Econometrics Practical Exercises. Second half of term

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Abstract

These practicals will help you follow the lectures, help with the exam and help you do your project.

1 Week 7

Use the Shiller data.

Generate LSP=log(NSP), s_t, log of the Standard and Poors 500 stock index.

Estimate the following models on the same sample: 1873-2016.

$$
\begin{aligned}
s_t &= a_1 + b_1 s_{t-1} + c_1 t + \varepsilon_{1t} : ARIMA(1,0,0) && (1) \\
\Delta s_t &= a_2 + \varepsilon_{2t} : ARIMA(0,1,0) && (2) \\
\Delta s_t &= a_3 + b_3 \Delta s_{t-1} + \varepsilon_{3t} + c_3 \varepsilon_{3,t-1} : ARIMA(1,1,1) && (3) \\
\Delta s_t &= a_4 + b_4 \Delta s_{t-1} + \varepsilon_{4t} : ARIMA(1,1,0) && (4) \\
\Delta s_t &= a_5 + \varepsilon_{5t} + c_5 \varepsilon_{3,t-1} : ARIMA(0,1,1) && (5)
\end{aligned}
$$

Test that $b_1 = 1$ in (1), using the appropriate critical value.

Use the AIC and BIC to choose between the models. Which is preferred on each criterion?

Answer

AIC chooses (1) BIC (2). Although the AR and MA terms are individually significant in (3), they cancel each other out and are not jointly significant. The AR term is not significant in (4) and the MA term is not significant in (5).

2 Week 8

ARDL/ECM

Using the Shiller data, estimate the ARDL and ECM models

$$
\begin{aligned}
ARDL &: d_t = \alpha_0 + \alpha_1 d_{t-1} + \beta_0 e_t + \beta_1 e_{t-1} + u_t, \\
ECM &: \Delta d_t = a_0 + a_1 d_{t-1} + b_0 \Delta e_t + b_1 e_{t-1} + u_t.
\end{aligned}
$$

and in each case calculate the long run elasticity of earnings to dividends. What is the relationship between the two models?

Answer. They are statistically identical reparameterisations.

Non-linear least squares

Estimate by non-linear least squares

$$\Delta d_t = \lambda_1 \theta \Delta e_t + \lambda_2(\theta_0 + \theta_1 e_{t-1} - d_t) + u_t.$$

Interpret the results.

Answer: This gives the theoretical parameters and their standard error directly.

GARCH

Estimate by ML GARCH(1,1) using a t distribution with v degrees of freedom (if available in your program).

$$\begin{aligned}
\Delta d_t &= a_0 + a_1 d_{t-1} + b_0 \Delta e_t + b_1 e_{t-1} + \varepsilon_t \\
\varepsilon_t &= t(0, h_t, v) \\
h_t &= \mu_0 + \mu_1 \widehat{\varepsilon}^2_{t-1} + \mu_2 h_{t-1} + u_t
\end{aligned}$$

Comment on your results.

Answer

The estimates of the coefficients of the mean equation are similar, but not the same, between estimation methods. For instance, the OLS estimate of b_1 is 0.32, the GARCH normal, 0.30 and the GARCH t, 0.23. The estimate of a_1 moves as well to stay close to being equal and opposite to b_1. The estimate of the t degrees of freedom at 2.8 indicates very fat tails. with t distribution, μ_1 is insignificant and μ_2 is significant, with normal both are significant. With both distributions $\mu_1 + \mu_2 > 1$, so the long run variance is not defined. Estimates may differ slightly by program.

3 Week 9

3.1 Summary statistics

Use the Shiller data on R, the short interest rate, and RL the long rate.

Generate inflation: INF=100*(log(CPI)-log(CPI(-1)))

Graph R, RL and INF, which tends to be higher, which is more volatile, does the pattern change over time?

Answer

INF is more volatile, R tends to be higher than RL early in the period and lower later. There is no clear trend in any of them, so do not include trend in exercises below.

3.2 Unit roots

Test R RL and INF for unit roots.

Answer: H0: unit root, critical value is -2.9. DF intercept no trend, R=-3.4, Reject H0; stationary. RL=-1.92. Do not reject H0; unit root. INF -8.39. Reject H0, stationary. Having short and long interest rates different orders of integration raises some economic issues of interpretation. Indicates the fragility of unit root testing.

3.3 VAR

Estimate a VAR(2), intercept, no trend, between R RL and INF.

Test for Granger causality between the variables.

Answer: At 5% level, nothing seems GC for R. R is GC for RL, R & RL are causal of INF.

Look at the impulse response function of RL to a shock in R. Use Generalized if available if not use Choleski with this ordering.

Answer: In the Choleski with this ordering, a one standard error shock to the short rate, 1.5%, causes an increase of 0.42 in the long rate in the first period, 0.58 in the second, 0.49 in the third, tending back to zero, but then moves back to zero reaching 0.07 after 40 years. The generalised are quite similar in shape, partly because this is a shock to the first variable.

Look at the contemporaneous correlations.

Answer: The highest correlation is between R and RL, 0.62, R and INF is 0.37, RL and INF 0.28.

If available look at the inverse roots to judge the stability of the VAR.

Answer: There are six inverse roots, one close to the unit circle, one pair complex but with a very small imaginary component.

4 Week 10

Test for the number of cointegrating vectors assuming unrestricted intercept no trend.

Answer. Both tests indicate 2 cointegrating vectors.

Assuming 2 cointegrating vectors, estimate the Vector error correction model. Use as identifying restrictions

$$\begin{bmatrix} 1 & 0 & \beta_1 \\ 0 & 1 & \beta_2 \end{bmatrix} \begin{bmatrix} R \\ RL \\ INF \end{bmatrix}$$

These will be the default for some programs. Test $\beta_1 = -1$, $\beta_2 = -1$, individually and jointly.

Answer:The individual tests are just t tests on the coefficients of inflation: (coefficient+1)/standard error. Neither hypothesis is rejected, t stats less than 2 The joint test requires estimating the restricted model, imposing the two restrictions. The LR test gives a chi-squared(2) test statistic with a p value of 0.4182, which does not reject the restrictions The bootstrapped critical value computed by Microfit of 7.1 is larger than the asymptotic critical value of 5.99. But in this case it does not make a difference to the conclusion.

Comment on the pattern of adjustment. On the basis of your results, suggest an alternative identification scheme.

Answer: Looking at the coefficients on the error correction terms R and INF show significant adjustment, RL does not have significant adjustment coefficients on the EC terms. Coefficients on the two cointegration terms are roughly equal and opposite so inflation cancels out. Might be better as a term structure equation of change in interest rates on lagged spread. Or might be two I(0) variables in accord with the unit root tests, but this is difficult to interpret in economic terms.

5 Week 11

To investigate whether long interest rates depend on future inflation estimate by IV/2SLS: RL C INF(+1) with instruments constant, INF, RL(-1) R(-1). Estimate this over 1872-2012 and for 1950-1990.

Answer: The estimate over the long period (0.44) has a much smaller coefficient on expected inflation than the short period, 0.89. Both significantly different from zero. In the short period it is not significantly different from one, in the long period it is.

How many over-identifying restrictions are there? If your package provides for it. Test the overidentifying restrictions, whether future inflation is exogenous and whether the instruments are strong.

Answer: There are two over-identifying restrictions and they are rejected in both cases. The instruments do not seem very strong in either period. F below 10 for whole period and just over for short period. The hypothesis that future inflation is exogenous is clearly rejected.