Discussion of

Gaussian mixture approximations of impulse responses and the non-linear effects of monetary shocks

by Barnichon and Matthes

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The beginning...

I would have loved to prepare a great discussion...

I asked for the codes to the authors

BUT

... no codes were provided to me...

"Unfortunately the code is not ready yet to be distributed (sorry!)"

This is odd...

The paper

- Interesting paper.
- Parameterizing impulse responses assuming the model is a moving average (MA).
- Application: non-linear effects of monetary policy shocks.

My discussion

- Review
- The poor man's non-linear empirical analysis
- I can give you my codes...
- I got the same results in the paper by running 4 regressions in 2 different experiments.
- How come?
- Few comments/questions

The non-linear model: specification 1

MA truncated at K:

$$y_t = \sum_{k=0}^{K} \psi_k^{\pm}(\varepsilon_{t-k})\varepsilon_{t-k}$$

where

$$\begin{aligned} \psi_k^{\pm}(\varepsilon_{t-k}) &= \psi_k^{+} I_{(\varepsilon_{t-k}>0)} + \psi_k^{-} I_{(\varepsilon_{t-k}<0)} \\ \psi_k^{x} &= \lambda_k^{x}, \quad x \in \{+,-\} \end{aligned}$$

Responses to shocks depend on:

1. sign of the shock;

Approximating with N Gaussian functions:

$$\lambda_k^{x} \simeq \sum_{n=1}^{N} a_n^{x} e^{-\left(\frac{k-b_n^{x}}{c_n^{x}}\right)^2}, \quad x \in \{+,-\}$$

evaluated at $k = 0, 1, 2, ..., K$

The non-linear model: specification 2

MA truncated at K:

$$y_t = \sum_{k=0}^{K} \psi_k^{\pm}(\varepsilon_{t-k}, z_{t-k})\varepsilon_{t-k}$$

where

$$\begin{aligned} \psi_k^{\pm}(\varepsilon_{t-k}, z_{t-k}) &= \psi_k^{+}(z_{t-k}) I_{(\varepsilon_{t-k}>0)} + \psi_k^{-}(z_{t-k}) I_{(\varepsilon_{t-k}<0)} \\ \psi_k^{x}(z_{t-k}) &= (1+\gamma^{x} z_{t-k})\lambda_k^{x}, \quad x \in \{+,-\} \end{aligned}$$

Responses to shocks depend on:

1. sign of the shock;
2. external variable z_{t-k} (unemployment: u_{t-k-1});

Approximating with N Gaussian functions:

$$\lambda_k^{x} \simeq \sum_{n=1}^{N} a_n^{x} e^{-\left(\frac{k-b_n^{x}}{c_n^{x}}\right)^2}, \quad x \in \{+,-\}$$

evaluated at $k = 0, 1, 2, ..., K$

On the model

Question: Given that we want to “approximate” only at points $k = 0, 1, 2, ...K$, are Gaussian functions the best?

Question: Why didn’t you have the experiment in which there is no contraction/expansion but only the external variable?

Notation

Notation is important.

Mathematics as a language? Use it properly.

Mixing up sequences and functions.

Fix notation and try to be consistent (example: $\psi_k^{\pm}(\varepsilon_{t-k}, z_{t-k})$ has never been defined in the paper...).

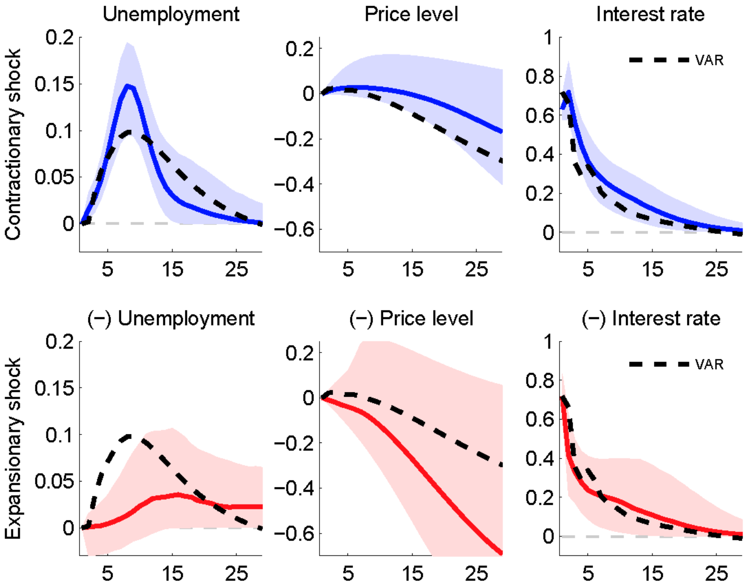
Estimation

Estimating an MA.

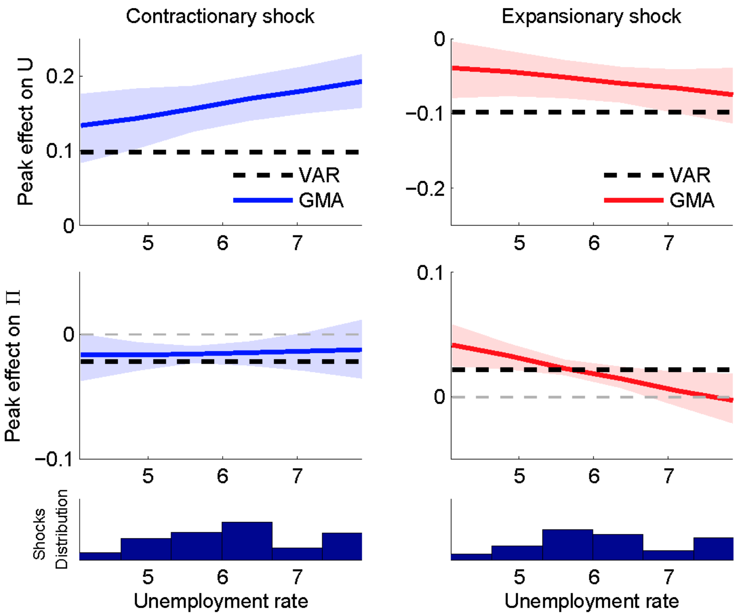
Computing the likelihood is easy (in theory...).

Cumbersome, because of the switching between positive and negative ε_t.

Cumbersome, because the model is multivariate (and structural).



Unemployment
Price level
Interest rate
(−) Unemployment
(−) Price level
(−) Interest rate
Contractionary shock
Expansionary shock
VAR
VAR
0.2
0.15
0.1
0.05
0
0.2
0
−0.2
−0.4
−0.6
1
0.8
0.6
0.4
0.2
0
5
15
25



Contractionary shock
Expansionary shock
Peak effect on U
Peak effect on Π
VAR
GMA
Shocks Distribution
Unemployment rate
Unemployment rate

Results

1. Contractionary vs. Expansionary shocks

- Contractionary monetary policy shocks ($\uparrow$ in FFR): big effects;

- Expansionary shocks ($\downarrow$ in FFR): almost zero effects.

2. Contractionary vs. Expansionary shocks + State Dependency

- Contractionary effect on unemployment is larger the higher is unemployment.

- Expansionary effect on unemployment is (weakly) larger the higher is unemployment.

- No state dependency of contractionary shocks.

- Expansionary shocks positive effect on inflation in a boom.

My linear empirical model

Monetary policy shocks (ε_t) from Romer and Romer, 2004.

Local projections (Jordà, 2005).

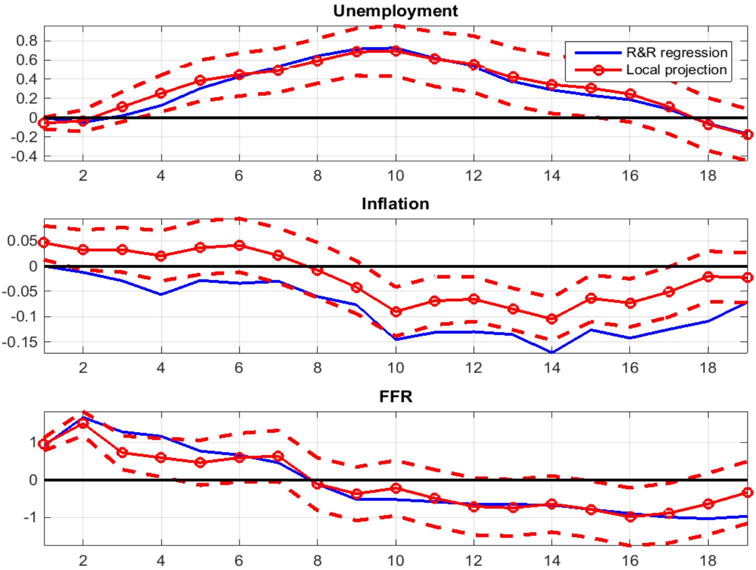
$$y_{t+h} = \alpha_h + \beta_h \varepsilon_t + \gamma' x_t + v_t \qquad \text{for } h = 0, 1, ..., H$$

Impulse responses: $\beta_0, \beta_1, ..., \beta_H$

Compare it to the Romer and Romer approach.

$$y_t = \sum_{j=0}^{H} \beta_j \varepsilon_{t-j} + \sum_{j=1}^{H} \alpha_j y_{t-j} + v_t$$

Impulse responses: $\frac{\beta(L)}{1-\alpha(L)}$



Unemployment
R&R regression
Local projection
0.8
0.6
0.4
0.2
0
-0.2
-0.4
2
4
6
8
10
12
14
16
18
Inflation
0.05
0
-0.05
-0.1
-0.15
FFR
1
0
-1

My non-linear empirical model

Contraction vs. expansion:

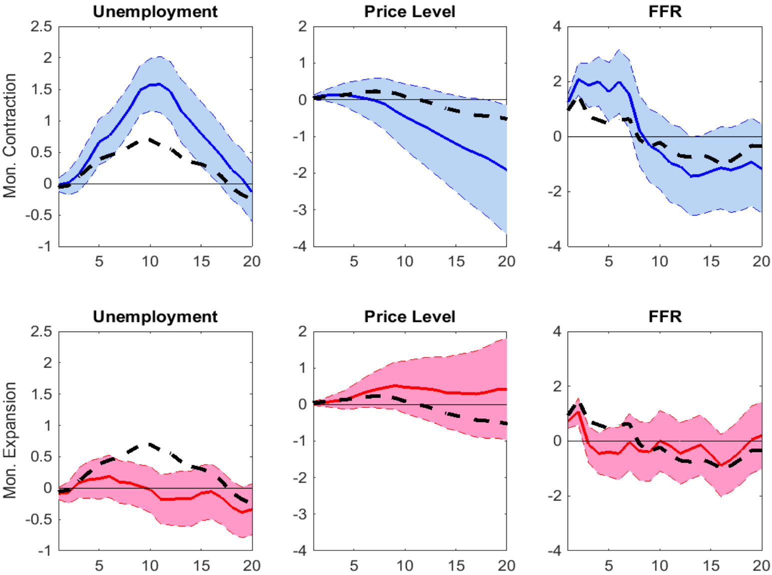
$$y_{t+h} = \alpha_h + \beta_h^+ \varepsilon_t^+ + \beta_h^- \varepsilon_t^- + \gamma' x_t + v_t \qquad h = 0, 1, ..., H$$

Boom vs. recession:

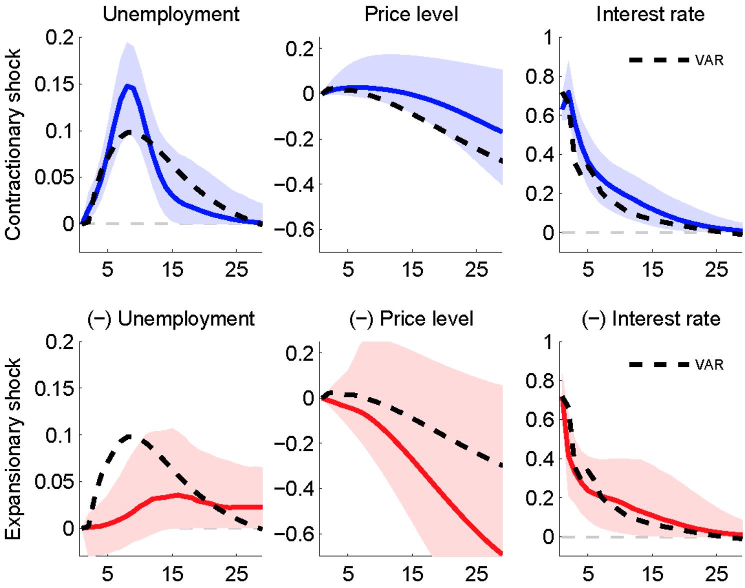
$$y_{t+h} = \alpha_h + \beta_h^B \varepsilon_t^B + \beta_h^R \varepsilon_t^R + \gamma' x_t + v_t \qquad h = 0, 1, ..., H$$

Combination of the two:

$$y_{t+h} = \alpha_h + \beta_h^{B,+} \varepsilon_t^{B,+} + \beta_h^{R,+} \varepsilon_t^{R,+} + \beta_h^{B,-} \varepsilon_t^{B,-} + \beta_h^{R,-} \varepsilon_t^{R,-} + \gamma' x_t + v_t$$
$$h = 0, 1, ..., H$$



Unemployment
Price Level
FFR
Mon. Contraction
Mon. Expansion
2.5
2
1.5
1
0.5
0
-0.5
-1
-2
-3
-4
4
5
10
15
20



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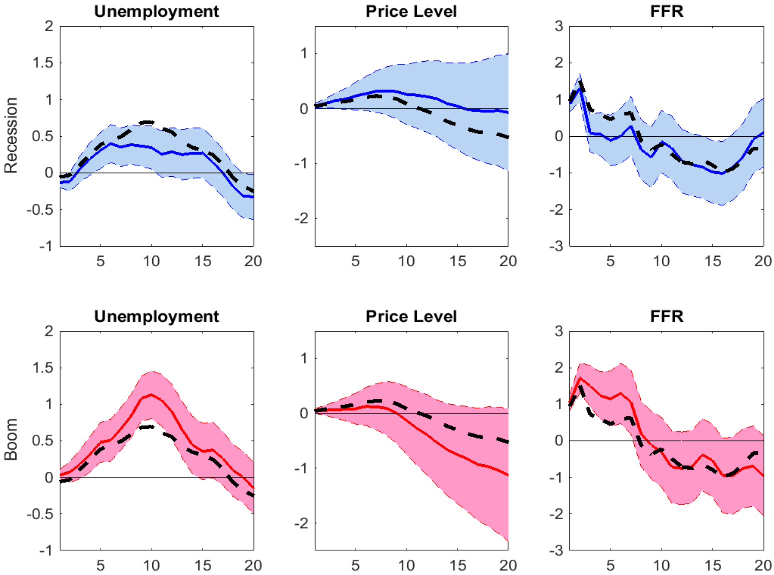
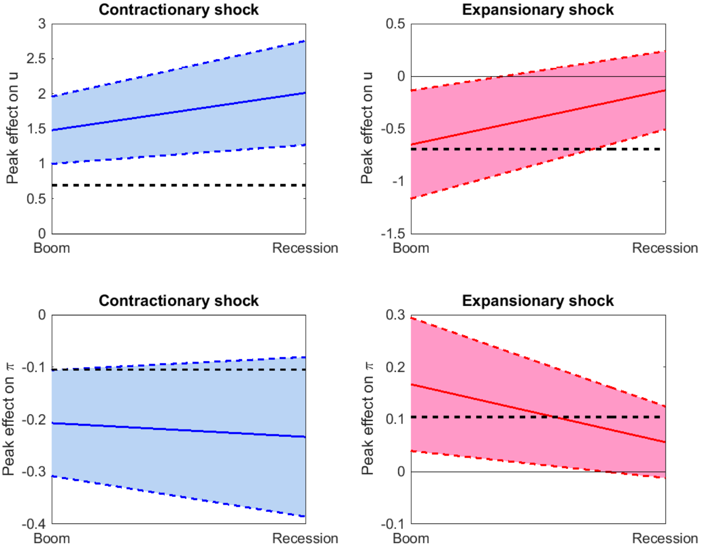
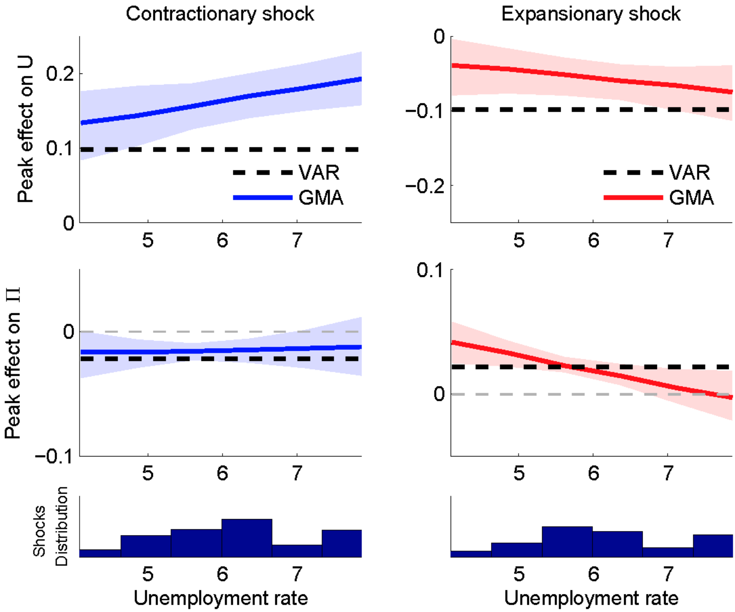
Price level
Interest rate
Contractionary shock
VAR
(−) Unemployment
(−) Price level
(−) Interest rate
Expansionary shock
VAR


Unemployment
Price Level
FFR
Recession
Boom
2
1.5
1
0.5
0
-0.5
-1
-2
3
-3
5
10
15
20


Contractionary shock
Expansionary shock
Peak effect on u
Peak effect on π
Boom
Recession
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-0.1
-0.2
-0.3
-0.4
0.3
0.2
0.1



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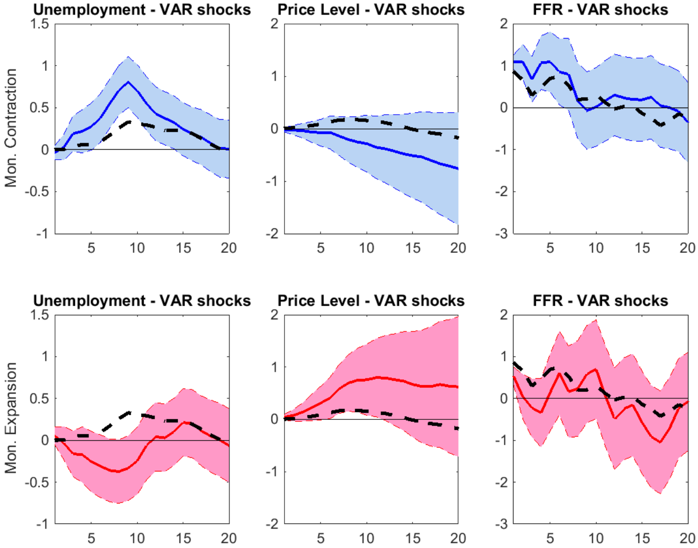
...what if I run a linear VAR?

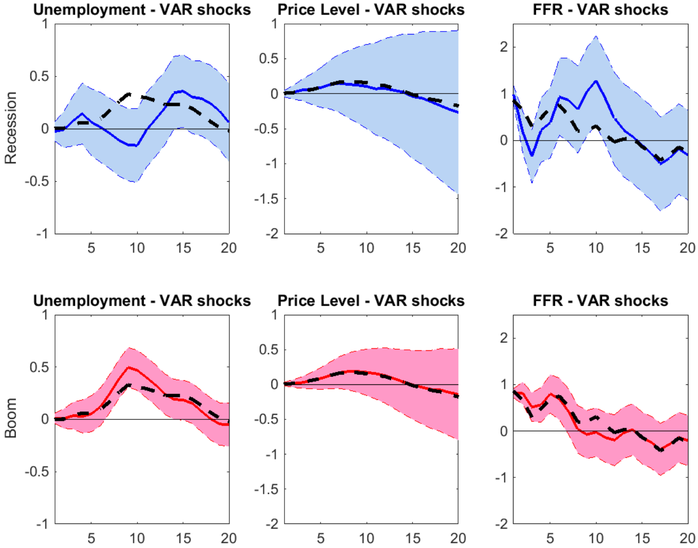
VAR on u_t, π_t and FFR_t with Choleski.

Local projections on identified monetary policy shocks, ε_t^{VAR}.

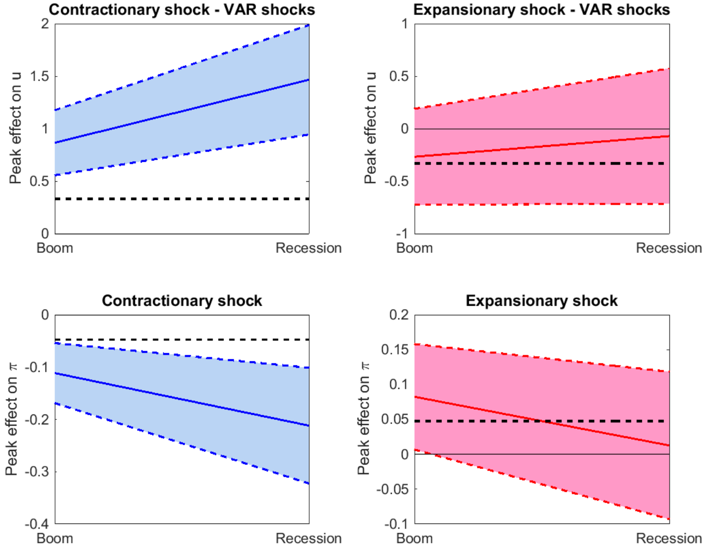
Very similar results!



Unemployment - VAR shocks
Price Level - VAR shocks
FFR - VAR shocks
Mon. Contraction
Unemployment - VAR shocks
Price Level - VAR shocks
FFR - VAR shocks
Mon. Expansion



Unemployment - VAR shocks
Price Level - VAR shocks
FFR - VAR shocks
Recession
Unemployment - VAR shocks
Price Level - VAR shocks
FFR - VAR shocks
Boom



Contractionary shock - VAR shocks
Peak effect on u
Boom
Recession
Expansionary shock - VAR shocks
Peak effect on u
Boom
Recession
Contractionary shock
Peak effect on π
Boom
Recession
Expansionary shock
Peak effect on π
Boom
Recession

How come?

$$corr(\varepsilon_t^{R\&R}; \varepsilon_t^{VAR}) = 0.45$$
$$corr(\varepsilon_t^{R\&R}; \varepsilon_t^{BM}) = 0.63$$

Residuals are not very correlated, but responses are very similar.

On one side, my results say that *R&R* properly identified shocks, but what about the VAR?

Question: VAR is able to uncover shocks but no good at uncovering non-linear responses?

Question: few outliers driving the results? 79-82 period?

Question: any explanations?

Comments/questions

- Controlling for the endogenous response of u_t?

- Zero-lower bound?

- Role of monetary policy shocks in business cycles? Variance decompositions?

- Uncertainty?

- This paper: shooting a fly with a bazooka?

Pulling a string

Congressman Goldsborough: *You mean you cannot push a string.*

Governor Eccles: *That is a good way to put it, one cannot push on a string. We are in the depths of a depression and ... beyond creating an easy money situation through reduction of discount rates and through the creation of excess reserves, there is very little if anything that the reserve organization [Federal Reserve Board] can do toward bringing about recovery.*

I believe that in a condition of great business activity that is developing to a point of credit inflation, monetary action can very effectively curb undue expansion.

Testimony before the House Committee on Banking and Currency, March 18, 1935.

Recession + expansion: little effects on unemployment

Boom + contraction: big effects on unemployment

They knew it!