

Question 1 (9 points) The CAPM

Describe a result from empirical tests of the CAPM that casts doubt on the universal applicability of the CAPM. In other words, the result should contradict some implication of the CAPM. There are multiple results you could choose. Credit is given for a correctly-chosen result and debits are applied for an incorrectly-chosen result. A few well-chosen sentences will be sufficient.

There are two main results from empirical tests that cast doubt on the CAPM. First, stocks with high BE/ME ratios tend to have positive alphas, while stocks with low BE/ME ratios tend to have negative alphas. Here, "alpha" means deviation from the beta-pricing relation implied by the CAPM. Second, stocks with low ME tend to have positive alphas, while stocks with high ME tend to have negative alphas.

Question 2 (10 points) Optimal portfolio choice

For this question, do *not* assume the CAPM is correct. You prefer portfolios with higher expected returns and lower standard deviations. Your current portfolio has an expected return of 11 percent/year and a standard deviation of 20 percent/year. You are considering adding another asset to your portfolio. This asset has an expected return of 9 percent/year, a standard deviation of 25 percent/year, and a correlation with the return to your portfolio of 0.4. The risk-free rate is 3 percent/year. Should you buy some of this asset to include in your portfolio? Your reasoning should be almost entirely mathematical.

Aside from changing the numbers, this question is taken straight from the end-of-chapter questions in Chapter 11. If adding the new asset to your portfolio gives you a higher expected return and a lower standard deviation, your old portfolio must not be mean-variance efficient. Check to see if the mean-variance efficiency beta equation holds for your portfolio. The beta of the new asset with respect to your portfolio's return is [correlation between returns \* standard deviation of new asset's return / standard deviation of portfolio's return] =  $0.4 * 0.25 / 0.20 = 0.5$ . The expected excess return to your portfolio is  $11\% - 3\% = 8\%$ . Thus, if your portfolio is MV-efficient, the expected return to the new asset must be

Expected return = risk-free rate + beta \* (expected excess return to portfolio)

Or,

Expected return = 3% + 0.5 \* 8% = 7%

The asset's expected return is actually 9%. Therefore your original portfolio is not M-V efficient; the new asset offers you more expected return than the beta-formula implies. Add some of the asset to your portfolio.

Question 3. Krieger, Inc.

For this question, adopt all of the assumptions of Modigliani and Miller, including the assumption that there are *no taxes*.

Krieger, Inc.'s current market value of equity is \$100MM. The expected return on the company's stock is 7 percent/year. The firm has no debt or cash. It is considering borrowing \$20MM. If it does so, it will use the funds to buy back \$20MM of equity. The market will view this debt as risk-free, thus the company will pay the risk-free rate on the debt, which is 3 percent/year.

a. (4 points) If the firm chooses to borrow the funds and buy back stock, what will be the firm's new enterprise value *and* the firm's new market value of equity?

Enterprise value does not change because in a perfect market without taxes, capital structure is irrelevant to enterprise value. Therefore the firm's new market value of equity is \$80 MM.

b. (5 points) The stock of the company has a market beta of 0.9. If the firm chooses to borrow the funds and buy back stock, what will be the new market beta of the company's stock?

Formula from class is

$$\beta_{LE} = \beta_U + \frac{D}{LE}(\beta_U - \beta_D)$$

Beta of debt is zero because it is risk-free. Debt is \$20MM, after buy-back equity is \$80MM. Therefore the beta of the company's stock will be  $0.9 + (1/4)(0.9) = 1.125$

c. (5 points) Assume the firm chooses to borrow the funds and buy back stock. Immediately after it does so, some bad macroeconomic news lowers Krieger's enterprise value by \$5MM. What is the dollar amount of the loss to Krieger's levered equity?

Levered equity falls by \$5MM. There are only two pieces to enterprise value, and the debt part is fixed. Therefore the levered equity absorbs the entire decline in the enterprise value.

d. (5 points) You are a stockholder in this company. Your shares are currently worth \$1000. Explain precisely how, if the firm decides to alter its capital structure as described here, you can alter your portfolio to offset this decision's effect on your portfolio.

Sell \$200 of the shares and invest that money in the risk-free asset. It is as if you continue to own (1000/100MM) of the enterprise value, since you own (800/80MM) of the firm's \$80MM in levered equity and (200/20MM) of \$20MM of debt.

e. (5 points) Krieger, Inc. wants to calculate the NPV of a project that has economic risks similar to the economic risks of each of the firm's other projects. After the debt issuance and stock buyback, what discount rate should the firm use to calculate the NPV? Do not assume the CAPM is correct.

We could do a wacc calculation, but it is easier to simply note that in a perfect market, capital structure does not affect discount rates. Since the discount rate was 7% before the recapitalization, it is 7% after.

Question 4. Whiting, Inc.

For this question, assume that the corporate tax rate is 40 percent. Adopt all of the other assumptions of Modigliani and Miller. Also assume that the CAPM is correct. The risk-free rate is 3 percent/year and the expected excess return to the market is 5 percent/year.

Whiting, Inc. has levered equity valued at \$80MM and debt valued at \$120MM. The market beta of the levered equity is 3.0. The debt has a market beta of 0.2.

a. (4 points) What is the expected return to Whiting's levered equity?

CAPM says  $3\% + 3 \cdot 5\% = 18\%$

b. (4 points) What is the expected return to Whiting's debt?

CAPM says  $3\% + 0.2 \cdot 5\% = 4\%$

c. (5 points) Whiting, Inc. wants to calculate the NPV of a project that has economic risks similar to the economic risks of each of the firm's other projects. What discount rate should the firm use to calculate the NPV?

Use the wacc formula with taxes,

$$\text{Wacc} = (\text{LE}/(\text{LE}+\text{D})) * r_{\text{LE}} + (\text{D}/(\text{LE}+\text{D})) * r_{\text{D}} * (1-\tau)$$

$$\text{Wacc} = (80/200) * 18 + (120/200 * 4 * 0.6 = 8.64\%$$

d. (6 points) If this firm had an all-equity capital structure, what would be the expected return to its unlevered equity?

There are a couple of ways to do this. One way is to use the formula

$$r_{\text{LE}} = r_{\text{U}} + \frac{\text{D}}{\text{LE}} (r_{\text{U}} - r_{\text{D}}) (1 - \tau)$$

And solve for  $r_{\text{U}}$ . Here,

$$18\% = r_{\text{U}} + (120/80) * (r_{\text{U}} - 4\%) (1 - 0.4)$$

$$18\% = r_{\text{U}} + 0.9(r_{\text{u}} - 4\%)$$

$$(18\% + 0.9 * 4\%) = 1.9r_{\text{u}}$$

$$r_{\text{u}} = 11.368\%$$

#### Question 5. Educating Meskerem

Your friend Meskerem says “There are two main advantages to raising debt to finance new projects instead of raising equity. First, there is the tax deductibility of interest. Second, if a firm gets into financial difficulty, equityholders can take advantage of debtholders by investing in high-risk business strategies regardless of whether the strategies are positive NPV.”

a. (7 points) How do risky business strategies allow equityholders to take advantage of debtholders? In your answer, be sure to explain why these strategies do not work as well if a firm is not in financial difficulty.

If a big bet pays off, equityholders get the up side of the bet. If the big bet fails, debtholders absorb the loss – they get less in bankruptcy than they would get if the big bet were not made. If the firm is not in financial danger, the losses are absorbed by equityholders, since the firm is not close to defaulting on its debt.

b. (7 points) Is Meskerem correct that the ability of equityholders to take advantage of debtholders is an advantage of debt? Be sure to discuss this question from the perspective of a time before the debt is issued and a time after the debt is issued.

She is correct ex-post (after the debt is issued), but not ex-ante (before it is issued). Debtholders demand a higher yield on the debt to account for the danger that the firm will attempt to exploit debtholders if the firm gets into trouble.

c. (6 points) Give an additional reason (not including the tax shield) why equityholders may prefer that new projects are financed with debt instead of equity. A few sentences are sufficient.

There are agency benefits of debt. Firm managers do not act in the best interests of the shareholders. Debt reduces the amount of cash that a firm's managers can spend on their own perks and empire building. This benefits shareholders.

Question 6. Springtime, Inc. WARNING – PARTS B AND C ARE MORE DIFFICULT THAN OTHER QUESTIONS ON THIS EXAM

Springtime, Inc. is an all-equity firm. Each year, it has an annual EBITDA of \$18MM and an annual EBIT of \$15MM. The difference is depreciation. These levels will be maintained by the firm forever. The tax rate is 35%, so the after-tax profits are \$9.75MM/year and the after-tax free cash flow is (adding back in depreciation) \$12.75MM. The risk-free interest rate is 6 percent/year.

a. (6 points) A new owner of the firm has heard that debt is good. Therefore she decides to issue perpetual debt, using the funds to buy back stock. She wants to issue enough perpetual debt so that the firm spends \$17MM of its \$18MM in EBITDA on interest payments. How much perpetual debt will the firm issue?

The interest paid on risk-free debt is the risk-free rate times the amount of the debt. Set this equal to \$17MM

$$17\text{MM} = 6\% * D$$
$$D = 283.3333\text{MM}.$$

b. (6 points) After the debt is issued, what is the market value of the tax shield? To simplify this problem, ignore any possible tax-loss carryforwards or tax-loss carrybacks. (Be careful—do not apply one of the formulas on your notes without thinking about it)

EBIT is 15MM before the debt is issued. EBIT will be negative after the debt is issued. Taxes will not be less than zero (recall we are ignoring tax-loss carrybacks), so the total tax savings are  $15\text{MM} * 0.35 = 5.25\text{MM}/\text{year}$ . This is received every year, therefore its market value is that of a perpetuity with a discount rate equal to the risk-free rate of 6%. The value is  $5.25/0.06 = 87.5\text{MM}$ .

c. (6 points) After the debt is issued, what is the firm's weighted-average cost of capital? (Again, be careful here – you do not have a formula to handle this case.)

There are a variety of ways to solve this problem. One is to explicitly calculate the value of levered equity, which is  $\$1\text{MM}/0.06$  [this comes from  $\$1\text{MM}$  in free cash flow valued as a perpetuity] =  $\$16\frac{2}{3}\text{MM}$ . The amount of debt that fully captures the tax shield is  $\$250\text{MM}$ . Multiply this by 0.06 to get an interest payment of  $\$15\text{MM}$ , which exactly wipes out EBIT. This firm has issued an additional  $\$33\frac{1}{3}\text{MM}$  in debt. The weighted average cost of capital is the weighted average of the cost of capital of these three parts of the capital structure. Since the cash flows are risk-free, everything has a return of 6%. Therefore the wacc is

$$\begin{aligned} \text{Wacc} &= (16\frac{2}{3})/300 * 0.06 + (33\frac{1}{3})/300 * 0.06 + (250)/300 * 0.06 * (1 - 0.35) \\ \text{Wacc} &= 0.0425, \text{ or } 4.25\% \end{aligned}$$

Here is another way. Of the  $\$18\text{MM}$  in EBITDA,  $\$3\text{MM}$  requires a 6% return and  $\$15\text{MM}$  requires a  $6\%(1 - 0.35)$  return after taxes. The average is

$$\text{Wacc} = 3/18 * 0.06 + 15/18 * 0.06 * 0.65 = 0.0425.$$