such that $\gamma_U \gamma_F' = 0$

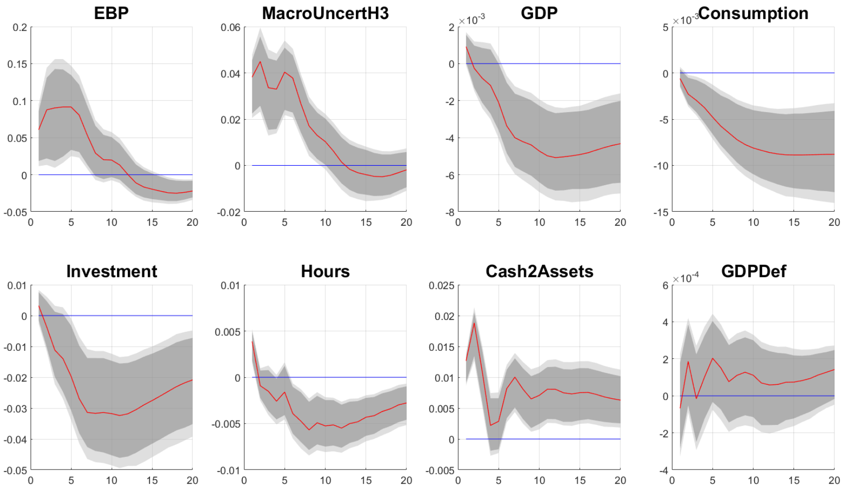


Intuition. Weight of the internal instrument should be large enough such that $\gamma_U \gamma_F' = 0$ endogenously holds.

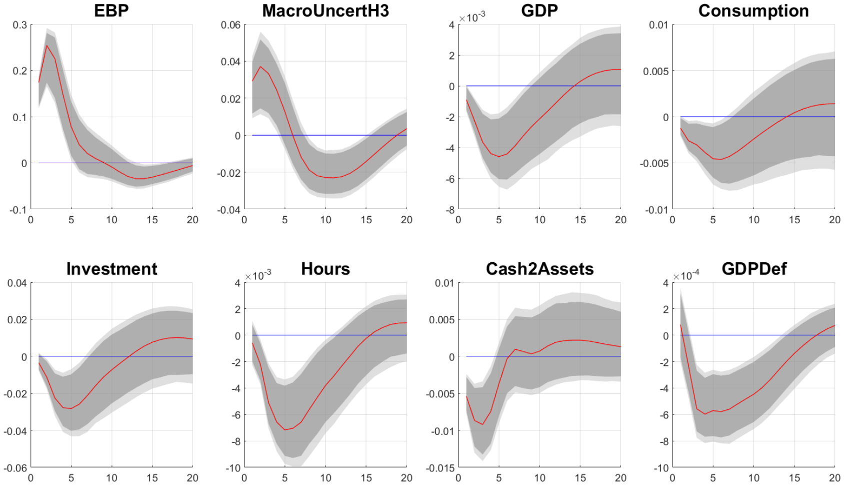
Roadmap

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

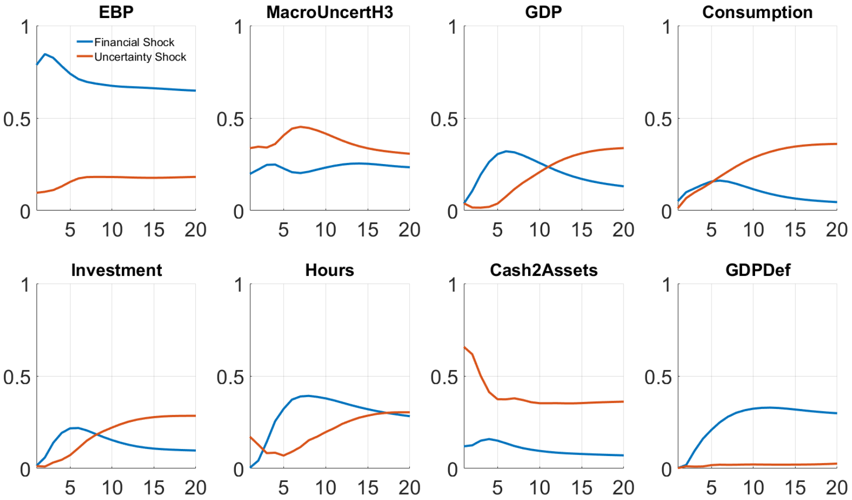
Uncertainty Shock



Financial Shock



Variance Explained



Roadmap

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

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,

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

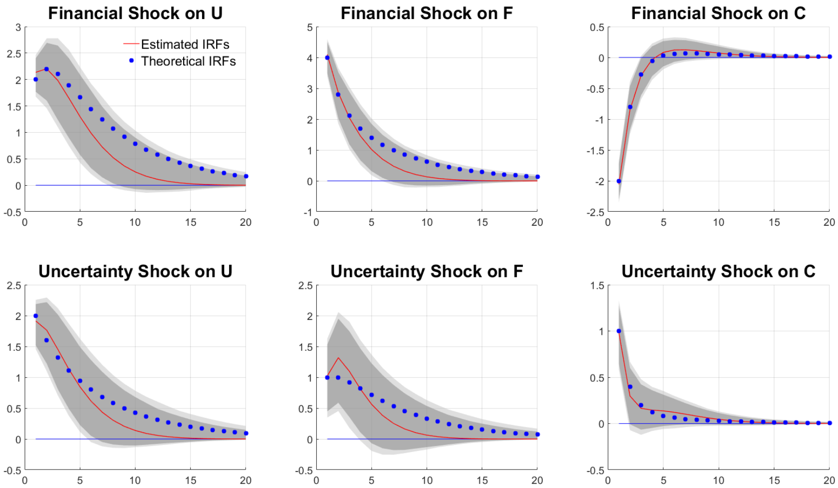
where $s_t^U \sim N(0, \sigma_U^2)$, $s_t^F \sim N(0, \sigma_F^2)$ and $s_t^U \perp s_t^F$.

Objective is to estimate structural parameters

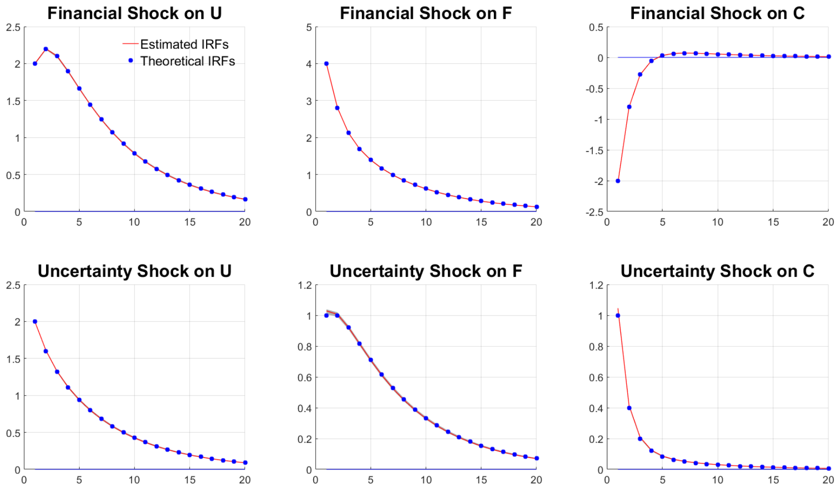
- Using $X_t = [U_t,\ F_t,\ C_t]$,
- only knowing that $A_{ji} \geq 0$ for $j, i = \{U,\ F,\ C\}$.

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

Appendix A - Result for T = 100



Appendix A - Result for T = 100000



Appendix B - Correlations with Other External Shocks

	Uncertainty Shocks	**Financial Shocks**
External Shocks		
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)