Econ 511, Spring 2020. Problem set #9
Estimating the Real Effects of Monetary Policy

Due April 6

1 Using VARs to Estimate the Real Effects of Monetary Policy

In this problem, you will be asked to produce impulse responses of a set of macroeconomic variables to a monetary policy shock. The shocks that you will consider will be identified using the method described in the Christiano et al. Handbook Chapter. You are also be provided with an excel file with the minimum set of variables to perform the exercise. For comparability with Christiano et al., the excel file includes quarterly series from 1959q1 to 1995q2 of the following variables:[1]

GDP87 Real GDP at 1987 prices

USAPGDP Implicit GDP deflator with 1987 = 1

PCOM The smoothed change in an index of commodity prices

FF FED funds rate

NBR Nonborrowed reserves plus extended credit

TOTR Total reserves

M_AGG A money aggregate (can be M1, M2, MB)

You have to turn in a Matlab program with your solutions (this program should perform ALL steps of your solution). You can find an econometrics toolbox for Matlab at www.spatial-econometrics.com. It is useful to download it for this exercise.

Your Matlab program should do the following:

1. Import the data.
2. Order the variables in the order listed above, which will be the ordering on which identification is based. In your solutions, briefly motivate the ordering in a couple of paragraphs. You should choose only one of the three monetary aggregate.

[1] The data are transformed using 100*ln(x), except for the FED funds rate and commodity prices.

3. De-trend all the series using an HP-filter with smoothing parameter 1,600. Then, run equation-by-equation OLS on the reduced-form VAR. Start with 2 lags and show how the fit of the regression increases as you increase the number of lags. For the rest of the exercise, choose two lags ($p = 2$).

4. For each regression, store the vector of estimated coefficients in a matrix $\hat{B}$ and the vector of disturbances (the residuals from the regressions) in a matrix $\hat{U}$. Given $K = 7$ variables, and T observations per series, $\hat{U}$ is of dimensions $(T - p)$ by K. From $\hat{U}$, calculate the variance covariance matrix, $\hat{V}$, a K by K matrix, and then its lower triangular representation via the Cholesky decomposition. You need thus to find A_0 such that $A_0^{-1} \left(A_0^{-1}\right)^T = \hat{V}$. Matlab will do that with the "chol" command.

5. Calculate the impulse responses of a monetary policy shock (a one percentage point change in the Federal Fund Rate), using the matrix of estimated OLS coefficients from the equation-by-equation regressions and the matrix A_0 to transform the impulse. Since the VAR has two lags and seven variables, it is easier to first reduce it to an expanded VAR(1) with one lag and 14 variables, using a state space representation. Call $\hat{C}$ the matrix of estimated coefficients $\hat{B}$, expanded for this state-space representation, i.e. $\hat{C}$ is $\hat{B}$ augmented with appropriate identity and zero matrices.

6. Calculate the standard errors of the impulse responses using the following bootstrap procedure. Let $j = 1$. For each time period $t \in \{p + 1, ..., T\}$, draw $\hat{u}_t(j)$ from $\hat{U}$ (the matrix of disturbances), with replacement. That is, draw a new matrix $\hat{U}(j)$ of disturbances where in each row you enter one randomly drawn row of $\hat{U}$. Draws are with replacement, so $\hat{U}(j)$ is not just $\hat{U}$ with a random permutation of its rows, but some rows of $\hat{U}(j)$ may be repeated, because drawn twice from $\hat{U}$. Using the matrix $\hat{C}$, the first observations in the actual empirical time series to initialize the calculation, and the errors $\hat{U}(j)$, calculate recursively a new set of time series for the $K = 7$ variables. With this new simulated dataset calculate again $\hat{B}(j)$, $\hat{V}(j)$, $\hat{A}_0(j)$ and the impulse responses. Repeat this procedure for $j = \{1, ..., 1000\}$ storing the impulse responses each time.[2]

7. Plot the impulse response functions with an 80% confidence interval. To do so, calculate the first and ninth decile of the impulse responses at each time $t = 1, 2...T$, so that 10% of them are left out on either side.

8. Interpret the IRFs. How persistent are the real effects of a monetary shock?

9. Split the time-series in two (which should be roughly before and after 1976) and estimate the IRF separately for the two halves. Are the IRFs similar? Exclude the last ten years and the first ten years of data. Are the IRFs similar? Do the results provide evidence in favor or against the assumptions of VARs?

10. Calculate and plot impulse response functions to a large monetary shock (five percent of the FFR, versus the previous one percent). Can the IRFs you obtain capture the often

[2] The idea of this procedure is to "reproduce" 1000 artificial time-series and estimate impulse response functions out of each one of them.

argued point that output reacts proportionally more to large than to small monetary shocks?

11. Change the order in which variables enter in the VAR, specifically, swap the GDP deflator and the FF rate. In the old ordering we used so far, prices (as measured by the GDP deflator) respond to monetary policy (FF rate) shocks only after a quarter, while the FF rate responds immediately to price shocks; in the new ordering, it is monetary policy to respond with a lag to price shocks, while prices respond immediately to monetary policy changes. Compute the IRFs for these variables w.r.t. each others' innovations for both VARs, the original ordering and the new ordering. Comment on any differences you find.