Nonlinear Transmission of Financial Shocks: Some New Evidence

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Introduction

- The 2008 recession sparked renewed interest in understanding how crises originating in the financial sector affect real activity
- Recent theoretical studies suggest important **nonlinear amplification** effects of financial shocks on the real economy
- However, little empirical support of the nonlinear amplification effects embedded in theoretical models

Q: Are there important nonlinearities in the transmission of financial shocks?

Related Literature

- Theoretical models on the nonlinear amplification mechanisms:

  Mendoza (2010), He and Krishnamurthy (2013), Brunnermeier and Sannikov (2014) and the survey in Brunnermeier, Eisenbach, and Sannikov (2013)

- Financial shocks in SVARs:

  Gilchrist and Zakrajšek (2012), Brianti (2020), Caldara et al. (2016), Gambetti and Musso (2017), Furlanetto et al. (2019), Meeks (2012), Peersman (2011), and Peersman and Wagner (2015)

- Nonlinear effects of financial shocks (sign asymmetry):

  Barnichon, Matthes and Ziegenbein (2020)

What we do

- Identify financial shocks as shocks to the excess bond premium (see Gilchrist and Zakrajšek (2012))
- Estimate a nonlinear VMA representation that features a nonlinear function of the financial shock
- Evaluate three sources of nonlinearity
  1. Sign
  2. Size
  3. State-dependence

N.B. Our procedure does **not** require assumptions on the distribution of the shocks

Econometric model

Macroeconomic and financial variables in the n-dimensional vector x_t have the following **structural representation**:

$$x_t = \nu + \beta(L)g(u_{ft}) + B(L)u_t \tag{1}$$

- $x_t = [IP_t, \pi_t, ur_t, EBP_t, NFCI_t, SP500_t, FFR_t]'$
- $g(u_{ft}) = u_{ft}^2$
- u_t are *serially independent* structural shocks with zero mean and identity covariance matrix

Econometric model

Assuming invertibility of the linear term $B(L)u_t$:

$$D(L)x_t = \mu + D(L)\beta(L)g(u_{ft}) + B_0 u_t \tag{2}$$

Assuming no lags of $g(u_{ft})$ enter equation (2), $D(L)\beta(L) = \beta_0$, the model can be rewritten as

$$\begin{aligned} x_t &= \mu + \tilde{D}(L)x_t + \beta_0 g(u_{ft}) + B_0 u_t \\ &= \mu + \tilde{D}(L)x_t + \beta_0 g(u_{ft}) + \alpha_0 u_{ft} + B_{-f0} u_{-ft} \end{aligned} \tag{3}$$

Nonlinear IRFs

IRFs to u_{ft} and $g(u_{ft})$ are $\alpha(L) = D(L)^{-1}\alpha_0$ and $\beta(L) = D(L)^{-1}\beta_0$.

Total effect is nonlinear:

$$\text{IRF}(g(u_{ft}), u_{ft} = u^*) \quad = \quad \alpha(L)u^* + \beta(L)g(u^*) \tag{4}$$

Now suppose $g(u_{ft}) = u_{ft}^2$. The effect of the financial shock will then be

$$\text{IRF}(u_{ft}^2, u_{ft} = u^*) \quad = \quad \alpha(L)u^* + \beta(L)(u^*)^2 \tag{5}$$

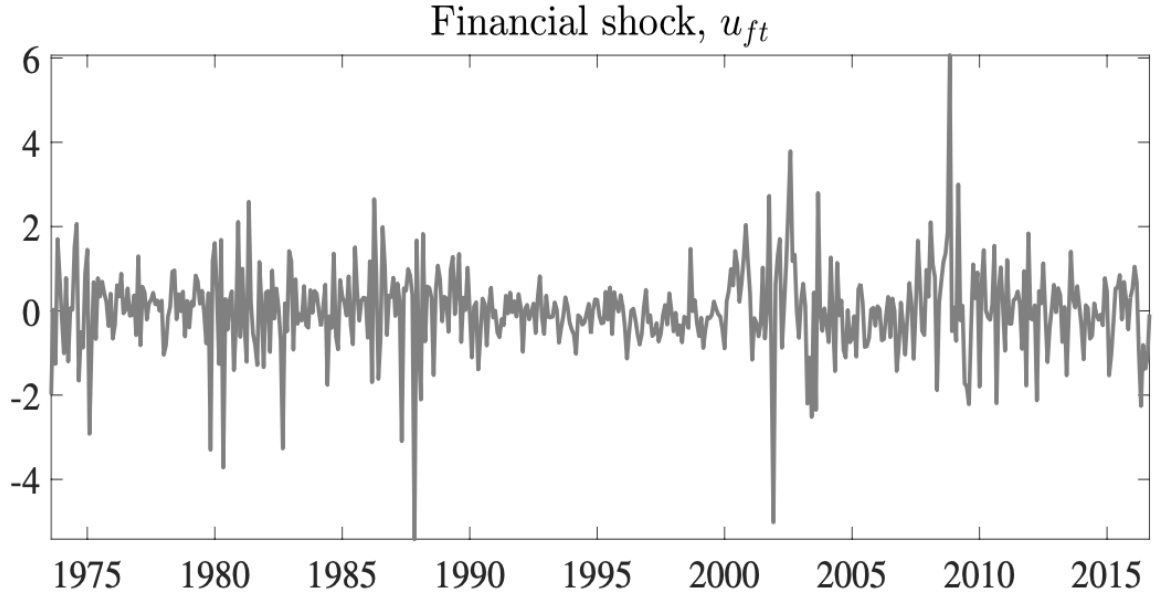
Identification and estimation

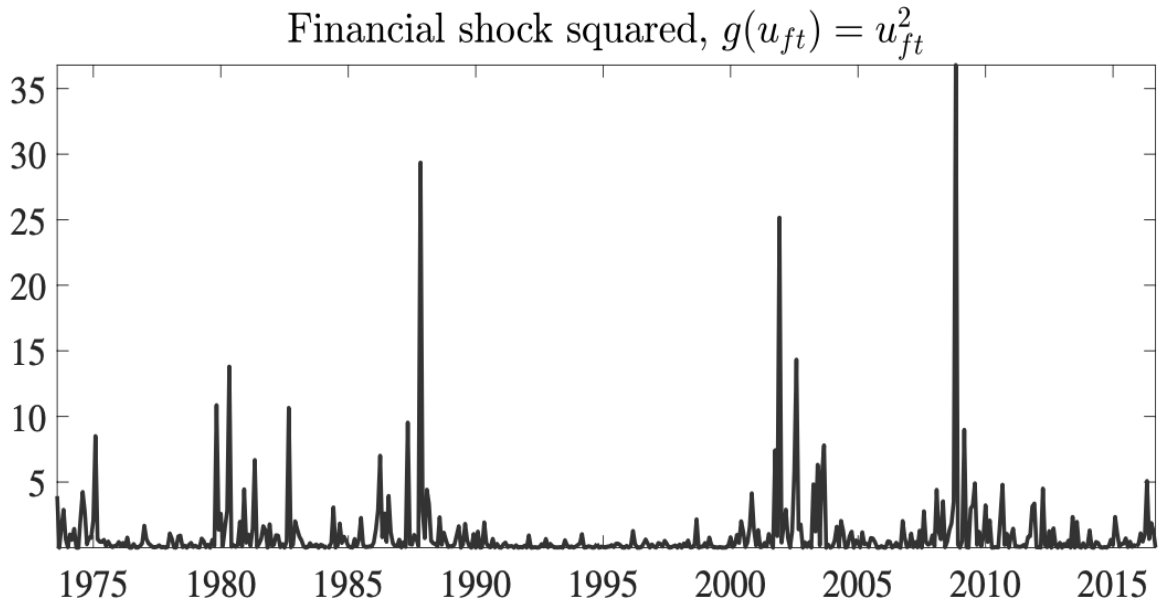
Two-step procedure:

1. Obtain an estimate of the financial shock $\hat{u}_{ft}$. Recursive identification in a VAR with x_t. Financial shock is the shock to the excess bond premium.
2. Use $\hat{u}_{ft}$ and $g(\hat{u}_{ft})$ as regressors in equation (3) and restrict α_0 and β_0 consistently ($\alpha_{0,j} = 0$ and $\beta_{0,j} = 0$ for $j = 1, 2, 3$, and $\beta_{0,4} = 0$).

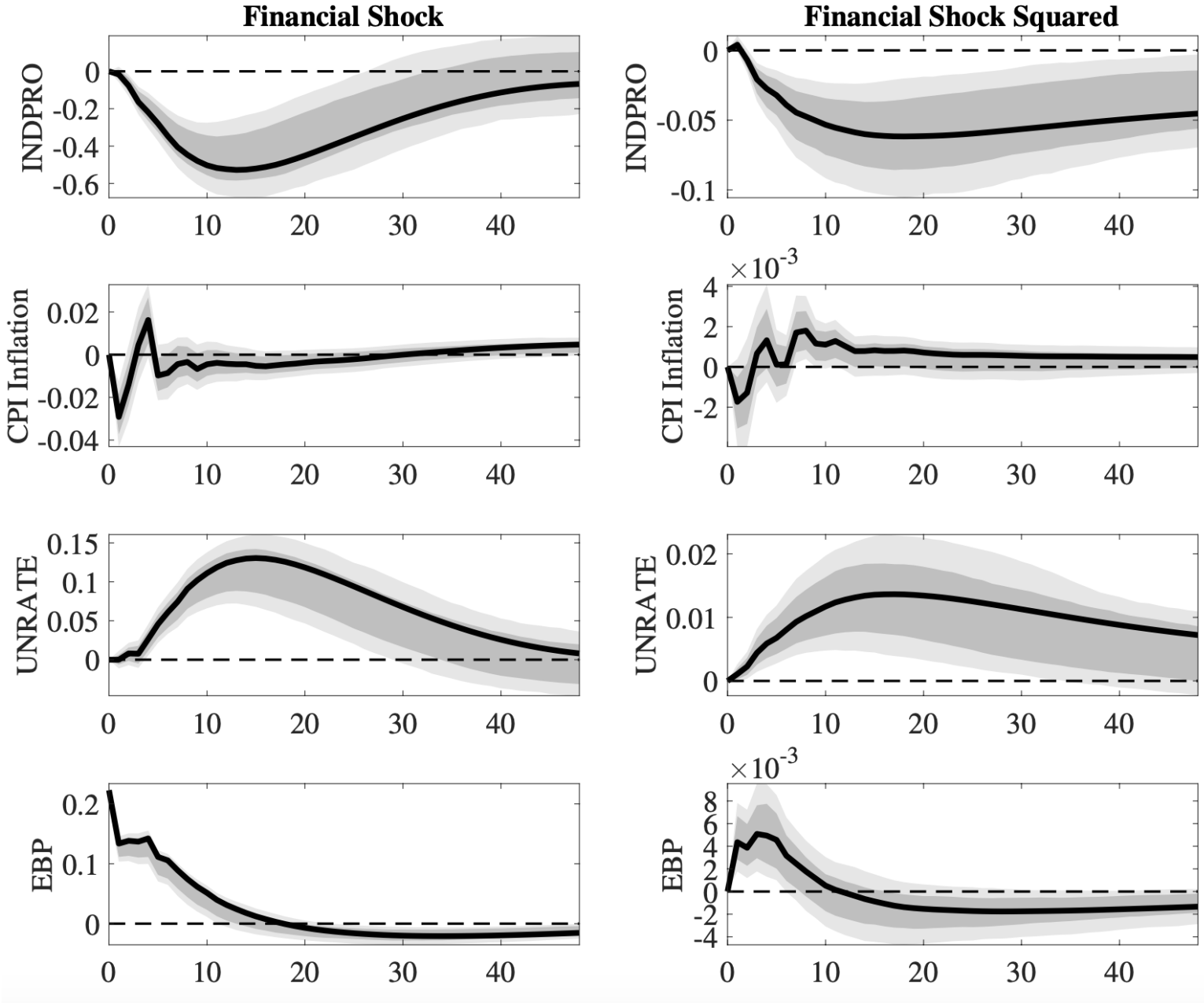
Remark: under these restrictions, financial shock is identified and estimated consistently as in GZ. However, consistent estimation of the IRFs requires estimation of the nonlinear model

The financial shock and its square

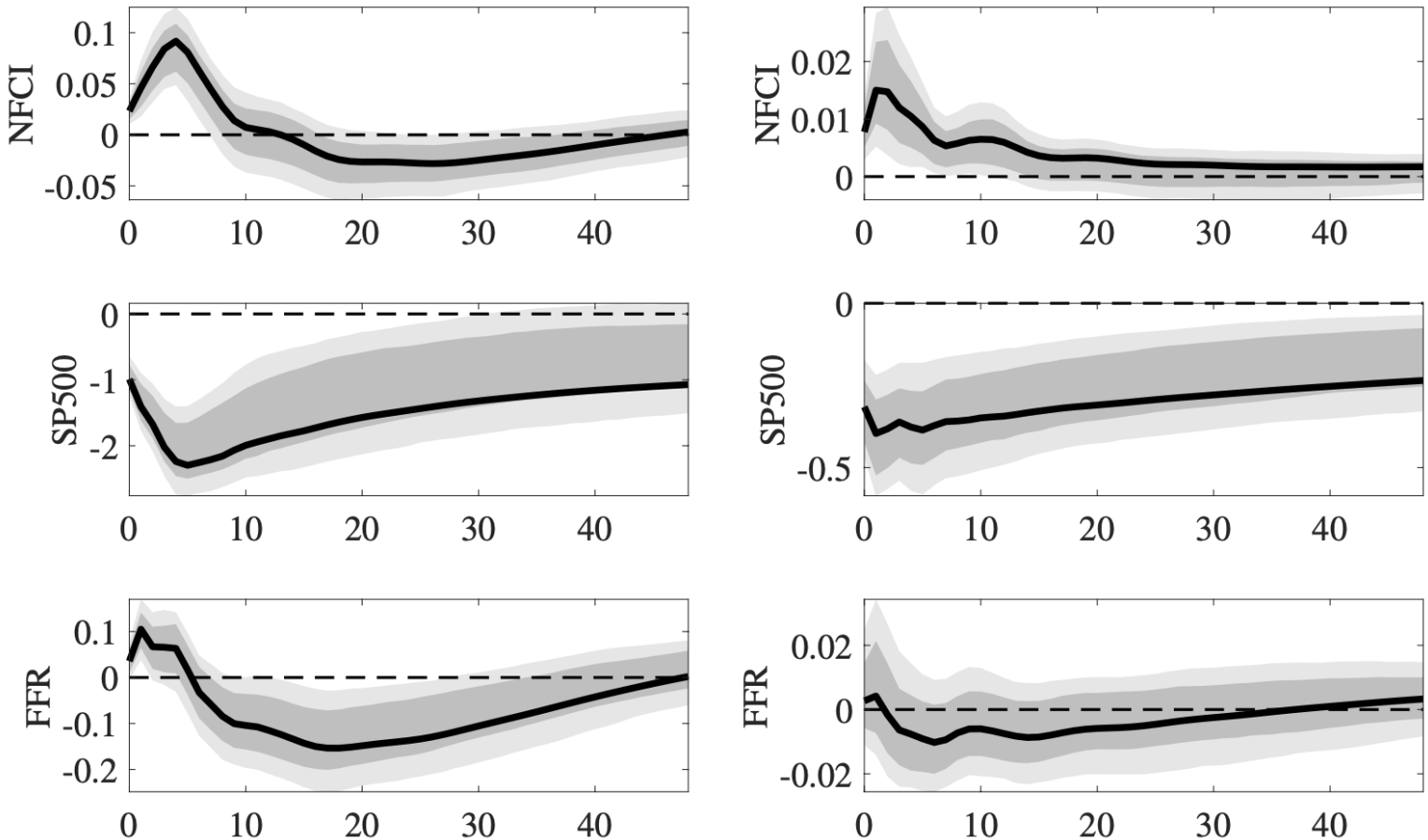




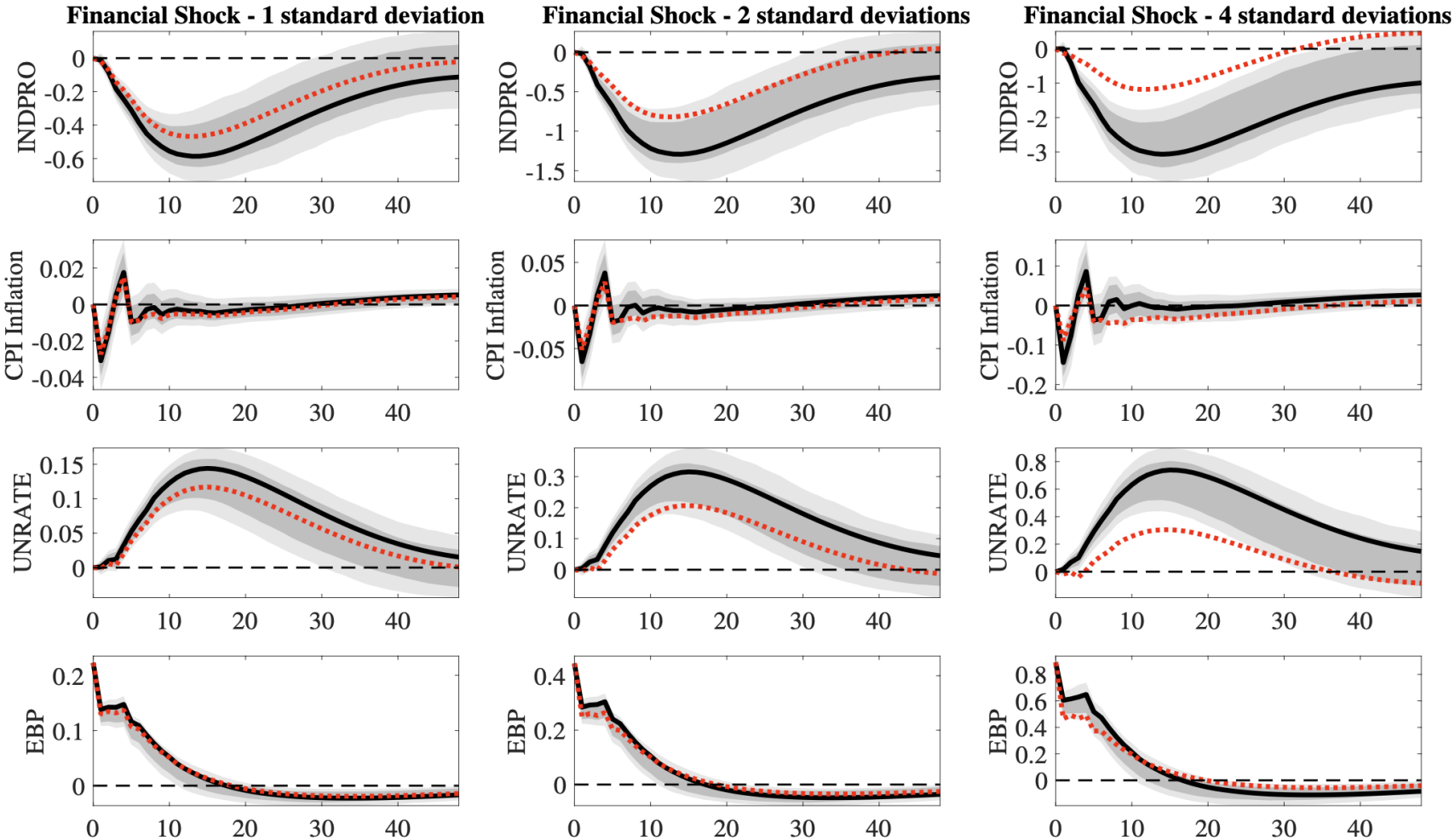
Nonlinear effects of financial shocks



Nonlinear effects of financial shocks



Size (and not only sign) matters



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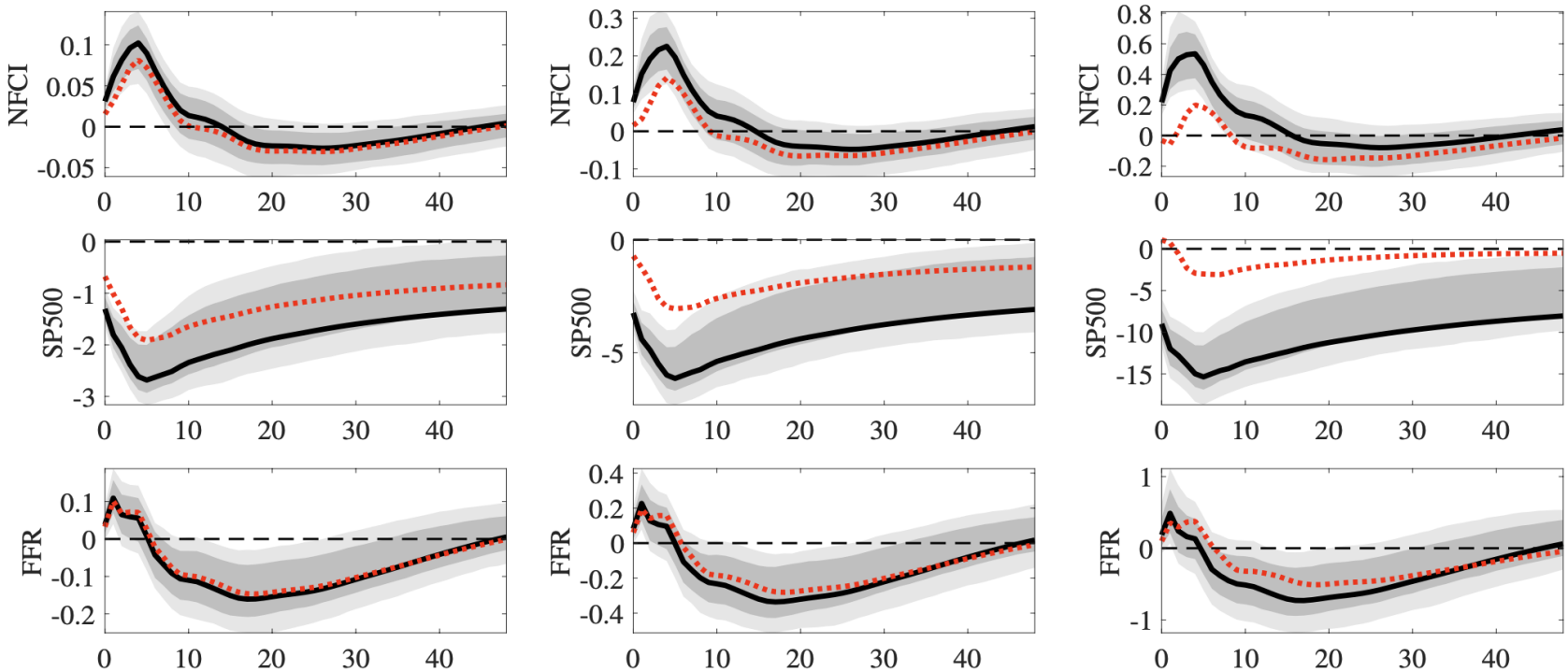
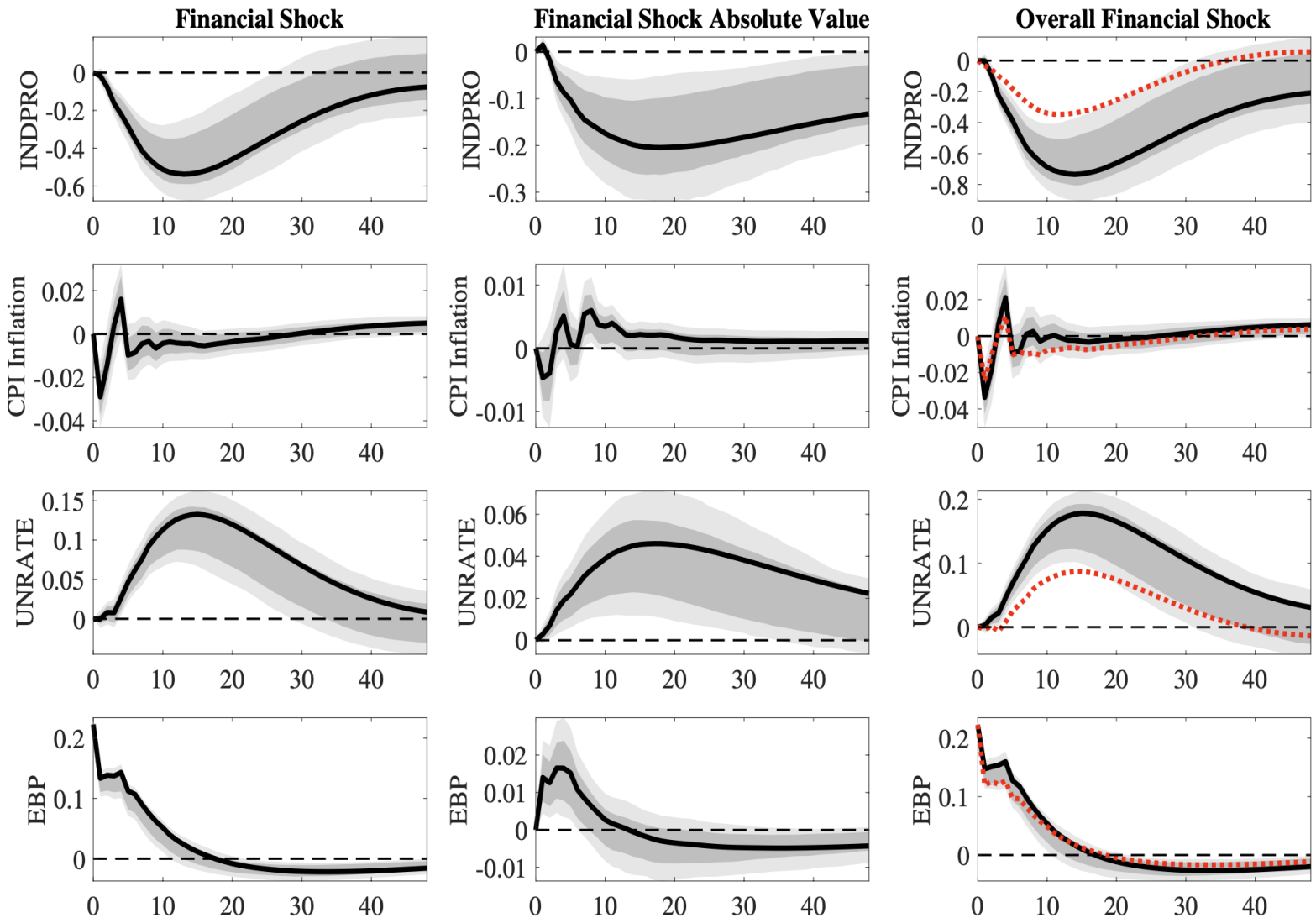


What if you include just sign?



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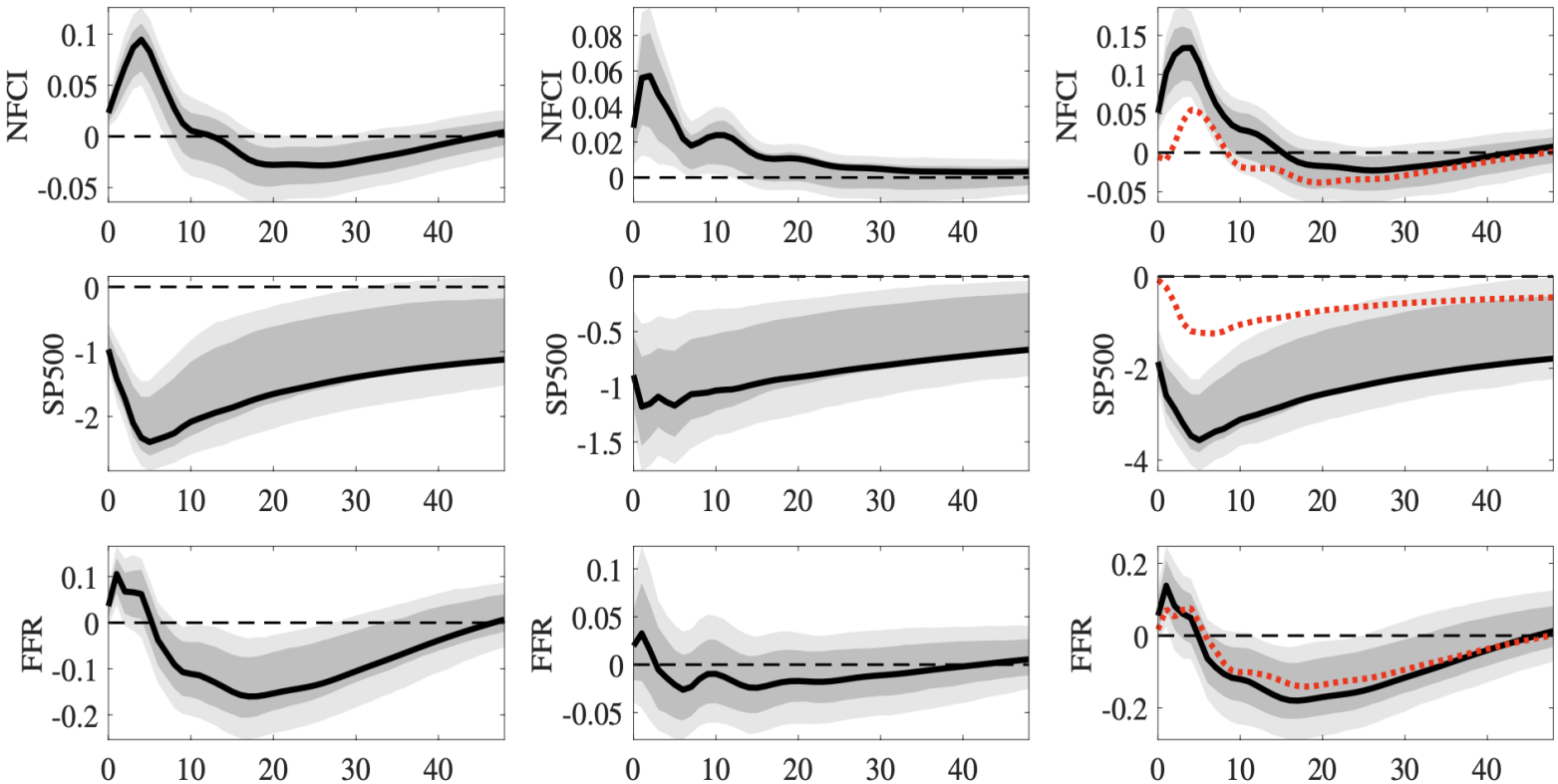
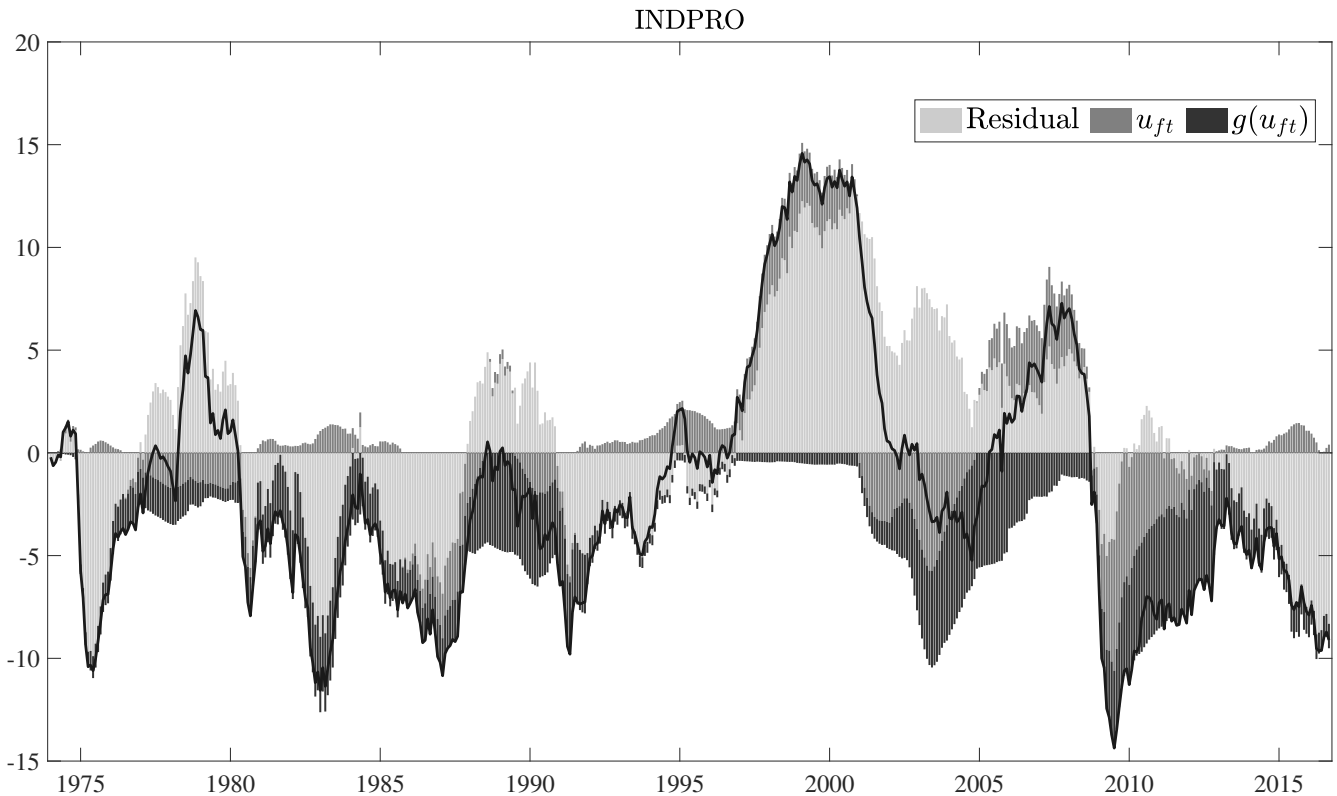


How relevant are financial shocks and their nonlinearities?



Conclusions

This paper: estimate a nonlinear VMA representation to assess the nonlinear effects of financial shocks

Main findings:

- Financial crises have played major role in last two recessions. Important nonlinear amplification of financial shocks
- Positive/negative asymmetry exclusively originates from big shocks. Small shocks are largely symmetric
- Big bad financial shocks have large effects on economic activity, while small shocks and financial expansions play little role

Thank you!