The Macroeconomic Impact of Financial and Uncertainty Shocks

Dario Caldara (FRB)    Cristina Fuentes-Albero (FRB)
Simon Gilchrist (Boston University)    Egon Zakrajšek (FRB)

CEF
Oslo, June 22-24 2014

1The views expressed in this paper are those of the authors, and not necessarily those of the Federal Reserve System.
Motivation

- The Great Recession and the subsequent slow recovery has heightened interest towards two non-traditional drivers of the cycle:
  - Financial shocks: Disruptions in the credit market intermediation process (Gilchrist and Zakrajšek, 2012);

- Financial disruptions lead to high uncertainty. Spikes in uncertainty lead to higher financial risk. Stock and Watson (2012):
  - Correlation between Gilchrist & Zakrajšek EBP and Baker et al policy uncertainty instruments: 0.79;
  - They conclude that: ...these two sets of instruments do not seem to be identifying distinct shocks.
Preview of Results

- This paper identifies two orthogonal shocks to financial risk and uncertainty using Structural VARs.

- We study the effects of both shocks on real, nominal and financial variables.

- Main findings:
  - Financial shocks lead to a deep and persistent decline in real variables, stock market, and bank lending.
  - Uncertainty shocks transmitted through financial conditions are recessionary.
  - Uncertainty shocks not affecting financial conditions provoke a short-lived decline in the stock market, but are not recessionary.
Data

We estimate monthly 9-variate VAR(6) models from 1973 containing:

- **Proxy for financial frictions:**
  - excess bond premium (Gilchrist and Zakrajšek, 2012);

- **Uncertainty proxy:**
  - RVOL, IVOL, VXO, DISP, BBD;

- **Real block:**
  - Industrial production index, employment, PCE;

- **Nominal block:**
  - PCE price index, federal funds rate, 10-year Treasury yield;

- **Stock market returns:**
  - Value-weighted total US stock return from the CRSP database.
Data

1. **Excess Bond Premium**
   - The GZ credit spread index (Gilchrist and Zakrajšek, 2012) is constructed using market prices of individual outstanding securities of US non-financial firms.
   - Decomposition of GZ spread index:
     - Systematic movements in default risk on individual firms;
     - **Excess bond premium (EBP)**: residual component capturing the variation in the average price of bearing exposure to corporate risk beyond the compensation for expected default.

2. **Realized Volatility**
   - Monthly standard deviation of daily firm-level stock returns for all U.S. nonfinancial corporations
Data
Statistical analysis

- The correlation between RVOL and EBP is 0.56.

- Run a battery of Granger causality tests:

  \[ y_t = \alpha + \sum_{i=1}^{h} \beta_i y_{t-i} + \sum_{j=1}^{k} \gamma_j x_{t-j} + \epsilon_{y,t}, \quad t = 1, \ldots, T \]


- The p-value for \( H_0: \) RVOL does not Granger-causes EBP is 0.0008

- The p-value for \( H_0: \) EBP does not Granger-causes RVOL is 0.0065
Methodology

- Reduced form VAR model:
  \[ Y_t = \mu + B(L) Y_{t-1} + u_t. \]

- The variance-covariance matrix of the one-step-ahead errors is:
  \[ \mathbb{E}[u_t u_t'] = \Sigma. \]

- The structural VAR model is
  \[ u_t = F e_t \]

  where
  \[ \mathbb{E}[e_t e_t'] = I_n \]
  \[ FF' = \Sigma \]
Methodology

▶ Identification problem. For any matrix $F$ there exists an alternative matrix $\tilde{F}$ such that $F = \tilde{F}Q$ and:

$$\tilde{F}QQ'\tilde{F}' = \Sigma$$

where $QQ' = I_n$

▶ Optimization-based approach: Statistical criteria to pin down matrix $Q$:
  ▶ Select shocks that maximize the response of some target variables for horizon 1 to $J$;
  ▶ Identify only a subset $m$ of shocks ($m < n$);

▶ Penalty function requires interpretation of identified shocks;

▶ Applications of penalty function: Uhlig (2005), Mountford and Uhlig (2009), Beaudry et al (2011), Arias et al (2013);

Methodology

▶ Why the optimization-based procedure?

▶ EBP and uncertainty indicators are fast-moving variables. Difficult to impose plausible zero contemporaneous restrictions.

▶ Financial and uncertainty shocks have the same qualitative effects on quantities and prices. Difficult to impose sign restrictions.

Methodology

- **Baseline identification:**
  - A financial shock is a shock that maximizes the response of the EBP for up to 3 months;
  - An uncertainty shock is a shock that maximizes the response of the uncertainty proxy (e.g. RVOL) for up to 3 months and is orthogonal to a financial shock.

- **Alternative identification:**
  - An uncertainty shock is a shock that maximizes the response of the uncertainty proxy (e.g. RVOL) for up to 3 months;
  - A financial shock is a shock that maximizes the response of the EBP for up to 3 months and is orthogonal to an uncertainty shock.
Responses to a Financial Shock Ordered First

- **Excess bond premium**
  - Percentage points
  - Months after shock

- **Realized volatility**
  - Percent
  - Months after shock

- **Industrial production**
  - Percent
  - Months after shock

- **Employment**
  - Percent
  - Months after shock

- **PCE**
  - Percent
  - Months after shock

- **Stock market**
  - Percent
  - Months after shock

- **Federal funds rate**
  - Percent
  - Months after shock

- **10-year treasury yield**
  - Percent
  - Months after shock

- **PCE - price index**
  - Percent
  - Months after shock
Responses to a Financial Shock Ordered Second
FEVD to a Financial Shock
Responses to an Uncertainty Shock Ordered First

- Excess bond premium
- Realized volatility
- Industrial production
- Employment
- PCE
- Stock market
- Federal funds rate
- 10-year treasury yield
- PCE - price index

Months after shock:
0  6 12 18 24 30 36

Percentage points
-0.05  0.00  0.05  0.10  0.15  0.20  0.25  0.30
Excess bond premium

Percent
-2  0  2  4  6
Realized volatility

Percent
-2.0  -1.6  -1.2  -0.8  -0.4  0.0  0.4  0.8
Industrial production

Percent
-0.8  -0.6  -0.4  -0.2  0.0  0.2
Employment

Percent
-0.6  -0.5  -0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2
PCE

Percent
-0.6  -0.5  -0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2
Stock market

Percent
-5  -4  -3  -2  -1  0  1  2
Federal funds rate

Percent
-0.5  -0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2
10-year treasury yield

Percent
-0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2  0.3
PCE - price index

Percent
-0.4  -0.3  -0.2  -0.1  0.0  0.1  0.2  0.3
Responses to an Uncertainty Shock Ordered Second

- Excess bond premium: Percentage points
- Realized volatility: Percent
- Industrial production: Percent
- Employment: Percent
- PCE: Percent
- Stock market: Percent
- Federal funds rate: Percent
- 10-year treasury yield: Percent
- PCE - price index: Percent
FEVD to an Uncertainty Shock

Excess bond premium

Realized volatility

Industrial production

Employment

PCE

Stock market

Federal funds rate

10-year treasury yield

PCE - price index
Results

- Baseline identification: financial shock explains all variability in EBP and RVOL correlated to the business cycle.

- Alternative identification: financial and uncertainty shocks drive the cycle:
  - Financial shocks are still the dominant driver;
  - EBP seems to be crucial to the transmission of uncertainty shocks.

- To study the role of EBP in transmitting uncertainty shocks we use a constrained penalty function:
  - An uncertainty shock is a shock that maximizes the response of RVOL for up to 3 months, restricting the response of EBP to be zero on impact.
Results

Uncertainty Shock – Constrained Penalty Function

Excess bond premium

Percentage points

Realized volatility

Percent

Industrial production

Percent

Stock market

Percent
Results
Response of Bank lending (1985 - 2012)
Conclusions

▶ This paper disentangles the macroeconomic impact of financial and uncertainty shocks in the U.S.

▶ Financial shocks are recessionary and are important drivers of the business cycle.

▶ Mixed evidence on uncertainty shocks:
  ▶ Recessionary when leading to financial disruptions;
  ▶ Smaller drivers of the cycle compared to financial shocks.

▶ Future research: Rationalize results through the lenses of a DSGE model.