Econometric Methods III - Problem Set 4

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Exercise 1: Granger Causality

See handwritten solutions

Exercise 2: Identification in Structural Vector Regressions

See handwritten solutions

Exercise 3: VAR Analysis: A small monetary model

1. **Loading the data**
   See Matlab File

2. **Estimate VAR model for lag length p=(1,2...8)**
   For each of the p lags, i.e. having p pre-sample and $T = 272 - p$ sample observations for the 3 variables, we estimate the VAR(p) model in the rewritten form

   $$Y = AZ + U$$

   where $Y = [y_1, y_2, ...y_T]$ and $U = [e_1, e_2, ...e_T]$ are (3xT)-Matrices and $A = [c : A_1 : ... : A_p]$ is a (3x(3p+1))-Matrix including the intercept vector and the p coefficient matrices. The estimator is given by

   $$\hat{A} = YZ'(ZZ')^{-1}$$

   Exemplary, we show in Table 1 the results for the estimator for the VAR(2) that will be used later on.

Table 1: Estimation Results for VAR(2)

c	A1			A2		
0,6263	0,3099	0,0147	0,0239	0,0931	-0,2054	-0,0240
0,0716	0,0264	0,5016	0,2272	0,0047	0,1156	-0,1744
-0,0409	0,1115	-0,1194	1,1714	0,0524	0,2633	-0,2216

3. **AIC and BIC**

   Table 2 shows the values of the Akaike and Bayesian information criteria (AIC and BIC, respectively) for the inclusion of all potential lags from 1 to 8 . We see that the AIC would suggest to use 8 lags whereas the BIC would suggest to use just one (each of them is minimized for these numbers of lags respectively). This disparity is certainly striking, but it is nonetheless in line with the nature of the two criteria. In this sense, we would expect the BIC to penalize non-parsimonious models (i.e. with a lot of parameters) relatively more than the AIC by construction.

Table 2: Selection criteria

Lags	1	2	3	4	5	6	7	8
AIC	-2.4196	-2.5036	-2.5808	-2.7021	-2.7493	-2.7533	-2.7332	-2.7709
BIC	-2.2601	-2.2238	-2.1799	-2.1795	-2.1044	-1.9854	-1.8417	-1.7550

4. **Covariance Stationarity of VAR(2)**

   Table 3 shows the modulus of all eigenvalues of the companion matrix for our VAR(2) model with a constant. Since they are all less than 1, we can say that our model is covariance-stationary.

Table 3: Modulus of eigenvalues

Eigenvalues	0.9501	0.6306	0.6306	0.2143	0.2143	0.2115

5. **VAR Plots**

   Figures 1, 2 and 3 plot the fitted values of the model against the actual series of GDP growth, inflation and treasury bill. We can see that the goodness-of-fit is particularly accurate for the case of the last two, while the predicted value for GDP is always visibly smoother than its corresponding actual series.

6. **Autocorrelation Plots**

   Figure 4 shows the autocorrelations up to order 20 of the residuals of our VAR(2) for all three variables. We can see that there is some correlation at certain lags for the inflation and treasury bill series but they are not present following a systematic patter. While the model could be improved, in general we could say that the ACFs of the residuals suggest that the model captures most of the variation in the data.

7. - 8. **IRFs and Bootstrapped Confidence Intervals**

In Figure 5 we plot the IRFs for all three variables to a one unit contractionary monetary policy shock at period 0. Furthermore, we plot the 95% confidence bounds obtained from the bootstrap technique with 1000 simulated samples.

In the third graph showing the IRF of the interest rate, we see that the contractionary monetary policy equals a direct increase in the Treasury Bill rate. This slowly fades out over time yet is still significantly different from zero after 20 quarters.

In the second graph, we depict the IRF of inflation. By the restrictions of the Cholesky decomposition, it is only affected with a lag. We see that after the first quarter inflation increases due to the monetary policy shock. This effect then fades out and is no longer significantly different from zero after about 10 quarters. Note that this seems contradictory to what economic theory would expect and could be an indication that our identification strategy is not ideal.

In the first graph, we see the IRF of GDP growth. Again, output growht is only affected by the shock with a lag and not contemporaneously. However, although the IRF seems to suggest an initial increase in output growth followed by a several quarter ongoing contraction, the confidence bounds suggest that non of this is significantly different from zero. Hence, with the given model we cannot make conclusions on the reaction of output.

Appendix

Figure 1: VAR(2) Actual vs fitted values - GDP

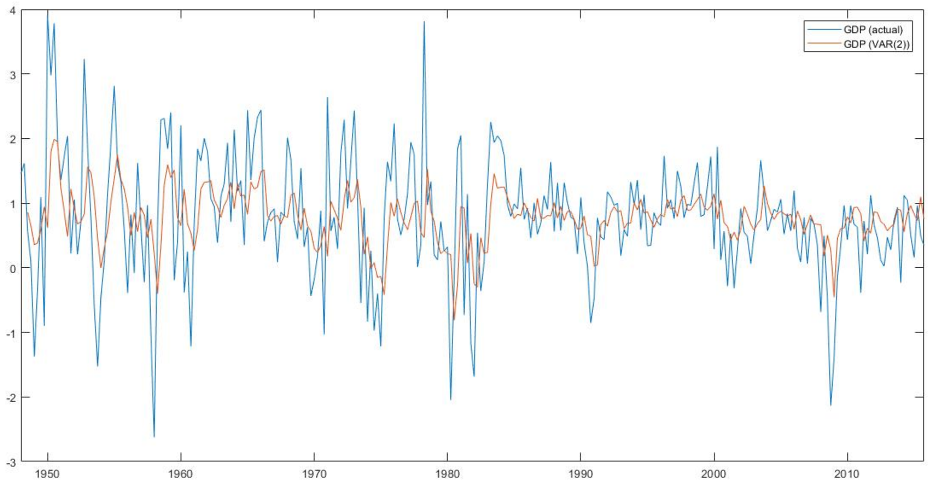

Figure 2: VAR(2) Actual vs fitted values - Inflation

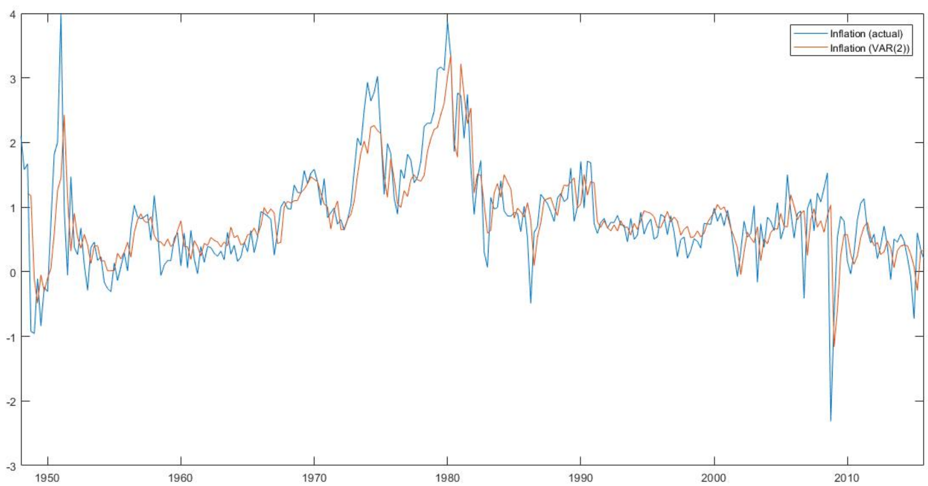

Figure 3: VAR(2) Actual vs fitted values - Treasury Bills

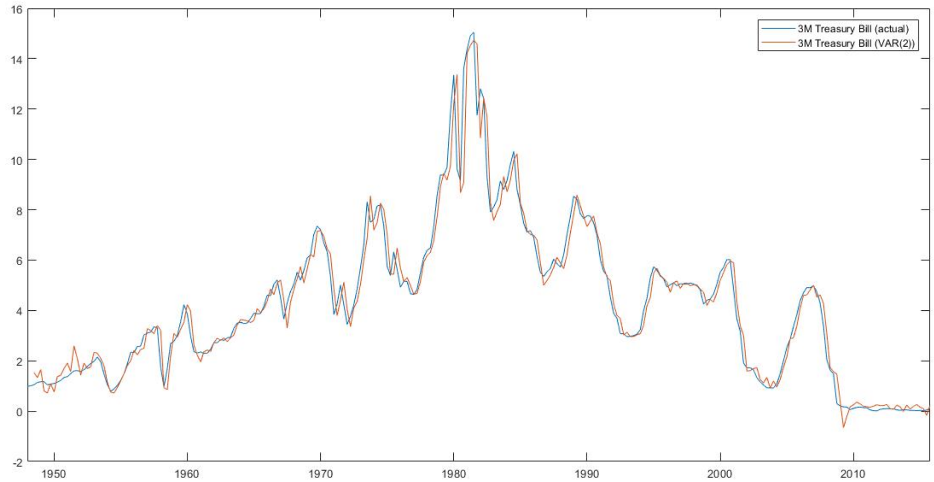

Figure 4: Autocorrelation of Residuals

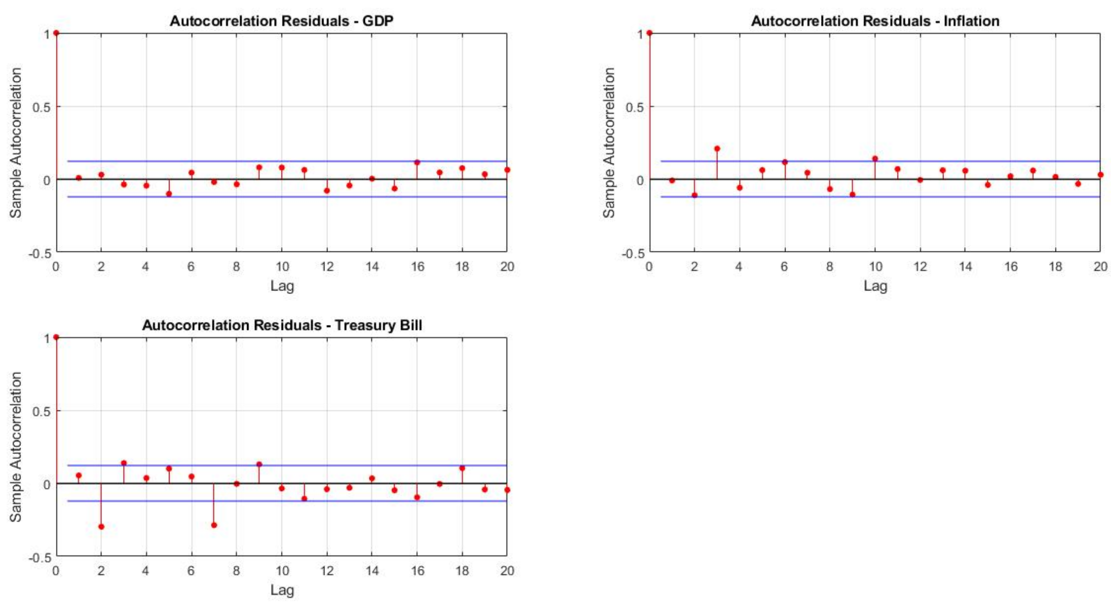

Figure 5: Responses to Monetary Shock