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
11 December 2013
Time: 09.00 - 13.00

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

Problem 1 (weight 20%)

Dichtl and Drobetz (2013) investigate[1] the 'Halloween effect', which claims that stock returns are higher in the winter half year (November - April) than in the summer half year (May - October). They use long time series of monthly returns (symbol: r_t), which are adjusted for dividends and transaction costs, of European stock indices. They perform regression analyses of these returns on a dummy variable (symbol: S_t) that has the value 1 for the months November through April and the value 0 for the months May through October: $r_t = \alpha_0 + \alpha_1 S_t + \varepsilon_t$ where ε_t is the error term. The estimated coefficients $\alpha_{1,2}$ and their t-values ($\alpha/\sigma(\alpha)$ where $\sigma(\alpha)$ is the standard error) are in the table below:

Index	α_0 $t(\alpha_0)$	α_1 $t(\alpha_1)$
EuroStoxx 50	-0.002	0.015
	(-0.370)	$(2.53)^*$
CAC 40	-0.000	0.014
	(-0.070)	$(2.38)^*$
FTSE 100	0.001	0.012
	(0.340)	$(2.64)^*$

* means significantly $\neq 0$

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

[1] Hubert Dichtl and Wolfgang Drobetz, Are stock markets really so inefficient? The case of the Halloween indicator, *Finance Research Letters*, vol.11, issue 3, 2014, pp. 112-121.

The Halloween effect is exploited by a simple timing strategy: 'sell in May and go away but be back by Halloween (end October)'. This requires that liquid investment instruments, such as passive mutual index funds, are available that allow investors to implement the strategy. Dichtl and Drobetz repeat their analyses using only the years in which such liquid investment instruments are available. In these second analyses the three α_1 coefficients are not significantly different from zero.

b) Does this second test by Dichtl and Drobetz contradict the Efficient Market Hypothesis (EMH)? If so, explain which form of the EMH it contradicts.

Problem 2 (weight 35%)

HappyHands is a successful employment agency, specialized in short-term contracts. The firm's debt has a book value of €10 million and an interest rate of 6%, while the book value of its equity is €5 million. Its current share price is €20 and it has 1 million shares outstanding. The β of its shares is 1.5. The firm considers extending its activities with renting out office equipment, under the name MerryMachines. To evaluate this project, the firm collected the following information about office equipment rental companies: on average, they have an equity β of 0.9 and a debt/value ratio of 0.2. Because this ratio-value is very low, the average business' debt can be considered risk free. The MerryMachines project will require an investment of €1.3 million and generate a perpetual after tax cash flow of €100 000 per year. The project will be financed with a perpetual loan of 60% of the investment. The bank agreed to provide the loan against an interest rate of 8%. The rest will be financed with equity. All debt in the office equipment rental business, including the perpetual loan, is predetermined and permanent. On the financial markets, the risk free interest rate is 4% and the return on the market portfolio is 12%. The corporate tax rate is 40% and there are no personal taxes to consider.

a) Should HappyHands accept the project or not? Use calculations to support your answer and make additional assumptions if necessary.

Problem 3 (weight 35%)

Shares of ZXco are traded on a financial market at a price of €50. Risk free debt is also available at a yearly interest rate of 7%. After each year the stock price can either increase with 25% or decrease with 20%. Both possibilities are equally likely. After 1 year the stock will pay a cash dividend of €5. American call options on the stock are also traded. They have an exercise price of €48 and mature after 2 years.

a) Calculate the price of the call option. Use a two-period three-moment binomial context, show calculations to support your answer and make additional assumptions if necessary.

Problem 4 (weight 10%)

What does the so-called trade-off theory of capital structure predict about the capital structure of firms that are very profitable? What is this prediction based on? Is this prediction in line with the results of empirical research?

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Problem 1 (weight 20%)

a) The results of Dichtl and Drobetz contradict the Efficient Market Hypothesis (EMH) in its weak form: the significant α_1 coefficients represent positive abnormal returns and the analyses only use historical return data. In efficient markets such a simple calendar anomaly should not persist over extended periods of time because the investment strategy to profit from it is easy to implement and does not require frequent trading, so it is not heavily affected by transaction costs.

b) Yes, this changes the conclusion because the significantly positive abnormal returns have disappeared. Apparently, the availability of liquid investment instruments, such as passive mutual index funds, has enabled investors to implement the 'sell in May' strategy and the abnormal returns are arbitraged away.

Problem 2 (weight 35%)

As always, the relevant data refer to the project and not to the mother company. The relevant data for the project come from the office equipment rental business: an equity β of 0.9, a debt/value ratio of 0.2, plus the remark that this debt can be considered risk free (so $\beta_d = 0$). Using the tax rate of 0.4, this allows us to calculate the asset β for the project:

$$\beta_a = \beta_e \times \left(\frac{E}{V - \tau D}\right) = 0.9 \times \left(\frac{0.8}{1 - 0.4 \times 0.2}\right) = 0.78261$$

Equivalently, we can use:

$$\beta_e = \beta_a + (1 - \tau)(\beta_a - \beta_d)\frac{D}{E}$$

which gives:

$$0.9 = \beta_a + (1 - 0.4)(\beta_a - 0)\frac{0.2}{0.8} \Rightarrow \beta_a = 0.78261$$

Together with the financial market data on r_f and r_m and the CAPM this gives us the opportunity cost of capital for the office equipment rental business: $r_a = 0.04 + 0.78 \times (0.12 - 0.04) = 0.1024$ or 10.24%. The project will be financed with 60% fixed and permanent debt, so we can use the Modigliani Miller formula to find the WACC: $r' = r_a(1 - \tau L) = 0.1024 \times (1 - 0.4 \times 0.6) = 0.077824$ or 7.8%. Given this WACC, the perpetual cash flow has a value of $100000/.078 = 1.2821$ million euro, which is smaller than the investment of 1.3 million euro, so the project should not be accepted.

It is also possible to calculate r_e for the office equipment rental business with the CAPM: $r_e = 0.04 + 0.9 \times (0.12 - 0.04) = 0.112$ and then to unlever:

$$\begin{aligned} r &= r_a = r_d(1-\tau)\frac{D}{V-\tau D} + r_e\frac{E}{V-\tau D} \\ r &= r_a = 0.04(1-0.4)\frac{0.2}{1-0.4\times 0.2} + 0.112\frac{0.8}{1-0.4\times 0.2} = 0.10261 \end{aligned}$$

The required return on equity of the MerryMachines project then becomes:

$$\begin{aligned} r_e &= r + (1-\tau)(r - r_d)\frac{D}{E} \\ r_e &= 0.1026 + (1-0.4)(0.1026 - 0.08)\frac{0.6}{0.4} = 0.12294 \end{aligned}$$

or 12.3%. The WACC then is:

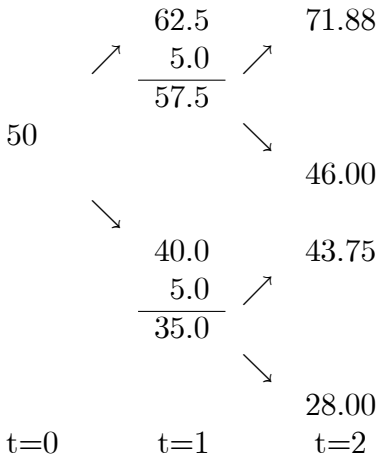
$$\begin{aligned} WACC &= r_e\frac{E}{V} + r_d(1-\tau)\frac{D}{V} \\ WACC &= 0.123 \times 0.4 + 0.08 \times (1-0.4) \times 0.6 = 0.078 \end{aligned}$$

and the calculations proceed as above. Different combinations of the above calculations are possible.

APV can also be used; APV base case is $100000/0.1024 = 976560$. The value of the tax shield is $(\tau r_d D)/r_d = \tau D = 0.4 \times (0.6 \times 1300000) = 312000$ so a total value of $976560 + 312000 = 1288560$ or a NPV of $1288560 - 1300000 = -11440 < 0$, so the same conclusion: do not accept the project

Problem 3 (weight 35%)

First, we set up the value tree for the stock:



The parameters of the binomial model are: $u = 1.25,\ d = 0.8$ and $r = 1.07$ so that

$$p = \frac{r-d}{u-d} = \frac{1.07-0.8}{1.25-0.8} = 0.6$$

Then we calculate the values of the option at maturity (t=2): $\max[0, S_T - X]$, which is $\max[0, 71.88 - 48] = 23.88$ in the upper node and 0 in all others. This gives t=1 values of

$$\frac{0.6 \times 23.88 + 0.4 \times 0}{1.07} = 13.39$$

in the upper node and 0 in the lower node. We have to compare these t=1 values alive with the values dead, which are $\max[0, 62.5-48] = 14.50$ in the upper node and $\max[0, 40-48] = 0$ in the lower node. We use the cum-dividend values, of course, because the point of exercising early is receiving the dividend. In the upper node exercising early gives a higher value than keeping the option alive: $\max[dead,\ alive] = \max[14.50, 13.39] = 14.50$. This gives an option value today of

$$\frac{0.6 \times 14.50 + 0.4 \times 0}{1.07} = 8.13$$

Problem 4 (weight 10%)

The so-called trade-off theory of capital structure predicts that the capital structure of firms that are very profitable should contain a large proportion of debt. This prediction is based on the fact that these firms have large taxable incomes that can support a lot of debt. So they can reduce taxes substantially without raising concern about possible financial distress. This prediction is not in line with the the results of empirical reseach, most studies find a negative relation between profitability and leverage.