NTNU Trondheim
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EXAM IN COURSE TIØ4146
FINANCE for SCIENCE and TECHNOLOGY STUDENTS
12 May 2020 Time: 09.00 - 13.00

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

Problem 1 (weight 20%)

Khanal and Mishra investigate[1] stock price reactions to stock dividends announcements. Stock dividends are dividends paid in the form stock (shares); a 10% stock dividend, for example, means that shareholders receive one new share for every ten shares they hold. Khanal and Mishra use a dataset from the Center for Research for Security Prices (CRSP). The dataset contains a broad range of information for commonly traded stocks on the NYSE, AMEX, and NASDAQ, as well as some indices. They select a sample that includes all available stock dividend events from January 2006 to December 2012. In total, they analyse 460 events using the market model and event study methodology. They use two variants of the market model; in the first, the return of the market portfolio is represented by the return of an equally weighted index, and in the second by that of a value weighted index. Their main results are summarized in Table 1 below.

Table 1: Cumulative average abnormal retuns (in %)

Window	Market index:	
(in days)	equally weighted	value weighted
-20 to -2	-0.22	0.24
-2 to +2	1.49*	1.55*
+2 to +20	1.41	1.44*

*means significantly different from zero

a) Which form of market efficiency is tested by Khanal and Mishra?

b) Do any of the results in Table 1 contradict the Efficient Market Hypothesis (EMH)? If so, explain which specific result(s) and why.

c) Table 1 shows that the results with an equally weighted index are not the same as those with a value weighted index. Does this make your conclusion about market efficiency under b) more relevant for specific categories of companies? Explain why and what these categories are.

[1] Khanal, Aditya R. and Mishra, Ashok K. Stock price reactions to stock dividend announcements: A case from a sluggish economic period, North American Journal of Economics and Finance, November 2017, Vol.42, pp.338-345

Problem 2 (weight 30%)

Haalborg is a well known aquavit producer for the European market. As an established, mature company with a loyal clientele, it has a stable financial position and good relations with its investors. Its 10 million outstanding shares have a low volatility, their annual standard deviation is 18%; they currently trade at €20 per share and give a return of 12.5% per year. Over the years, Haalborg has build up substantial financial reserves and its debt is comparatively low. Only 35% of its total book value of €240 million is debt, over which it pays 6% interest. Its loans are long term and stable, they are not regularly renegotiated and adjusted.

The recent lockdown measures by the government have limited the demand for aquavit, so now Haalborg has some excess capacity in it distillery plants. Management sees an opportunity to fill this capacity by producing alcohol-based hand sanitizer, popularly known as AntiBac. This product is in great demand during the virus pandemic and fetches good prices. Moreover, the government's stimulating measures have made it very easy to get loans for this sort of projects. Management has calculated that it wants to use 75% debt to finance the €30 million investment to set up the production line. The bank is willing to provide a loan to that amount; it charges 8.5% interest on the loan,. The principal amount has to be paid back in three equal amounts starting one year from now. The rest of the project will be financed internally using Haalborg's retained earnings.

The other producers of alcohol-based hand sanitizer have a long term presence in this market. They, too, are stable, mature companies with very long term loans that are not regularly renegotiated and adjusted. The interest rate on their loans is, on average, 7.5%. Their shares have a higher volatility (30% annually) and are priced to give an annual return of 17.5%. These companies are more prudent in their financing: on average, 65% of their total market value is debt.

The AntiBac project will produce after tax cash flows of €15 million after one year, of €10 million after two years and of €7.5 million after three years. After that, the pandemic is expected to be over and Haalborg will withdraw from this market.

On financial markets, the market risk premium is 8% and the risk free interest rate is 4%; the corporate tax rate is 30% and other taxes can be ignored.

a) Should Haalborg take on the AntiBac project or not? Show calculations to support your answer and make additional assumptions if necessary.

Problem 3 (weight 30%)

Before he was arrested, Bernie Madoff, the fraudster currently serving a 150 year prison sentence, reported consistently high returns for his funds, combined with low volatility. He claimed to obtain these results (which we now know to be fictitious) by using a split-strike conversion strategy. This strategy consists of taking a long position in a share[2], combined with a long out of the money put and a short out of the money call. Suppose shares of ZXco currently trade at €75. ZXco does not pay dividends and the shares have an annual volatility of 25%. European put and call options on the share are also traded. They have a maturity of 6 months and exercise prices of €65, €70, €75, €80 and €85. The risk free interest rate is 5% per year.

a) Briefly explain why a split-strike conversion strategy reduces volatility.

b) Calculate how much it costs to set up a split-strike conversion strategy with ZXco's securities. Show calculations to support your answer and make additional assumptions if necessary.

[2]Split-strike conversion is usually applied to a basket (portfolio) of shares, mimicking an index, in combination with index options. Applied to a single stock, as here, it is also known as a *collar*.

c) What are the maximum and the minimum profits of the strategy under b) at maturity? Show calculations to support your answer and make additional assumptions if necessary.

Problem 4 (weight 20%)

Ikenberry, Lakonishok and Vermaelen[3] investigate the effects of stock repurchase announcements on stock prices. Stock repurchases and dividends are alternative ways in which companies can pay out money to their shareholders. Stock repurchases reduce the number of outstanding shares. Using event study methodology, Ikenberry et al. find positive CAAR for the announcing companies for up to 36 months after the announcement.

a) Are these findings in line with trade-off theory of capital structure?

Filbeck, Gorman and Vora[4] examine the stock-price reactions to the announcements of new equity issues. New equity issues increase the number of outstanding shares. Using a methodology similar to that of event studies, Filbeck et al. find that the price reactions are significantly negative.

b) Are these findings in line with trade-off theory of capital structure?

Table 2 below summarizes some financial data (in €10^6) for three different companies:

Table 2: Company summary statistics

Company	A	B	C
Current assets (book value)	150	200	100
Fixed assets (book value)	200	400	100
Total market value	455	750	300

c) According to the trade-off theory of capital structure, which of these companies has the highest debt/value ratio and which has the lowest, all other things being equal? Briefly explain your answer.

[3] David Ikenberry, Josef Lakonishok and Theo Vermaelen, Stock Repurchases in Canada: Performance and Strategic Trading, The Journal of Finance, Vol. 55, No. 5 (Oct., 2000), pp. 2373-2397

[4] Greg Filbeck, Raymond F. Gorman and Gautam Vora, Stock-Price Reaction to Equity Issues of Utilities: The Influence of Regulatory Climate, Managerial and Decision Economics, Vol. 18, No. 7/8, 1997

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Problem 1 (weight 20%)

a) Khanal and Mishra investigate stock price reactions to stock dividends announcements. Such announcements are public information, so they test the semi-strong form of market efficiency.

b) In event studies, market efficiency is tested by the significance of the post-event drift in the CAAR. As the table shows, this drift is significant for the analysis using a value weighted market index, so the CAAR of 1.44 in the window +2 to +20 contradicts the semi-strong form of market efficiency.

c) The contradiction is found using a value weighted market index, in which the larger firms have a stronger influence on the index values. In the analysis using an equally weighted index no contradiction is found. This means that the contradiction is more relevant for large firms than for small firms, i.e. the post event drift is particularly found among the larger firms.

Problem 2 (weight 30%)

As always, the project characteristics determine the parameters of the investment decision. The description makes clear that the project is another line of business, so Haalborg's details are irrelevant. We begin by calculating the opportunity cost of capital in the hand sanitizer business. The description also makes clear that debt can be considered perpetual (very long term) and predetermined (not regularly renegotiated and adjusted), so we can use the formulas corresponding to the Modigliani-Miller analyses (this can also be done in terms of βs):

$$r_a = r_d(1-\tau)\frac{D}{V-\tau D} + r_e\frac{E}{V-\tau D}$$

so for the hand sanitizer business

$$r_a = 0.075(1-.3)\frac{.65}{1-.3\times.65} + 0.175\frac{.35}{1-.3\times.65} = 0.1185$$

It is also possible to first calculate the WACC in the hand sanitizer business:

$$\begin{aligned} WACC &= r_e\frac{E}{V} + r_d(1-\tau)\frac{D}{V} \\ &= 0.175\times.35 + 0.075(1-.3).65 \\ &= 0.095375 \end{aligned}$$

and then solve the Modigliani-Miller formula for r_a :

$$\begin{aligned} WACC &= r_a\left(1-\tau\frac{D}{V}\right) \\ 0.095375 &= r_a\left(1-0.3\frac{0.65}{1}\right) \quad \rightarrow \quad r_a = 0.1185 \end{aligned}$$

Alternatively, we can use the formula for r_e in reverse:

$$\begin{aligned} r_e &= r_a + (r_a - r_d)(1-\tau)\frac{D}{E} \\ 0.175 &= r_a + (r_a - 0.075)(1-0.3)\frac{.65}{.35} \;\Rightarrow r_a = 0.1185 \end{aligned}$$

The project is short term and debt is predetermined: the loan must be paid back in in three equal amounts starting one year from now. As a result, capital structure will change from year to year, and so will the cost of equity and the WACC. This means that APV is the only practical method. We first calculate the base case PV, i.e. the present value of the after tax cash flows discounted at the OCC. We just calculated the OCC as 11.85%, so the base case present value is:

$$\frac{15}{1.1185} + \frac{10}{1.1185^2} + \frac{7.5}{1.1185^3} = 26.764$$

The only side-effect apparent in the problem text is that of taxes. The loan is $0.75 \times 30 = 22.5$ in the first year, $2/3 \times 22.5 = 15$ in the second year and $1/3 \times 22.5 = 7.5$ in the third year. The tax advantage is $\tau \times r_d \times D$, so in:

year 1: $22.5 \times 0.085 \times 0.3 = 0.57375$

year 2: $15 \times 0.085 \times 0.3 = 0.3825$

year 3: $7.5 \times 0.085 \times 0.3 = 0.19125$

Debt is predetermined, so the tax advantages have to be discounted with cost of debt. Their present value is:

$$\frac{0.57375}{1.085} + \frac{0.382\,5}{1.085^2} + \frac{0.191\,25}{1.085^3} = 1.0034$$

The APV is thus:

$$26.764 + 1.0034 - 30 = -2.2326$$

Haalborg should not take on the AntiBac project.

Problem 3 (weight 30%)

Question a)

A split-strike reduces volatility because it 'cuts off' the high and low tails of the stock's returns. The short call caps the possible gains from the stock (provides a ceiling), but it generates cash. The cash is used to increase the return of the position and to finance the put, which insures against a (large) loss of stock (provides a floor). So a part of the upward potential is given up to reduce the downside risk, resulting is lower volatility.

Question b)

Analyses have shown that it is optimal not to have a perfectly symmetric split-strike strategy, but to buy the put option more deeply out of the money than the call option. However, split-strike conversion strategies are usually illustrated with symmetric positions, as is done here. Since the stock price is €75, we choose an exercise price of €70 for the put and €80 for the call. We calculate their prices with the Black and Scholes formula. For the put:

$S_0 = 75$, $X = 70$, $r = 0.05$, $\sigma = 0.25$ and $T = 0.5$

$$\begin{aligned} d_1 &= \frac{\ln(S_0/X) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} \\ &= \frac{\ln(75/70) + (0.05 + 0.5 \times 0.25^2)0.5}{0.25\sqrt{0.5}} = 0.620 \end{aligned}$$

and

$$d_2 = d_1 - \sigma\sqrt{T} = 0.620 - 0.25\sqrt{0.5} = 0.44322$$

The Black and Scholes formula for a put is:

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

NormalDist$(-0.62) = 0.26763$ and NormalDist$(-0.44322) = 0.3288$ so that the value of the put is:

$$O_{p,0} = 70 \times e^{-0.05\times0.5} \times 0.3288 - 75 \times 0.26763 = 2.38$$

For the call:
$S_0 = 75$, $X = 80$, $r = 0.05$, $\sigma = 0.25$ and $T = 0.5$

$$\begin{aligned} d_1 &= \frac{\ln(S_0/X) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} \\ &= \frac{\ln(75/80) + (0.05 + 0.5 \times 0.25^2)0.5}{0.25\sqrt{0.5}} = -0.1353 \end{aligned}$$

and

$$d_2 = d_1 - \sigma\sqrt{T} = -0.1353 - 0.25\sqrt{0.5} = -0.312$$

The Black and Scholes formula for a call is:

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

NormalDist$(-0.1353) = 0.4462$ and NormalDist$(-0.312) = 0.3775$ so that the value of the call is:

$$O_{c,0} = 75 \times 0.4462 - 80 \times e^{-0.05\times0.5} \times 0.3775 = 4.01$$

So it costs

$$-75 - 2.38 + 4.01 = -73.37$$

to set up this this split-strike. A long put with X=65 and a short call with X=85 are also possible. The different combinations are summarized in Table 3 below.

Table 3: Split-strike conversions

X put	X call	O_p	O_c	Split-strike
65	80	1.11	4.01	−72.10
65	85	1.11	2.48	−73.63
70	80	2.38	4.01	−73.37
70	85	2.38	2.48	−74.90

Question c)

To calculate the profit at maturity we first calculate the future values of the prices paid/received for:

the stock $e^{0.05\times0.5} \times -75 = -76.90$

the put $e^{0.05\times0.5} \times -2.38 = -2.44$

Table 4: Profit split-strike position

S_T	65	70	75	80	85
stock $S_T - 76.9$	-11.90	-6.90	-1.90	3.10	8.10
long put $-2.44 + \max[0, 70 - S_T]$	2.56	-2.44	-2.44	-2.44	-2.44
short call $4.11 + \min[0, 80 - S_T]$	4.11	4.11	4.11	4.11	-0.89
Total	-5.23	-5.23	-0.23	4.77	4.77

the call $e^{0.05\times0.5} \times 4.01 = 4.11$

We then calculate the profits of the stock and options at different end prices of the stock; the calculations are summarized in Table 4 below:

Of course, we can also calculate the payoffs at maturity and then subtract the future value of the sum of the prices paid/received: $(-75 - 2.38 + 4.01) \times e^{0.05\times0.5} = -75.227$

Table 5: Profit split-strike position, alternative setup

S_T	65	70	75	80	85
stock S_T	65	70	75	80	85
long put $\max[0, 70 - S_T]$	5	0	0	0	0
short call $\min[0, 80 - S_T]$	0	0	0	0	-5
- FV sum premiums	-75.227	-75.227	-75.227	-75.227	-75.227
Total	-5.227	-5.227	-0.227	4.773	4.773

We see that the minimum profit (loss) from the position is €-5.23 and the maximum profit is €4.77. From end price of 70 and below, the loss from the share is cancelled out by the profit from the put and at end prices of €80 and above the loss from the short call is cancelled out by the profit from the share. The position is depicted in Figure 1.

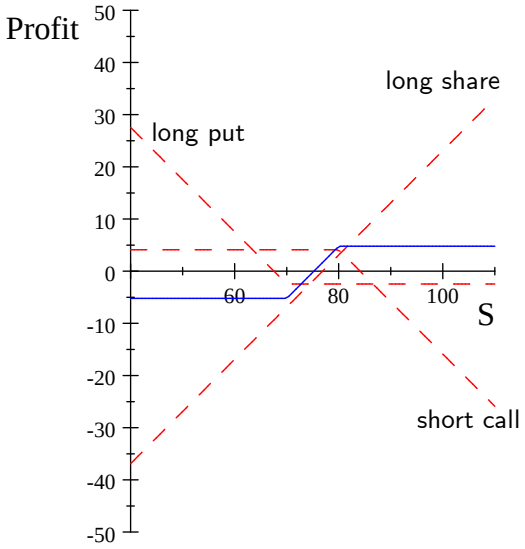

Figure 1: Profit diagram of a split-strike position.

Problem 4 (weight 10%)

Question a)

According to the trade-off theory of capital structure, all capital structure changes should be in the direction of the optimum and, hence, increase firm value. So the findings

of Ikenberry et al. are in line with trade-off theory of capital structure.

Question b)

According to the trade-off theory of capital structure, all capital structure changes should be in the direction of the optimum and, hence, increase firm value. So the findings of Filbeck et al. are not in line with trade-off theory of capital structure.

Question c)

From Table 2 we can derive 3 determinants of capital structure according to the trade-off theory:

1. tangibility of assets (fixed/total assets), which is expected to have a positive effect on leverage
2. market/book value, which is expected to have a negative effect on leverage
3. size (total capitalization), which is expected to have a positive effect on leverage

We see that all three determinants point in the same direction: company B (C) has the highest (lowest) fixed/total assets ratio, the lowest (highest) market/book value and the largest (smallest) size. The calculations are summarized in Table 6 below.

Table 6: Company debt determinants

Company	Effect	A	B	C
Fixed/total assets (tangibility)	+	0.57	0.67	0.50
Market/book value	-	1.30	1.25	1.50
Size (rank)	+	2	1	3
Debt/value (rank)		2	1	3