Financial and Uncertainty Shocks

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Alternative Drivers of Economic Fluctuations

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

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

Stock and Watson (2012)

Theoretical Definitions

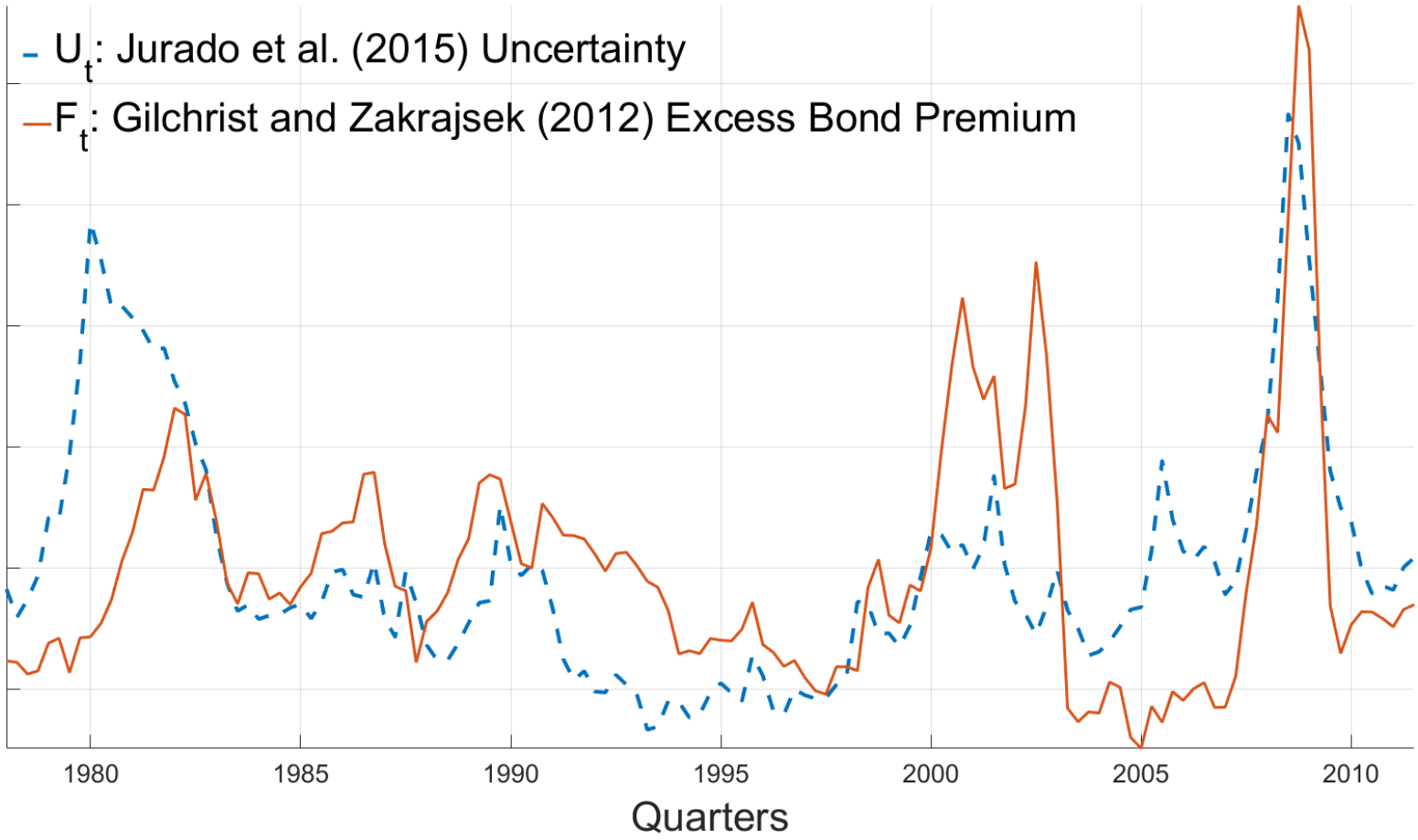
Financial Shocks. Unanticipated innovations to financial conditions orthogonal to any other known economic disturbance.

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

Uncertainty Shocks. Innovations to the forecast error variance of aggregate variables orthogonal to any other known economic disturbance.

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

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 sequentially 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 hold as ready cash

- Coffer as petty cash
- Bank account
- Bank 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 is a Substitute for External Finance

1. Financially constrained firms use cash as an **internal source of investment funding**.

   Kaplan and Zingales, 1997 QJE

2. Financially constrained firms **store cash in good times** and **use it in bad ones**.

   Almeida, Campello, Weisbach, 2004 JF

3. After a negative credit supply shock firms **burn cash** to **avoid investment cuts** and **reduce financial costs**.

   Campello, Graham, Harvey, 2010 JFE

4. At a country level, **cash-to-assets is positively correlated to credit-to-GDP**.

   Lins, Servaes, Tufano (2010) JFE

Cash is Positively Correlated with Uncertainty

1. Financially constrained firm **holds more cash if cash flow is more volatile**.

   Han and Qiu (2007) JCF

2. Firms **increase their liquidity ratios when macroeconomic uncertainty increases**.

   Baum, Coglayan, Stephan, Talavera (2008) EM

3. Using UK data, they show that **cash is positively associated to higher uncertainty**.

   Bloom, Mizen, Smietanka (2018) WP

4. In response to an **uncertainty shock**, firms **increase cash reserves**.

   Alfaro, Bloom, Lin (2018) NBER WP

Roadmap

1. Cash Holdings
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Three-Period Partial Equilibrium Model

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

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

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

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

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

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

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,

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

First Order Conditions

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

Comparative Statics

Given the first order conditions,

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

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
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Empirical Analysis

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

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

- where $\iota_t' \iota_t = \Sigma_\iota$
- dataset ranges from 1986q1 to 2015q4

Sequential Penalty Function Approach

Step 1 - Uncertainty Shock

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

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

Step 2 - Financial Shock

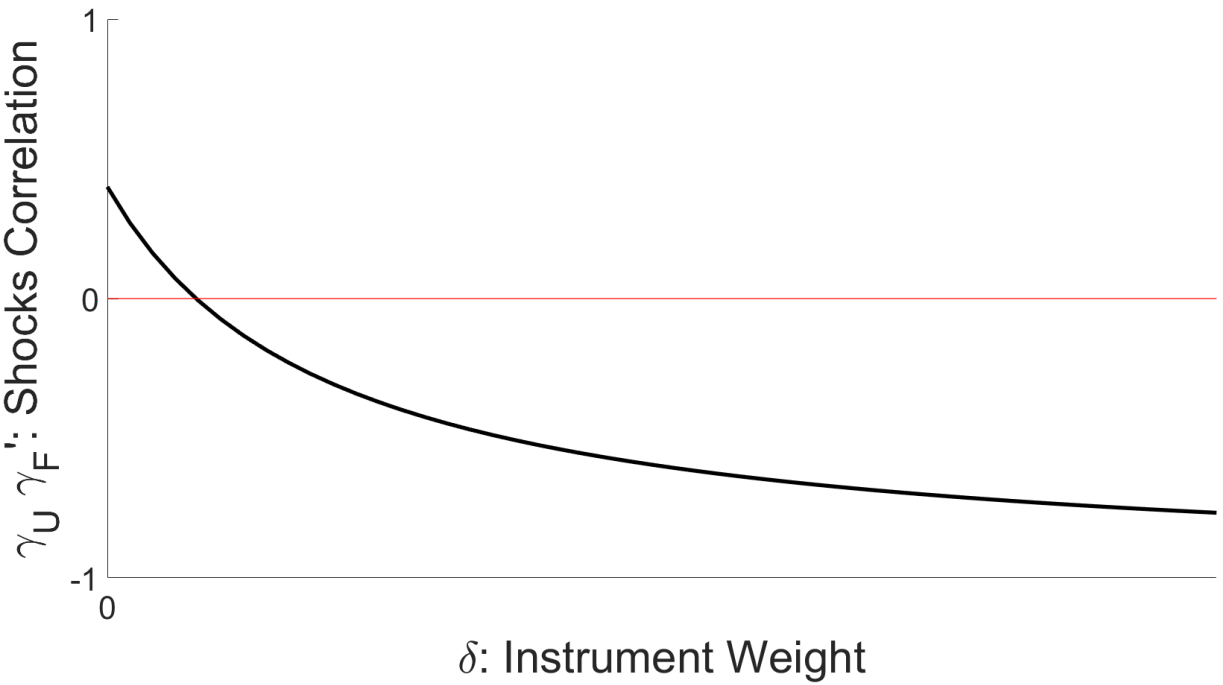
$$\max_{\gamma_F} \quad \underbrace{e_F A_0 \gamma_F}_{\text{Impact on F}} - \delta \underbrace{e_C A_0 \gamma_F}_{\text{Impact on Cash}}$$

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

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. Internal instrument intervention should be strong enough such that $\gamma_U \gamma_F' = 0$ endogenously holds.

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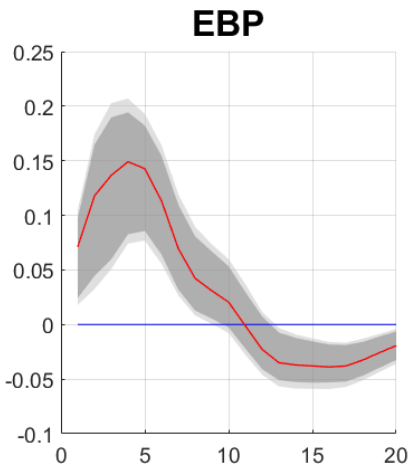
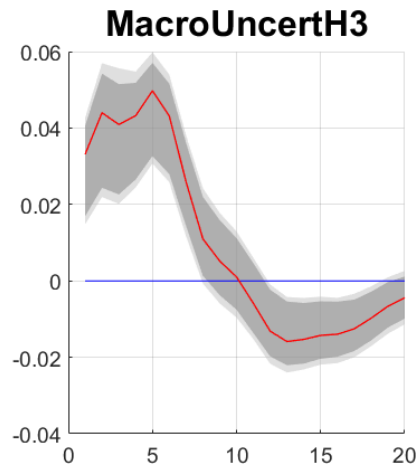
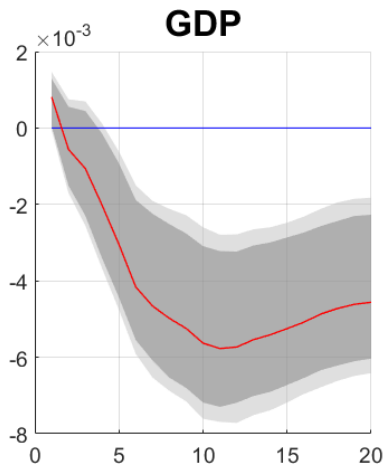
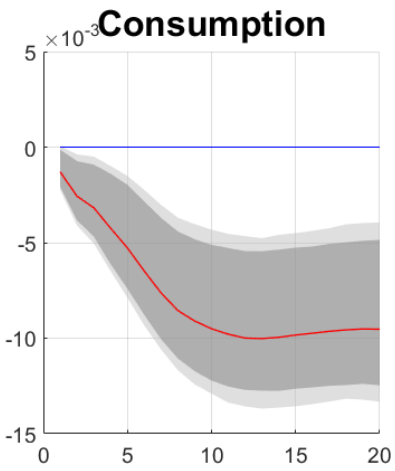
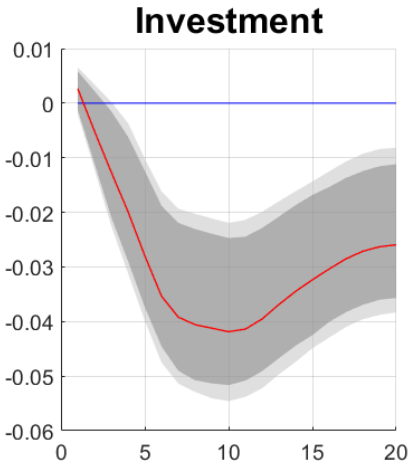
Uncertainty Shock

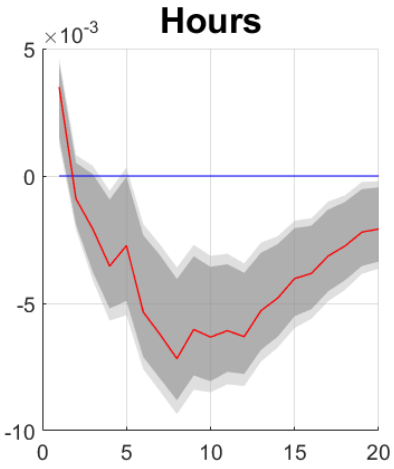


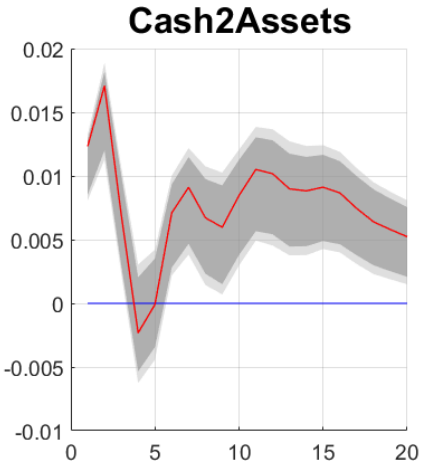




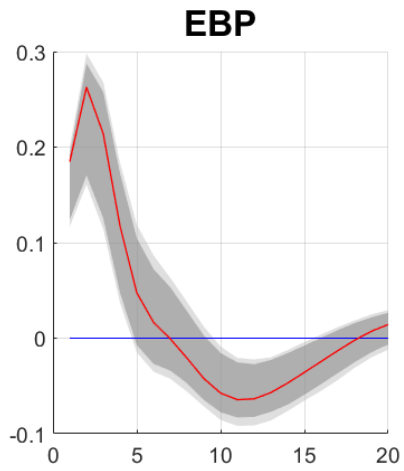


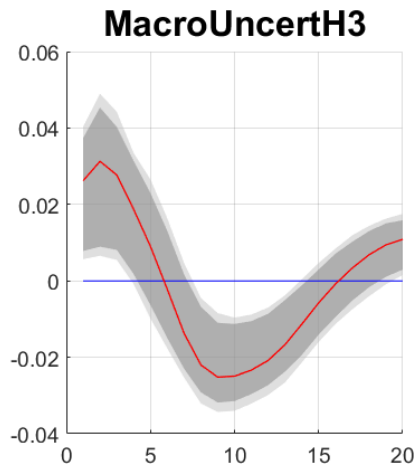


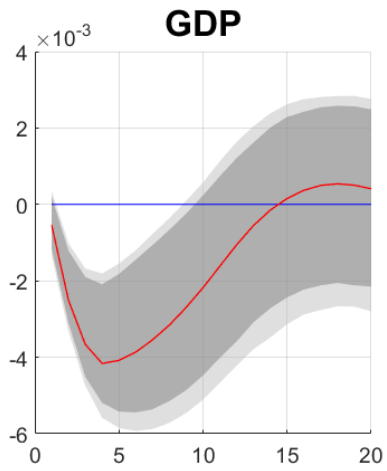


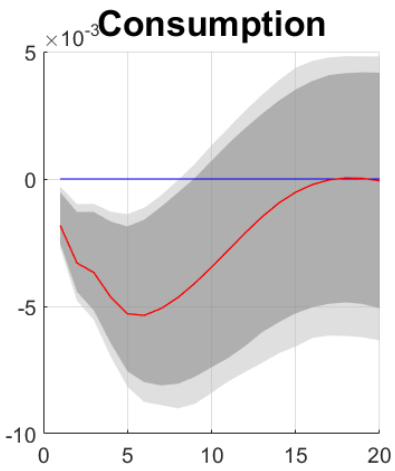


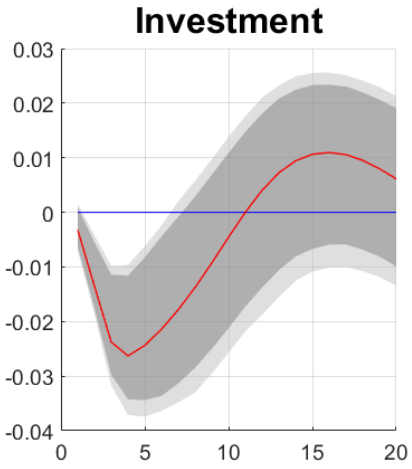
Financial Shock

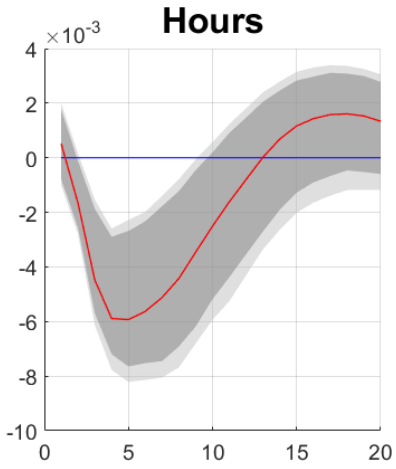


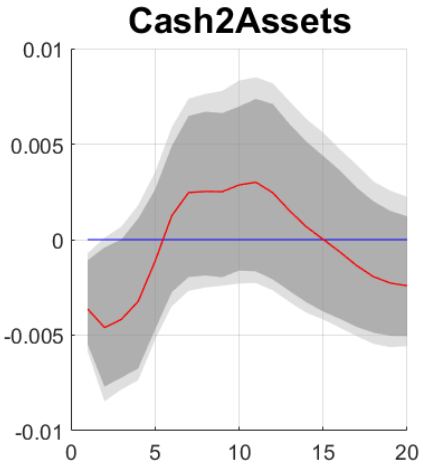




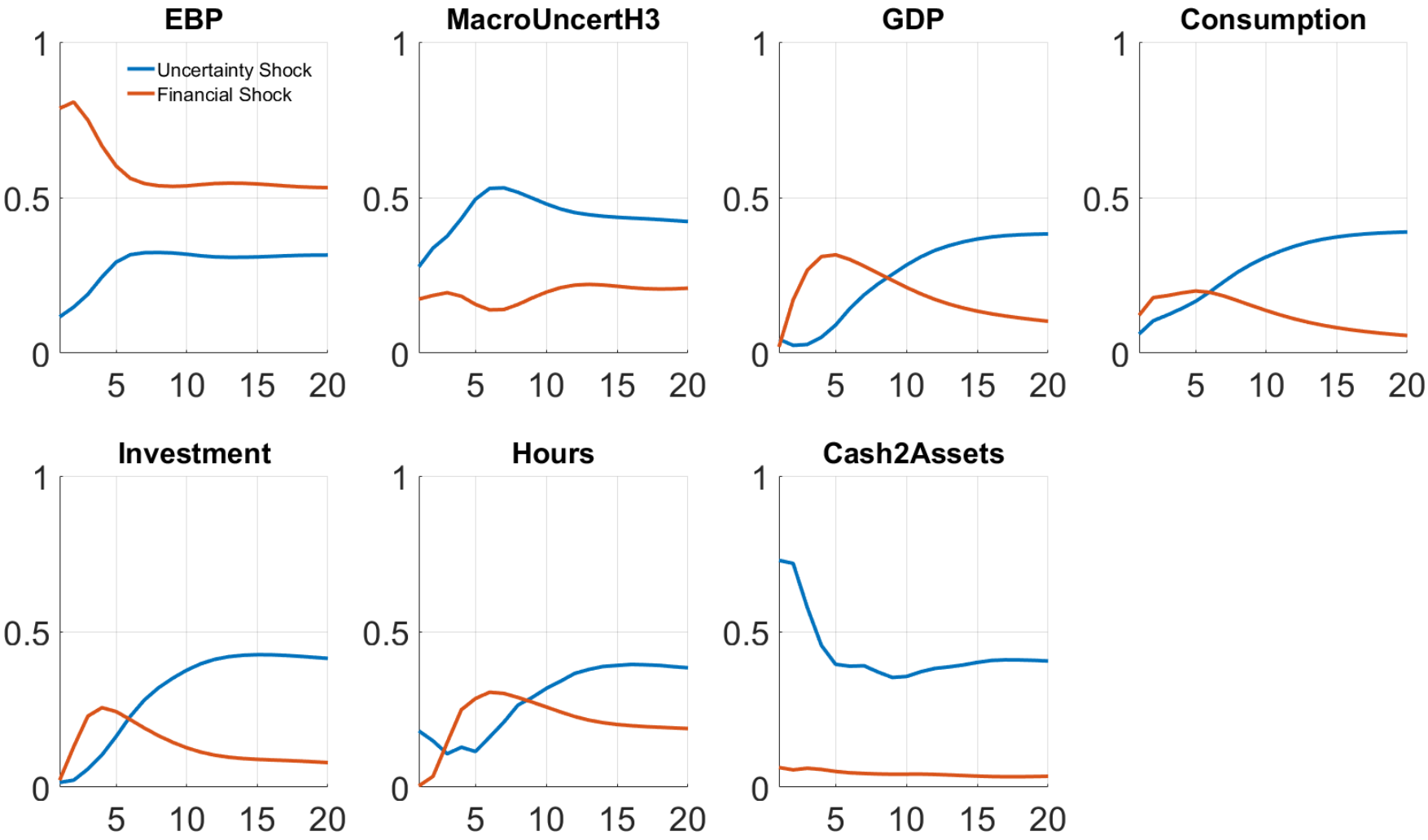








Variance Explained



Roadmap

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Conclusions

So far,

- Cash as an internal instrument to simultaneously identify financial and uncertainty shocks
- An econometric tool to overcome known SVAR shortcomings
- Empirical results confirm the relevance of both shocks
- Financial shocks have larger effects in the short run while uncertainty shocks in the medium run

Nest Steps,

- Firm-level evidence on the differential response of cash
- General equilibrium model

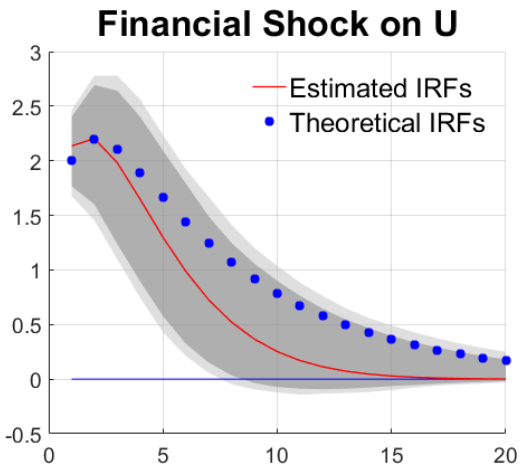
Appendix A - Simulated Data

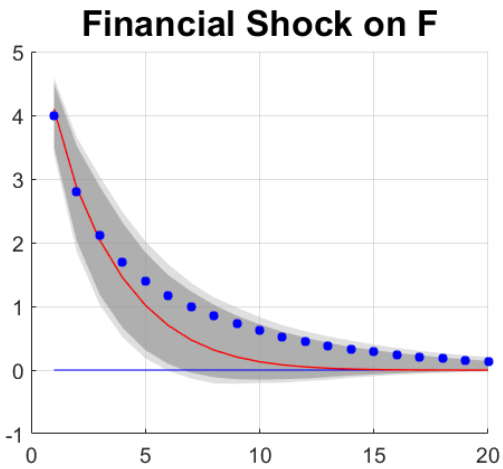
Simulate the model,

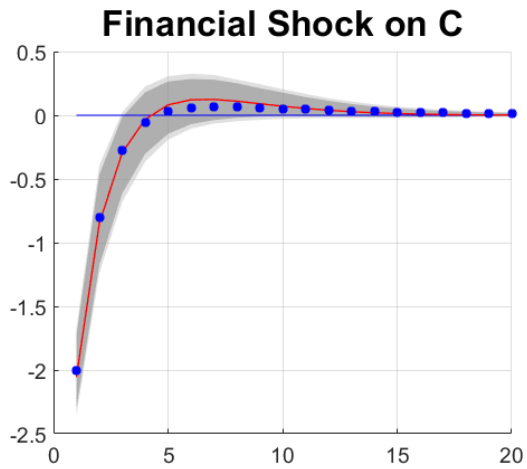
$$\begin{cases} X_t = \rho_{XX} X_{t-1} + \rho_{XY} Y_{t-1} + \rho_{XZ} Z_{t-1} + \alpha_{1X} s_t^1 + \alpha_{2X} s_t^2 \\ Y_t = \rho_{YX} X_{t-1} + \rho_{YY} Y_{t-1} + \rho_{YZ} Z_{t-1} + \alpha_{1Y} s_t^1 + \alpha_{2Y} s_t^2 \\ Z_t = \rho_{ZX} X_{t-1} - \rho_{ZY} Y_{t-1} + \rho_{ZZ} Z_{t-1} + \alpha_{1Z} s_t^1 - \alpha_{2Z} s_t^2 \end{cases}$$

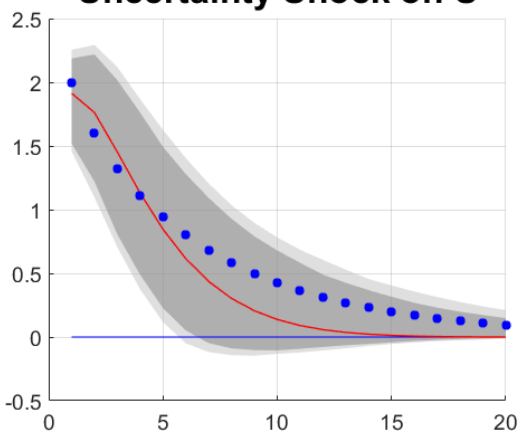
Objective is to estimate s_t^1 and s_t^2 under the assumption that we only know the sign of α_{ij}, $i = \{1, 2\}$, and $j = \{X, Y, Z\}$.

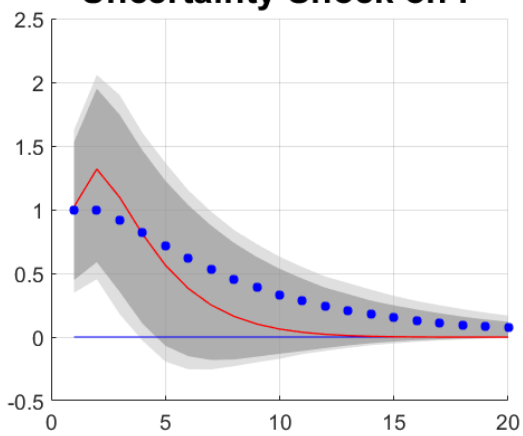
Appendix A - Result for T = 100

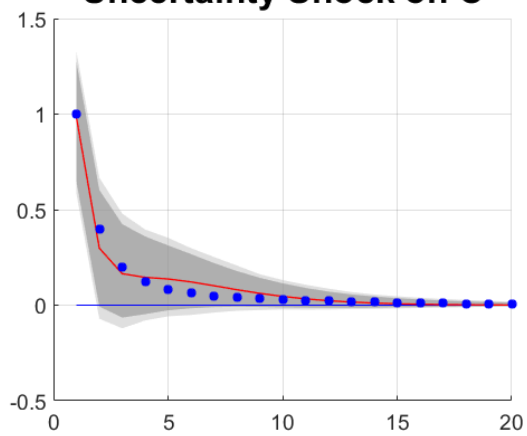












Appendix A - Result for T = 100000