Uncertainty Shocks and Financial Shocks

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October 2018

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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) Econometrica

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

Stock and Watson (2012)

Definitions

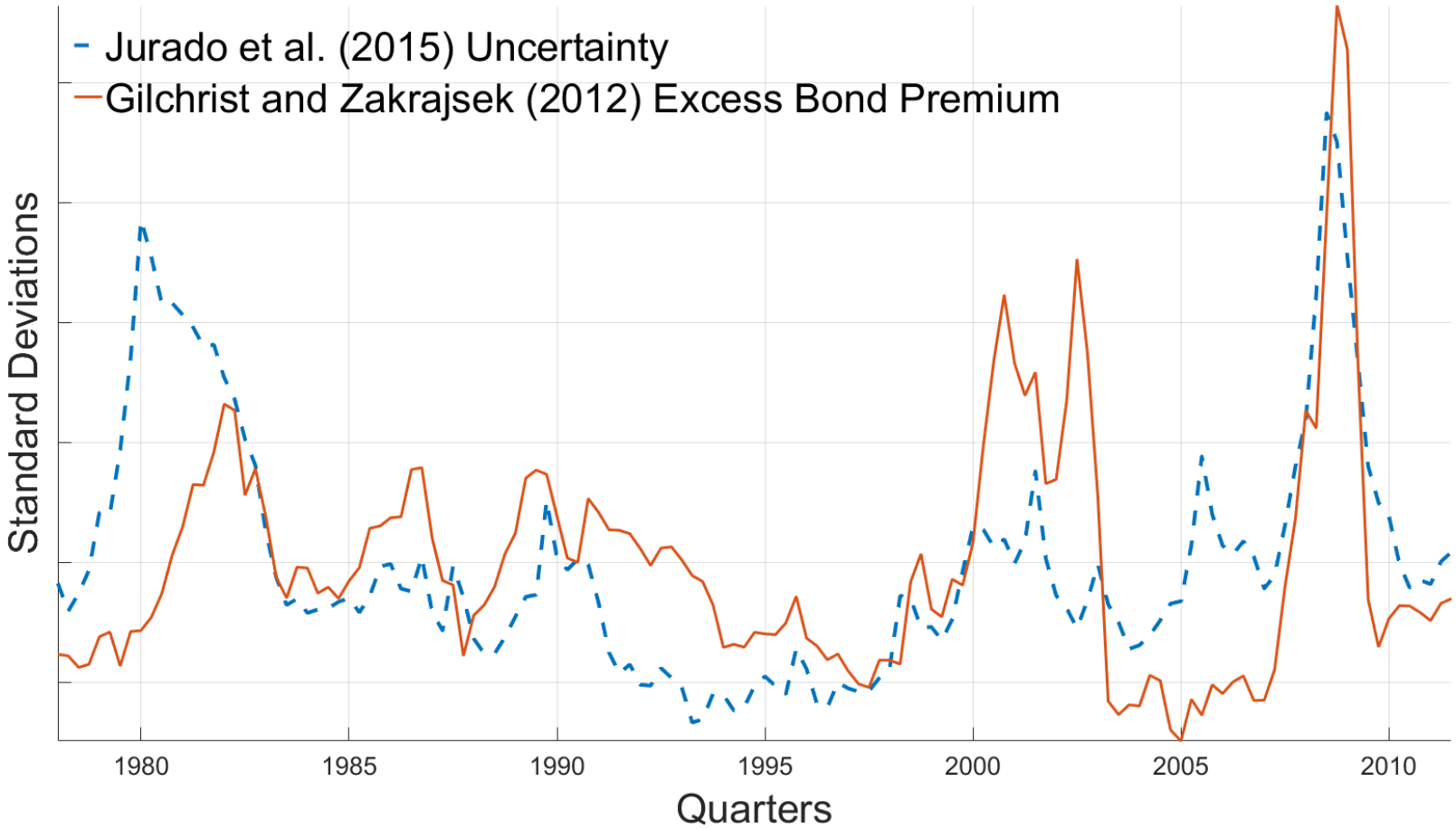
Financial Shocks. Unanticipated innovations to financial conditions orthogonal to any other known economic disturbance.

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

Uncertainty Shocks. Innovations in the expected variance of future (traditional) shocks which cannot be explained by any current source of economic fluctuations.

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

Empirical Challenge



Empirical Challenge (cont.)

Uncertainty shocks and financial shocks are deeply **confounded**.

$\Rightarrow$ correlation of raw series is above 0.5

$\Rightarrow$ correlation of their **innovations** remains close to 0.5

Empirical literature did not succeed yet to disentangle these two exogenous sources due to:

1. Simultaneity
   $\Rightarrow$ Both types of variables are fast moving
2. Effect on observables
   $\Rightarrow$ They have the same qualitative effects on 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. I argue that there exists a variable which responds differently to financial and uncertainty shocks.
2. I provide a **new econometric tool** to identify two structural shocks when an internal instrument is available.

Roadmap

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

Corporate Cash Holdings

Cash reserves refer to money which a corporation keeps on hand to cover any emergency funding or short-term requirements.

The typical U.S. large firm has cash equal to about 15% of total assets.

Together with current cash flow is consider the most important **internal source of finance**.

Cash provides **unconditional liquidity** available at any time.

Cash Reserves and Financial Frictions

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 **burn it in bad ones**.

   Almeida, Campello, Weisbach, 2004 JF

3. After a negative credit supply shock firms **purposely burn cash** to **avoid investment cuts** due to credit constraints.

   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 Reserves and 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 Reserves
2. **Model**
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Setting

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 $\; y_1 \sim F$

Period 2 $\quad d_2 = g(I_0) - b_0 + h(I_1) - b_1$

$$\begin{aligned} \max_{\{b_t, i_t, c\}_{t=0,1}} \quad & \mathbb{E}\left[d_0 + d_1 + d_2 \middle| F \right] \\ \text{subject to} \quad & b_t \leq (1 - \tau_t) i_t, \quad t = 0, 1 \\ & d_t \geq 0, \quad t = 0, 1, 2 \end{aligned}$$

Financial shock: $\uparrow \tau_0$ vs Uncertainty shock: $\uparrow F$

Solution

Financially constrained firm: $I_t^* < I_t^{FB}$ for $t = 0, 1$

$$\Rightarrow \; b_t = (1 - \tau_t) i_t \quad \text{for} \quad t = 0, 1$$

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

which implies $I_0 = \frac{y_0 - c}{\tau_0}$ and $I_1 = \frac{y_1 + c}{\tau_1}$. Objective function is,

$$\max_c g\left(\frac{y_0 - c}{\tau_0}\right) - \frac{y_0 - c}{\tau_0} + \mathbb{E}\left[h\left(\frac{y_1 + c}{\tau_1}\right) - \frac{y_1 + c}{\tau_1}\middle| F\right]$$

and optimal condition for $c^*(\tau_0, F)$ is

$$\underbrace{g'\left(\frac{y_0 - c^*(\tau_0, F)}{\tau_0}\right)}_{\text{Marginal Return of } I_0} = \underbrace{\mathbb{E}\left[h'\left(\frac{y_1 + c^*(\tau_0, F)}{\tau_1}\right)\middle| F\right]}_{\mathbb{E} \text{ Marginal Return of } I_1}$$

Comparative Statics

Given the Euler equation for cash c,

$$\underbrace{g'\left(\frac{y_0 - c^*(\tau_0, F)}{\tau_0}\right)}_{\text{Marginal Return of } I_0} = \underbrace{\mathbb{E}\left[h'\left(\frac{y_1 + c^*(\tau_0, F)}{\tau_1}\right)\middle| F\right]}_{\mathbb{E} \text{ Marginal Return of } I_1}$$

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

$\Rightarrow\ c^*(\tau_0, Q) > c^*(\tau_0, F)$ as long as $h'''(\cdot) > 0$

Financial shock: $\tau_0^f > \tau_0$ which is a decrease in b_0

$\Rightarrow\ c^*(\tau_0^f, Q) < c^*(\tau_0, F)$

Discussion and Testable Implications

$$g'\left(\frac{y_0 - c^*(\tau_0, F)}{\tau_0}\right) = \mathbb{E}\left[h'\left(\frac{y_1 + c^*(\tau_0, F)}{\tau_1}\right)\middle| F\right]$$

Taking into account **endogenous responses** of τ_0 to F or viceversa how can my identification assumption be interpreted?

> Financial shock $\Rightarrow$ firms perceive to need more liquidity today rather than tomorrow, use cash today
>
> Uncertainty shock $\Rightarrow$ firms perceive to need more liquidity tomorrow rather than today, save cash for tomorrow

Uncertainty shocks look like **expected financial shocks**

$\Rightarrow$ This is a testable implication!

$\Rightarrow$ $corr(\iota_t^U, s_{t,t+1}^F) \geq 80\%$

Roadmap

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Penalty Functions (I)

Penalty functions is a maximization problem where the importance of the constraint depends on some assumptions.

Consider the standard constrained maximization problem,

$$\max_x f(x) \quad \text{s.t} \quad g(x) \geq 0$$

a penalty function is an unconstrained maximization problem

$$\max_x f(x) + H(g(x))$$

$\Rightarrow$ Assumptions on $H(\cdot)$ determines the importance of $g(x)$.

Penalty Functions (II)

Given $\max_x f(x)$ s.t $g(x) \geq 0$, I assume $H(\cdot)$ to be linear,

$$\max_x f(x) + \delta g(x), \quad \delta > 0$$

$\Rightarrow$ the larger δ, the more important $g(x)$

Applied to SVARs, PFA has the flavor of **sign restrictions** but with the advantage that the problem is **just identified**.

Shortcoming: parameter δ is exogenously chosen making the identification strategy less credible.

Identification (I)

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

- $X_t = [U_t \quad F_t \quad Y_t]'$ where Y_t are macroeconomic variables.
- $\iota_t' \iota_t = \Sigma_\iota$

Step 1

$$\begin{aligned} \max_{\gamma_U} \quad & \textstyle\sum_{t=0}^{K} e_U' B^t \tilde{A}_0 \gamma_U + \delta e_C' \tilde{A}_0 \gamma_U \\ \text{subject to} \quad & \delta \geq 0 \quad \text{and} \quad \gamma_U \gamma_U' = 1 \end{aligned}$$

Step 2

$$\begin{aligned} \max_{\gamma_F} \quad & \textstyle\sum_{t=0}^{J} e_F' B^t \tilde{A}_0 \gamma_F - \delta e_C' \tilde{A}_0 \gamma_F \\ \text{subject to} \quad & \delta \geq 0, \quad \gamma_F \gamma_F' = 1 \quad \text{and} \quad \gamma_U \gamma_F' = 0 \end{aligned}$$

where $\tilde{A}_0 \tilde{A}_0' = \Sigma_\iota$ and e_j is a selection vector of variable j.

Identification (I)

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

- $X_t = [U_t \quad F_t \quad C_t \quad Y_t]'$
- $\iota_t'\iota_t = \Sigma_\iota$

Step 1 - Uncertainty Shock

$$\begin{aligned} \max_{\gamma_U} \quad & \sum_{t=0}^{K} e_U' B^t \tilde{A}_0 \gamma_U + \delta e_C' \tilde{A}_0 \gamma_U \\ \text{subject to} \quad & \delta \geq 0 \quad \text{and} \quad \gamma_U \gamma_U' = 1 \end{aligned}$$

An uncertainty shock maximizes its effect on uncertainty over the first K quarters with penalty (merit) δ if cash is negative (positive) on impact.

Identification (I)

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

- $X_t = [U_t \quad F_t \quad Y_t]'$ where Y_t are macroeconomic variables.
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Step 2 - Financial Shock

$$\begin{aligned} \max_{\gamma_F} \quad & \sum_{t=0}^{J} e_F' B^t \tilde{A}_0 \gamma_F - \delta e_C' \tilde{A}_0 \gamma_F \\ \text{subject to} \quad & \delta \geq 0, \quad \gamma_F \gamma_F' = 1 \quad \text{and} \quad \gamma_U \gamma_F' = 0 \end{aligned}$$

A financial shock maximizes its effect on credit spread over the first J quarters with penalty (merit) δ if cash is positive (negative) on impact.

Identification (I)

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

- $X_t = [U_t \quad F_t \quad Y_t]'$ where Y_t are macroeconomic variables.
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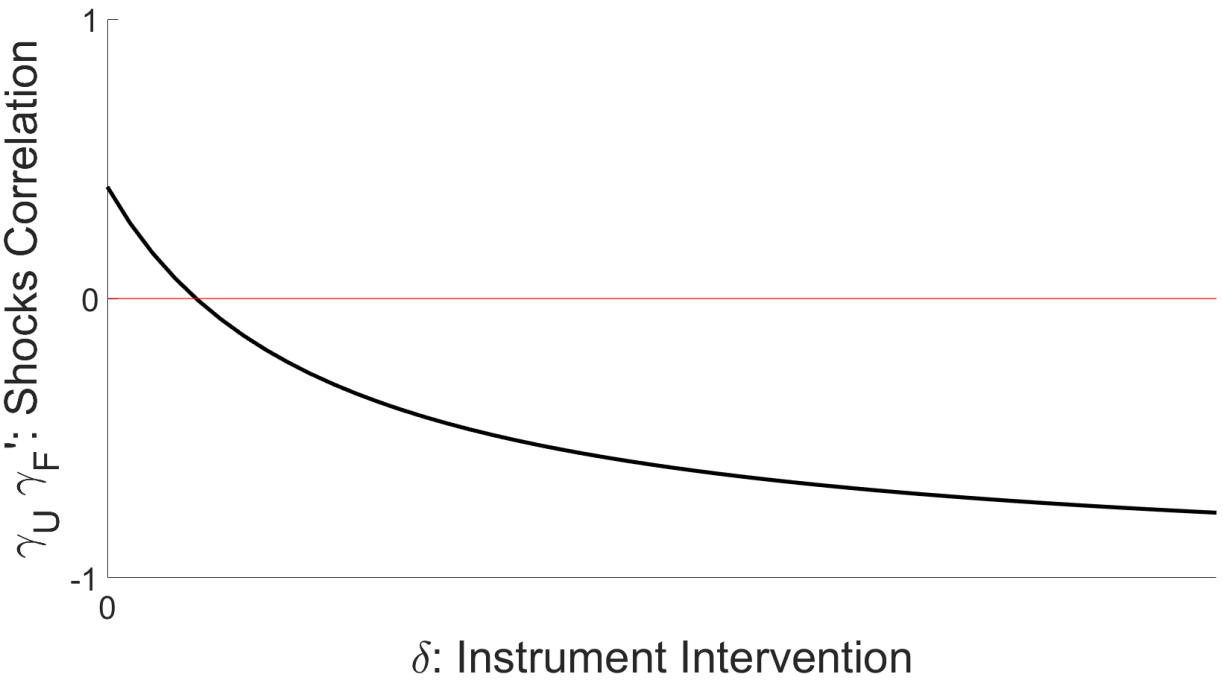
where $\tilde{A}_0 \tilde{A}_0' = \Sigma_\iota$ and e_j is a selection vector of variable j.

Identification (II)

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 $\gamma_U \gamma_F' = 0$.

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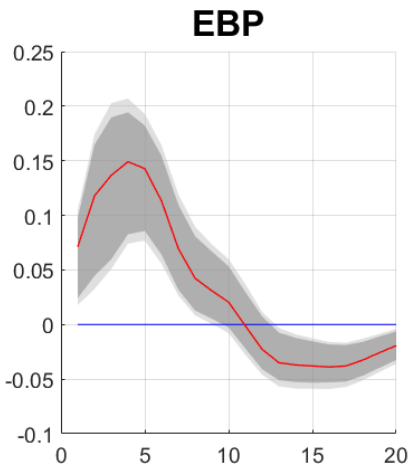
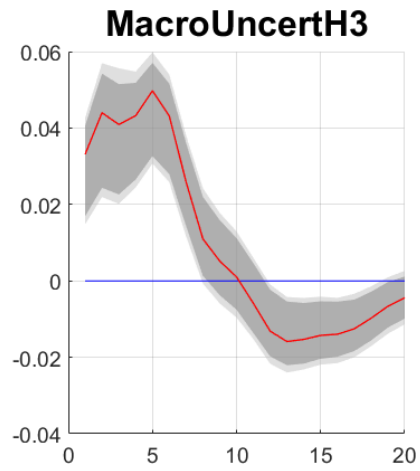
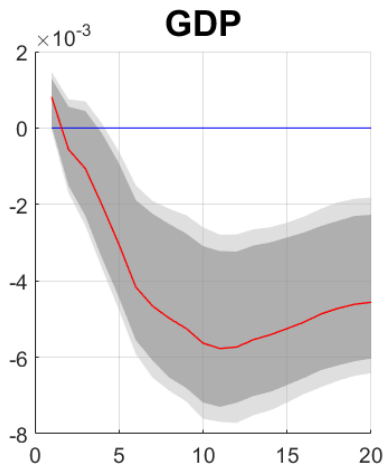
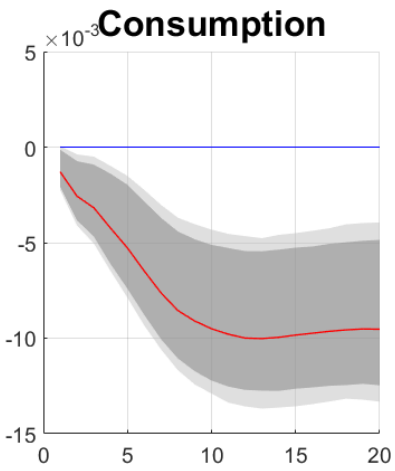
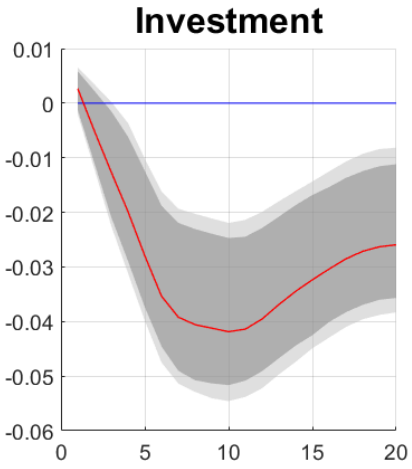
Uncertainty Shock

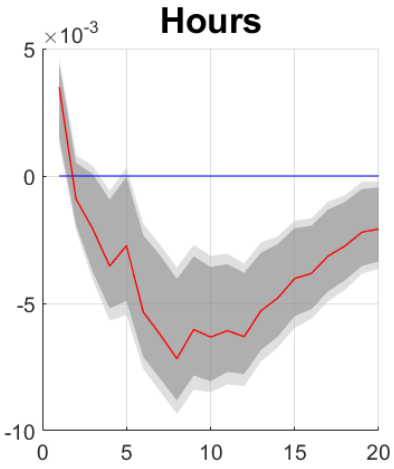


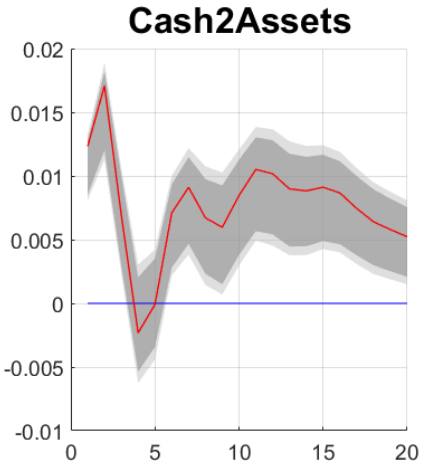




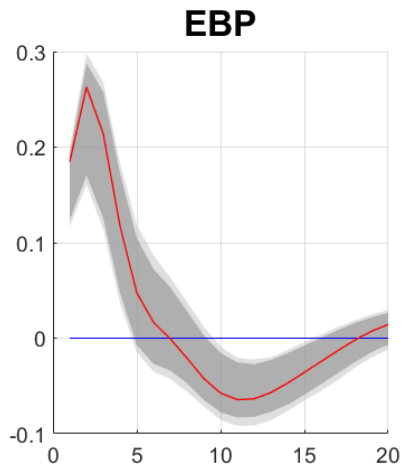


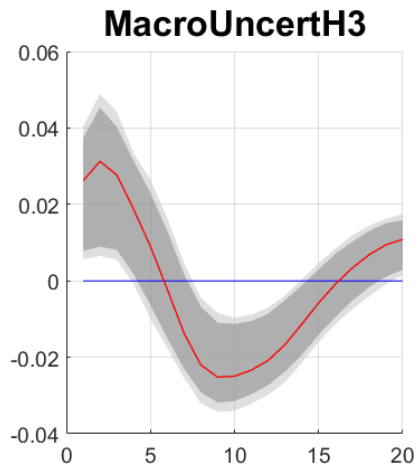


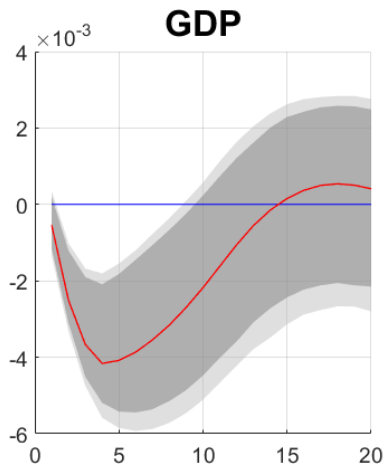


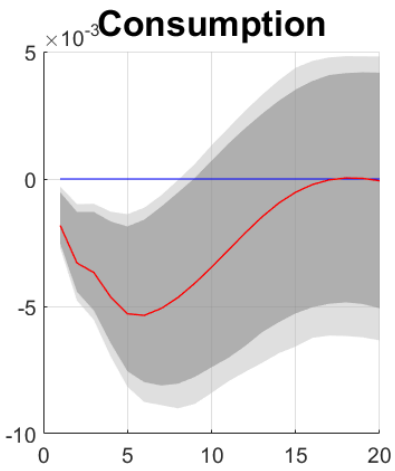


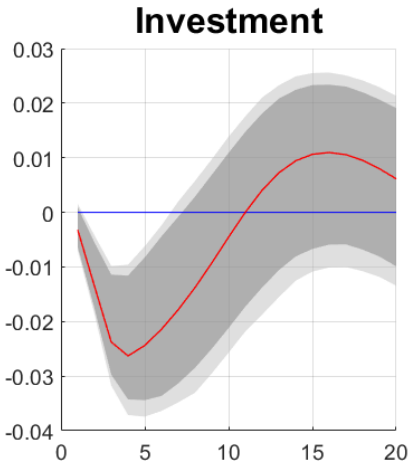
Financial Shock

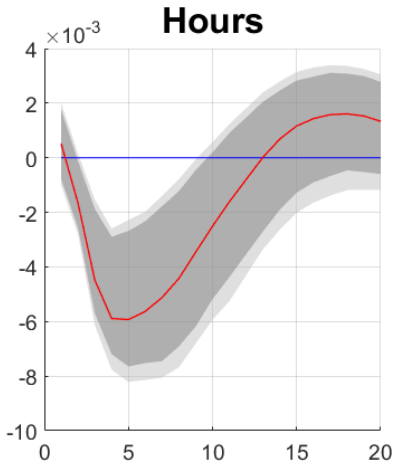


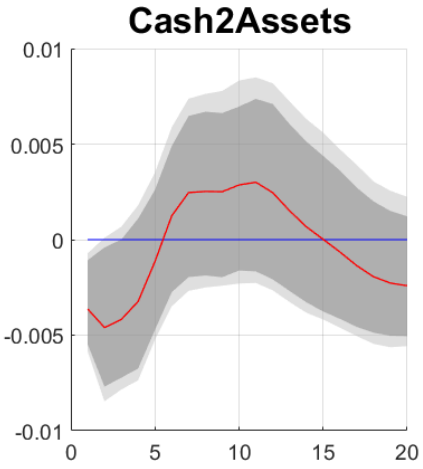




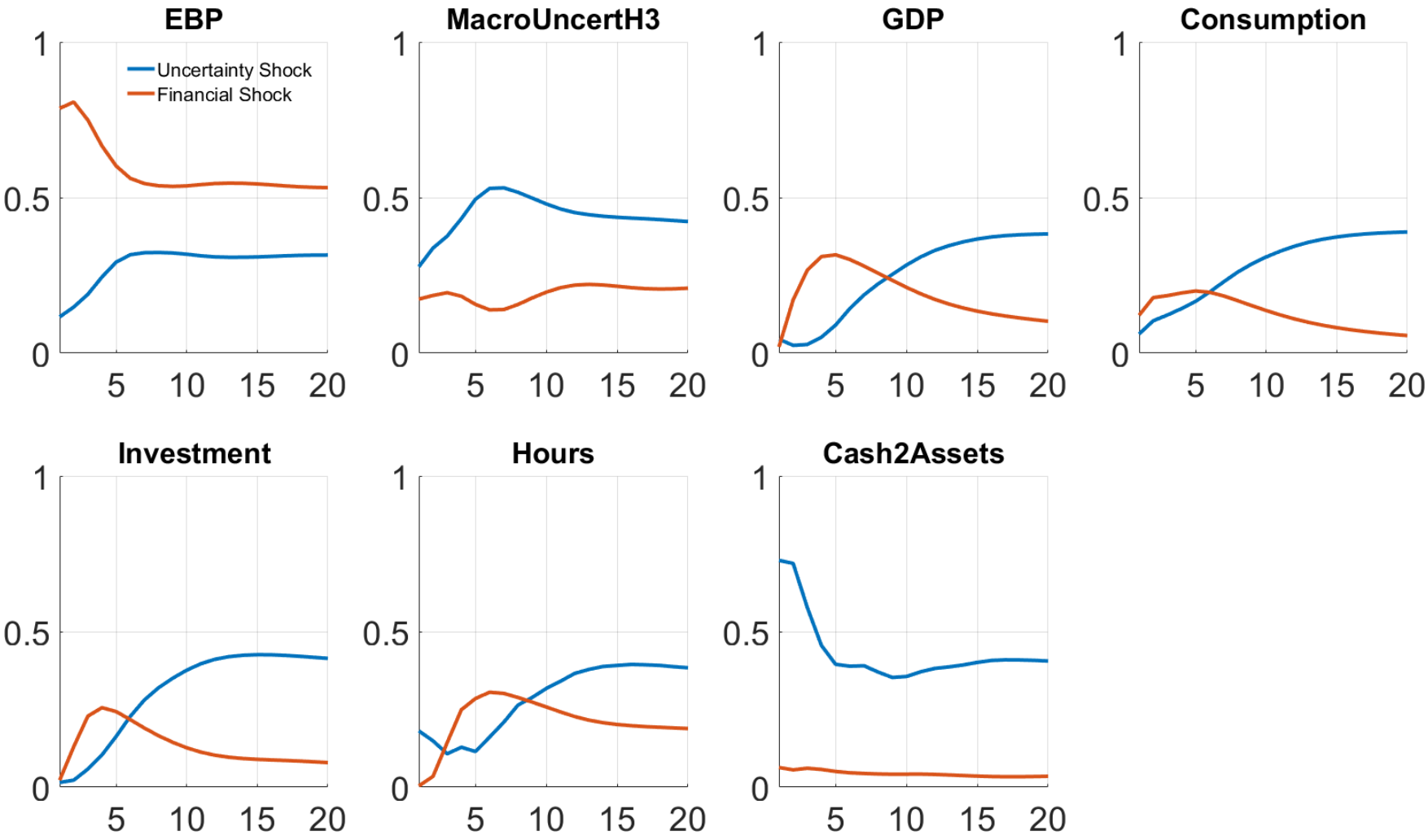








Variance Explained



Roadmap

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Conclusions

Cash can be used as an internal instrument to simultaneously identify uncertainty and financial shocks

GPFA seems to be able to use internal instruments to fully disentangle two confounded shocks

Both shocks have a remarkable effect on aggregate variables

Financial shocks have larger effect in the short run while uncertainty shocks in the medium run