QFAT – Assignment E

Datasets

Pairs_Price.csv
Pairs_RI.csv

2 different share classes of 8 different companies

Stock Price:
Prices adjusted for stock splits

Return Index (RI):
Index that takes into account dividends and other corporate actions

Source: Datastream

1. Pairs Trading and Statistical Arbitrage
Data: Pairs_Price.csv and Pairs_RI.csv

In this assignment, you have to explore the potential profits on trading twin stocks. The accompanying Excel sheet contain the stock price and the return index at close of 16 stocks, corresponding to two share classes for the following eight companies: A.P. Møller Mærsk (Denmark), Industrivärden, Investor, Svenska Handelsbanken and Volvo (Sweden), Volkswagen (Germany), Hyundai Motors (Korea) and Store Enso (Finland). All these shares pay dividends and you can assume that two stocks in the same pair pay the same dividend on the same day. (For Volkswagen and Hyundai Motors there is a small difference in dividends but we can safely ignore this in this problem.)

Stock prices have been adjusted for splits, but not for dividends and other corporate actions, whereas you can think of the return index as a stock price adjusted for dividends and other corporate actions (i.e. with reinvested dividends etc.).

1.1: Pair correlation
First calculate the daily returns for each stock. Then calculate the correlation between daily returns for the stocks in the each pair. Make a bar plot of the correlations.

1.2: Pair co-movement
Adjust all the return indices to 100 on the September 8, 2004. Plot the return indices for stocks in the same pair together and assess whether you think there may be an arbitrage strategy. Do you see any unusual or surprising patterns?

1.3: Spreads
Calculate and plot the relative spread between the stock prices in the same pair (i.e., one price divided by the other minus 1) and assess whether you think there may be an arbitrage strategy. Do you see any unusual or surprising patterns?

1.4: Pairs trading based on absolute prices
Implement the following strategy: At close on the last day of each year, take a self-financing position in each pair where you go long the stock with the lowest price and short the one with the highest price. The initial value of each long position should be $1 and, similarly, the initial value of each short position should be $1. Hold the position for a year and rebalance again at close on the last day of the year.

a) Why might this strategy be profitable? Hint: What happens if the share price is unchanged from rebalancing to rebalancing?
b) Calculate the yearly excess return per pair, the SR, and test whether the yearly excess returns are statistically significant from zero (under the assumption that returns are independent and normally distributed).
c) Same as question b for a portfolio consisting of all eight pairs, equally weighted.
d) Which costs would you incur if you were to implement this strategy in practice?

1.5: Pairs trading based on “unusual” price spreads: mean-reversion
Consider the following alternative strategy: Put on a trade whenever the spread (relative price difference) between the stocks in a pair is “unusual” relative to the recent historical value of this spread. Specifically, at such times, go long $1 of the stock that is currently cheap (relative

to what it "usually" is) and shortsell \$1 of the stock which is currently expensive. Each day, either rebalance back to \$1 long and \$1 short or, when the spread again is "usual," close the position. The strategy can be implemented in many ways, for instance, you can do the following for each pair on each day:

- Calculate the relative price spread $S_t = \frac{P_t^A - P_t^B}{P_t^B}$, where P_t^A and P_t^B are the prices of each of the share classes on day t.
- Calculate the rolling 20-day average spread, $\overline{S_t} = \sum_{i=t-19}^{t} \frac{S_i}{20} =$, and the 20-day spread volatility, $\sigma_t^S = \sqrt{\sum_{i=t-19}^{t} (S_i - \overline{S_t})^2 / 19.}$
- Calculate the z-score of the spread, $z_t = \frac{S_t - \overline{S_t}}{\sigma_t^S}$.
- Open a position when the absolute value of the z-score exceeds 2, going long the stock that is usually cheap and short the other one (i.e., sign the positions based on the sign of the z-score).
- Close the position when the sign of the z-score reverses.
- Calculate the daily return (zero on days where no position is open).
- Calculate the daily return of a strategy that equal weights all the pairs (including pairs that have no position on).

a) Why might this strategy be profitable?
b) Assume you can observe closing prices and trade on these prices same day, i.e. if z_t exceeds 2 on day t, a position is opened at close on day t and profits are recorded from day *t+1*. Plot the cumulated profits from the strategy for each pair and for the equal-weighted portfolio. What is the annualized SR of the portfolio?
c) Alternatively, assuming that you have to wait one day from you observe close prices until you trade. Now plot the cumulated profits from the strategy for each pair and the portfolio. What is the annualized SR of the portfolio? Which is more realistic and implementable, b or c?