LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Corporate Investment Appraisal

Masters in Finance

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Problem Set 7: Capital Structure in the Presence of Corporate Taxes

SOLUTIONS

1. **Estimate the Present Value of the Interest Tax Shield (PV(TaxShield))**

   Your firm currently has $100 million debt at an annual interest rate of 10%. The terms of the loan involve annual repayment of $20 million. Suppose that the marginal tax rate that affects this firm is 40%, and that the debt tax shields have the same risk as the loan. What is the present value of the debt tax shields?

Year	0	1	2	3	4	5
Debt	100	80	60	40	20	0
Interest		10	8	6	4	2
Tax Shield		4	3.2	2.4	1.6	0.8
PV	9.67					

2. **Estimate the Weighted Average Cost of Capital (WACC)**

   Ragu Inc. currently has debt of $1 million, and shares with a market capitalization of $2 million. The firm pays taxes at 36%, the cost of equity is 10% and the cost of debt is 7%.

   a) Calculate Ragu's pretax WACC rate.

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D = \frac{2}{3} 10\% + \frac{1}{3} 7\% = 9\%$$

   b) What is Ragu Inc.' WACC rate?

$$r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{E+D} r_D(1 - T_c) = \frac{2}{3} 10\% + \frac{1}{3} 7\%(1 - 36\%) = 8.16\%$$

3. **Modigliani-Miller Proposition I with Tc**

Millie Industries forecasts an annual FCF of $6 million in perpetuity. Its tax rate is 35% and its unlevered cost of capital is 15%. The firm has debt of $18 million, which it intends to keep permanently.

Data:

$$FCF = \$6\ m \text{ perpetuity}$$
$$T_c = 35\%$$
$$R_U = 15\%$$
$$D = \$18\ m \text{ permanent}$$

a) What would Millie Industries' value be in case it had no debt?

$$V^U_{Millie} = \frac{\$6m}{0.15} = \$40 \text{ million}$$

b) What is Millie Industries' value if financed with debt?

$$V^L_{Millie} = V^U_{Millie} + T_c D = \$40\ m + 0.35 \times \$18\ m = \$46.3 \text{ million}$$

4. **MM with Tc**

KGB Manufacturing is an unlevered company with 20 million shares outstanding with a price of $7.00 each. KGB plans to announce that it will get a loan of $40 million, with the intention of using those funds to repurchase equity. The firm will pay interest on this debt, and has no plans to change its level in the future. KGB's tax rate is 50%.

Data:

$$D = 0$$
$$\#\text{ Shares} = 20 \text{ million}$$
$$\text{Share Price} = \$7.00$$
$$\uparrow D = \$40\ m, \text{ permanent}$$
$$T_c = 50\%$$

a) What is the market value of KGB's assets before the announcement?

$$E = 20m \times \$7.00 = \$140 \text{ m} = \text{Unlevered Value of Assets}$$

b) What is the market value of KGB's assets after issuing debt, but before the repurchase takes place?

Beginning

Assets	140	Debt	0
		Equity	140
Total	140	Total	140

Issues Debt:

Assets	140+20	Debt	40
Cash	40	Equity	140+20
Total	200	Total	200

because PV(ITS) = 0.5*40 = 20

c) What is the price of a share immediately before the repurchase? How many shares will KGB repurchase?

$$Share\ Price = \frac{\$160m}{20m} = \$8.00$$

$$\#Shares\ to\ Repurchase = \frac{\$40m}{\$8.0} = 5\ milion$$

d) What is the stock price after the repurchase?

After the Repurchase:

Assets	160	Debt	40
Cash	0	Equity	120
Total	160	Total	160

$$Share\ Price = \frac{\$120m}{20m - 5m} = \$8.0$$

5. Valuation with the WACC method

Greenday is considering selling one of its factories. It is expected that the factory will generate a FCF of $1.25 million next year, growing at an annual rate of 2%. Greenday's cost of equity is 8.5%, its cost of debt is 6%, its tax rate is 35% and its debt-equity ratio is 2.3. If the risk of this factory is the same as the average risk of the company and Greenday plans to keep the debt-equity ratio constant, for how much should it sell the factory?

Data:

$$FCF_1 = \$1.25\ m; g = 2\%\ per\ year$$
$$R_E = 8.5\%$$
$$R_D = 6\%$$
$$T_c = 35\%$$

$$\frac{D}{E} = 2.3$$

Average Risk, same constant D/E ratio. We can use the WACC method:

$$r_{WACC} = \frac{1}{3.3}8.5\% + \frac{2.3}{3.3}6\%(1 - 0.35) = 5.29\%$$

$$PV = \frac{\$1.25m}{0.0529 - 0.02} = \$37.95\ million$$

6. **Valuation with the WACC method**

Suppose that Lucky Technologies has an equity cost of capital of 12%, market capitalization of $12.8 billion and an enterprise value of $15.4 billion. Suppose also that Lucky's cost of debt is 6.5% and that its marginal tax rate is 35%.

Data:

$$R_E = 12\%$$
$$E = \$12.8\ billion$$
$$E + D = \$15.4\ billion$$
$$R_D = 6.5\%$$
$$T_c = 35\%$$

a) What is Lucky's WACC rate?

$$r_{WACC} = \frac{12.8}{15.4}12\% + \frac{2.6}{15.4}6.5\%(1 - 0.35) = 10.687\%$$

b) If Lucky keeps its debt-equity ratio constant, what is the value of a project with average risk and the following expected cash flows?

Year	0	1	2	3
FCF	-100	70	80	90

$$PV_0 = \frac{70}{1.10687} + \frac{80}{1.10687^2} + \frac{90}{1.10687^3} = 194.90$$

$$NPV_0 = -100 + 194.90 = 94.90 > 0.$$

c) If Lucky keeps its debt-equity ratio as promised, what is the Debt Capacity of the project of question b)?

D/E=2.6/12.8 constant, or D/(D+E)=2.6/15.4=16.88% constant, implies that each period D=0.1688*(PV Total)

Year	0	1	2	3
FCF	-100	70	80	90
PVt	194.90	145.73	81.31	0
Dt=0.1688PVt	32.91	24.60	13.73	0

Why?

At t=0, PV=194.90, D=0.1688*194.90=32.91.

At t=1:

$PV_1 = \frac{80}{1.10687} + \frac{90}{1.10687^2} = 145.73$ and D1=0.1688*145.73=24.60.

Etc…

7. Valuation with the APV method

Consider Lucky's project from question 6.

a) What is Lucky's unlevered cost of capital?

$$R_U = Pre - tax\ WACC = \frac{12.8}{15.4}12\% + \frac{2.6}{15.4}6.5\% = 11.07\%$$

b) What is the unlevered value of the project?

$$V_0^U = \frac{70}{1.1107} + \frac{80}{1.1107^2} + \frac{90}{1.1107^3} = 193.55$$

c) What are the interest tax shields of the project? What is their present value?

d) Year	0	1	2	3
Dt=0.1688PVt	32.91	24.60	13.73	0
Interest =6.5%*Dt-1	0	0.065*32.91 =2.14	1.60	0.89
ITSt=35%*Interest	0	0.75	0.56	0.31

$$PV(ITS) = \frac{0.75}{1.1107} + \frac{0.56}{1.1107^2} + \frac{0.31}{1.1107^3} = 1.36$$

e) Show that Lucky's project's APV corresponds to the value computed using the WACC method.

$$V^L = V^U + PV(ITS) = 193.55 + 1.36 = 194.90$$

8. Valuation with the FTE method

Consider Lucky's project of questions 6 and 7.

a) What are the Free Cash Flows to Equity of the project?

$$FCFE = FCF - AfterTax\ InterestPayment + NetBorrowing$$

#	Year	0	1	2	3
1	FCF	-100	70	80	90
2	Interest =6.5%*Dt-1	0	2.14	1.60	0.89
3	AfterTax Interest =Interest(1-Tc)	0	2.14(1-0.35) =1.39	1.04	0.58
4	Dt	32.91	24.60	13.73	0
5	Net Borrowing	32.91	24.60-32.91= -8.30	-10.88	-13.73
6=1-3+5	FCFE	-67.09	+60.31	+68.08	+75.69

b) Compute the project's NPV using the Flow to Equity method. Compare it to the NPV computed with the WACC method.

$$NPV_0 = -67.09 + \frac{60.31}{1.12} + \frac{68.08}{1.12^2} + \frac{75.69}{1.12^3} = 94.90$$

Same as with WACC method.

9. Changes in the ratio D/E and in the Cost of Capital

Santa and Granny (SG) has historically kept a debt-equity ratio of approximately 0.50. The current share price is $50, with 2.5 billion shares outstanding. The firm faces a stable demand; as a consequence it has a low equity beta (0.60) and can issue debt at a rate of 4.20%, just 20 basis points higher than the risk-free interest rate of 4%. The expected return of the market is 11% and SG's income tax rate is 30%.

Data:

$$\frac{D}{E} = 0.5$$
$$Share\ Price = \$50$$
$$\#\ Shares = 2.5\ billion$$
$$\beta_E = 0.6$$
$$R_D = 4.20\%$$
$$R_F = 4\%$$
$$E(R_M) = 11\%$$
$$T_C = 30\%$$

a) This year SG expects a free cash flow of $6.5 billion. What constant annual growth rate for the FCF would be consistent with the stock price?

Data:

$FCF_1 = \$6.5\ billion;\ g = ?$

$$r_E = 4\% + 0.6(11\% - 4\%) = 8.2\%$$

$$r_{WACC} = \frac{1}{1.5}8.2\% + \frac{0.5}{1.5}4.2\%(1 - 0.3) = 6.45\%$$

$$E = \$50 \times 2.5\ billion = \$125\ billion$$

$$D = 0.5E = 0.5 \times \$125\ billion = \$62.5\ billion$$

$$E + D = \$187.5\ billion$$

$$\$187.5\ billion = \frac{\$6.5\ billion}{0.0645 - g}$$

$$g = 2.98\%$$

b) SG believes it could increase leverage without creating bankruptcy risk or other costs. With a higher debt-equity ratio of 0.75, the firm is convinced that the cost of debt would slightly increase to 4.50%. If SG announces that it will implement this restructuring through a leveraged recap, determine the increase in stock price that would result from the additional tax savings.

Data: Leveraged Recapitalization $\frac{D}{E} = 0.75$; $R_D = 4.50\%$

With Initial Data compute Ru (using MM prop II) or PretaxWacc:

$$PreTax\ WACC = \frac{1}{1.5}8.2\% + \frac{0.5}{1.5}4.2\% = 6.87\%$$

With the New Capital Structure, re-estimate the levered cost of equity, the wacc rate and the enterprise (present) value of PG:

$$R_E = 6.87\% + 0.75(6.87\% - 4.5\%) = 8.64\%$$

$$r_{WACC} = \frac{1}{1.75}8.64\% + \frac{0.75}{1.75}4.5\%(1 - 0.3) = 6.29\%$$

$$PV = \frac{\$6.5\ billion}{0.0629 - 0.0298} = \$196.49\ billion$$

Enterprise Value increases by $8.99 billion (corresponds to the increment in PV(ITS) due to more debt), which would make the stock price (when the cash of the additional loan entered) rise to:

$$Stock\ Price = \frac{\$125\ billion + \$8.99\ billion}{2.5\ billion} = \$53.6$$

10. Pre-Determined Debt level

On your way to an important meeting regarding an investment project, you review the analysis performed by a trainee in the finance department:

Observing the spreadsheet, you understand that the cash flows are correct, but that your trainee used the FTE method, discounting the FCFE at the *firm's* equity cost of capital.

	0	1	2	3	4
EBIT		10.0	10.0	10.0	10.0
Interest (5%)		–4.0	–4.0	–3.0	–2.0
Earnings Before Taxes		6.0	6.0	7.0	8.0
Taxes		–2.4	–2.4	–2.8	–3.2
Depreciation		25.0	25.0	25.0	25.0
Cap Ex	–100.0				
Additions to NWC	–20.0				20.0
Net New Debt	80.0	0.0	–20.0	–20.0	–40.0
FCFE	–40.0	28.6	8.6	9.2	9.8
NPV at 11% Equity Cost of Capital	5.9				

However, the debt associated with this project differs substantially from the historical debt-equity ratio of the firm (0.40). For this project, the firm will get an upfront loan of $80 million, repaying $20 million in year2, $20 million in year 3, and $40 million in year 4.

Therefore, the equity cost of capital of the project will probably be higher that the firm's, and will not be constant over time – invalidating the computations presented in the table above. Clearly the FTE method is not the most appropriate one.

Data:

$$\frac{D^{Firm}}{E} = 0.4$$

$$D_0 = \$80\ m;\ D_1 = \$80\ m;\ D_2 = \$60\ m;\ D_3 = \$40\ m;\ D_4 = \$0$$

$$T_C = 40\%$$

a) What is the present value of the interest tax shield associated to this project?

Pre-Determined Debt Levels, $R_{TaxShield} = R_D = 5\%$

Year	0	1	2	3	4
Interest=5%*D_{t-1}	0	4	4	3	2
ITSt=40%*Interest	0	1.6	1.6	1.2	0.8

$$PV(ITS) = \frac{1.6}{1.05} + \frac{1.6}{1.05^2} + \frac{1.2}{1.05^3} + \frac{0.8}{1.05^4} = \$4.67\ million$$

b) What are the free cash flows of the project?

FCF = EBIT (1-Tc)+Depreciation-CapEx-Increases in NWC

#	Year	0	1	2	3	4
1	EBIT		10	10	10	10
2	EBIT(1-Tc)		6	6	6	6
3	Deprec.		25	25	25	25
4	CapEx	100				
5	Change in NWC	20				-20
6=2+3-4-5	FCF	-120	31	31	31	51

c) With the information we have, what is the best estimate of the value of the project?

Using the APV Method:

$$R_U = \frac{1}{1.4}11\% + \frac{0.4}{1.4}5\% = 9.29\%$$

$$V^U = \frac{31}{1.0929} + \frac{31}{1.0929^2} + \frac{31}{1.0929^3} + \frac{51}{1.0929^4} = \$113.81\ million$$

$$V^L = 113.81 + 4.67 = \$118.48\ million$$

$$NPV = -120 + 118.48 = -\$1.52\ million$$