Changes in the Transmission of Monetary Policy: Evidence from a Time-Varying Factor-Augmented VAR

Christiane Baumeister  
*Ghent University*

Philip Liu  
*International Monetary Fund*

Haroon Mumtaz  
*Bank of England*

*Second International Conference in Memory of Carlo Giannini*
*Banca d’Italia, 19-20 January 2010*
Motivation

• Decline in output and inflation volatility
  – Changes in the conduct of monetary policy
  – Absence of adverse non-policy shocks
    • E.g. Primiceri (2005), Sims and Zha (2006)
  – Changes in the transmission mechanism
    • E.g. Boivin and Giannoni (2006)

• Methodology
  – Small-scale VARs
  – Time variation

• Shortcomings
  – Limited amount of information
  – Missing variables bias reduced-form estimation
  – Misidentification of structural shocks
Motivation

• Large datasets
  – Information about aggregate economy and sectoral conditions
    • Bernanke and Boivin (2003), Stock and Watson (2002)

• Methodology
  – Factor-augmented VARs
    • Bernanke, Boivin and Eliasz (2005), Stock and Watson (2005)

• Shortcoming
  – No time variation
Contribution

• Factor-augmented vector autoregression with time-varying coefficients and stochastic volatility to re-examine monetary transmission mechanism

• Advantages
  – Better identification of monetary policy shocks
  – Estimate time-varying impulse responses for all the variables included in dataset
Contribution

• Dataset
  – Macroeconomic indicators and financial variables
    • Real activity and income measures, employment, asset prices, interest and exchange rates, monetary aggregates and price indices
  – Sectoral conditions
    • Commodity price data
    • Disaggregate price and quantity series for personal consumption expenditures (Boivin, Giannoni, and Mihov 2009)
  – Quarterly frequency
  – 1960Q1-2008Q3
Empirical model

- **FAVAR**

\[
X_{i,t} = \Lambda F_t + \Psi Y_{j,t} + e_{i,t}
\]

- **Observation equation**

\[
\begin{pmatrix}
X_{1,t} \\
\vdots \\
X_{N,t} \\
R_t
\end{pmatrix} = \begin{pmatrix}
\Lambda^{11} & \Lambda^{21} & \Lambda^{31} & \Psi^{11} \\
. & . & . & . \\
. & . & \Lambda^{3N} & \Psi^{1N} \\
0 & 0 & 0 & 0 & 1
\end{pmatrix} \begin{pmatrix}
F^1_t \\
F^2_t \\
F^3_t \\
R_t
\end{pmatrix} + \begin{pmatrix}
e^1_{1t} \\
e^2_{2t} \\
e^3_{3t} \\
0
\end{pmatrix}
\]

- **Transition equation**

\[
Z_t = \delta_t + \sum_{l=1}^{L} \phi_{l,t} Z_{t-l} + \nu_t
\]

where \( Z_t = \{ F^1_t, F^2_t, F^3_t, R_t \} \)
Empirical model

• Time-varying features (e.g. Primiceri 2005, Benati and Mumtaz 2007)
  – Law of motion of the coefficients
    \[ \theta_t = \theta_{t-1} + \eta_t \]
  – VAR innovations
    \[ \nu_t \sim N(0, \Omega_t) \]
    \[ \Omega_t = A_t^{-1} H_t (A_t^{-1})' \]
  • Stochastic volatilities
    \[ \ln h_{i,t} = \ln h_{i,t-1} + \varepsilon_t \]
  • Contemporaneous interactions
    \[ \alpha_i = \alpha_{i-1} + \tau_t \]
  – Estimated with Bayesian methods (MCMC algorithm)
Identification

- Choleski decomposition with federal funds rate ordered last
- Impulse responses (Koop et al. 1996)

\[ \Delta_{t+k} = E(Z_{t+k} | \Omega_{t+k}, \mu_{MP}) - E(Z_{t+k} | \Omega_{t+k}) \]

- Time-varying impulse responses of each underlying variable

\[
\begin{pmatrix}
\Lambda^{11} & \Lambda^{21} & \Lambda^{31} & \Psi^{11} \\
. & . & . & . \\
. & . & \Lambda^{3N} & \Psi^{1N} \\
0 & 0 & 0 & 1
\end{pmatrix}
\times
\begin{pmatrix}
\Delta F^1_t \\
\Delta F^2_t \\
\Delta F^3_t \\
\Delta R_t
\end{pmatrix}
\]
Results

• Contractionary monetary policy shock: 1% increase in FFR
Results

- Contractionary monetary policy shock: 1% increase in FFR
Results

• Comparison small-scale system versus FAVAR
Results

• Disaggregate price and quantity responses

1975

PCE Prices - 1975

PCE Quantities - 1975

2008

PCE Prices - 2008

PCE Quantities - 2008
Results

- Relation between price and quantity responses

Cross-sectional regression line:

\[ IRFq_{i,t+4} = \alpha + \beta \cdot IRFc_{i,t+4} \]
Results

• Smoothed densities of cross-sectional price responses

4 quarters after shock

16 quarters after shock
Results

• Moments of cross-sectional distribution of individual price responses over time
Results

- Evolution of price and quantity responses for major sub-categories 8 quarters after the monetary impulse
Implications

- Cross-sectional heterogeneity of price responses
  - Various channels of monetary transmission at work
  - Durables most sensitive
  - Nondurables goods widely dispersed

- Relative price effects
  - Long-lasting effects on dispersion
  - Movements of sectoral prices in different directions

- Policy implications
  - Key role of price-setting behaviour in transmission of monetary policy shocks
  - Aggregate price measures are poor indicators for pricing behaviour
  - Different weights on components of price index in policy analysis (e.g. Aoki 2001, Carlstrom et al. 2006)
Conclusions

• Transmission of monetary policy impulses in data-rich and time-varying environment

  – Aggregate level
    • Considerable time variation hidden in small systems
    • No price puzzle for aggregate price indices

  – Disaggregate level
    • Heterogeneity in propagation of monetary policy shocks
    • Disaggregate dynamics important to inform policymakers about relative price effects of monetary policy actions
    • Insights into price-setting behaviour of firms
    • Challenges for macroeconomic models used for policy analysis