

Problem set 5:

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Exercise 1: Firm valuation and capital structure in the CAPM

A limited-liability company produces a good that will be sold one period of time from now (in period 1). The firm has chosen its optimal amount of investment, I^* , and will with certainty produce an amount $Q = F(I)$ to be sold at a price \tilde{P} . The price is uncertain at the time of the investment.

The firm decides to sell shares after the investment is undertaken. That is, a share is a claim to the future cash flow $\tilde{P}Q$.

- (a) If priced according to the CAPM, the return on a share in this company (k) is given by

$$1 + \tilde{r}_k = \frac{\tilde{P}}{V(\tilde{P})}$$

Explain why.

- (b) Show that the CAPM- β of this firm can be written as

$$\beta_k = \frac{(1 + r_f)}{\sigma_M^2 \frac{E(\tilde{P})}{\text{cov}(\tilde{P}, \tilde{r}_m)} - E(\tilde{r}_m) + r_f}$$

Give an interpretation of this expression. Why doesn't the β depend on the initial investment?

Assume that a fraction $1 - a$ of the investment was financed by debt that with full certainty will be paid back with interest rate in period 1.

- (c) What is the Modigliani-Miller irrelevance result?
(d) The investment decision is made in period 0. How does the

decision to partly loan-finance the project affect the investment decision? (Remember that the firm knows its optimal I^*).

(e) How does the loan-financing affect the CAPM- β of the project?

Go back to the case with full equity-financing, and assume that the company considers to merge with another company (j). This second company will produce a product in quantity Y that will be sold next period at an uncertain price P' . The necessary investments are already made.

(f) What is the CAPM- β of the merged company? Give an interpretation of the relationship between the β of the merged company and the β of the two companies by themselves.

Exercise 2: Using the CAPM

(a) You observe 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 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 OBXindex of $cov(\tilde{R}_1, \tilde{R}_M) = 0.006$. A share in Entra is currently priced at 100 NOK per share.

Calculate an estimate of the market β of Entra.

(c) Use the information from (b) for this exercise.

Suppose the CAPM is true. What is the expected price of an Entra stock one year from now?

Exercise 3: Arbitrage pricing theory

- (a) You observe the following three portfolios and their exposure to the factors f_1 and f_2 .

Portfolio	Expected return	f_{i1}	f_{i2}
1	7.3	0.2	2.5
2	6.2	0.8	0
3	7.3	1.0	1.0

If the APT holds and the factors above are sufficient to describe the pricing of assets in the economy, the following equation can be used to price any security,

$$E(R_i) = c_0 + c_1 f_{i1} + c_2 f_{i2}$$

Find the parameters of this equation.

- (b) Assume there is a security S with expected return 9.2%, $f_{S1} = 0.9$ and $f_{S2} = 0.5$. Is there an arbitrage opportunity?