ECON 815

Identifying Monetary Policy Shocks

Winter 2014

The Problem

We would like to find the best design for monetary policy.

But we do not have good samples to evaluate different designs.

Solution is to resort to models for conducting policy experiments.

Which model should we use to base our design on?

Approach

Three steps:

1) Identify monetary policy shocks for actual economies.

2) Characterize the response of the economy to such shocks.

3) Conduct the same experiment (reaction to shock) in the model economy.

If the responses look similar, we trust the model to be a good approximation of reality and use it to give advice for monetary policy.

But MP reacts to shocks in the economy and is itself subject to shocks.

Feedback Rules

Consider the model

$$S_t = f(\Omega_t) + \sigma\epsilon_t$$

- S_t is the policy instrument.
- f is the feedback rule.
- ϵ_t MP shock with unit variance.

What are the shocks?

- change in preferences
- strategic considerations
- measurement error and imperfect observability (mistakes?)

<u>Idea:</u>

1. Estimate the feedback rule.
2. Use the current and lagged errors to estimate the response of a variable to the shock.

Using a VAR

We start off with a VAR of the form

$$Z_t = \mathbf{B_0} Z_{t-1} + \cdots + \mathbf{B_q} Z_{t-q} + u_t$$

where u_t are disturbances and $Eu_t u_t' = \mathbf{V}$.

u_t are the errors and cannot be seen as fundamental economic disturbances to variables in the VAR model.

Suppose there exists a matrix $\mathbf{A_0}$ such that $\mathbf{A_0} u_t = \epsilon_t$, where ϵ_t are the fundamental shocks in the economy.

Then, we have

$$\mathbf{A_0} Z_t = \mathbf{A_1} Z_{t-1} + \cdots + \mathbf{A_q} z_{t-q} + \epsilon_t$$

where $\mathbf{B_i} = \mathbf{A_0^{-1}} \mathbf{A_i}$ and $\mathbf{V} = \mathbf{A_0^{-1}} \mathbf{D} \mathbf{A_0}$ for $E\epsilon_t \epsilon_t' = \mathbf{D}$.

We can estimate $\mathbf{B_i}$ and $\mathbf{V}$ via OLS and the fitted errors, but we need to obtain $\mathbf{A_0}$ for the IRFs.

Identification Problem

Assume that the fundamental shocks are uncorrelated, i.e. $\mathbf{D}$ is a diagonal matrix.

Without any further restrictions on $\mathbf{A_i}$, we can set $\mathbf{D} = \mathbf{I}$.

- $\mathbf{V}$ is a symmetric matrix of dimension k
- $\mathbf{A_0}$ has k^2 elements

We have $k(k+1)/2$ restrictions to determine k^2 parameters.

We need to find restrictions on A_0 so that we can identify the MP shock.

Solving the Identification Problem

Order the variables according to

$$Z_T = \begin{pmatrix} X_{1t} \\ S_t \\ X_{2t} \end{pmatrix}$$

where

- X_{1t} are variables in Ω_t contemporaneously and with lags
- X_{2t} are variables in Ω_t only with lags

This ordering is important, but the ordering within X_{1t} and X_{2t} is irrelevant.

The *recursiveness assumption* imposes the following restrictions:

$$\mathbf{A_0} = \begin{pmatrix} a_{11} & 0 & 0 \\ a_{21} & 1/\sigma & 0 \\ a_{31} & a_{32} & a_{33} \end{pmatrix}$$

Interpretation:

- zero block/middle row – don't see X_{2t} when setting policy
- zeros in top row – MP shock orthogonal to X_{1t}

Any (!) A_0 that satisfies these restrictions will produce the same IRFs to the shock that is associated with variable S_t.

But we cannot say anything about the dynamic responses to shock to the other variables (without further restrictions).

I will use the so-called Cholesky decomposition of $\mathbf{V}$ to obtain identification via a lower triangular matrix.

Monetary Policy Shocks in Canada

I use the following specification à la CEE:

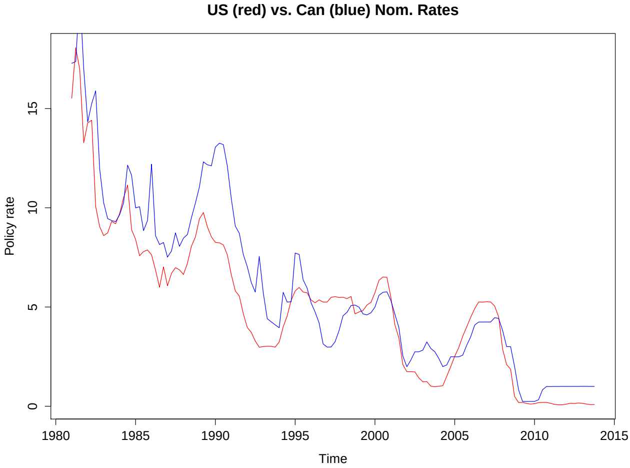
- S_t is the actual overnight rate
- X_{1t} has GDP and some price/inflation measure
- X_{2t} has M2

Problem: Where is US monetary policy?

Idea: Include the feds fund rate as a proxy in X_{1t}.

Why? only influence from US policy on Can policy

US and CAN monetary policy



Estimated Shocks

Specification for reaction function:

- everything in levels
- normalized to some base year (except interest rates)
- lag-length 2
- run it with and without fed funds rate

Shocks are smoothed over three periods (quarters).

Separate estimation for inflation targeting period to account for likely reduction in shocks.

(standard deviation for est. shock about 77.2% (0.361/0.468))

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Time series regression with "ts" data:
Start = 1981(3), End = 2013(4)

Call:
dynlm(formula = on_rate ~ ff_rate + gdp + p + L(gdp, 1:2) + L(p,
    1:2) + L(ff_rate, 1:2) + L(m2, 1:2) + L(on_rate, 1:2))

Residuals:
     Min       1Q   Median       3Q      Max
-2.32182 -0.32039 -0.03311  0.32726  2.40874

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       2.19363    1.43013   1.534  0.12779
ff_rate           0.22491    0.10460   2.150  0.03361 *
gdp              -0.29336    0.12834  -2.286  0.02409 *
p                 0.02209    0.08644   0.256  0.79874
L(gdp, 1:2)1      0.63079    0.19364   3.258  0.00147 **
L(gdp, 1:2)2     -0.33932    0.12401  -2.736  0.00719 **
L(p, 1:2)1        0.04573    0.13684   0.334  0.73884
L(p, 1:2)2       -0.10113    0.09716  -1.041  0.30008
L(ff_rate, 1:2)1  0.62021    0.14552   4.262 4.15e-05 ***
L(ff_rate, 1:2)2 -0.69546    0.10316  -6.742 6.42e-10 ***
L(m2, 1:2)1       0.27982    0.13416   2.086  0.03919 *
L(m2, 1:2)2      -0.27072    0.13453  -2.012  0.04649 *
L(on_rate, 1:2)1  0.72943    0.07706   9.465 4.25e-16 ***
L(on_rate, 1:2)2  0.08814    0.07532   1.170  0.24430
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6957 on 116 degrees of freedom
Multiple R-squared: 0.9747,  Adjusted R-squared: 0.9719
F-statistic: 343.7 on 13 and 116 DF,  p-value: < 2.2e-16
```

Figure: Model fit with FF-rate – 1981 - 2013

```
Time series regression with "ts" data:
Start = 1994(3), End = 2013(4)

Call:
dynlm(formula = on_rate ~ ff_rate + gdp + p + L(gdp, 1:2) + L(p,
    1:2) + L(ff_rate, 1:2) + L(m2, 1:2) + L(on_rate, 1:2), start = c(1994,
    3), end = c(2013, 4))

Residuals:
     Min       1Q   Median       3Q      Max
-0.92801 -0.18014 -0.02548  0.09137  2.36280

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       2.30086    1.48192   1.553  0.12545
ff_rate           0.43194    0.14844   2.910  0.00497 **
gdp              -0.05548    0.09883  -0.561  0.57651
p                -0.03467    0.05517  -0.628  0.53195
L(gdp, 1:2)1      0.10705    0.14727   0.727  0.46994
L(gdp, 1:2)2     -0.02541    0.08999  -0.282  0.77857
L(p, 1:2)1        0.11550    0.08474   1.363  0.17769
L(p, 1:2)2       -0.14291    0.06871  -2.080  0.04155 *
L(ff_rate, 1:2)1 -0.19284    0.27097  -0.712  0.47926
L(ff_rate, 1:2)2 -0.06066    0.16337  -0.371  0.71163
L(m2, 1:2)1       0.04557    0.10949   0.416  0.67867
L(m2, 1:2)2      -0.03186    0.10921  -0.292  0.77143
L(on_rate, 1:2)1  0.98754    0.10980   8.994  5.8e-13 ***
L(on_rate, 1:2)2 -0.22729    0.11875  -1.914  0.06009 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.3962 on 64 degrees of freedom
Multiple R-squared: 0.9615,   Adjusted R-squared: 0.9536
F-statistic: 122.8 on 13 and 64 DF,  p-value: < 2.2e-16
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Figure: Model fit with FF-rate – 1994 - 2013

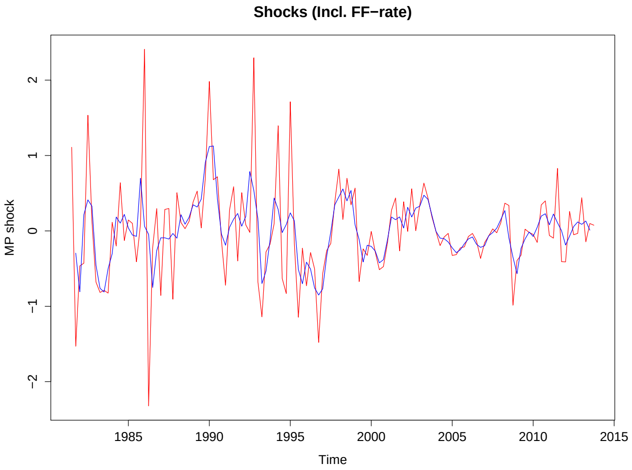

Figure: Shocks with FF-rate – 1981 - 2013

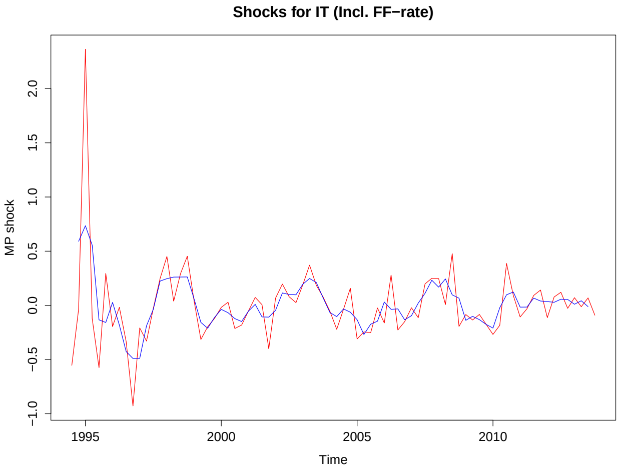

Figure: Shocks with FF-rate – 1994 - 2013

IRFs – Full Model

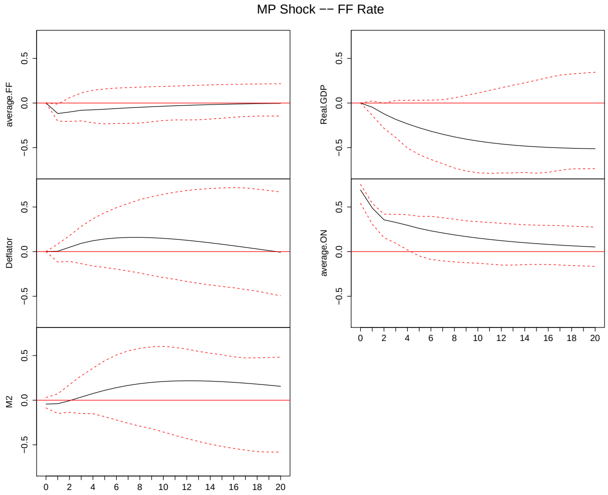

Figure: Orthogonalized IRF to MP Shock – 1981 - 2013

IRFs – No Federal Funds Rate

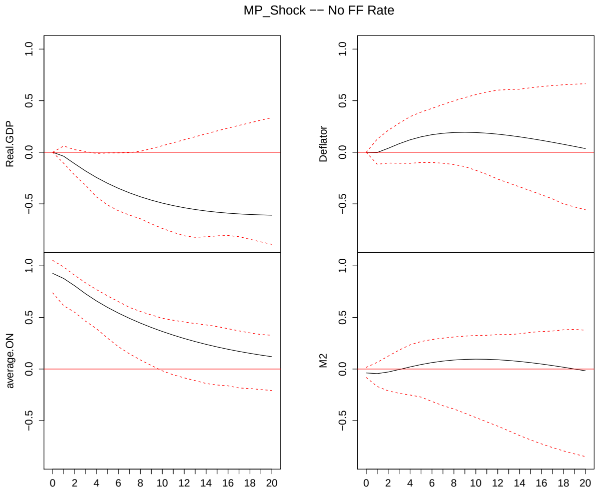

Figure: Orthogonalized IRF to MP Shock – 1981 - 2013

IRFs – Inflation Targeting Regime

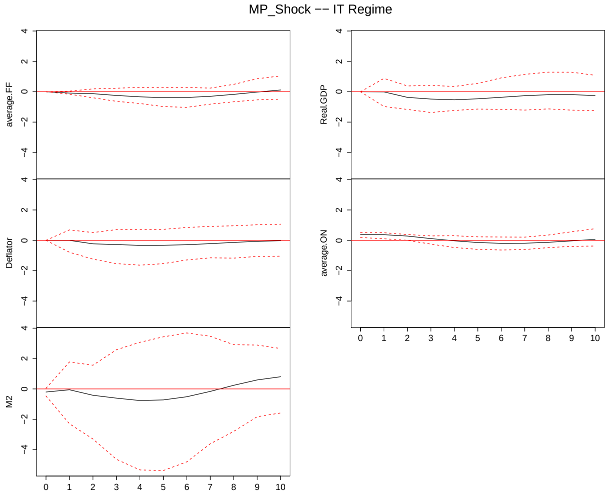

Figure: Orthogonalized IRF to MP Shock – 1994 - 2013