Transmission of financial shocks and leverage of banks: An endogenous regime switching framework

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Contribution

New Endogenous Regime-Switching model framework

We extend previous literature by

1. ***Time-varying probabilities*** *in* ***Regime Switching*** **Vectorautoregressive** (RS VAR) *models* (extension of Sims, Waggoner and Zha (JoE 2008))
2. ***General, non-recursive identification schemes in regime switching models*** *- incl. sign restrictions and narrative sign restrictions* (we extend *Antolin-Diaz and Rubio-Ramirez, AER 2018*, and *Arias, Rubio-Ramirez and Waggoner, Econometrica 2018,* from constant parameter to regime switching models)
3. ***Different identification schemes in different regimes***

Novel empirical analysis: Banks and transmission of financial shocks to the macroeconomy

- Use large bank-level data set and our new regime switching model

1. ***Market-based leverage*** **of financial institutions** (building on *Adrian and Brunnermeier, AER* 2016):
   - Amplification of financial shock transmission
2. **Different transmission of financial shocks** in different regimes
   (as in *Hubrich and Tetlow, JME 2015*)
3. **Heterogeneity** of financial institutions

New Regime Switching Structural VAR model

RS-SVAR model with time-varying transition probabilities:

$$A_0(s_t^c)y_t = A_+(s_t^c)x_t + \Xi^{-1}(s_t^v)\varepsilon_t, \qquad (1)$$

y_t: Endogenous variables; $x_t' = \left[y_{t-1}', \cdots, y_{t-p}', 1\right]$
ε_t: vector of standard normal shocks
$A_0(s_t^c), A_+(s_t^c)$: Coefficient matrices
$\Xi^{-1}(s_t^v)$: Diagonal matrix with standard deviations of shocks

Transition matrix: Probability of staying in regime j allowed to depend on endogenous variable(s):

- Diagonal elements give time-varying persistence of j^{th} regime:

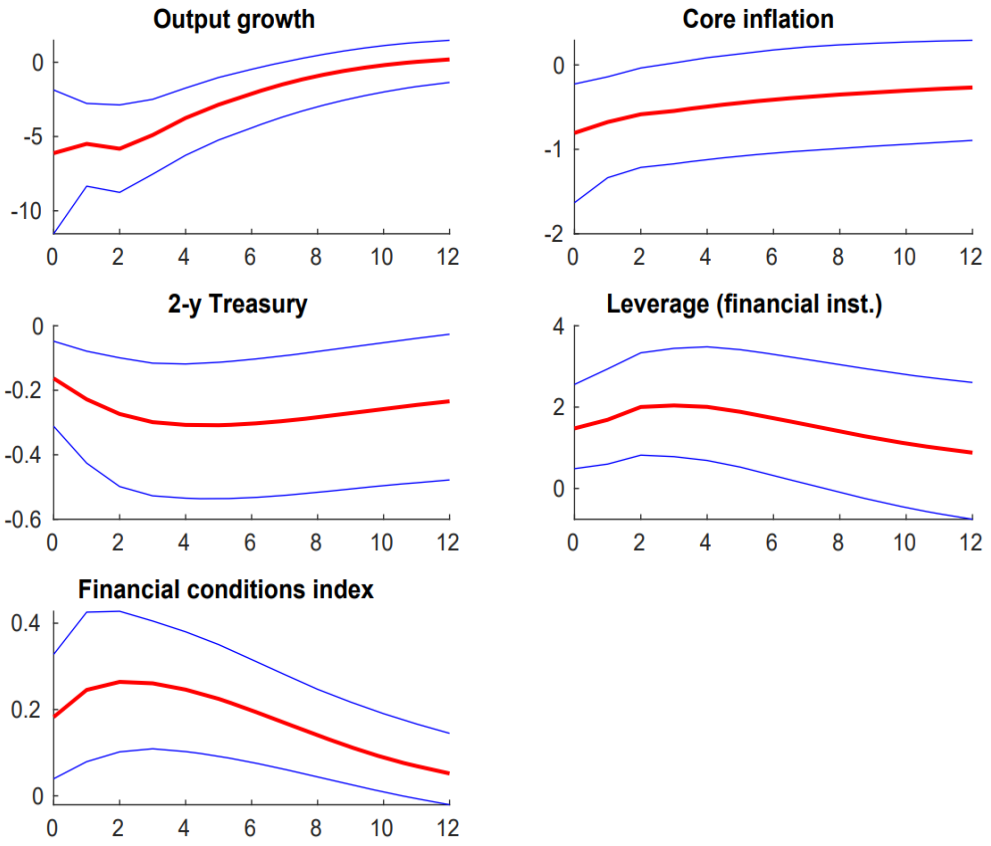
$$p_{t+1(j)|t(j)} = \frac{1}{1 + e^{-u_{j,t}}}$$

where

$$u_{j,t} = c_j + \gamma_j y_{t,t-k+1}$$

where $y_{t,t-k+1}' = [y_t', \cdots, y_{t-k+1}']$

Endogenous regime switching model with general, non-recursive restrictions: Example sign restrictions



High financial constraint regime:

- Identification: Sign restrictions only contemporaneously on all endogenous variables

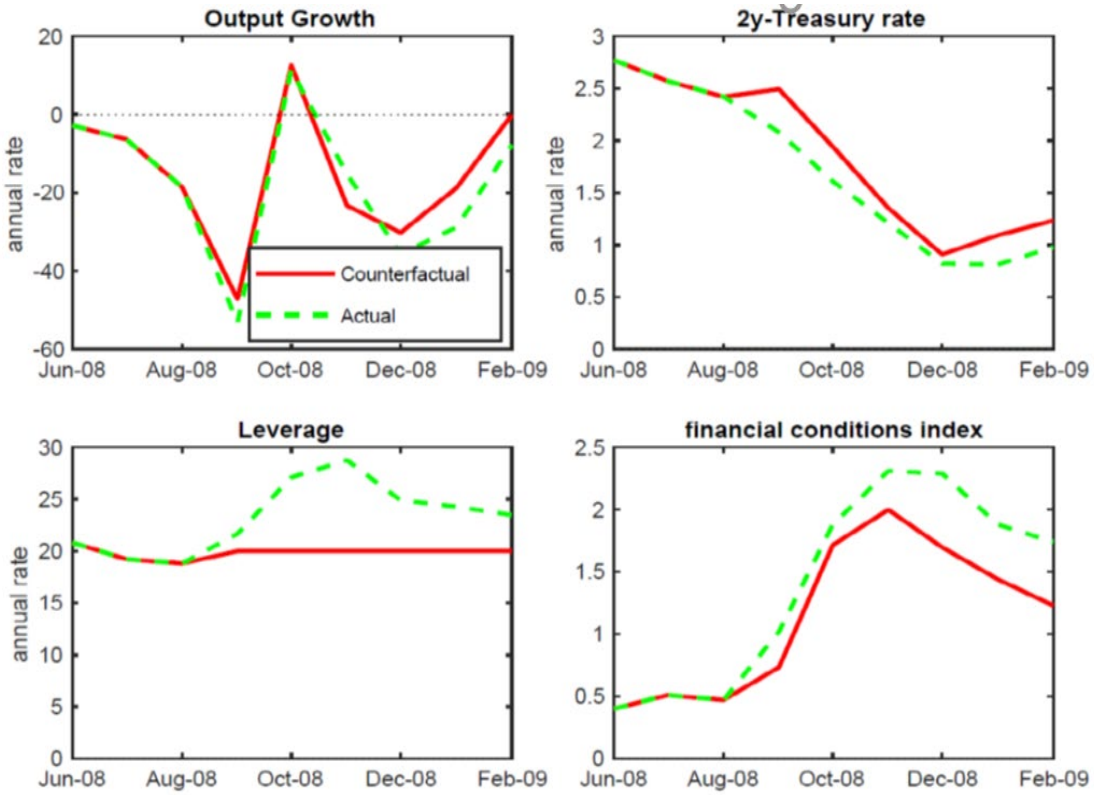
Responses to financial shock (median)

- Protracted negative output response
- Market leverage initially increases, then declines due to deleveraging

➢ Deleveraging can lead to amplification effects with adverse implications for the real economy

Robustness: Results robust with fewer narrative sign restriction

Counterfactual: Illustrates role of leverage ratio



- What if (market) leverage would have remained constant September 2008? **– Counterfactual red line**
  - Avoiding large increase and subsequent fall in market leverage
  - Less pronounced constraints in financial conditions
  - Less pronounced decline in output growth and quicker recovery

➢ Real effects amplified by leverage of financial institutions in high financial constraint regime

➢ Evidence that leverage ratio useful regulatory tool

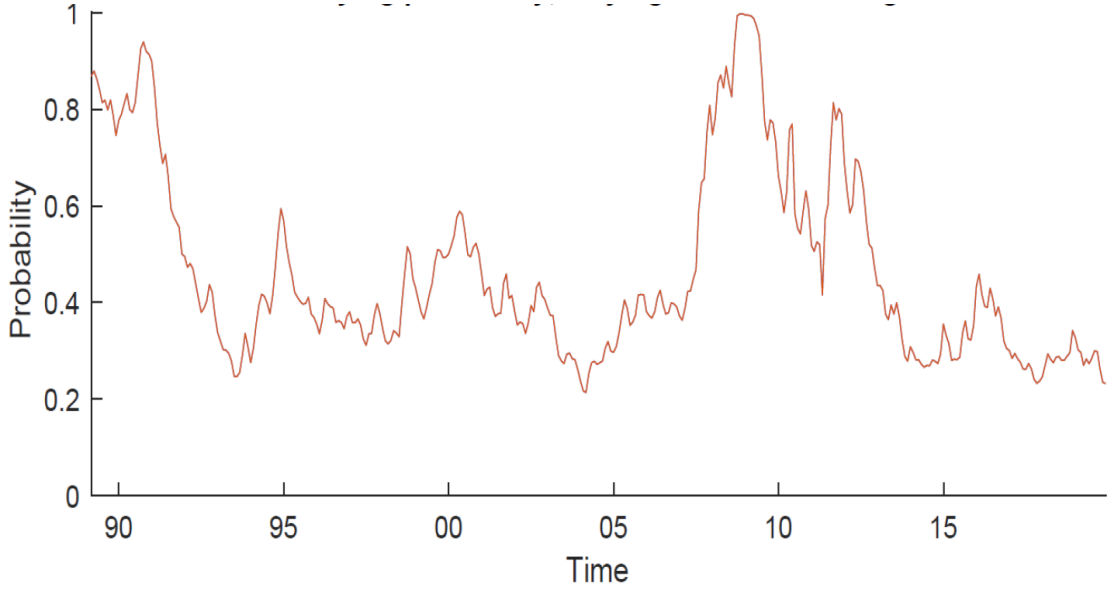
Conclusions and implications for financial stability policy

- **New Endogenous Regime Switching model framework:**
  - Time-varying probability of switching regime, depends endogenously on the state of the economy
  - *General, non-recursive identification schemes (incl. sign restrictions) in regime switching models*
  - *Extension: narrative sign restrictions - results are robust with fewer sign restrictions*

- **Implications for financial stability and policy**
  - Our empirical findings in a novel model support conclusion from theoretical macroeconomic models incorporating bank balance sheets:
    - Deleveraging can lead to procyclical financial amplification effects with adverse implications for the real economy
    - Leverage ratio useful as complementary regulatory tool
  - Extensions (in progress): Heterogeneity of financial institutions: GSIBs, Non-banks

Background slides

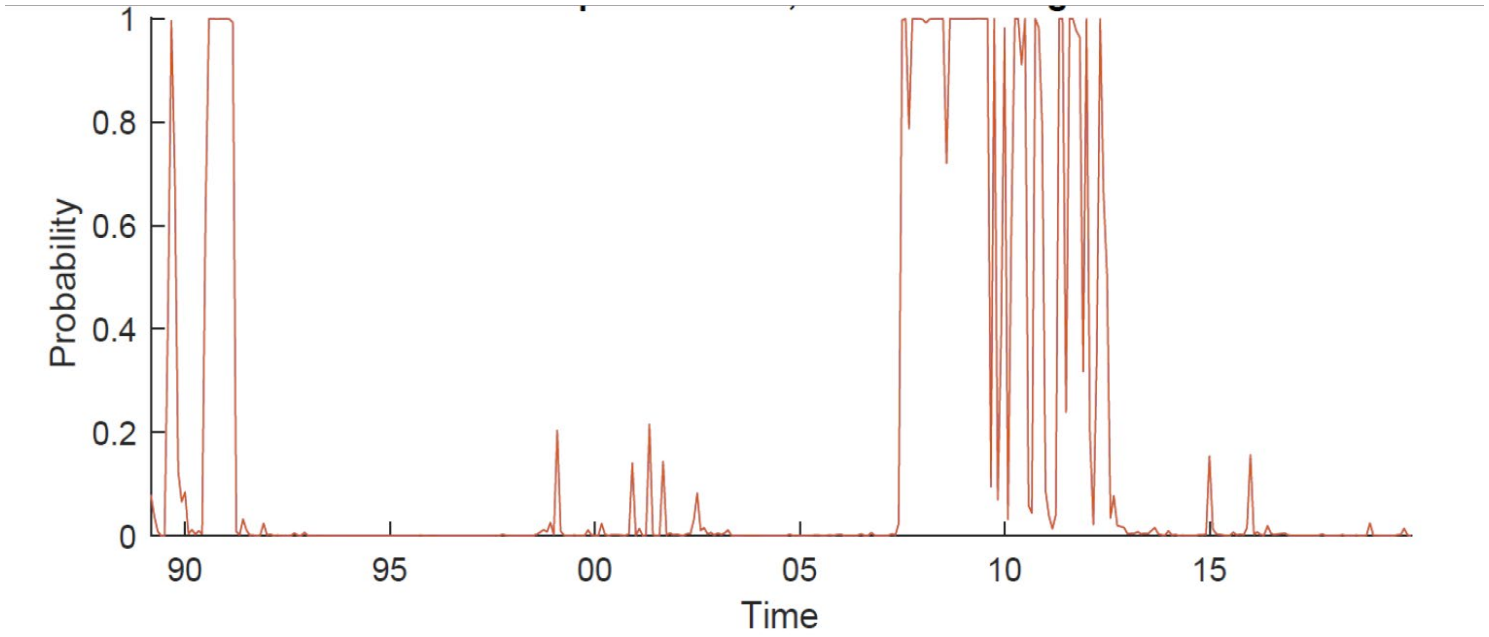
Probability of staying in financial constraint regime



- Time-varying probabilities of staying in high financial constraints regime
  - Dependent on interest rate, leverage and financial conditions
  - Median, conditional on being in that regime
  - Probability declines sharply in 2009/2010

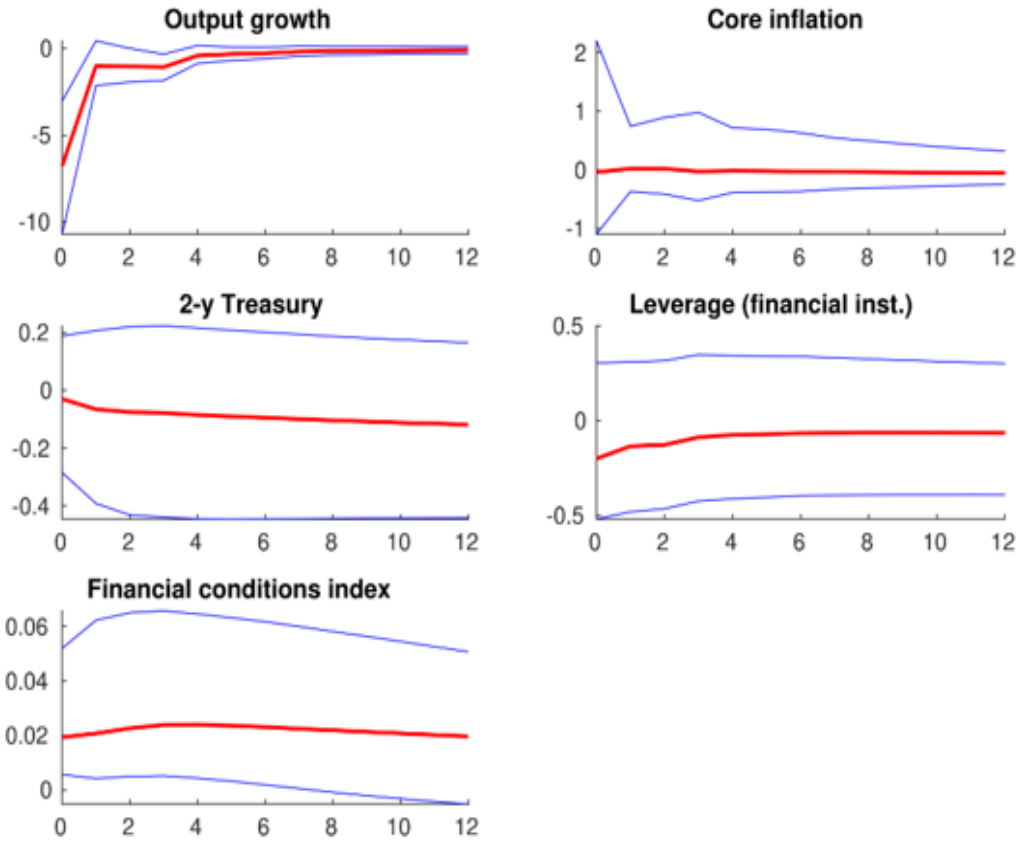
➢ Endogenous regime switching model useful for regime interpretation

Financial constraint regime



- Smoothed probabilities of **being in high financial constraint regime** (median)
- **Financial stress and recession: S&L crisis, 1990/91 recession, GFC and recession**

Endogenous regime switching model with general, non-recursive restrictions: Example sign restrictions - normal regime



Normal times

- Identification: Sign restrictions only contemporaneously on financial stress and output growth

Responses to financial shock (median)

- Small, nonpersistent negative output response
- Market leverage insignificant

➢ Leverage does not matter in normal times

Robustness: Results robust with fewer narrative sign restriction

References

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