MW82: Time Series Analysis - Take Home Exam

Winter term 2023/24

To complete this course, each group (max two students) has to hand in a typed paper, performing the tasks below. You can use both R and Stata to solve the problem set. Work must be done independently of other groups.

Please hand in your solutions in **one PDF-file** (one per group, including all the names and student numbers) as well as a **well-formatted code file** no later than **18.03.2024 23:59:59** to sabbadini@dice.hhu.de and heimeshoff@dice.hhu.de. **This assignment has to be completed in English.**

The provided dataset (metals.csv) contains quarterly information (1995q1-2012q4) about the following series:

- rmp: real metals price index in which the nominal price index (2005=100) has been deflated by the U.S. producer price index (all items, 2005=100);
- ipac: industrial production index for the so-called group of "advanced economies" (seasonally adjusted, base 2005=100);
- ipcn: Chinese industrial production (seasonally adjusted, base 2005=100);
- oil: real price of oil (average of the WTI and Brent prices, both in dollars per barrel, deflated by the U.S. producer price index);
- euro: euro-dollar exchange rate (euros per dollar, DM per dollar before 1999 converted at EUR1 = DM 1.95583).

Preliminaries

Load the necessary libraries: vars, urca, dplyr

(a) Load the data stored in `metals.csv` .

(b) Create the logarithm of each variable both as "values" and variables in the "data".

(c) Define the series $log(rmp), log(ipac), log(ipcn),$ and $log(oil)$ as time series objects, plot and describe them.

Stationarity

(a) Are the time series stationary at the 5%? When they are non-stationary investigate if they are trend-stationary at the 5%.

(b) Which model did you choose to test part a) and why?

(c) Create the first difference of all the four series as "values".

(d) Run the appropriate test to establish the order of integration of the series $log(rmp), log(ipac), log(ipcn)$, and $log($

Cointegration & ECM

Consider a linear regression of $log(rmp)$ on the **I(1)** variables and a time trend.

(a) What is the order of integration of the resulting residuals? What do you conclude about the cointegration relationship among the variables?

(b) Which critical values do you use? How do you obtain them?

(c) For the ECM, create the first lag of the residuals using "$< -head(stats ::)$"

(d) Based on your results, estimate an ECM two-stage equation for only one series – the change in metals prices ($\Delta \log(rmp)$).
Hint: You might need to first convert *as.numeric* the first difference variables created above.

(e) Discuss the sign of the correction term.

(f) Use both Johansen trace and maximum eigenvalue tests to determine the number of cointegrating vectors among the I(1) variables.

(g) What is the difference between the two different tests?

VAR

(a) Perform the adequate test to determine whether $\Delta \log(oil)$ Granger causes $\Delta \log(rmp)$.