

## Exercises VII. Volatility

**Topics:** Modelling volatility: GARCH, TGARCH, EGARCH, GARCH-X

### Exercise 1

File jpy.xls

jpy Yen US dollar exchange rate July 7, 2002 – July 7, 2007  
From Brooks p 403

Calculate log-returns of exchange rate  
 $r_{jpy} = 100 * \log(jpy/jpy(-1))$

Make sure, that log-returns have no autocorrelation.

To estimation different GARCH models select: *Quick/Estimate Equation* and *Estimation settings* choose ARCH

#### Estimation of GARCH model

Model for mean  $r_{jpy}_t = c + \varepsilon_t$   
rjpy c

Model for variance GARCH(1,1):  $\sigma_t^2 = \alpha_0 + \alpha_1 u_{t-1}^2 + \beta_1 \sigma_{t-1}^2$   
ARCH 1  
GARCH 1

Compare the obtained results with the example from Brooks textbook p 403.

Which is the sum of GARCH model parameters  $\alpha_1 + \beta_1$ ?

#### Estimation of GJR or TGARCH model

Threshold order 1

Compare the obtained results with the example from Brooks textbook p 407.

Is the parameter of  $\text{RESID}(-1)^2 * (\text{RESID}(-1) < 0)$  statistically significant?

#### Estimation of EGARCH model

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left( \frac{|u_{t-1}|}{\sqrt{\sigma_{t-1}^2}} - \sqrt{\frac{2}{\pi}} \right)$$

Model EGARCH

Perform asymmetry testing.

#### Forecasting

Perform GARCH(1,1) estimation using the sample from July 7, 2002 to July 6, 2005 and forecast volatility until July 2007

## Exercise 2

Files sp500.wf1 and sp500.prg

File sp500.wf1 consists data of S&P500 (sp500) and log return (2p500ret) from Apr 5, 1988 to Apr. 6, 2005.

File sp500.prg is EViews program file, which estimates for log returns models with following specification:

Model for mean AR(1)  
Models for variance GARCH(p,q), p=0,1,2 and q=1,2,3

Open file sp500.wf1

Open file sp500.prg. Examine the contents of the program.

To perform estimations, select Run.

Find the matrix with values of Schwarz's criterion. Which is the best model?

Perform residual tests for the best model

- Correlogram-Q-statistics of standardized residuals
- Correlogram-Q-statistics of standardized residuals squared
- Histogram–Normality Test
- ARCH LM test

Perform static and dynamic forecasts.

## Exercise 3

File dowjones.txt

Engle and Patton<sup>1</sup> used daily close price data on the Dow Jones Industrial Index, over the period August 23, 1988 to August 22, 2000, representing 3131 observations. They took the log-difference of the value of the index to convert the data into continuously compounded returns. They used the lagged level of the three month US Treasury bill rate as exogenous regressor  $x$  and the corresponding GARCH(1,1)-X model is

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2 + \varphi x_{t-1}$$

They assumed a constant conditional mean.

Estimate the same model. Compare your results with the results of the authors of this paper.

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<sup>1</sup> Engle, R. & Patton, A. What good is a volatility model? *Quantitative Finance*, 2001, Vol. 1, pp. 237-245.