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

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Motivation

- Decline in output and inflation volatility
  - Changes in the conduct of monetary policy
    - E.g. Clarida, Gali and Gertler (2000), Cogley and Sargent (2002, 2005)
  - 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

$$\begin{pmatrix} X_{1,t} \\ \vdots \\ X_{N,t} \\ R_t \end{pmatrix} = \begin{pmatrix} \Lambda^{11} & \Lambda^{21} & \Lambda^{31} & \Psi^{11} \\ . & . & . & . \\ . & . & \Lambda^{3N} & \Psi^{1N} \\ 0 & 0 & 0 & 1 \end{pmatrix} \cdot \begin{pmatrix} F_t^1 \\ F_t^2 \\ F_t^3 \\ R_t \end{pmatrix} + \begin{pmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \\ 0 \end{pmatrix}$$

  - Transition equation

$$Z_t = \delta_t + \sum_{l=1}^{L} \phi_{l,t} Z_{t-l} + v_t \quad \text{where} \quad Z_t = \left\{ F_t^1, F_t^2, F_t^3, R_t \right\}$$

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

$$v_t \sim N(0, \Omega_t) \qquad \Omega_t = A_t^{-1} H_t (A_t^{-1})'$$

  - Stochastic volatilities

$$\ln h_{i,t} = \ln h_{i,t-1} + \varepsilon_t$$

  - Contemporaneous interactions

$$\alpha_t = \alpha_{t-1} + \tau_t$$

  – Estimated with Bayesian methods (MCMC algorithm)

Identification

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

$$\Delta_{t+k} = E(Z_{t+k} \mid \Omega_{t+k}, \mu_{MP}) - E(Z_{t+k} \mid \Omega_{t+k})$$

- Time-varying impulse responses of each underlying variable

$$\begin{pmatrix} \Lambda^{11} & \Lambda^{21} & \Lambda^{31} & \Psi^{11} \\ . & . & . & . \\ . & . & \Lambda^{3N} & \Psi^{1N} \\ 0 & 0 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} \Delta_t^{F_t^1} \\ \Delta_t^{F_t^2} \\ \Delta_t^{F_t^3} \\ \Delta_t^{R_t} \end{pmatrix}$$

Results

- Contractionary monetary policy shock: 1% increase in FFR

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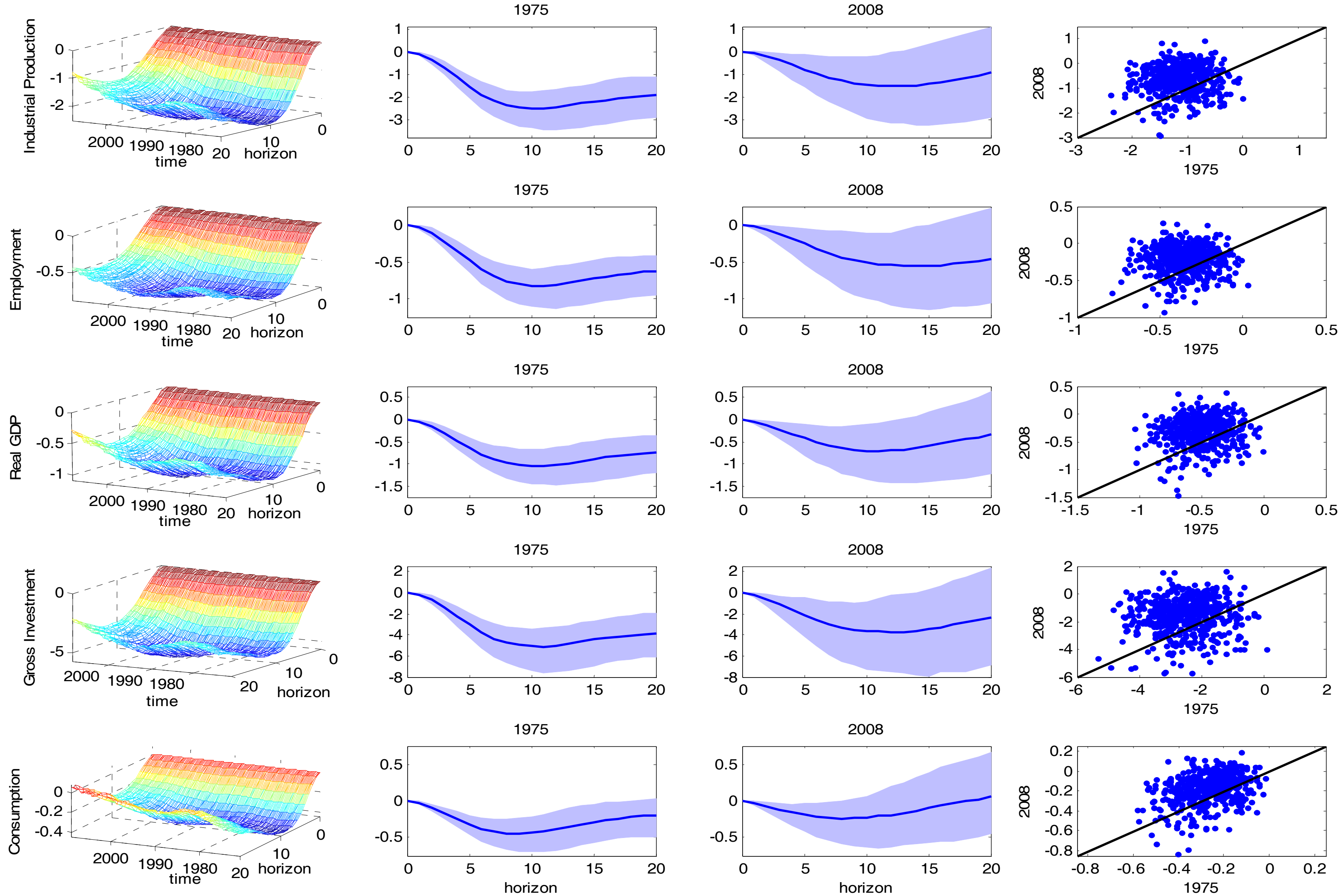

Results

- Contractionary monetary policy shock: 1% increase in FFR

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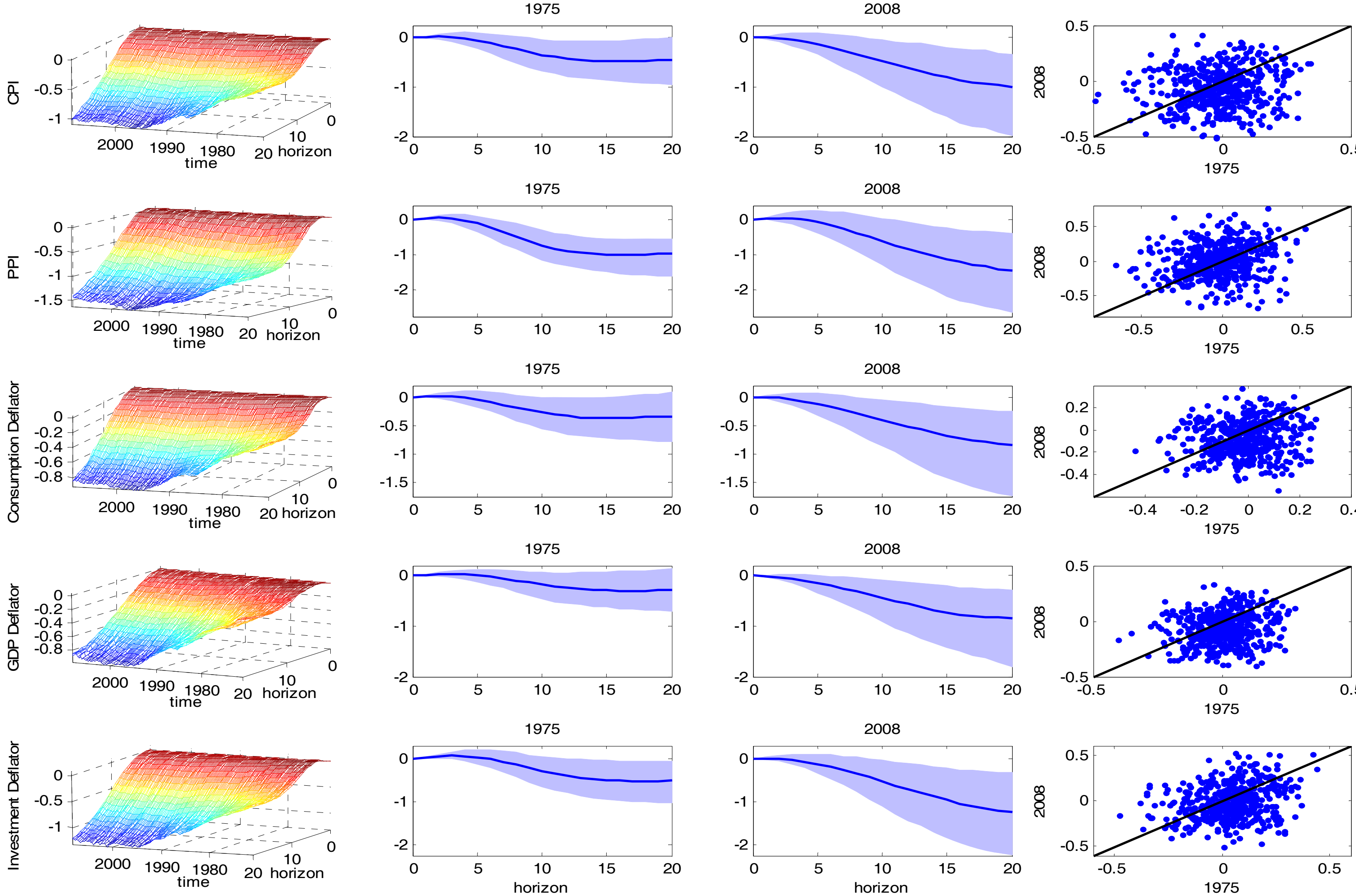


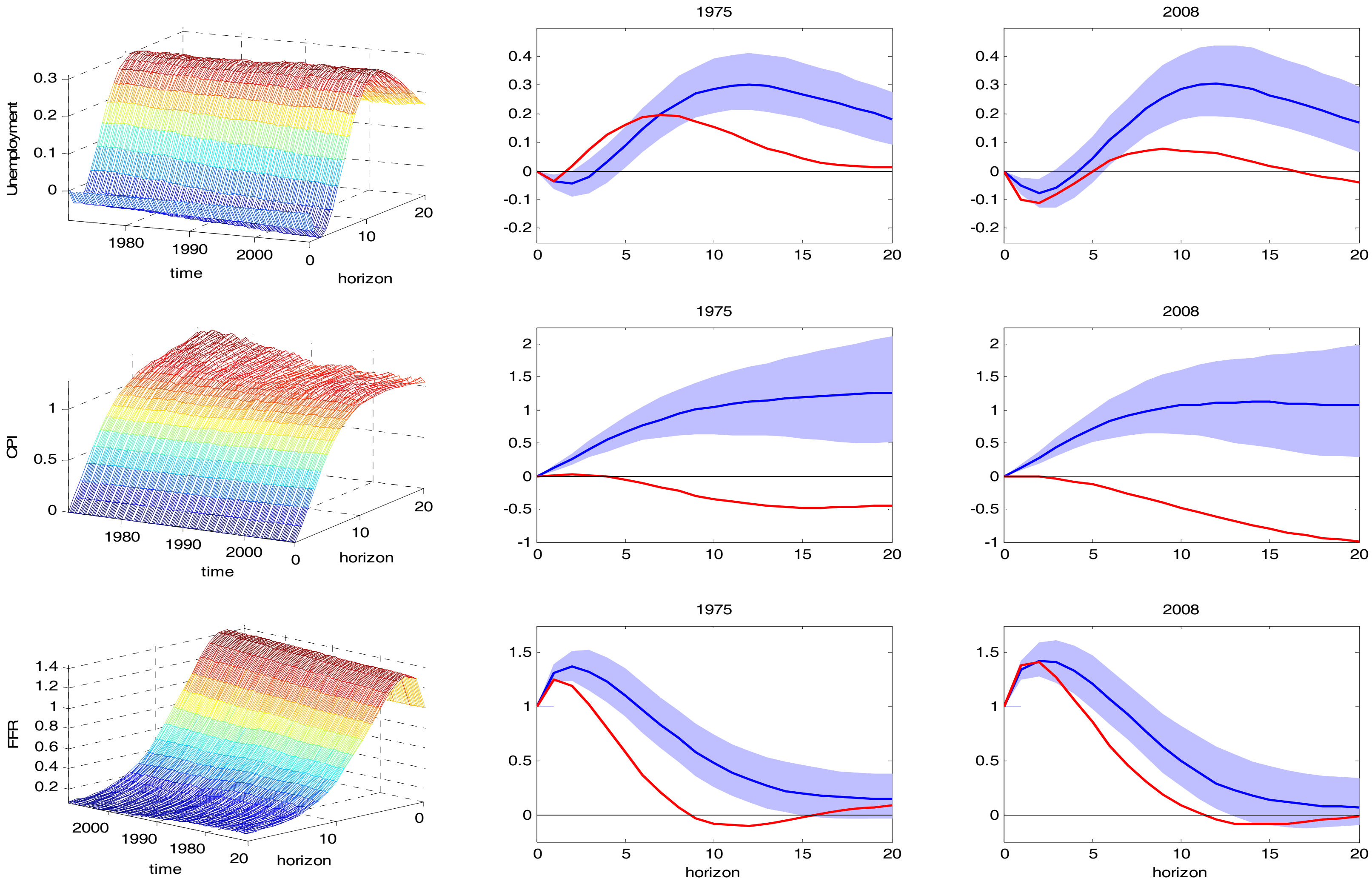
Results

- Comparison small-scale system versus FAVAR

UNEMP

CPI

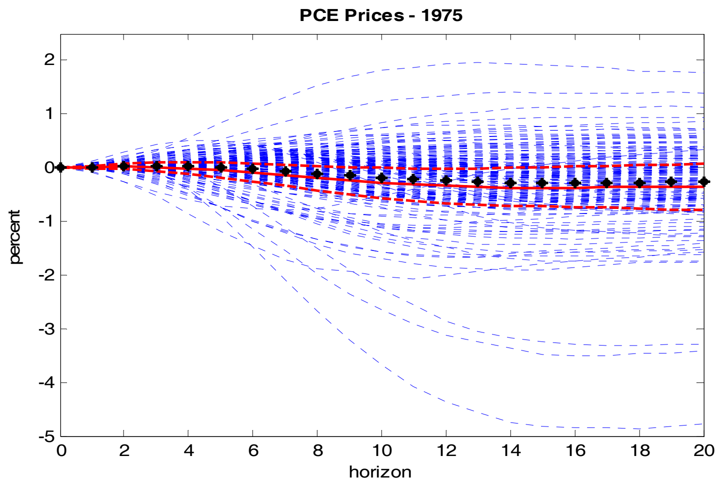
FFR

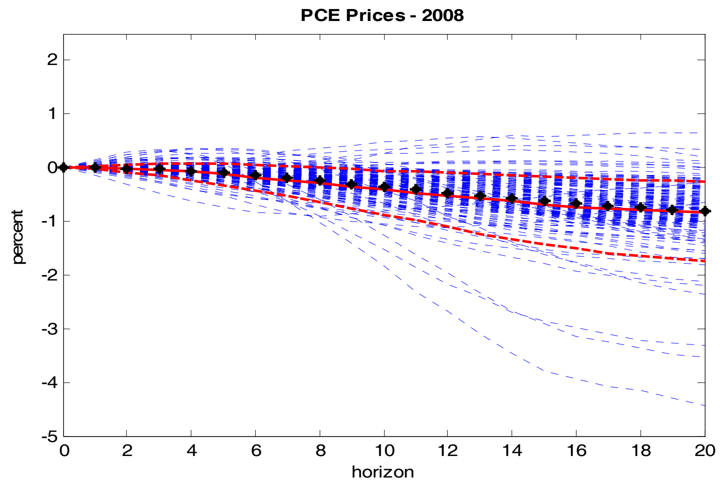


Results

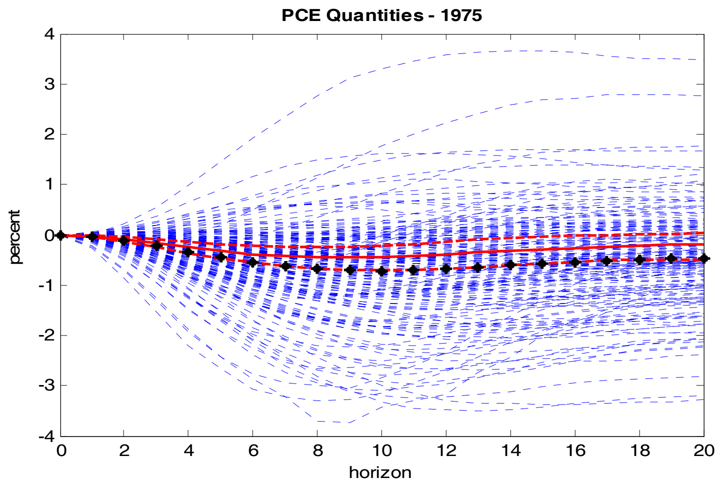
- Disaggregate price and quantity responses

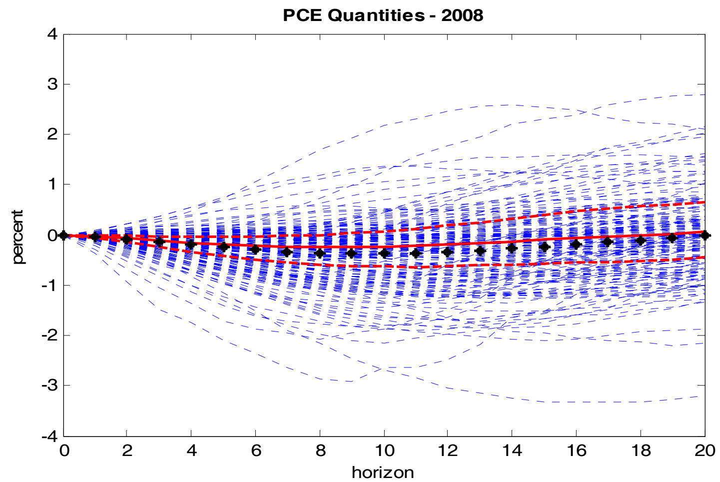
1975 PRICES 2008





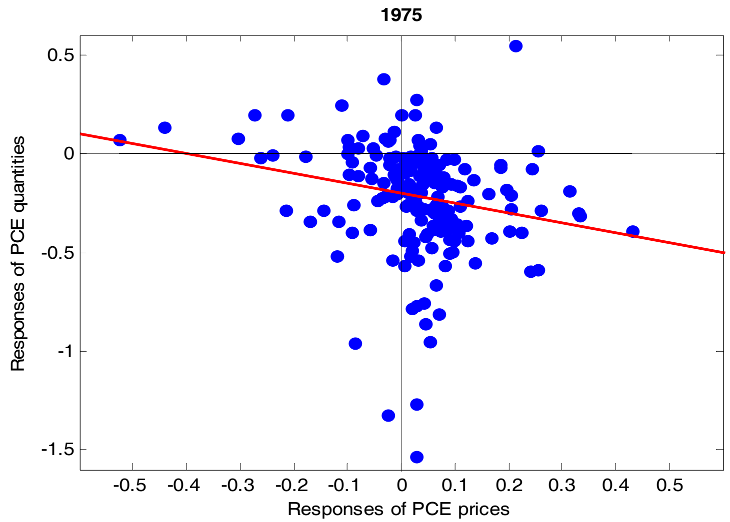
QUANTITIES

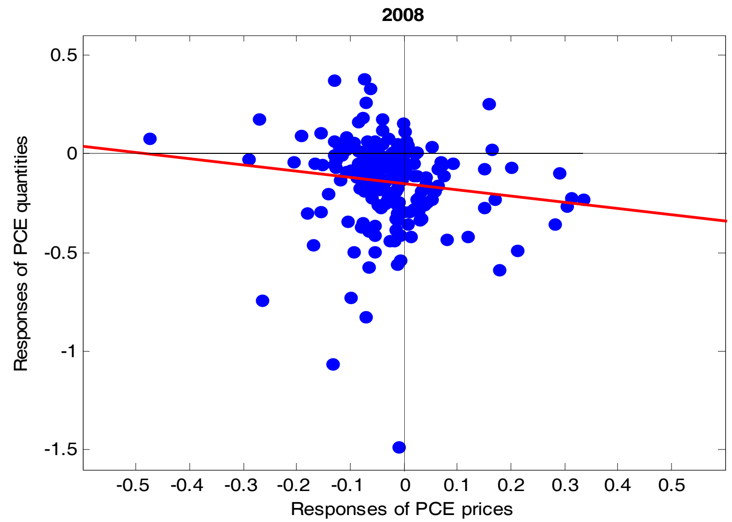


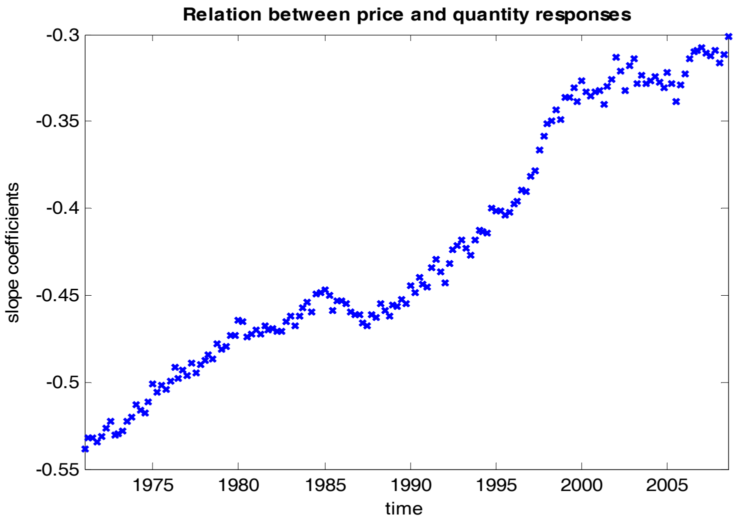


Results

- Relation between price and quantity responses







Cross-sectional regression line:

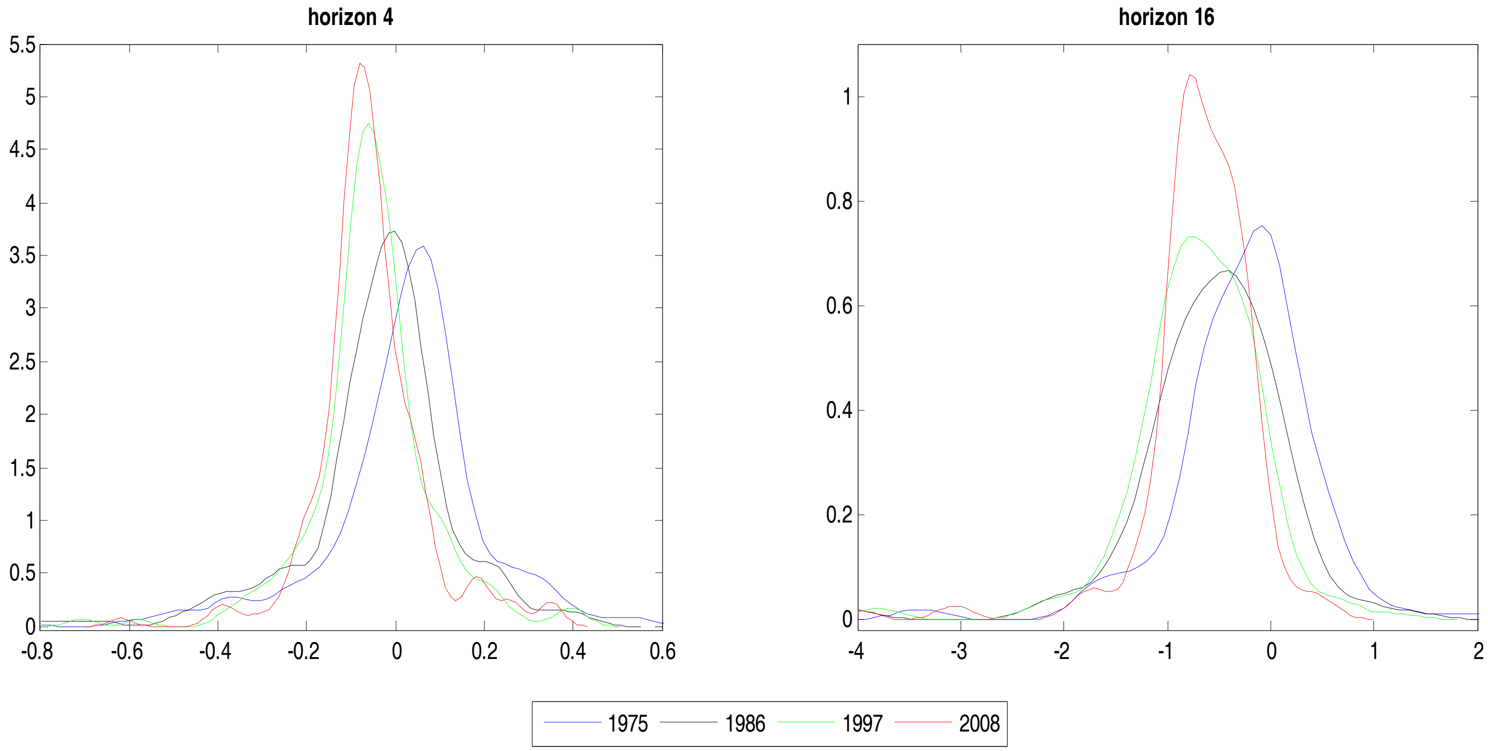
$$IRFq_{i,t+4} = \alpha + \beta \cdot IRFp_{i,t+4}$$

Results

- Smoothed densities of cross-sectional price responses
  - Lastrapes (2006), Balke and Wynne (2007)

4 quarters after shock

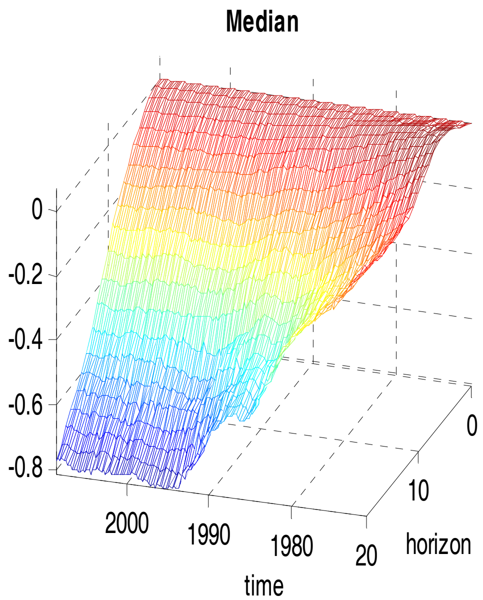
16 quarters after shock



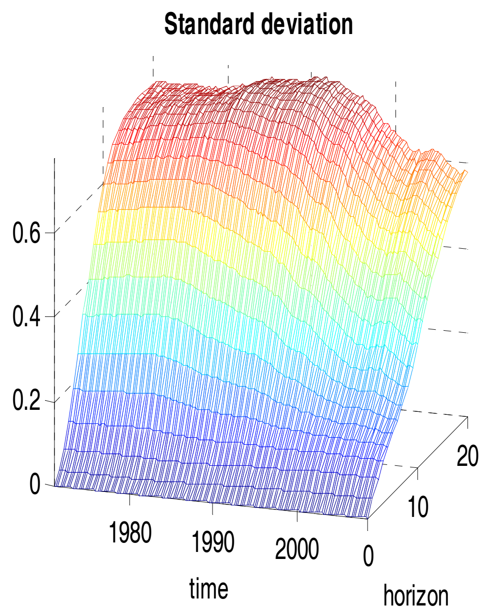
Results

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

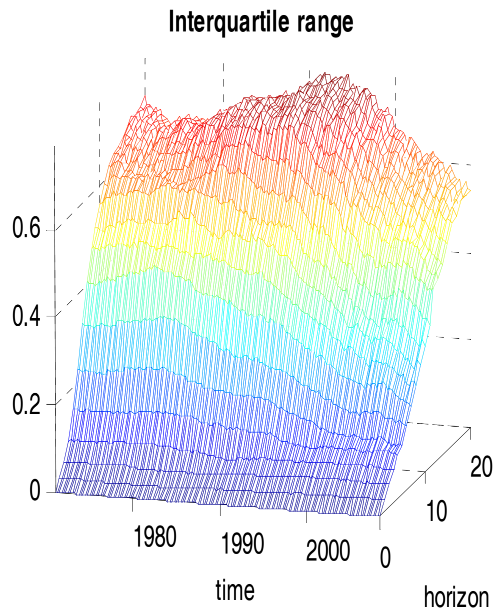
MEDIAN



STANDARD DEVIATION



INTERQUARTILE RANGE



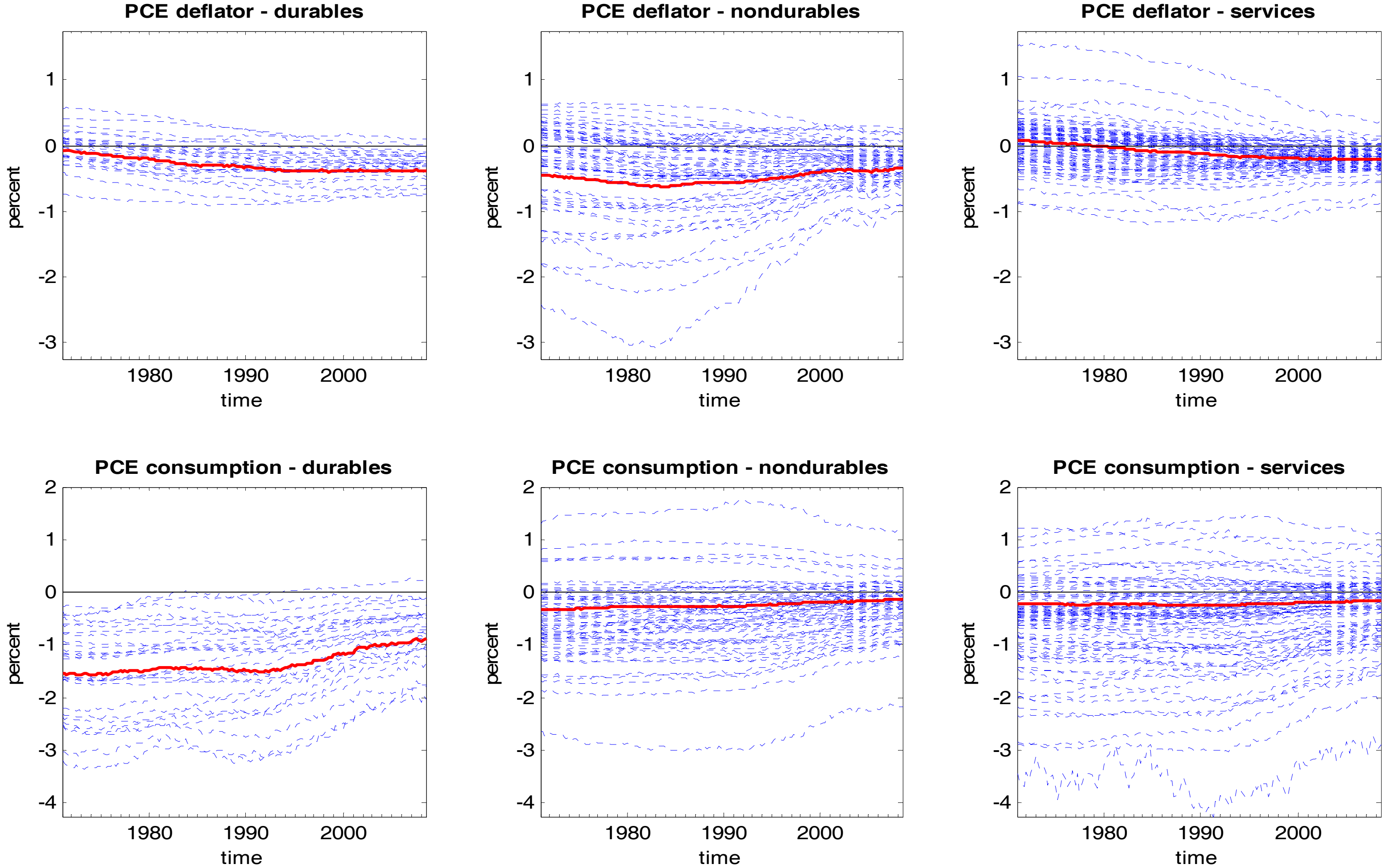
Results

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

DURABLES | NONDURABLES | SERVICES

PRICE

QUANTITY



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