Homework 2: Macroeconomics 210C

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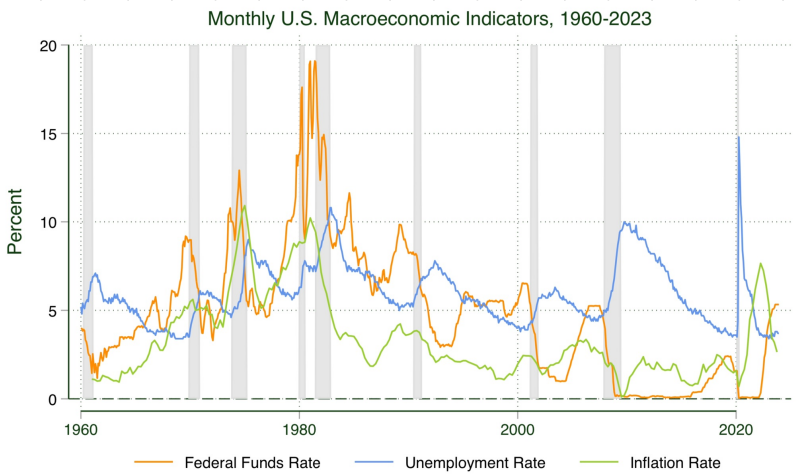
1. VARs

Download data for the Federal Funds Rate, the civilian unemployment rate, and the GDP deflator inflation rate from FRED.

(a) Plot the data. Make sure all graphs are appropriately labelled.

Figure 1: Monthly U.S. Macroeconomic Indicators, 1960-2023



(b) Aggregate all series to a quarterly frequency by averaging over months.

Estimate a VAR with 4 lags from 1960Q1:2007Q4. The ordering of your variables should be π_t, u_t, R_t.

VAR: vector autoregression ; useful to summarize relationships between macroeconomic time series and examine response to structural shocks.

Considering 4 lags from 1960 Q1: 2007 Q4.

$$X_t = A_0 + \sum_{s=1}^{4} A_s \cdot X_{t-s} + e_t$$

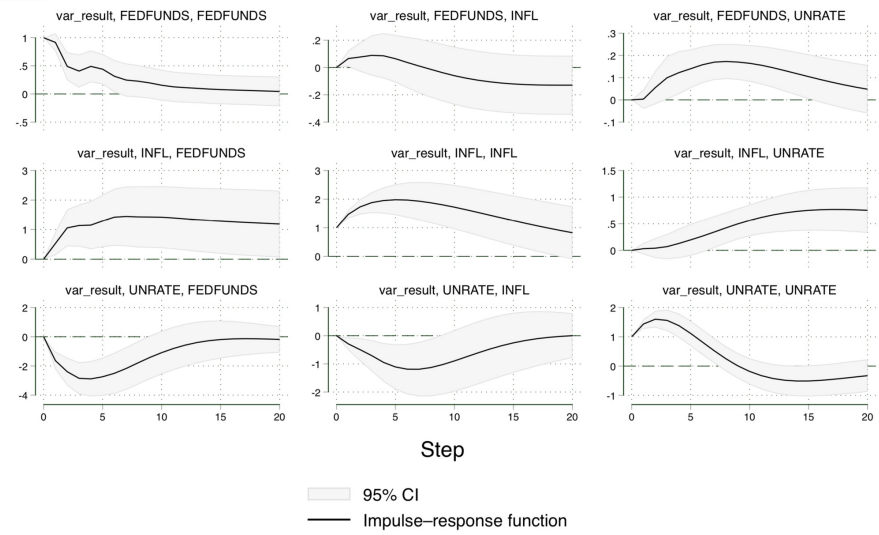
$$X_t = A_0 + A_1 X_{t-1} + A_2 \cdot X_{t-2} + A_3 \cdot X_{t-3} + A_4 \cdot X_{t-4} + e_t$$

$$\overbrace{\begin{pmatrix} \pi_t \\ u_t \\ R_t \end{pmatrix}}^{X_t} = \overbrace{\begin{pmatrix} a_{10} \\ a_{20} \\ a_{30} \end{pmatrix}}^{A_0} + \overbrace{\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{21} & a_{23} & a_{33} \end{pmatrix}}^{A_1} \overbrace{\begin{pmatrix} \pi_{t-1} \\ u_{t-1} \\ R_{t-1} \end{pmatrix}}^{X_{t-1}} + \overbrace{\begin{pmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{21} & b_{23} & b_{33} \end{pmatrix}}^{A_2} \overbrace{\begin{pmatrix} \pi_{t-2} \\ u_{t-2} \\ R_{t-2} \end{pmatrix}}^{X_{t-2}} + \overbrace{\begin{pmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{21} & c_{23} & c_{33} \end{pmatrix}}^{A_3} \overbrace{\begin{pmatrix} \pi_{t-3} \\ u_{t-3} \\ R_{t-3} \end{pmatrix}}^{X_{t-3}} + \overbrace{\begin{pmatrix} d_{11} & d_{12} & d_{13} \\ d_{21} & d_{22} & d_{23} \\ d_{21} & d_{23} & d_{33} \end{pmatrix}}^{A_4} \overbrace{\begin{pmatrix} \pi_{t-4} \\ u_{t-4} \\ R_{t-4} \end{pmatrix}}^{X_{t-4}} + \overbrace{\begin{pmatrix} e_{\pi,t} \\ e_{u,t} \\ e_{R,t} \end{pmatrix}}^{e_t}$$

Where:

- π_t = inflation rate.
- u_t = unemployment rate.
- R_t = Federal Funds interest rate.

Figure 2: Impulse Response Function (IRF) from VAR on π_t, u_t, R_t with 4 lags from 1960 Q1: 2007 Q4



(c) Briefly, explain why it would make sense to end the sample in 2007Q4?

In 2008, U.S had a financial crisis followed a boom and bust cycle in the housing market that originated several years earlier and exposed vulnerabilities in the financial system. The crisis led to a revere economic recession, with millions of people losing their jobs and many businesses going bankrupt. To overcome this crisis, between September 2007 and April 2008, the target for the Federal Funds rate was lowered from 5.25% to 2%, and the discount rate was lowered from 5.75% to 2.25%. Therefore, under this context, it would make sense to end the sample in 2007Q4 before the beginning of the Great Recession since this financial crisis affected monetary variables and employment at the same time period, and then, our assumption that the shocks have to be uncorrelated among our variables can be invalid during a global crisis.

(d) Plot the IRFs from the SVAR with the same ordering. [Optional: add 95% error bands]

The structural VAR allows simultaneous causality:

$$A x_t = A_0 + \sum_{s=1}^{4} A_s x_{t-s} + B e_t$$

$$A = \begin{pmatrix} 1 & 0 & 0 \\ a_s & 1 & 0 \\ b_s & c_s & 1 \end{pmatrix}, \quad B = \begin{pmatrix} d_s & 0 & 0 \\ 0 & e_s & 0 \\ 0 & 0 & f_s \end{pmatrix}, \quad x_t = \begin{pmatrix} \pi_t \\ u_t \\ R_t \end{pmatrix}$$

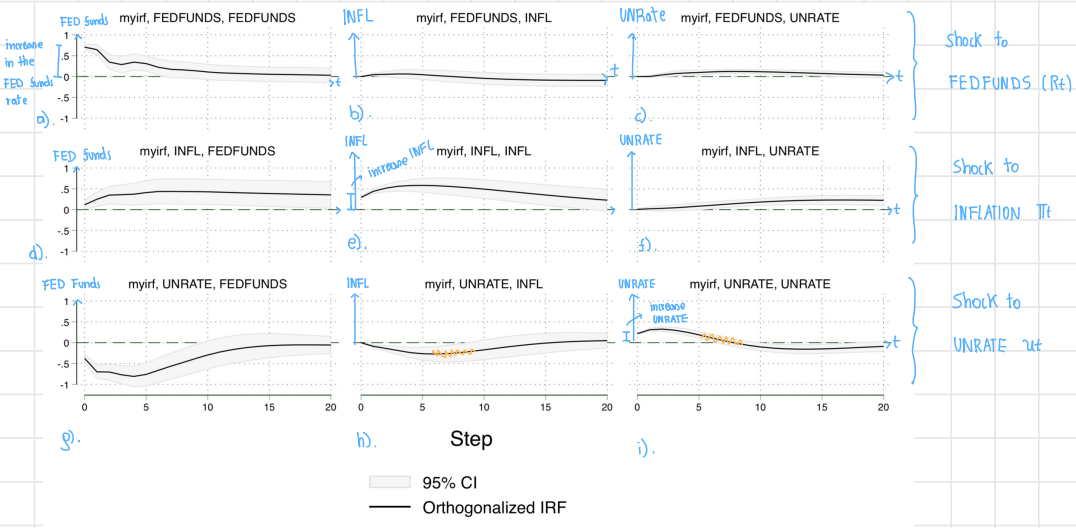
$$\begin{cases} \pi_t = A_0 + \sum_{s=1}^{4} \pi_{t-s} + e_{\pi t} \\ a \cdot \pi_t + u_t = A_0 + \sum_{s=1}^{4} (a_s \pi_{t-1} + u_t) + e_{ut} \\ b \pi_t + c \cdot u_t + R_t = A_0 + \sum_{s=1}^{4} (b_s \pi_{t-1} + c_s \cdot u_{t-1} + R_{t-1}) + e_{Rt} \end{cases}$$

And the solution is a recursive system:

a) We assume that π_t has contemporaneous effect on u_t and R_t, but not viceversa.

b) We assume that u_t has contemporaneous effect on R_t, but not viceversa.

Figure 3: Impulse Response Function (IRF) from SVAR on π_t, u_t, R_t with 4 lags from 1960 Q1: 2007 Q4



(e) Briefly, interpret your results.

terest rate but not on the inflation rate. Finally, interest rate shocks do not contemporaneously affect the other two variables. We can interpret this in the sense that monetary policy shocks affecting the interest rate take time to impact the inflation rate and the unemployment rate. This is consistent with the lag that monetary policy

In this case, the identification strategy implies that the inflation shocks have contemporaneous impact on both the unemployment rate and the nominal interest rate. Also, it implies that the unemployment rate shock has contemporaneous impact on the nominal interest rate but not on the inflation rate. And, finally, interest rate shocks don't contemporaneously affect the other two variables. We can interpret this no contemporaneous effect from the interest rate shock in the sense that the monetary policy shock affecting the interest rate take time to impact the inflation rate and the unemployment rate.

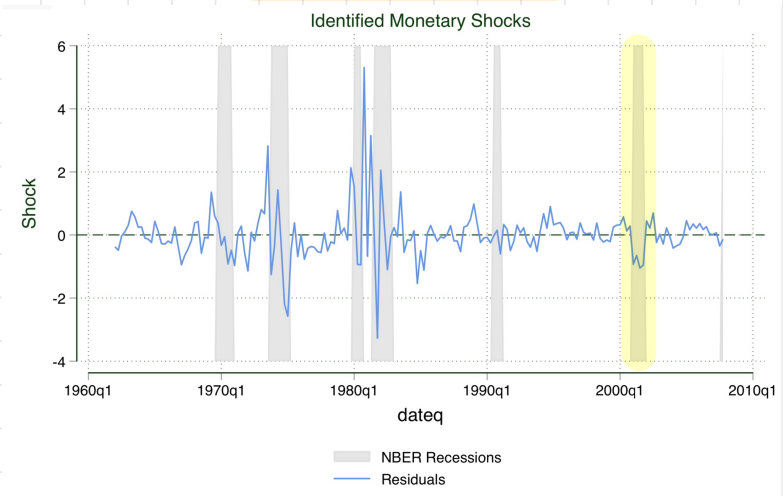
Shock to FED funds: this shock produces a slight increase in the inflation, which eventually disappears. It also produces a more significant but shorter increase in the unemployment rate, which also disappears.

Shock to INFLATION: this shock is followed by an increase in the Federal Funds Rate, as a central bank response to this to this shock. Inflation initially rise beyond the shock before dissipating moderately (price puzzle happens), and unemployment increase slightly by the end of the horizon.

Shock to UNEMPLOYMENT: this shock produces that the Federal Funds Rate initially drops as the central bank responds to the shock, followed by a decrease in inflation which drives a small increase in unemployment, which eventually dissipate.

(f) Plot the time series of your identified monetary shocks.

Figure 4: Identified monetary shocks



(g) What are the identified monetary shocks in 2001Q3 and 2001Q4? How should one interpret these shocks?

The Monetary Shocks in 2001Q3, and 2001Q4 is probably related to the interest rate cuts due to the terrorist attack of September 11th. Before this event, the FED had already cutted the interest rate and the economy was in a recession. However, since the September event was a surprise and unexpected for the economy, we can interpret it as an exogenous Monetary shock.

2. Romer shocks

(a) Download the Romer-Romer shocks from my website and merge it with your VAR dataset. Set the values of the Romer shocks to zero before 1969Q1.

Done in the code.

(b) Following Romer-Romer, construct the IRF from the estimation equation

$$y_t = \alpha + \sum_{s=1}^{8} \beta_s y_{t-s} + \sum_{s=0}^{12} \gamma_s RR_{t-s}$$

where $y_t \in [\pi_t, u_t, R_t]$ are the outcome variables and RR_t are the Romer shocks estimated from 1960Q1:2007Q4. [Optional: add 95% error bands]

Figure 5: IRF from VAR on π_t, u_t, R_t with 8 lags for Romer Residual RRt and 12 lags from 1960Q1:2007Q4

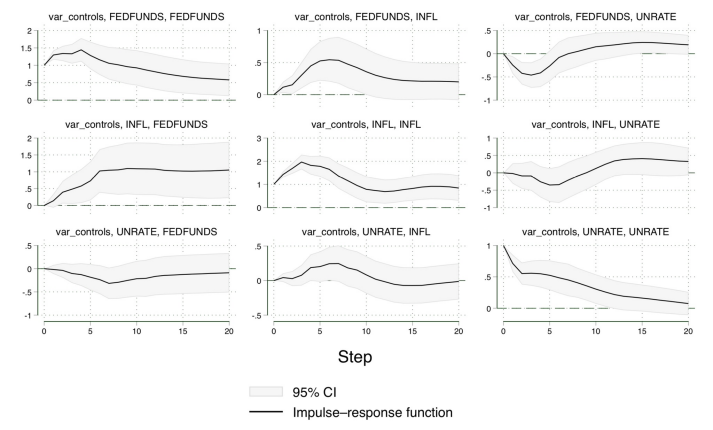
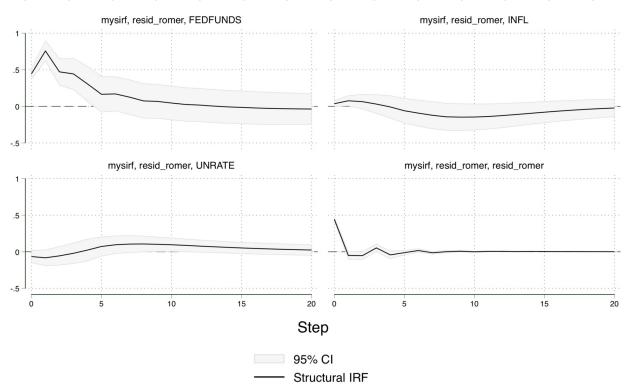
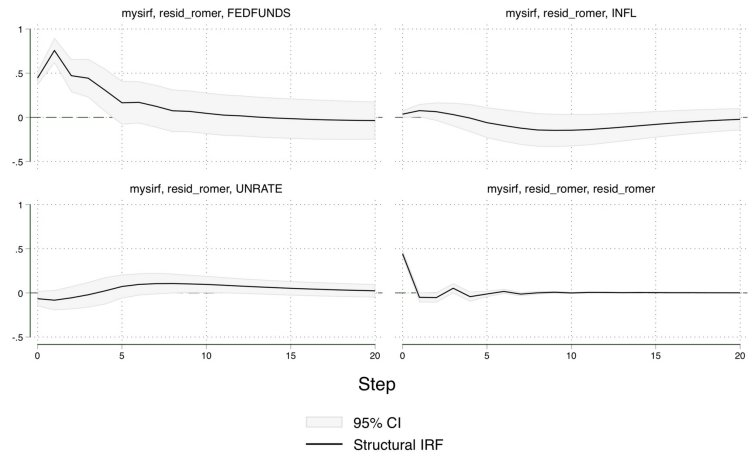


Figure 6: IRF: Impulse of RRt and reponse on π_t, u_t, R_t



(c) Now estimate an SVAR ordered RR_t, π_t, u_t, R_t with four lags from 1960Q1:2007Q4 and plot the IRFs. [Optional: add 95% error bands]

Figure 7: IRF: Impulse on RR_t, and responses on RR_t, π_t, u_t, and R_t



Graphs by irfname, impulse variable, and response variable

(d) Briefly, explain why it is sensible to order the Romer shock first in the VAR.

$$VAR = \begin{pmatrix} \text{Romer shock} \\ \vdots \end{pmatrix}$$

It is sensible to the Romer shock first in the VAR because, by construction, it's exogenous to the information contained in all other variables. Hence, RR shocks are the most exogenous variable in our VAR setting because they capture deviations of the FED funds rate from their usual way of responding to available macroeconomic variables of interest.

(e) Compare the IRFs for the Romer shocks from the two methods. How are they different, and why?

They are different because they used a different method. In the SVAR, unemployment is contemporaneously influence for both inflation and Romer shock, and inflation is influenced contemporaneously by the Romer shock in addition to the lagged terms. In the VAR method, there are only the lagged term channels.

Also, the IRF of the RR shocks on all indices tend to be larger in magnitude in the VAR estimation than in the SVAR. It can be explained by considering that we are accounting for contemporaneous shocks in the impulse variable that are omitted from the VAR estimation but are related with previous shocks to the impulse variable.

(f) Compare the VAR IRFs for the Romer shocks with the VAR IRFs for the SVAR shocks in Question (1d). How are they different, and why?

The first difference is that in (d) there was no significant decrease in inflation as a Result of a Federal Funds shock, but we observe a decrease in inflation with the Romer shock.

Then, the second difference is that in (d) there is a relation between higher interest rates and higher inflation, and this could be explained by the fact that the Federal Reserve may have taken action in anticipation of inflation when the monetary shock happened. Instead, with the Romer shocks, we eliminated endogeneity, allowing us to see the true, and direct impact of the policy.

(g) Compare the Romer-Romer the identified monetary shocks in 2001Q3 and 2001Q4 with the SVAR identified monetary shocks. How are they similar / different?

SVAR identified monetary shock: -1.037 and -0.985 respectively.

Romer shocks: -0.16 and -0.57 respectively.

Therefore, the monetary shocks are way smaller in the RR model. This is because the SVAR treated the FED's easing response as an exogenous monetary shock. However, the event in september 11th caused the FED to revise its assessment about future growth and inflation, leading to an immediate drop in interest rates. This means that the easing on September 11th was endogenous. The RR shocks consider the FED forecast which included a downward revision of macroeconomic variables due to the terrorist attack, which helps to consider the drop in interest rates in September 2001 as a less exogenous policy.