Assignment #7

feedback session for this assignment: 08-02-2021

General remarks: This assignment deals with impulse response functions and variance decompositions. It builds strongly on the variable transformations conducted in Assignment 6. For that reason, the data preparation step is identical for both assignments.

1. Loading Data and Data Description

1. The SWISS_1976_2014.xlsx file contains Swiss seasonally-adjusted macroeconomic data: quarterly interest rate in percent (first column), quarterly Consumer Price Index (second column), quarterly Gross Domestic Product in Mio CHF (third column) and quarterly Money Stock M1 in Mio CHF (fourth column). The first observation is from the first quarter of 1976 and the last observation is from the last quarter of 2014; hence $T = 156$. Load the data into your program.
   Hint: Throughout the assignment, we use the following notation to refer to the respective series:
   - m: M1
   - r: interest rate
   - p: Consumer Price Index
   - y: GDP
2. Plot the four time series into one window and describe the stylized facts of the series. Make your graphs look professional.
3. Now, transform the series according to:
   - $\tilde{m} = \Delta \ln m$
   - $\tilde{r} = \Delta r$
   - $\tilde{p} = \Delta \ln p$
   - $\tilde{y} = \Delta \ln y$

   As in task 1.2 plot the series into one window and describe their stylized facts. Briefly explain an advantage of performing the VAR estimation using the transformed data instead of the data in levels.

2. Estimating Vector Autoregression Models

Similar to the 6^{th} assignment, we estimate a VAR model with MATLAB. Towards that purpose, the VAR estimation toolbox is needed. The model's primitive and standard form are written in the previous assignment.

1. Include the VAR estimation toolbox `VAR2_toolbox` into your working directory. It is a folder containing five MATLAB function files.
   Hint: The toolbox can be downloaded from Ilias and should be saved in your working directory by writing

```
addpath('VAR2_toolbox');
```

somewhere at the beginning of your program.

2. As in the last assignment, use the function `PHI()` to estimate the VAR model from the 6^{th} assignment (the model is described in task 2.2). Make sure that you understand what the function returns to you and that the ordering of the variables is in line with the model in task 2.2 of the 6^{th} assignment.

3. Perform a Cholesky decomposition of the variance-covariance matrix of the composite shocks. In order to do so, use the function `Cholesky_decomposition()` that is in the toolbox. The input argument of the function is the matrix that is to be decomposed and the procedure returns the matrices $\mathbf{D}$, $\mathbf{A}$, $\mathbf{B}_0$, and $\mathbf{C}$.

3. Produce impulse response functions

1. To compute impulse response functions, you need the coefficient matrices of the vector moving average (VMA) representation. Use the function `VAR_2()` to obtain the sequence of Ψ_s, where $s = 1, \ldots, S_{max}$. Read the documentation of the function's code to understand what it returns to you.
   The function has four input arguments: `Phi_1` and `Phi_2` are computed by the function `PHI` above, `S_max` refers to the maximum number of forward iterations that you want to perform and `p` gives the number of lags in the VAR. Compute the VMA coefficient matrix for the first **ten** lags. Remember that the underlying VAR model uses one lag.
   Hint: The first n rows contain the matrix of parameter estimates for the first lag. The second n rows contain the matrix of parameter estimates for the second lag.

2. Compute the orthogonalized impulse response functions (IRFs) in order to examine the effect of a shock in one variable on itself and the other variables in the VAR. To do so, use the function `orthogonalized_response()`:

   ```
   psi_orthogonalized = orthogonalized_response(Psi,A,C,S_max,sd).
   ```

   The input variable `sd` determines whether the function computes IRFs for one unit shocks or one standard deviation shocks. We are interested in standard deviation shocks. Read the documentation carefully and set `sd` accordingly. Make sure that you understand how the IRFs are aligned in the output matrix.

3. Plot your results in a comprehensive way, i.e. plot the response of one variable to its own shock and the shock in the other three variables into one graph (i.e., four plots in total).

4. Describe and compare patterns of impulse response functions by answering the following questions: How pronounced (big/small) are the responses to shocks, i.e., the response of one variable to its own shocks and the shocks in the other variables? How persistent are these shocks?

4. Conduct a variance decomposition

1. Conduct a variance decomposition of each economic variable by using the function `variance_deco()`:

   `variance_dec = variance_deco(Psi,A,D,S_max)`

   Hint: `variance_dec` collects in the rows the forecast horizon (s) and in the columns the variance decomposition values. Read the documentation of the function to understand the ordering of the decompositions.

2. Plot the variance decomposition of each variable into one graph and make your graphs look professional.

3. Discuss the results and draw a conclusion from the plots of the variance decompositions. How do the variances of the four series decompose?

4. Now, change the ordering of the variables to $\mathbf{x}_t = [\tilde{p}, \tilde{y}, \tilde{m}, \tilde{r}]$. How does this change affect your impulse response function and the variance decomposition? Briefly explain the reason for this result.

5. Assume you want to obtain impulse response functions using a Cholesky decomposition and economic theory does not provide you with a plausible ordering of the variables. How would you proceed?