Gimme a Break! Identification and Estimation of the Macroeconomic Effects of Monetary Policy Shocks in the U.S.

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Monetary policy shocks and VARs

- SVARs: Employed to establish stylized facts, perform model selection
- A lot of attention devoted to the effects of monetary policy shocks
- Benchmark: *Recursive identification scheme, fixed coefficients* (Christiano et al. 1999, 2005)
- Pros: No need to identify other shocks
- Cons: *Zero restrictions at odds with most DSGE models* (e.g. Smets and Wouters 2007), *evidence against such restrictions* (Faust et al. 2004, Del Negro et al. 2007)
- Non-recursive schemes: Unfeasible
This paper's approach

- This paper: **Novel identification scheme to identify shocks in VARs – "SVAR-WB"**
- How: Information coming from **break in the reduced-form VCV matrix, contemporaneous coefficients**
- Application: 7-VAR, post-WWII U.S. data
- Empirical exercises:
  i) **IRFs in pre-mid 1980s, Great Moderation**
  ii) **estimation of DSGE model with the cost-channel via IRF matching**
This paper’s results

- Evidence of **instability in the U.S. post-WWII IRFs to a monetary policy shock**

- **Post-WWII fixed coefficient-VAR evidence de facto driven by the Great Inflation phase** (e.g., price puzzle)

- Evidence robust to alternative assumptions underlying the processes at hand (stationary, non-stationary and cointegrated)

- **Recursive- vs. non-recursive SVAR-WB imply quite similar dynamics pre-1984**, not quite so during the Great Moderation (entity of the response, size, sign)

- **IRF matching approach** with non-recursive SVAR-WB suggests **instabilities in the structural parameters, in particular as for the cost-channel**
Plan of the presentation

- Literature review
- SVAR-WB: Theory
- SVAR-WB vs. alternatives: Evidence
- DSGE estimation with IRF matching
- Conclusions
State of the art


Consider the following VAR model:

\[
\begin{align*}
  z_t &= \Pi w_t + u_t, \quad u_t = C e_t \\
  e_t &\sim WN(0_n, I_n) \\
  \Sigma_u &= E(u_t u'_t)
\end{align*}
\]

- Fixed-coefficient model: Not enough information to identify the \(n^2\) elements of the \(C\) matrix
- Break(s) in the covariance-structure of the data are of help for the econometrician!
The role of the break

- Assume a break at time $t = T_B$ occurs, and consider the following VAR structure:

$$z_t = \Pi(t)w_t + u_t, \quad u_t = C(t)e_t$$

$$e_t \sim WN(0_n, I_n)$$

$$\Pi(t) = \Pi_1 \times 1(t < T_B) + \Pi_2 \times 1(t \geq T_B)$$

$$\Sigma_u(t) = \Sigma_{u,1} \times 1(t < T_B) + \Sigma_{u,2} \times 1(t \geq T_B)$$

- Key assumption: $\Sigma_{u,1} \neq \Sigma_{u,2}$, i.e. that there are two volatility regimes in the data
The role of the break (cont’d)

- Crucial assumption in the literature: Changes in $\Sigma_u$ not associated with a change in $C$, which is fixed
- Identification of $C$: $\Sigma_{u,1} = CC'$, $\Sigma_{u,2} = CVC'$
- Our kick: We do allow for a time-dependent $C$
  
  $$C(t) = C + Q \times 1 (t \geq T_B)$$
Changes in C: Identification

- Identifying restrictions:

\[ \Sigma_{u,1} = CC' \]
\[ \Sigma_{u,2} = (C + Q)(C + Q)' \]

- Additional restrictions (needed):

\[
\begin{pmatrix}
\text{vec}(C) \\
\text{vec}(Q)
\end{pmatrix} = 
\begin{pmatrix}
S_C & S_I \\
0_{n^2 \times a_C} & S_Q
\end{pmatrix} 
\begin{pmatrix}
\varphi \\
q
\end{pmatrix} + 
\begin{pmatrix}
s_C \\
s_Q
\end{pmatrix}
\]

- Under these restrictions, NS rank condition + N order condition (see proof in the paper)
The very general model

- The previous model can be seen as a particular case of the more general model:
  \[
  \Sigma_{u,1} = CC' \\
  \Sigma_{u,2} = (C + Q)\Lambda(C + Q)'
  \]
  
  that nests the Rigobon (2003) and Lanne and Lütkepohl (2008) specifications

- Additional restrictions (needed):
  \[
  \begin{pmatrix}
  \text{vec}(C) \\
  \text{vec}(Q) \\
  \omega(\Lambda)
  \end{pmatrix}
  =
  \begin{pmatrix}
  S_C & S_I & 0 \\
  0 & S_Q & 0 \\
  0 & 0 & S_\Lambda
  \end{pmatrix}
  \begin{pmatrix}
  \varphi \\
  q \\
  \lambda
  \end{pmatrix}
  +
  \begin{pmatrix}
  s_C \\
  s_Q \\
  s_\Lambda
  \end{pmatrix}
  \]

- Under these restrictions, NS rank condition + N order condition (see Bacchiocchi and Fanelli, 2013)
Empirical application: SVAR-WB

- Estimation of a seven variable VAR, U.S. quarterly data, 1954Q3-2008Q2
- Sample edges: Data availability, no ZLB
- \( z_t = (NDCONS_t, DCONS_t, INVEST_t, GDP_t, INFL_t, FFR_t, 10YR_t)' \), constants, four lags
- Break \( T_B = 1984Q1 \), LR Chow-type test rejects the null of stability
  - 1954Q3-1983Q4 = 'Great inflation' period
  - 1984Q1-2008Q2 = 'Great Moderation' period
- Recursive- vs. non-recursive SVAR-WB
Recursive- vs. non-recursive SVAR-WB

- Mapping structural shocks $e_t$ – reduced-form residuals $u_t$:

  $$u_t = C(t)e_t$$
  $$= C + Q \times 1(t \geq T_B)e_t$$

- Recursive SVAR-WB: $C$ lower triangular, $Q$ lower triangular

- Non-recursive SVAR-WB: $C$ full, $Q$ diagonal
Recursive SVAR-WB: Pre- vs. post-1984

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Intro
Literature review
SVAR-WB: Theory
SVAR-WB: Evidence
DSGE, IRF-matching approach
Conclusions
Recursive SVAR-WB vs. fixed-coeff. SVAR
Recursive SVAR-WB vs. fixed-coeff. SVAR (cont’d)
Recursive models

- Clear recessionary effects in the Great inflation sample, price puzzle
- Much larger uncertainty in the post-1984 period, no price puzzle
- Fixed-coefficient VARs estimated with post-WWII data: Dynamics fully driven by pre-1984 period
- What if data analyzed with non-recursive SVAR-WB?
Recursive- vs. non-recursive SVAR-WB

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Recursive- vs- non-recursive SVAR-WB

- Pre-break period: Quite similar dynamics, contemporaneous zero-restrictions not so problematic
- Post-break sample: Non-recursive SVAR-WB predicts significantly negative responses of real variables and the long-term policy rate, deflation
- Can we discriminate between the two frameworks? No, if we stick to the unconstrained formulations (just-identified models)
- Coefficients of C and Q not all significant! Constrained formulations, best fitting model (LR tests, likelihood)
  - constrained recursive VAR-WB: Log-lik = 1540.12, $\chi^2(23)=33.36$, p-value=0.08
  - constrained non-recursive VAR-WB: Log-lik = 1550.25, $\chi^2(22)=13.10$, p-value=0.94
- Non-recursive SVAR-WB favored by the data
SVAR-WB for IRF matching estimates

- IRFs to a monetary policy shock often used to estimate DSGE models via IRF matching procedure (Rotemberg and Woodford 1997, Boivin and Giannoni 2006, Christiano et al. 2005, Altig et al. 2011)

- Approach based on fixed-coefficient recursive VAR, recursive DSGE models

- Most microfounded DSGE models not-recursive, though

- SVAR-WB can be employed to estimate non-recursive DSGE models, detect structural parameter instabilities

- Application: Small-scale cost-channel model à la Ravenna and Walsh (2006), Surico (2008)
DSGE model with the cost-channel

\[
\pi_t = \beta[\xi_\pi E_t \pi_{t+1} + (1 - \xi_\pi) \pi_{t-1}] + \kappa x_t + \kappa \alpha R_t + \epsilon^\pi_t
\]

\[
x_t = \xi_x E_t x_{t+1} + (1 - \xi_x) x_{t-1} - \tau(R_t - E_t \pi_{t+1}) + \epsilon^x_t
\]

\[
R_t = (1 - \phi_i)(\phi_\pi \pi_t + \phi_x x_t) + \phi_i R_{t-1} + \epsilon^i_t
\]
### DSGE model: IRF matching estimates

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<tbody>
<tr>
<td>$\zeta_x$</td>
<td>0.50 (0.01)</td>
<td>0.42 (0.02)</td>
<td>0.09 (0.16)</td>
</tr>
<tr>
<td>$\tau$</td>
<td>0.03 (0.001)</td>
<td>0.09 (0.01)</td>
<td>0.73 (0.22)</td>
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<tr>
<td>$\xi_\pi$</td>
<td>0.53 (0.02)</td>
<td>0.27 (0.05)</td>
<td>1.00 (0.18)</td>
</tr>
<tr>
<td>$\kappa$</td>
<td>0.01 (0.01)</td>
<td>0.01 (0.01)</td>
<td>0.11 (0.02)</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>3.08 (2.07)</td>
<td>0*</td>
<td>0.00 (1.80)</td>
</tr>
</tbody>
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Distance: 133.39, 137.82, 20.09
Time-varying role of the cost-channel

- **Cost-channel: Time-dependence detected**
- Result which comes from time-dependence of the price puzzle
- Interpretation: Financial liberalization in the early 1980s.
Conclusions

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Thank you!