New Economic School, applied programs

Econometrics 2

Home assignment 4

To be handed in at 23:00 on Saturday, February 25, 2023

Your homework should consist of two parts: 1) a report on all exercises; 2) a thoroughly commented script which loads the data, makes all the required computations, and produces all the required tables and/or graphs. The script could be in any language you want (Python, R, EViews, Stata, Gretl etc.). The report can be either handwritten or in PDF format.

The homework is to be handed in into a Git repository, created for you at Bamboo.nes.ru and to the dedicated slot at my.NES.

The repository for this particular homework is

https://bamboo.nes.ru/git/<username>/metrix2-2022-hw4.git,

where `<username>` denotes your NES username (e.g. my username is `sgolovan`).

In order to hand your work in do the following:

- Clone your Git repository (use your usual NES username and password when asked):

```
git clone https://bamboo.nes.ru/git/<username>/metrix2-2022-hw4.git
cd metrix2-2022-hw4
```

- Create, modify, commit your code. Use the default `master` branch for simplicity.
- Push it to the remote repository:

```
git push
```

- Do the same for your report.

Problem 1. In this problem you are requested to replicate the VAR estimates from (Bloom, 2009).[1] In your repository you will find a data file `vardata.csv` which contains the data used in the paper.

The variables in the data set are:

`YEAR`	Year
`MONTH`	Month
`IPM`	Industrial production in manufacturing (seasonally adjusted)
`EMPM`	Employment in manufacturing (seasonally adjusted)
`HOURSM`	Hours in manufacturing
`CPI`	Consumer price index
`WAGE`	Wages
`FFR`	Federal funds rate
`STOCK`	Stock market levels (S&P 500)
`VOLATBL`	Uncertainty indicator
`CLEAN`	Dummy variable indicating large stock market volatility shocks (1 corresponds to the month of the highest shock impact, see (Bloom, 2009, Figure 1) for details)
`FCLEAN`	Dummy variable indicating large stock market volatility shocks (1 corresponds to the month when the shock had started)
`OCLEAN`	Dummy variable indicating large stock market volatility shocks that come from oil price changes and terrorist attacks
`XCLEAN`	Dummy variable indicating large stock market volatility shocks other than for `OCLEAN`

Use these data to perform the exercises below.

[1] The paper is available at my.NES: https://my.nes.ru/?student/courses/view_cfile&file_id=309525&cid=4623

(1) Read the dataset into computer's memory. Convert it to a bunch of time series.
(2) Plot the `IPM`, `EMPM`, `HOURSM`, `CPI`, `WAGE`, `FFR`, `STOCK` and `VOLATBL` series. Does they seem to be stationary? Explain.
(3) Following Bloom, 2009, create the logs for `IPM`, `EMPM`, `CPI`, `WAGE` and `STOCK`. Call them `LIPM`, `LEMPM` etc.
(4) Bloom uses the Hodrick–Prescott filter to estimate and then remove trends from the non-stationary variables. Do that for the variables `HOURSM`, `FFR`, `LIPM`, `LEMPM`, `LCPI`, `LWAGE`, `LSTOCK`. Use the standard monthly value for $\lambda = 1600 \cdot 3^4$. Call the detrended variables `CHOURSM`, etc. (Notice, that the Hodrick–Prescott filtering procedure requires that the series doesn't have missing values, so remove them beforehand.)
(5) Bloom estimates triangular VAR using the following variables in the following order: `CLSTOCK`, `CLEAN`, `CFFR`, `CLWAGE`, `CLCPI`, `CHOURSM`, `CLEMPM`, `CLIPM`. He uses VAR with 12 lags. Can you justify the ordering and the lags choice?
(6) Do the estimation of the vector autoregression from (5) yourself, and check if the residuals are a white noise (graphically).
(7) Compute the impulse response functions for the production `CLIPM` with respect to `CLEAN` and to `CFFR` and plot them. Compare your result with (Bloom, 2009, Figure 2). (You don't have to plot them onto the same graph, just using `IRAnalysis.plot()` is good enough).
(8) Is using 12 lags really necessary in this case? Try to find more parsimonious specification, but still taking care of the model residuals. Again, plot the IRF from (7), compare with the paper.
(9) Can you suggest another way of detrending `STOCK` or `CPI`? Do that and again, estimate the VAR and plot the IRFs. Do the results change by switching from deterministic trends in the stock market index and CPI?

Hint: If you're using Python, then the following resource might be useful for you: https://www.machinelearningplus.com/time-series/vector-autoregression-examples-python/. Also, consult the `tsa.vector_ar` documentation https://www.statsmodels.org/dev/vector_ar.html. To plot autocorrelations of the residuals, use `model.fit().plot_acorr(nlags)` with appropriate number of lags. The documentation on the Hodrick–Prescott filter can be found at https://www.statsmodels.org/stable/generated/statsmodels.tsa.filters.hp_filter.hpfilter.html.

References

Bloom, N. (2009). The impact of uncertainty shocks. *Econometrica*, *77*(3), 623–685.