

UNIVERSITY OF OSLO
DEPARTMENT OF ECONOMICS

Exam: **ECON4510 – Finance Theory**

Date of exam: Tuesday, May 23, 2017 **Grades are given:** June 12, 2017

Time for exam: 2.30 p.m. – 5.30 p.m.

The problem set covers 4 pages (incl. cover sheet)

Resources allowed:

- No written or printed resources – or calculator - is allowed (except if you have been granted use of a dictionary from the Faculty of Social Sciences)

The grades given: A-F, with A as the best and E as the weakest passing grade. F is fail.

YOU MAY ANSWER IN ENGLISH OR NORWEGIAN.

Some advice: Start by reading through the whole exam, and make sure that you allocate time to answering questions you find easy. You can get a good grade even if there are parts of problems that you do not have time to solve. It is better to try to do something on each question than to get bogged down with one question. If you find you are spending too much time on one question, stop working on it and plan to get back to it if you have time at the end. Make sure you state any assumptions you make.

1. Consider an economy where there are two assets, A and B , with expected returns $E(\tilde{R}_A)$ and $E(\tilde{R}_B)$, standard deviation of returns σ_A and σ_B , and covariance s_{AB} .
 - (a) Use a mean/standard-deviation diagram to illustrate the mean and standard deviation of various portfolios one can obtain by creating portfolios combining these two assets, assuming no restrictions on short selling.
 - (b) How would the set of combinations of mean and standard deviations for possible portfolios change if the investors could not short sell the assets?
 - (c) Let p_A and p_B be the prices of shares in assets A and B , respectively, and let x_A and x_B be the total number of shares of the respective assets. Define the “market portfolio” as the portfolio with weights $\omega = p_A \cdot x_A / (p_A \cdot x_A + p_B \cdot x_B)$ on asset A and $1 - \omega$ on asset B . Suppose first that all investors are identical (and do not necessarily have mean-variance preferences) and assume that the asset market is in equilibrium. Explain why asset prices p_A and p_B must be such that it is optimal for all investors to hold the market portfolio.
 - (d) Assume now that investors have linear-quadratic preferences although investors can differ in risk aversion and wealth. Moreover, assume that investors can purchase a risk-free asset with return r_f . Show that all investors hold exactly the same portfolio of risky assets, although they may differ in their holdings of the risk-free asset.
 - (e) Define \tilde{R}_M as the return on the market portfolio. Write down an expression for the expected return on each asset i as a function of r_f , $E(\tilde{R}_M)$, $cov(R_i, \tilde{R}_M)$, and $var(\tilde{R}_M)$. Note: you get more points if you *derive* this expression (i.e., motivate how it is obtained).
2. Consider an economy with many risky assets but no risk free asset. Assume that investors have linear-quadratic preferences.

- (a) Show that a version of CAPM can be derived even without a risk free asset.
 - (b) Suppose investors differ in their risk aversion and/or their invested wealth. Explain why investors in this case (i.e., when there is no risk-free asset) will in general not hold the market portfolio.
3. Suppose you want to test empirically if CAPM holds true. Your plan is to test if assets lie on the Security Market Line.
- (a) Derive an empirical strategy to perform this test (explain in words). In particular, explain why it is common to do such tests for portfolios of assets rather than for individual assets.
 - (b) Suppose you find that your estimate for the expected return on portfolios of assets (where these portfolios are constructed so that assets in each portfolio have roughly the same market β) are roughly linear as a function of the expected β of each portfolio. However, according to this linear function the return on a portfolio with $\beta = 0$ is higher than the risk-free rate. Would this observation constitute a rejection of CAPM? Motivate your answer.
 - (c) If you wanted to show that CAPM is rejected in Norwegian stock market data, how would you do so in practice (i.e., what would the test look like and what portfolios would you construct)?
 - (d) Would Richard Roll be convinced by your test? Why or why not.
4. Portfolio management evaluation. Critiques of the Norwegian oil fund (SPU) have argued that SPU should halt all active portfolio management and instead aim for a purely passive investment strategy. In response to this critique SPU have argued that their investment strategy has delivered a return which is 0.25% larger than the return on the benchmark index set by the fund's owner (i.e., the Ministry of Finance). Moreover, they argue that the Sharpe ratio of the return on the fund is larger than the Sharpe ratio on assets in the market.
- (a) Discuss the statement: *“Investors should go for passive investments rather than active portfolio management because active management is more expensive but yields the same average rate of return as passive management.”*
 - (b) Explain why a positive excess return is not necessarily evidence of superior investment skills.
 - (c) Suppose you, as a portfolio manager, is being evaluated with the measure “get as much excess return as possible given a certain Tracking Error bound” and assume that CAPM is true. How could you beat the expectations of the fund owner?

- (d) Explain why the Sharpe ratio of the portfolio relative to the Sharpe ratio of the market is a useful measure to evaluate SPU, provided that CAPM is true.
- (e) Define the “Appraisal ratio” for a portfolio manager who holds a portfolio p as

$$AR_p \equiv \frac{\alpha_p}{\sigma(\tilde{\varepsilon}_p)},$$

where α_p and $\tilde{\varepsilon}_p$ are derived from running the following regression:

$$\tilde{R}_p - r_f = \alpha_p + \beta_p (\tilde{R}_p - \tilde{R}_B) + \tilde{\varepsilon}_p,$$

and where \tilde{R}_p and \tilde{R}_B are the realized returns on the portfolio p and the benchmark portfolio, respectively, and β_p is the market beta on the portfolio p .

- i. Suppose you, as a portfolio manager, is being evaluated with the AR measure, given a certain Tracking Error bound. Suppose the “pricing anomalies” of the past will persist in the future. How could you beat the expectations of the fund owner?
- ii. How would you evaluate a portfolio manager in the presence of “known” pricing anomalies?

5. Smaller questions:

- (a) You observed the following situation

Security	Beta	Expected return
Renewable Energy Corp	1.3	0.23
Statoil	0.6	0.13

Assume these securities are correctly priced. Based on the CAPM, what is the expected return on the market? What is the risk free rate?

- (b) Assume that the annual risk-free rate is $r_f = 1\%$ and that the annual mean and standard deviation of the return on the Oslo Børs OBX index are 6% and 10%, respectively. Using stock prices over the last three years you find that the return on Telenor stocks have had an annualized covariance with the OBX index of $cov(\tilde{R}_i, \tilde{R}_M) = 0.006$. A share in Entra is currently priced at 100 NOK per share.
- i. Calculate an estimate of the market β of Entra.
 - ii. Suppose CAPM is true. What is the expected price of a Entra stock one year from now?
- (c) Assume that every asset has the same expected return. Furthermore, all assets have the same covariance with each other. As the number of assets in the portfolio grows, which becomes more important: Variance or covariance? Why?