NTNU Trondheim
Norwegian University of
Science and Technology

Faculty of Social Sciences
and Technology Management
Department of Industrial Economics
and Technology Management

Contact person for the exam:
Name: D. van der Wijst
Phone: 73593599

EXAM IN COURSE TIØ4146
FINANCE for SCIENCE and TECHNOLOGY STUDENTS
2 December 2014
Time: 09.00 - 13.00

Aid A: All calculators allowed
All printed and written material allowed

Problem 1 (weight 20%)

Farmen (2001) analysed the price development of stocks on Oslo Stock Exchange that were not traded on trading days (i.e. the exchange was open but there was no transaction in these stocks). He found that the non-traded stocks had a significantly negative performance the day after the non-trading day.

a) Do Farmen's results contradict the Efficient Market Hypothesis (EMH)? If so, explain which form of the EMH they contradict.

According to Aftenposten of 2001-09-26, Morgan Funshares was one of the few investment funds that performed comparatively well during the preceding period of sharp decline on the stock market. It fell with only 5,4% while most other funds fell with about 20%. The fund invests in lines of business that are unethical or unhealthy, such as tobacco, porn, casinos, junk food and chocolate. The idea behind the fund is that the demand for such products is not affected strongly by the business cycle.

b) Does the performance of Morgan Funshares contradict the Efficient Market Hypothesis (EMH)? If so, explain which form of the EMH it contradicts.

Baesel, Shows and Thorpe[1] (1982) tested the predictive ability of the Wall Street guru Joe Granville. Joe predicts 'up' days (i.e. days with a price increase) and he uses a technical method that includes analyses of several time series and other public stock market related information as e.g. the ratio of price advances to price declines. In the test period the percentage of 'up' days was 51,7%, so a random prediction of 'up' days would have a 51,7% chance of being correct. Joe's 'up' predictions were correct 57,0% of the times, the difference is statistically significant.

[1] The Journal of Portfolio Management, Spring 1982, Vol. 8, No. 3: pp. 5-9

c) Do these results contradict the Efficient Market Hypothesis (EMH)? If so, explain which form of the EMH it contradicts.

Problem 2 (weight 35%)

Fredrik Johnsen's company, Backline Ltd., owns one of the largest tanker fleets in the world. It operates very large crude carriers (VLCCs) for long distances and Suezmax tankers for shorter trips. The oil tanker business goes up and down with the economy as a whole so it has an almost average business risk. However, Backline Ltd. has heavily mortgaged its ships. Overall it financed its assets with 80% debt, so the company has a very high equity β of 3.5. Because the ships are used as collateral Backline pays only 5% interest on its debt, which has a market value of €1280 million. Backline has 80 million outstanding shares which are currently priced at €4. On financial markets the risk free interest rate is 4% and the return of the relevant market portfolio is 8.5%. The corporate tax rate is 30% and personal taxes can be ignored.

Johnsen considers redeploying his maritime expertise in the fish farming business with a project called Sea Harvest. To prepare for a decision, Backline's staff collected information about fish farming. The industry comprises many small family firms, but the only large company, Marsal, represents the type of business Johnsen has in view. Marsal has an equity β of 1.2, a debt-equity ratio of 0.6, it pays 5.5% interest on its debt and the market value of its shares is €1 billion (10^9). Fredrik Johnsen's business philosophy is to start big and borrow heavily. The Sea Harvest project will generate a perpetual after tax cash flow of €5 million per year starting one year after the investment is made. The required investment is €80 million and it will be financed using a debt-equity ratio of 1.5. The bank has agreed to extend the loan against an interest rate of 6.5% and Johnsen has no problem financing the rest with equity. All debt in the fish farming industry, including the loan for the Sea Harvest project is rebalanced.

a) Should Backline invest in the Sea Harvest project? Show calculations to support your answer and make additional assumptions if necessary.

Problem 3 (weight 35%)

It is 30 October 2014 and shares of Opera Software trade at NOK 82.50 on Oslo Stock Exchange. Opera is a volatile share, its annual volatility is 30%. Options on Opera shares are also traded on Oslo Stock Exchange (albeit with a very low volume). One of these options is OPERA4X90, a put option with an exercise price of NOK 90 and a time to maturity of 1.5 months (it matures on 18 December 2014). Opera does not pay dividends and the risk free interest rate is 4% per year.

a) What is the value today (30 October 2014) of option OPERA4X90? Use the Black and Scholes formula (which assumes that the option is European), show calculations to support your answer and make additional assumptions if necessary.

Problem 4 (weight 10%)

In problem 2 it is mentioned that Backline Ltd. has heavily mortgaged its ships. Explain briefly what the trade-off theory of optimal capital structure predicts about the relation between collateral on the one hand and optimal capital structure on the other. Be specific in what is traded off against what.

NTNU Trondheim
Norwegian University of
Science and Technology

Faculty of Social Sciences
and Technology Management
Department of Industrial Economics
and Technology Management

Contact person for the exam:
Name: D. van der Wijst
Phone: 73593599

EXAM IN COURSE TIØ4146
FINANCE for SCIENCE and TECHNOLOGY STUDENTS
2 December 2014
Time: 09.00 - 13.00
solutions

Aid A: All calculators allowed
All printed and written material allowed

Problem 1 (weight 20%)

a) The results of Farmen do not contradict the Efficient Market Hypothesis (EMH). The fact that a stock is not traded on a day is relevant and apparently negative information, that is reflected in the price next day. Note that Farmen's results cannot be translated into a profitable strategy: by trading in anticipation of the price decline after a non trading day, the event itself is eliminated.

b) The performance of Morgan Funshares does not contradict the Efficient Market Hypothesis (EMH). Funds with a low sensitivity for the business cycle (so a low beta) are expected to go down less in a period of price decline. They are also expected to go up less in a period of price increase.

c) Joe Granville's predictive ability contradicts the Efficient Market Hypothesis (EMH) in the semi-strong form (strong form is also acceptable if properly motivated, Joe's 'model' can be considered private information; weak form is not correct since the question explicitly mentions 'other public stock market related information'). According to this form of the EMH, it is not possible to predict stock market developments with public information. The study does not show that profits can be made with this.

Problem 2 (weight 35%)

Fish farming is another line of business than shipping oil, so the background data on Backline are irrelevant. The OCC has to be calculated from Marsal. We are given its equity beta, β_e, and its cost of debt, r_d. Given the market data on r_f and r_m we can use the CAPM to calculate either r_e or β_d Marsal:

$$\beta_e = 1.2 \Rightarrow r_e = 0.04 + 1.2 \times (0.085 - 0.04) = 0.094$$

Alternatively, we can use the CAPM in reverse to find the β of debt for Marsal:

$$0.055 = 0.04 + \beta_d \times (0.085 - 0.04) \Rightarrow \beta_d = 0.333$$

We can now unlever the returns or the βs to find the OCC. Since debt is rebalanced we use:

$$r_a = r_d \frac{D}{V} + r_e \frac{E}{V} = 0.055 \times \frac{6}{16} + 0.094 \times \frac{10}{16} = 0.0794$$

So the OCC is 0.0794. The same result can be obtained by using the formula for r_e (MM prop.2 without taxes) in reverse.
Alternatively, we can unlever the β:

$$\beta_a = \beta_d \frac{D}{V} + \beta_e \frac{E}{V} = 0.333 \times \frac{6}{16} + 1.2 \times \frac{10}{16} = 0.875$$

and using the CAPM reproduces the OCC: $r_a = 0.04 + 0.875 \times (0.085 - 0.04) = 0.0794$
We can now find the required return on equity for the Sea Harvest project:

$$r_e = r + (r - r_d)\frac{D}{E} = 0.0794 + (0.0794 - 0.065)\frac{1.5}{1} = 0.101$$

The WACC then becomes:

$$WACC = r_d(1 - \tau)\frac{D}{V} + r_e \frac{E}{V} = 0.065 \times (1 - 0.3) \times \frac{1.5}{2.5} + 0.101 \times \frac{1}{2.5} = 0.0677$$

Alternatively, we can use the Miles-Ezzell formula:

$$\begin{aligned} WACC &= r_a - \frac{D}{V} r_d \tau \left(\frac{1 + r_a}{1 + r_d}\right) \\ WACC &= 0.0794 - \frac{1.5}{2.5} \times 0.065 \times 0.3 \times \left(\frac{1.0794}{1.065}\right) = 0.0675 \end{aligned}$$

It is also possible to calculate the WACC for Salmar, then use ME in reverse to find r_a, and the use ME again to find the project's WACC. With a WACC of 6.8% the value of the €5 million cash flow is $5/0.068 = 73.529$ or €73.529 million. This gives the project a NPV of $73.529 - 80 = -6.471$, so Backline should not go ahead with the project.
APV can also be used. The base case NPV is the yearly cash flow of €5 million discounted at the OCC minus the investment:

$$\frac{5}{0.0794} = 62.972 \text{ and } 62.972 - 80 = -17.028$$

The tax shield is $\tau r_d D$ or $0.3 \times 0.065 \times (1.5/2.5) \times 80 = 0.936$. Since debt is rebalanced, the tax advantage has to be discounted at the OCC so $0.936/0.0794 = 11.788$ If debt is rebalanced periodically the multiplication factor $(1 + r_a)/(1 + r_d)$ should be used:

$$11.788 \times \left(\frac{1.0794}{1.065}\right) = 11.947$$

The APV then becomes: $-17.028 + 11.947 = -5.081$ The conclusion is the same: Backline should not go ahead with the project.

Problem 3 (weight 35%)

We use the Black and Scholes formula to calculate the option's value. The five determinants are: $S_0 = 82.50$, $X = 90$, $r = .04$, $\sigma = .3$ and $T = 0.125$ (i.e. $1.5/12$)(other calculations, e.g. in days, are also correct).

$$d_1 = \frac{\ln(S_0/X) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} = \frac{\ln(82.50/90) + (.04 + .5.3^2).125}{.3\sqrt{.125}} = -0.72018$$

$$d_2 = d_1 - \sigma\sqrt{T} = -0.72018 - .3\sqrt{.125} = -0.82625$$

The formula for a put is:

$$O_{p,0} = Xe^{-rT}N(-d_2) - S_0N(-d_1)$$

The areas under the normal curve for the values of $-d_1$ and $-d_2$ are NormalDist(0.72018) = 0.76429 and NormalDist(0.82625) = 0.79567. The option price is:

$$O_{p,0} = Xe^{-rT}N(-d_2) - S_0N(-d_1) = 90e^{-0.04\times0.125}0.79567 - 82.50 \times 0.76429 = 8.1992$$

or NOK 8.20. It is also possible to use the Black and Scholes formula for a call and then use the put-call parity to calculate the value of a put, although it is a roundabout way to get this result.

Problem 4 (weight 10%)

In the trade-off theory of optimal capital structure the expected tax advantage of debt is traded off against the expected costs of financial distress. Collateralizing a loan with assets that have a high second hand value, such as ships, reduces the expected costs of financial distress. This reduces the risk of the loan, which will lead to a higher debt ratio.