

## Corporate Finance

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### Question 1. Hardwood Factories, Inc.

Hardwood Factories (HF) expects earnings this year of \$6/share, and it plans to pay a \$4 dividend to shareholders this year. HF will retain \$2/share of its earnings to reinvest in new projects with an expected return of 15 percent per year. Suppose HF will maintain the same dividend payout rate, retention rate, and return on new investments in the future and will not change its number of outstanding shares.

a. (5 points) Use the dividend discount model to forecast a growth rate of earnings for HF.

Use the formula from the dividend discount model. The payout rate is  $2/3$  and the retention rate is  $1/3$ . Therefore the growth rate of earnings and dividends is  $g = 1/3 * 0.15 = 0.05$ .

b. (6 points) Using the same dividend discount model, if HF's cost of equity capital is 12 percent, what price would you estimate for HF stock?

The current stock price is from the growing perpetuity formula. The numerator is the expected dividend next year, which is  $\$4(1.05)$ . The denominator is the discount rate minus the growth rate, which is  $0.12 - 0.05 = 0.07$ . Therefore the stock price is  $4(1.05)/.07 = 4.2/.07 = 60$ .

c. (8 points) Suppose HF instead plans to pay a \$1 dividend, retaining \$5 per share in earnings. Also suppose HF will maintain the same dividend payout rate of  $1/6$ , retention rate of  $5/6$ , and expected return of 15 percent per year on new investments. Continue to assume HF's cost of equity capital is 12 percent. According to the dividend discount model, what is the stock price? (The answer should be nonsensical.) What is a problem with the dividend discount model that this example illustrates?

Look at the growth rate formula. With a retention rate of  $5/6$ , the growth rate of earnings and dividends is  $5/6 * 0.15 = 0.125$ . This exceeds the cost of capital of 12%, so the value of the growing perpetuity is infinite. If we went ahead and computed the stock price, we would get  $1(1.125)/(0.12 - 0.125) = -225$ , which is a nonsensical stock price. The problem is that the return to new investments is fixed to 15% regardless of how much the firm invests. In reality, return to investment declines with the amount invested.

Question 2. Portfolio theory

(10 points) Assume all investors want to hold a portfolio that, for a given level of volatility, has the maximum possible expected return. Explain why, when a risk-free asset exists, all investors will choose to hold the same portfolio of risky stocks.

On a graph with standard deviation on the x-axis and expected return on the y-axis, draw the usual mean-variance efficient frontier of risky assets and add the line from the risk-free asset that is tangent to the mean-variance efficient frontier of risky assets. That line represents the mean-variance efficient frontier of \*all\* assets. Investors want to have as high a value on the y-axis as possible for a given x-axis value, so they want to be on the line. To be on the line, an investor holds a portfolio of the risk-free asset and the tangency portfolio.

Question 3. Portfolio practice

Your investment portfolio consists of \$1 million invested in only one stock—Wharfin Enterprises. Suppose the risk-free rate is 3 percent, Wharfin stock has an expected return of 10 percent and a volatility of 50%, and the market portfolio has an expected return of 8 percent and a volatility of 16 percent. Under the CAPM assumptions,

a. (8 points) What alternative investment has the lowest possible volatility while having the same expected return as Wharfin Enterprises? What is the volatility of this investment?

The expected excess return to Wharfin is  $10\% - 3\% = 7\%$ . The expected excess return to the market is  $8\% - 3\% = 5\%$ . Since the CAPM is assumed true, the beta of Wharfin is  $7/5$ . Another portfolio with a beta of  $7/5$  is a portfolio that invests  $7/5$  in the market and borrows (shorts)  $2/5$  in the risk-free asset. This portfolio's expected return is

$$7/5 (8\%) - 2/5 (3\%) = 10\%$$

This portfolio's standard deviation is, using the formula of a two-asset portfolio where one of the assets is riskfree,

$$7/5(16\%) = 22.4\%$$

b. (8 points) What investment has the highest possible expected return while having the same volatility as Wharfin Enterprises? What is the expected return of this investment?

Put a weight of  $W$  on the market, where  $W$  satisfies  $W(16\%) = 50\%$ . Therefore  $W=3.125$ . The total portfolio is 3.125 in the market and a short position of 2.125 in the risk-free asset. The expected return is

$$3.125(8\%) - 2.125(3\%) = 31.375\%$$

Question 4. Fuller Inc.

Fuller Inc. is currently an all-equity firm with an expected return of 10 percent. It is considering a leveraged recapitalization in which it would borrow and repurchase existing shares. For this question, assume perfect capital markets, including no taxes.

a. (6 points) Suppose Fuller borrows to the point that its debt-equity ratio is 0.6. With this amount of debt, the debt cost of capital is 6 percent. What will the expected return of levered equity be after this transaction?

Here is the relevant formula. Debt makes levered equity riskier, so the expected return is higher (as long as the unlevered firm has a risk premium.)

$$r_{LE} = r_U + \frac{D}{LE}(r_U - r_D)$$

Plugging in the numbers we are given, the expected return to levered equity is  $0.1 + 0.6(0.1 - 0.06) = 0.124$

b. (4 points) Suppose instead Fuller borrows to the point that its debt-equity ratio is 1.5. With this amount of debt, Fuller's debt will be much riskier. As a result, the debt cost of capital will be 8 percent. What will the expected return of levered equity be in this case?

With these numbers, the result is  $0.1 + 1.5*(0.1 - 0.08) = 0.13$

c. (7 points) A senior manager argues that it is in the best interest of the shareholders to choose the capital structure that leads to the highest expected return for the stock. How would you respond to this argument?

Such a policy is not in the best interest of shareholders. Shareholders are made better off by a policy that puts as much value in their hands as possible. In the case of a leveraged buyout, this is the sum of the repurchased shares and the remaining market value of the stocks. Expected return is determined by the stock's beta and the risk-free rate. Put differently, the expected return on an asset is just compensation for the asset's risk -- it does not represent anything extra that investors receive.

### Question 5. Casper International

Casper International has \$20 million in debt outstanding. The debt is perpetual; in other words, the firm will pay interest only on this debt. CI's marginal tax rate is expected to be 30 percent for the foreseeable future.

a. (5 points) Suppose CI pays interest of 5 percent per year on its debt. What is its annual interest tax shield?

Annual cash flow is tax rate \* interest rate \* amount of debt. Here,  $0.30 * 0.05 * 20\text{MM} = \$300,000$ .

b. (6 points) What is the present value of the interest rate tax shield, assuming its risk is the same as the loan? Also assume perfect markets except for corporate taxes.

With perpetual debt, the interest rate tax shield is a perpetuity paying (tax rate)\*interest rate \* amount of debt every year. The discount rate is the interest rate, so that cancels in the formula, leaving tax rate \* amount of debt. The answer is  $0.3 * 20\text{MM} = 6\text{MM}$ .

c. (5 points) Suppose instead that the interest rate on the debt is 7 percent. What is the present value of the interest tax shield in this case?

The same formula applies. Here, the interest rate is higher, but so is the discount rate applied to the tax shield so the result remains tax rate \* amount of debt, or \$6MM.

### Question 6. Krieger, Inc.

Krieger, Inc has \$300 million of excess cash. The firm has no debt and 200 million shares outstanding with a current market price of \$20/share. Krieger's board has decided to pay out this cash as a one-time dividend. Assume a perfect capital market, including no corporate or personal taxes.

a. (4 points) What is the ex-dividend price of a share?

Prior to the payment, the market value of the firm is  $\$20/\text{share} * 200 \text{ MM shares} = \$4\text{B}$ . This includes the  $\$300\text{MM}$  of cash. After the dividend payment, the market value of the firm falls to  $\$4\text{MM} - 300\text{MM} = 3.7\text{B}$ . Divide this by 200 MM shares to produce  $\$18.50/\text{share}$ .

b. (4 points) If the board instead decided to use the cash to do a one-time share repurchase, what is the price of the shares once the repurchase is completed?

In a perfect capital market, the buyback has no effect on the share price. Therefore the price remains \$20/share.

c. (4 points) Which policy (in part a or b) makes investors in the firm better off, and why?

Investors are indifferent. In the first case they get \$1.50/share of dividend and a stock worth \$18.50/share. In the second case they get no dividend and a stock worth \$20/share. The value is \$20 in either case.

d. (5 points) Suppose the board decided to do the share repurchase, but you, as an investor, would have preferred to receive a dividend payment. How can you leave yourself in the same position as if the board had elected to make the dividend payment instead? I am looking for a precise mathematical description of what you will do.

You want to sell a fraction  $(1.50)/20 = 0.075$  of your shares. For example, if you have 1000 shares worth \$20, sell 75 of them at \$20/share for \$1500. You will have a remaining stock portfolio of \$18,500. The combination of \$1500 in cash and \$18,500 in stock is precisely the same combination you would have if the company paid \$1.50/share in dividend.

Question 7. Google

Google has an enterprise value of \$130.3B. It has no borrowed funds and holds \$26.5B in cash. It has never paid a dividend, and it spends very little money buying back shares. The Wall Street Journal of May 7, 2010 reports “The company’s cash position is larger than any other tech company’s ... Google could pay out the whole pile, which amounts to more than \$80 per share. But tech companies don’t like to pay dividends. Google’s current acquisition efforts aren’t making a dent. So where else might Google put the money to work?”

a. (7 points) If Google decides to pay out a large amount of this cash, would a typical stockholder today prefer a dividend payment or a stock buyback, and why?

Stock buyback. Currently, statutory tax rates on dividends and capital gains are equal. However, the effective capital gains tax is less than the dividend tax rate because investors have the ability to defer capital gains taxes, thus lowering their present value. Investors prefer the method of distributing cash that has the lower effective tax rate.

b. (9 points) Now assume that Google management expects that two years from now, Google will have positive NPV opportunities in the future that require investments of close to \$30B. It can either hold on to its current cash until it is needed, or pay out its cash now, then raise additional funds in debt or equity markets if future projects require additional funds. Explain why Google likely prefers the first option to the second option. Three well-chosen sentences will suffice. (Hint: This question asks you to describe the pecking order theory.)

Internal cash from retained earnings is cheaper to use than is external cash from debt or equity markets because outside investors must be compensated for their informational disadvantage relative to corporate insiders. Outsiders are concerned that firms tend to raise cash externally when the company is overvalued in order to dilute current shareholders' claims on an overvalued asset. They require compensation even when the firm is actually not overvalued (because outsiders don't know it is not overvalued), which hurts existing shareholders.

#### Question 8. Breakfast

You and your friend Olivia have a great idea for an additive for breakfast cereals. You want to calculate the project's NPV. Olivia says, "Our project has risk similar to projects of Flaxseed Enterprises. Our tax rate will be the same as that for Flaxseed. Like Flaxseed, we will issue default-free debt. But we prefer to use a larger fraction of debt than Flaxseed. Therefore we should discount our expected cash flows by

$$wacc = k \times r_{LE} + (1 - k)r_f(1 - \tau)$$

In this equation,  $r_{LE}$  is the expected return to Flaxseed's levered equity,  $r_f$  is the risk-free rate paid to debtholders,  $\tau$  is the corporate tax rate, and  $k$  is **your** preferred ratio of  $(LE/(LE+D))$ .

a. (9 points) Assume a perfect market except for corporate taxes. Explain to Olivia why her formula will not produce the correct discount rate for your project. In your answer, be sure to say whether the formula Olivia proposes will produce a discount rate that is too high, too low, or whether it is not clear whether the formula's rate is too high or too low.

Olivia's formula implicitly assumes that your project's expected return to levered equity will equal Flaxseed's expected return to levered equity. But a firm or project's expected return to levered equity is determined, in part, by the D/E ratio. The higher the D/E ratio, the higher the expected return to levered equity. Thus if Flaxseed really had a capital structure with  $LE/(LE+D)=k$ ,  $r_{LE}$  would be higher. Thus the wacc calculated from this formula is too low, because it underestimates the required expected return to equityholders.

b. (7 points) What alternative method can you use to calculate your project's NPV? (Just name it, do not go into detail.) What information from Flaxseed Enterprises do you need to calculate this NPV?

We can use the Adjusted Present Value (APV) method. We need Flaxseed Enterprises' expected return to unlevered equity. We can calculate this from its D/E ratio, its expected return to levered equity, and its expected return to debt (which is the risk-free rate).

#### Question 9. Steering Wheels

Hopkins Inc (HI) makes steering wheels for cars. It has no debt and 100 million shares outstanding. The current market value of the firm is \$1700MM, thus the current share price is \$17. The company has been experimenting with a cheaper production process. If it is successful, the market value will jump to \$1800MM, but if not, the market value will drop to \$1600MM. Outside investors believe that HI's managers know whether the process is successful, but that information is not yet public. Based on outsiders' information, the probability of success is 50 percent.

HI must raise \$400 million to build a new production facility. Because the firm would suffer a large loss of both customers and engineering talent in the event of financial distress, managers believe that if HI borrows the \$400 million, the present value of financial distress costs will exceed any tax benefits by \$15 million. At the same time, HI faces a lemons problem if it attempts to raise the \$400 million by issuing equity.

a. (8 points) Suppose that if HI issues equity, the share price will remain \$17. To maximize the value of current shareholders, would managers choose to issue equity or borrow the \$400 million if

i. They know the process is a failure? Make an explicit computation to answer this question.

If they issue equity, they will sell  $400/17=23.52941$ MM shares, for a total of 123.52941MM shares. When the failure of the project is known, the market value of the firm falls to  $\$1600\text{MM}+\$400\text{MM} = \$2000\text{MM}$ , for a share price of  $\$2000/123.52941=\$16.19/\text{share}$ . If they issue debt, the market value of the firm (after learning the project is a failure) is  $\$1600\text{MM} + \$400\text{MM} - \$15\text{MM} = \$1985\text{MM}$ . Debt holders claim \$400MM of this value, leaving \$1585MM for equityholders. This is \$15.85/share. Existing shareholders prefer \$16.19/share to \$15.85/share, so they will issue equity.

ii. They know the process is a success? Again, make an explicit computation to answer this question.

If they issue equity, they will sell  $400/17=23.52941$ MM shares, for a total of 123.52941MM shares. When the success of the project is known, the market value of the firm rises to  $\$1800\text{MM}+\$400\text{MM} = \$2200\text{MM}$ , for a share price of  $\$2200/123.52941=\$17.81/\text{share}$ . If they issue debt, the market value of the firm (after learning the project is a success) is  $\$1800\text{MM} + \$400\text{MM} - \$15\text{MM} = \$2185\text{MM}$ . Debt holders claim  $\$400\text{MM}$  of this value, leaving  $\$1785\text{MM}$  for equityholders. This is  $\$17.85/\text{share}$ . Existing shareholders prefer  $\$17.85/\text{share}$  to  $\$17.81/\text{share}$ , so they will issue debt.

b. (4 points) Given your answer to part (a), what should investors conclude if HI announces it will issue equity? What will be the new share price?

Investors should conclude the process is a failure, thus the share price will drop immediately to  $\$16/\text{share}$ . ( $\$1600\text{MM}$  market value, 100MM shares)

c. (4 points) Given your answer to part (a), what should investors conclude if HI announces it will issue debt? What will be the new share price?

Investors should conclude the process is a success, thus the share price will rise immediately to  $\$17.85/\text{share}$ . ( $\$1785\text{MM}$  market value, 100MM shares)

d. (5 points) Suppose that managers know the process is successful. Moreover, assume managers can, if they choose, release test results to convince outside investors of this fact. Show that managers can make current shareholders better off by releasing this information just prior to raising  $\$400$  million than just after raising the  $\$400$  million. (Hint – if they release the information, will they choose to use equity or debt to raise the  $\$400$  million?)

They will release the information, then raise equity. Issuing equity allows the firm to save the  $\$15\text{MM}$  in costs associated with debt. Releasing the information avoids the lemons problem, thus the share price immediately jumps to  $\$18/\text{share}$ , in contrast with the  $\$17.85/\text{share}$  in part (c).

Question 10. HiTest

Suppose HiTest Industries has an equity cost of capital of 12 percent, market capitalization of \$10 billion, and an enterprise value of \$15 billion. Suppose HiTest's debt cost of capital is 4 percent and its marginal tax rate is 30 percent.

a. (4 points) What is HiTest's WACC?

Here,  $LE = \$10B$ ,  $LE + D = \$15B$ , so  $D = \$5B$ . The wacc formula is

$$wacc = (10/15) * 12\% + (5/15) * 4\% * (1 - 0.30) = 0.089333 = 8.9333\%$$

b. (4 points) If HiTest maintains a constant debt-equity ratio, what is the NPV of a project with average risk and the following expected cash flows?

Year	0	1	2	3
FCF	-100	30	70	50

$$NPV = -100 + 30/1.089333 + 70/(1.089333^2) + 50/(1.089333^3) = 25.2096$$

c. (8 points) If HiTest maintains its debt-equity ratio, what is the debt capacity of the project in each year 0, 1, and 2?

Debt capacity is  $(D/(LE+D)) * \text{continuation value}$ . Here,  $D/(LE+D)$  is  $1/3$ . Continuation value is PV of future cash flows. In year zero, continuation value =  $30/(1+wacc) + 70/(1+wacc)^2 + 50/(1+wacc)^3 = 125.2096$ . In year one, continuation value is  $70/(1+wacc) + 50/(1+wacc)^2 = 106.395$ . In year two, continuation value is  $50/(1+wacc) = 45.900$ . Therefore debt capacity is 41.7365, 35.465, and 15.300 respectively.

Question 11. LoTest

Suppose LoTest Industries has an equity cost of capital of 9 percent, a debt cost of capital of 3 percent, a marginal corporate tax rate of 25 percent, and a debt-equity ratio of 2.0. Suppose LoTest maintains a constant debt-equity ratio.

a. (4 points) What is LoTest's WACC?

We know  $D/LE = 2$ . Therefore  $D/(LE+D) = D/((D/2)+D) = 1/(1/2 + 1) = 1/1.5 = 2/3$ . Then  $LE/(LE+D) = 1/3$ . The wacc formula is

$$1/3 * 9\% + 2/3 * 3\% * (1 - 0.25) = 4.5\%$$

b. (4 points) What is LoTest's unlevered cost of capital?

It is given by the pre-tax wacc, since LoTest has a constant D/E ratio. The formula is

$$1/3 * 9\% + 2/3 * 3\% = 5.0\%$$

c. (4 points) Explain intuitively why LoTest's unlevered cost of capital is less than its equity cost of capital and higher than its WACC.

The unlevered cost of capital is less than its equity cost of capital because levered equity is riskier – its beta is higher, so it has a higher expected return. The unlevered cost of capital exceeds its WACC because there is no tax shield with unlevered equity. The tax shield lowers the cost of capital.

Question 12. Computer manufacturing

Your firm is considering buying some equipment for \$50 million to speed up production of computers. You expect incremental operating profits (EBITDA) of \$24 million per year in years one through four. The equipment is a capital expenditure, and will be depreciated on a straight-line basis for four years. At that time it will be worthless; your firm will discard it. Because this project will increase your firm's sales of computers, it requires \$5 million of net working capital in year zero, to be recovered in year four when the equipment wears out. The corporate tax rate is 30 percent. All cash flows occur at year-ends. The risk-free rate is 4 percent per year.

a. (12 points) If the expected return to the stock market is 10 percent, and the asset beta for this project is 1.5, what is the NPV of the unlevered project?

The discount rate for the unlevered project is from the CAPM. The formula is

$$r_u = r_f + \beta x (r_M - r_f), \text{ or } r_u = 4\% + 1.5 (10\% - 4\%) = 13\%$$

Here is a table of cash flow information for the project.

Year	0	1	2	3	4
cap ex	-50				
EBITDA		24	24	24	24
depreciation		-12.5	-12.5	-12.5	-12.5
NWC	-5	0	0	0	5
pretax income	0	11.5	11.5	11.5	11.5
after-tax income	0	8.05	8.05	8.05	8.05
unlevered cash flow	-55	20.55	20.55	20.55	25.55

Use the 13% discount rate to compute the NPV of the final row of numbers. The result is 9.19198.

b. (12 points) Suppose that you can finance \$40 million of the project with a coupon bond. The bond sells for \$40 million, pays an annual coupon of 4 percent in years one through four, and also returns the principal of \$40 million at the end of year four. What is the NPV of the project, including the tax shield of the debt?

The annual interest payment is 4% times \$40MM = \$1.6MM. Note that this is much less than the pretax income of the unlevered firm, so the entire \$1.6MM is a shield against income tax. The annual tax shield cash flow is the tax rate times \$1.6MM, or \$480,000. This is received in years one through four, and is discounted at the expected return to the debt (which is the risk-free rate) of 4 percent. The result is NPV of tax shield = 1.74235, so the entire NPV of the levered project is 9.19198+1.74235 = 10.93433.