Exam for
econ4510 May 2021

1 CAPM (45%)

Assume that investors have linear-quadratic preferences. There are many risky assets.

1. Assume first that there is no risk free asset. Explain, with the use of a diagram, the trade-off between risk and return for the investors. In particular, draw the investors' indifference curves and the opportunity set of possible portfolios.

2. Consider a stock with expected return $\bar{r}_j$ and standard deviation of return σ_j. Explain why this stock must have more risk (higher σ_j) than the portfolio of the efficiency frontier which has the same expected return $\bar{r}_j$.

3. Suppose a risk free asset with return r_f is introduced. How will this change the opportunity set for the investors? Explain why all investors will purchase a combination of two portfolios, even though they may have different risk aversion. What must these portfolios be in equilibrium?

4. Explain how the equilibrium in this economy implies the CAPM formula for asset-pricing

5. Explain – in light of Roll's critique – why it is difficult to test the empirical validity of CAPM.

6. Assume that over the last five years, the average real return on the market portfolio has been 9% while the standard deviation of this return has been 10%. Moreover, the risk free rate has been 1% over this period. The stock Equinor has had a covariance of 0.009 with the market portfolio over the last five years. Calculate the market β for Equinor and the expected return on the Equinor stock, according to CAPM.

2 Option pricing (40%)

A stock price is currently NOK 100. It is known that over the next month the price will either increase by 6% or fall by 5%. The following month the stock price will have the same evolution in prices (up by 6% or down by 5%). The risk-free interest rate is 6% per annum with continuous compounding.

1. What is the value of a one-month European call option with a strike price of NOK 102?

2. What is the value of a two-month European call option with a strike price of NOK 102?

3. Explain how a put option can be constructed using a call option and the underlying stock.

4. What is the value of a one-month European put option with a strike price of NOK 102?

5. Why must the replicating portfolio for a call option always involve debt? What does this imply for the investment risk for the option relative to the underlying asset?

3   Portfolio management (15%)

Over the last five years, the Norwegian Oil Fund has had an annual return on stocks of 10.68%. The corresponding number for the benchmark index (i.e., the benchmark portfolio the fund is asked to follow – which is the global index of stocks) is 10.53%. The *Relative Return* is therefore 10.68%-10.53%=0.15%. During the same period, the Jensen's Alpha[1] for the fund was 0.01%. These measures are all recorded before costs. The costs of the management of stocks was on average 0.05% during this period.

1. Explain why Jensen's Alpha is a better measure of performance than the Relative Return.

2. Define "active management" as any deviation from the benchmark portfolio. How would you judge the active management of the Oil Fund over the last five years?

3. The tracking error for the Oil Fund is 0.44% and the Sharpe ratio for the fund is approximately equal to the Sharpe ratio for the benchmark (0.72 over the last five years). In light of this, please evaluate the statement that "The Norwegian Oil Fund is, for all practical purposes, an index fund."

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[1] Jensen's Alpha is defined as "Average return in excess of the risk-free rate minus beta-adjusted benchmark excess gross-of-fees return."