(*) denotes those problems to be covered in detail during the tutorial session

(*) Problem 1. (Ross, Westerfield & Jaffe) You invest $100,000 in the stock of Liana Rope Company. To make the investment, you borrowed $75,000 from a friend at a cost of 10 percent. You expect your equity investment to return 20 percent. There are no taxes. What would your return be if you did not use leverage?

**Solution:**

You are in fact an entrepreneur who collects funds from equity-holders (yourself) and debt-holders (your friend) and you start a company (portion of Liana Rope). You are interested in the return on unlevered equity, which is the same as return on assets (if the firm has no debt, equity = assets).

In the general case it is true that:

\[
R_{\text{equity}} = R_{\text{assets}} + \left[ R_{\text{assets}} - R_{\text{debt}} \right] \times \frac{D}{E} \times [1 - \text{tax}]
\]

No taxes =>

\[
20 = R_{\text{assets}} + \left[ R_{\text{assets}} - 10 \right] \times \frac{75,000}{25,000} \\
= R_{\text{assets}} \times (1 + 3) - 30
\]

\[
=> R_{\text{assets}} = 50/4 = 12.5 \%
\]

(*) Problem 2. (Ross, Westerfield & Jaffe) Levered, Inc. and Unlevered, Inc. are identical companies with identical business risk. Their earnings are perfectly correlated. Each company is expected to earn $96 million per year in perpetuity, and each company distributes all its earnings. Levered’s debt has a market value of $275 million and provides a return of 8%. Levered’s stock sells for $100 a share, and there are 4.5 million outstanding shares. Unlevered has only 10 million shares outstanding worth $80 each. Unlevered has no debt. There are no taxes. Which stock is a better investment?

**Solution:**

The value of Unlevered (assets = equity) = 80 * 10 million = $800 million = 96 / return (assets, U) => return (assets, U) = 96 / 800 = 12%
Since Unlevered and Levered have the same business risk => same return on assets, the total value of Levered (equity + debt) = \( \frac{96}{0.12} = 800 \) million. Debt (levered) = 275 million => Equity (Levered) has to be equal to 800 – 275 = 525 million but it is not. It is just 4.5 * 100 = 450 million.

Levered’s Equity is undervalued => it is a better investment.

(*) Problem 3. (Ross, Westerfield & Jaffe) Rayburn Manufacturing is currently an all-equity firm. The firm’s equity is worth $2 million and the cost of that equity is 18%. Rayburn pays no taxes. Rayburn plans to issue $400,000 in debt and to use the proceeds to repurchase stock. The cost of debt is 10%.

a. After Rayburn repurchases the stock, what will the firm’s return on assets be? What about the WACC?
b. After the repurchase, what will the cost of equity be?
c. Explain your result in (b).

Solution:

Note that return on assets which is identical to return on unlevered equity (when the firm has no debt) does NOT depend on the capital structure of the firm, but on the riskiness of the business only. This makes answering question (a) very easy.

a. Return on assets after the stock repurchase is the same as before. Before the repurchase, as the firm has no debt, return (assets) = return (unlevered equity) = 18%. Therefore, return on assets after the debt repurchase = 18% as well. Because the firm pays no taxes, WACC = R(assets) = 18%.

b. \( R(levered\ equity) = return\ (assets) + [return(assets) – return(debt)] \times (1 – tax) \times \frac{D}{E} \)

Therefore,

\[
R(levered\ equity) = 18 + (18 – 10) \times 1 \times \frac{400,000}{1,600,000} = 18 + 8 \times 0.25 = 20%
\]

We can now re-answer part (a) as follows:

\[
WACC = (1/5)(10\%) + (4/5)(20\%) = 18\%
\]

Hence, as was noted above, there is no change in WACC as we issue cheaper debt because the required return on equity is rising at the same time.

c. As the company’s leverage increases, return on equity also rises because the risk of equity goes up in the presence of more debt per unit of equity. (Recall that shareholders are residual claimants on the assets of the firm.)
(*) Problem 4. (Ross, Westerfield & Jaffe) The market value of a company with $500,000 debt is $1,700,000. EBIT are expected to be a perpetuity. The pretax interest rate on debt is 10%. The company is in the 34% tax bracket. If the company were 100% equity financed, the equity shareholders would require a 20% return. 

a. What would the value of the firm be if it were financed entirely with equity? 

b. What is the net income to the stockholders of the levered firm?

Solution:

a. Value levered = Value unlevered + Debt * tax rate

Value unlevered = 1,700,000 – 500,000 * 0.34

= 1,700,000 – 170,000 = 1,530,000

b. We need EBIT – Interest – Taxes

EBIT * (1- tax) / R(assets) = EBIT * (1- tax) / R(unlevered equity) = Value unlevered

EBIT * (1 – tax) / 0.20 = 1,530,000

EBIT * (1 – tax) = 1,530,000 * 0.20 = 306,000

EBIT = 306,000 / (1 – 0.34) = 306,000 / 0.66 = 463,636.36

Interest = 0.10 * 500,000 = 50,000

EBT = 463,636.36 – 50,000 = 413,636.36

EAT (earnings to shareholders) = 413,636.36 * 0.66 = 273,000

You could also do this problem using the value of levered company directly. Let’s do this as an illustration:

Value of levered firm = value of equity + value of debt

1,700,000 = (net income of stock holders) + 500,000

return on levered equity

Return on levered equity = return on assets + D/E(return on assets – return on debt)(1-tax)

Therefore, return on equity = 0.2 + 0.5/1.2(0.2-0.1)(0.66) = 0.2275

Hence, 1,200,000*0.2275 = net income of stock holders = 273,000.
Note, that this is the same results that we found earlier.
Problem 5. (Ross, Westerfield & Jaffe) An all-equity firm is subject to a 30-percent corporate tax rate. Its equity holders require a 20-percent return. The firm’s initial market value is $3,500,000, and there are 175,000 shares outstanding. The firm issues $1,000,000 of bonds at 10% and uses the proceeds to repurchase common stock. Assume there is no change in the costs of financial distress for the firm. According to M&M, what is the new market value of the equity of the firm?

Solution:

Just due to the fact that the firm will have debt its value will increase:

Value (levered) = Value unlevered + debt * tax rate
= 3,500,000 + 1,000,000 * 0.3
= 3,800,000

As in the recapitalized firm, debt = 1,000,000
=> new equity value = 3,800,000 –1,000,000 = 2,800,000.

(*) Problem 6. (Ross, Westerfield & Jaffe) Green Manufacturing, Inc. plans to announce that it will issue $2,000,000 of perpetual bonds. The bonds will have a 6-percent coupon rate. Green Manufacturing currently is an all-equity firm. The value of Green’s equity is $10,000,000 and there are 500,000 shares outstanding. The revenue from the sale of the bonds will be entirely used to buy back shares and then Green will maintain the new capital structure indefinitely. The expected annual pre-tax earnings of Green are $1,500,000. Those earnings are also expected to remain constant into the foreseeable future. Green is in the 40-percent tax bracket.

a. What is Green’s current required return on assets?
b. How many shares of stock will Green retire?
c. What is Green’s cost of equity after the capital restructuring?

Solution:

a. Before the restructuring R(assets) = R(unlevered equity) = EAT / Equity
R(assets) = 1,500,000 * (1 – 0.4) / 10,000,000 = 900,000 / 10,000,000 = 9%

b. At the announcement of the reorganization (but before anything is done) the value of the firm will increase with the interest tax shield on the new debt.

Value (new) = Value (old) + tax * Debt = 10 + 0.40 * 2 = 10.8 million

As there are 500,000 shares outstanding, the price of each of them is 10,800,000 / 500,000 = $21.60.
Green Manufacturing has to retire 2,000,000 worth of equity => it has to buy back 2,000,000 / 21.6 = 92,593 shares.

c. After the debt is issued and the proceeds used to buy back 92,593 shares at 21.60, the value of the equity will be 10.8 – 2 = (500,000 – 92,593) * 21.60 = 8.8 million.

\[
R(\text{levered equity}) = R(\text{assets}) + [R(\text{assets}) - R(\text{debt})] \times (1-t) \times D / E
\]
\[
= 9 + (9 - 6) \times (1 - 0.4) \times 2 / 8.8
\]
\[
= 9 + 3 \times 0.6 \times 0.227
\]
\[
= 9.409\%
\]

**Problem 7.** (Ross, Westerfield & Jaffe) The Nikko Company has perpetual EBIT of $4,000,000 per year. The aftertax all-equity discount rate \( R(a) = 15\% \). The company’s tax rate is 35\%. The cost of debt capital is 10 percent, and Nikko has $10 million in debt in its capital structure.

a. What is Nikko’s value?
b. What is Nikko’s WACC?
c. What is Nikko’s cost of equity?

**Solution:**

a. Value company = Value unlevered + tax shield on interest payments = \[
\frac{\text{EBIT} - \text{taxes}}{R(a)} + \text{Debt} \times \text{tax rate} = (4 \times 0.65) / 0.15 + 10 \times 0.35 = 20,833,333
\]

b. We can solve this question in two ways:

\[
\begin{align*}
\text{WACC}_L & = \frac{D}{L} r_D (1-t) + \frac{E}{L} r_E \\
\text{WACC}_L & = \frac{\text{EBIT}(1-t)}{V_L}
\end{align*}
\]

Using (1), we first need to get the return on equity for the levered firm:

\[
R(a) + [R(a) - R(\text{debt})] \times (1-t) \times D / E = 15 + 5 \times 0.65 \times 10 / 10.83 = 18\%
\]

Therefore, the WACC for the firm is:

\[
\begin{align*}
\text{WACC}_L & = \frac{10}{20.833} \times 0.10(1 - 0.35) + \frac{10.833}{20.833} \times 0.18 = 0.1248
\end{align*}
\]

Now, using (2), we can get the same answer more quickly:

\[
\text{WACC}_L = \frac{4,000,000(1-0.35)}{20,833,000} = 0.1248
\]
c. \( R(levered \text{ equity}) = R(a) + [R(a) - R(debt)] \times (1 - t) \times D / E = 15 + 5 \times 0.65 \times 10 / 10.83 = 18\% \)

(*) **Problem 8.** (Ross, Westerfield & Jaffe) Mitsubishi Inc. is a levered firm with a debt-to-equity ratio of 0.25. The beta of common stock is 1.15, while the beta of debt is 0.3. The market-risk premium is 10 percent and the risk-free rate is 6 percent. The corporate tax rate is 35 percent. The SML holds for the company.

a. If the new project of the company has the same risk as the common stock of the firm, what is the cost of equity on the project?
b. If a new project of the company has the same risk as the overall firm, what is the weighted average cost of capital on the project?

**Solution:**

a. To find the cost of equity on the project, we use CAPM and the fact that the beta the project is like that of the firm’s equity, 1.15. 
\[
R(\text{equity}) = 6 + 10 \times 1.15 = 17.5\% 
\]

b. Beta of the project is the same as the beta of the firm, so the WACC of the firm coincides with WACC of the project.

\[
R(\text{equity}) = 17.5\% \text{ from above} \\
R(\text{debt}) = 6 + 10 \times 0.3 = 9\% \\
WACC = R(\text{equity}) \times E / (D + E) + R(\text{debt}) \times (1 - t) \times D / (D + E)
\]

We know that \( D / E = 0.25 \Rightarrow D = 0.25 \times E \Rightarrow D + E = 1.25 \times E \)

\[
WACC = 17.5 \times E / 1.25 \times E + 9 \times 0.65 \times 0.25 \times E / 1.25 \times E \\
= 17.5 \times 0.8 + 9 \times 0.65 \times 0.2 \\
= 14 + 1.17 = 15.17\% 
\]

**Problem 9.** (Ross, Westerfield & Jaffe) Sunrise Industries Corp. is planning to repurchase part of its common stock in the open market by issuing corporate debt. As a result, the debt to equity ratio is expected to rise from 40 percent to 50 percent. The annual interest payment on its outstanding debt amounts to $0.75 million with an interest rate at 10 percent. The expected earnings before interest are $3.75 million. There are no taxes in the country where Sunrise operates. (Treat the debt and earnings as perpetuities to simplify calculation).

a. What is the total value of Sunrise Industries Corp?
b. What is the expected return on equity before and after the announcement of the stock repurchase plan?
c. How would the stock price change at the announcement of the repurchase?
Solution:
a. Interest payment = 0.75 million = Debt * 0.10
   Debt = 0.75 / 0.1 = 7.5 million
D / E = 0.40 before the restructuring
=> E = Debt / 0.40
=> Equity = 18.75 million
Therefore, Value = D + E = 7.5 + 18.75 = 26.25 million
b. Also, Equity = Earnings to shareholders / return (equity)
Earnings to shareholders = Earnings before interest – Interest = 3.75 – 0.75 = 3 million
return (equity) = Earnings / Equity = 3 / 18.75 = 16 % (before repurchase)
After repurchase, in the absence of taxes, the value of the firm will remain 26.25, because the additional interest tax shield is worth zero.
=> Debt = ½ Equity = 1/3 Value = 8.75 million
Interest payments = 0.10 * 8.75 = 0.875
Earnings to shareholders = 3.75 – 0.875 = 2.875 million
Return (equity) = Earnings/ Equity = 2.875 / (8.75 * 2) = 16.4 %
c. In the case of restructuring through share repurchases the stock price rises due to the additional interest tax shield. In the absence of taxes, this shield is worth zero => no change.

Problem 10. (Ross, Westerfield & Jaffe) North Pole Fishing Equipment and South Pole Fishing Equipment Corp. would have identical beta of 1.2 if both of them were all-equity financed. The capital structures of the two firms are as follows:

<table>
<thead>
<tr>
<th></th>
<th>North Pole</th>
<th>South Pole</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debt</td>
<td>$ 1,000,000</td>
<td>$ 1,500,000</td>
</tr>
<tr>
<td>Equity</td>
<td>$ 1,500,000</td>
<td>$ 1,000,000</td>
</tr>
</tbody>
</table>

The expected market rate of return is 12.75% and the 3-month T-bill rate is 4.25 %. Corporate tax rate is 35 % (assume that bond beta is zero).
a. What are the betas of the two firms, respectively?
b. What are the required rates of return on the two firms’ equity?
c. Try to give an intuitive explanation of the different betas and the returns on equity obtained in parts (a) and (b).

Solution:
(a) In general,

\[ \beta_{Equity} = \left[ 1 + \frac{(1-T_c)Debt}{Equity} \right] \beta_{Unlevered~Firm} \]

Therefore,

\[ \beta_{North~Pole} = \left[ 1 + \frac{(1-0.35)1,000,000}{1,500,000} \right]1.2 = 1.72 \]

\[ \beta_{South~Pole} = \left[ 1 + \frac{(1-0.35)1,500,000}{1,000,000} \right]1.2 = 2.37 \]

(b) Just need to apply the CAPM formula here.

\[ R_{North~Pole} = r_f + \beta_{North~Pole} (R_m - R_f) \]

\[ R_{North~Pole} = 4.25\% + 1.72(12.75\% - 4.25\%) = 18.87\% \]

\[ R_{South~Pole} = r_f + \beta_{South~Pole} (R_m - R_f) \]

\[ R_{South~Pole} = 4.25\% + 2.37(12.75\% - 4.25\%) = 24.40\% \]

(c) Beta of South Pole is higher because of its higher leverage even though both firms have the same level of risk in the case of all-equity financing. Therefore, the required rate of return for South Pole is also higher.