

## Chapter 3: Modern Portfolio Theory - part 2

### Exercises

1. Suppose your financial newspaper of last Monday shows that the company with the highest  $\beta$  coefficient on your stock exchange was ZXco. The company has a  $\beta$  of 2.1 and a market value of €4.25 billion ( $10^9$ ). Assume that the company is only financed with equity, no debt, that the risk free interest rate is 5% and that the required rate of return of an appropriate index of all shares on the stock exchange is 15%.

(a) What is the required rate of return on ZXco stocks?

ZXco's management proposes to raise €4.25 billion in additional equity capital and to invest this amount in risk free government bonds. Ignoring taxes and transaction costs:

- (b) Calculate the required rate of return of ZXco stocks after the proposed investment. What are the company's market value and its  $\beta$  coefficient?
  - (c) What general phenomenon does this example illustrate?
2. You have estimated regressions for a number of stocks and indices using 3 years of daily return data. For each stock you estimated the following regression equation:

$$r_{it} - r_{ft} = \alpha_i + \beta_i(r_{mt} - r_{ft}) + \varepsilon_{it}$$

where  $r_{it}$  is the return of stock  $i$  on day  $t$ ,  $r_{ft}$  is the risk free interest rate on day  $t$ ,  $r_{mt}$  is the return of the market index on day  $t$ ,  $\alpha_i$  and  $\beta_i$  are the regression coefficients obtained for stock  $i$ , and  $\varepsilon_{it}$  is the disturbance term. For a particular stock you estimated  $\alpha = 0.025$  with a standard error of  $\sigma_\alpha = 0.018$  and  $\beta = 1.46$  with a standard error of  $\sigma_\beta = 0.084$ .

- (a) What does the CAPM predict for the values of  $\alpha$  and  $\beta$ ?
  - (b) Are the estimation results in agreement with the prediction of the CAPM?
  - (c) Is this stock riskier or less risky than the market as a whole?
3. On the website accompanying this course, a spreadsheet (DataChpt3prt2Ex3.xlsx) is posted that contains the daily returns of three stocks (Amazon, Cisco and Logitech) plus an index (IXIC, the Nasdaq Composite Index), from June 2012 through May 2013. The US risk free interest rate over that period was very low, say 0.5% per year. Using the IXIC index as a proxy for the marked portfolio, calculate for each stock:
    - (a) the characteristic line
    - (b) the Sharpe ratio
    - (c) the Treynor ratio
    - (d) Jensen's alpha

4. In the arbitrage example in the text (section 3.4.3) we had an arbitrage portfolio of  $.2P_1 + .3P_2 + .5P_3$ , but we did not say how the portfolio weights were obtained. The equilibrium (i.e. arbitrage free) factor model (pricing relation) is  $E(r_i) = .075 + .06b_{i1} + .03b_{i2}$  and the arbitrage portfolio's sensitivities to the two factors are .75 and .7.
- (a) Show how the portfolio weights are calculated.
- (b) A variation on the same theme: show the composition of the two pure factor portfolios.
5. The economy of the land Southway is dominated by two industries: oil production and fish farming. Hence, two pervasive economic risk factors determine the risk premiums on the local stock market: the returns of the oil industry and the returns of the fish farming industry (which, in turn depend on the world market prices of oil and fish). There are three large mutual funds that hold well diversified portfolios of domestic stocks. You have made a summary of the funds' returns and their sensitivities for the two risk factors; Table 1 gives the summary.

Table 1: Funds' returns and sensitivities

Mutual fund	Exp. return	Sensitivities	
		Oil: $b_1$	Fish: $b_2$
1	0.172	1.2	0.8
2	0.208	0.9	1.4
3	0.136	0.5	0.7

- (a) Describe how the sensitivities  $b_1$  and  $b_2$  can be obtained.
- (b) Calculate the risk premiums for oil price risk, fish price risk and the risk free interest rate.
- (c) You want to divide your money over the three mutual funds in such a way that your portfolio has a sensitivity of 1 for the oil price risk and a sensitivity of 1 for the fish price risk. Can you make such a portfolio and, if so, how do you divide your money over three funds?