GESTÃO FINANCEIRA II

PROBLEM SET 5 – SOLUTIONS

(FROM BERK AND DEMARZO'S "CORPORATE FINANCE")

LICENCIATURA – UNDERGRADUATE COURSE

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Chapter 18
Capital Budgeting and Valuation with Leverage

18-4. Suppose Goodyear Tire and Rubber Company is considering divesting one of its manufacturing plants. The plant is expected to generate free cash flows of \$1.5 million per year, growing at a rate of 2.5% per year. Goodyear has an equity cost of capital of 8.5%, a debt cost of capital of 7%, a marginal corporate tax rate of 35%, and a debt-equity ratio of 2.6. If the plant has average risk and Goodyear plans to maintain a constant debt-equity ratio, what after-tax amount must it receive for the plant for the divestiture to be profitable?

We can compute the levered value of the plant using the WACC method. Goodyear's WACC is

$$r_{wacc} = \frac{1}{1+2.6}8.5\% + \frac{2.6}{1+2.6}7\%(1-0.35) = 5.65\%.$$

Therefore, $V^L = \dfrac{1.5}{0.0565-0.025} = \$47.6$ million

A divestiture would be profitable if Goodyear received more than \$47.6 million after tax.

18-5. Suppose Lucent Technologies has an equity cost of capital of 10%, market capitalization of \$10.8 billion, and an enterprise value of \$14.4 billion. Suppose Lucent's debt cost of capital is 6.1% and its marginal tax rate is 35%.

a. What is Lucent's WACC?

b. If Lucent maintains a constant debt-equity ratio, what is the value of a project with average risk and the following expected free cash flows?

Year	0	1	2	3
FCF	–100	50	100	70

c. If Lucent maintains its debt-equity ratio, what is the debt capacity of the project in part (b)?

a. $r_{wacc} = \dfrac{10.8}{14.4}10\% + \dfrac{14.4-10.8}{14.4}6.1\%(1-0.35) = 8.49\%$

b. Using the WACC method, the levered value of the project at date 0 is

$$V^L = \frac{50}{1.0849} + \frac{100}{1.0849^2} + \frac{70}{1.0849^3} = 185.86.$$

Given a cost of 100 to initiate, the project's NPV is 185.86 – 100 = 85.86.

c. Lucent's debt-to-value ratio is d = (14.4 – 10.8) / 14.4 = 0.25. The project's debt capacity is equal to d times the levered value of its remaining cash flows at each date.

Year	**0**	**1**	**2**	**3**
FCF	–100	50	100	70
VL	185.86	151.64	64.52	0
D = d*VL	46.47	37.91	16.13	0.00

18-6. **Acort Industries has 10 million shares outstanding and a current share price of $40 per share. It also has long-term debt outstanding. This debt is risk free, is four years away from maturity, has annual coupons with a coupon rate of 10%, and has a $100 million face value. The first of the remaining coupon payments will be due in exactly one year. The riskless interest rates for all maturities are constant at 6%. Acort has EBIT of $106 million, which is expected to remain constant each year. New capital expenditures are expected to equal depreciation and equal $13 million per year, while no changes to net working capital are expected in the future. The corporate tax rate is 40%, and Acort is expected to keep its debt-equity ratio constant in the future (by either issuing additional new debt or buying back some debt as time goes on).**

a. Based on this information, estimate Acort's WACC.

b. What is Acort's equity cost of capital?

a. We don't know Acort's equity cost of capital, so we cannot calculate WACC directly. However, we can compute it indirectly by estimating the discount rate that is consistent with Acort's market value. First, E = 10 × 40 = $400 million. The market value of Acort's debt is

$$D = 10 \times \frac{1}{0.06}\left(1 - \frac{1}{1.06^4}\right) + \frac{100}{1.06^4} = \$113.86 \text{ million.}$$

Therefore, Acort's enterprise value is E + D = 400 + 113.86 = 513.86.

Acort's FCF = EBIT×(1 − τ_C) + Dep – Capex – Inc in NWC

FCF = 106 × (1 – 0.40) = 63.6

Because Acort is not expected to grow,

$$V^L = 513.86 = \frac{63.6}{r_{wacc}} \text{ and so } r_{wacc} = \frac{63.6}{513.86} = 12.38\%.$$

b. Using $r_{wacc} = \frac{E}{E+D} r_E + \frac{D}{D+E} r_D (1-\tau_c)$,

$$12.38\% = \frac{400}{513.86} r_E + \frac{113.86}{513.86} 6\%(1-0.40)$$

solving for r_E:

$$r_E = \frac{513.86}{400}\left[12.38\% - \frac{113.86}{513.86} 6\%(1-0.40)\right] = 14.88\%.$$

18-8. **You are a consultant who was hired to evaluate a new product line for Markum Enterprises. The upfront investment required to launch the product line is $10 million. The product will generate free cash flow of $750,000 the first year, and this free cash flow is expected to grow at a rate of 4% per year. Markum has an equity cost of capital of 11.3%, a debt cost of capital of 5%, and a tax rate of 35%. Markum maintains a debt-equity ratio of 0.40.**

a. What is the NPV of the new product line (including any tax shields from leverage)?

b. How much debt will Markum initially take on as a result of launching this product line?

c. How much of the product line's value is attributable to the present value of interest tax shields?

a. WACC = (1 / 1.4)(11.3%) + (.4 / 1.4)(5%)(1 – .35) = 9%

V^L = 0.75 / (9% – 4%) = $15 million

NPV = -10 + 15 = $5 million

b. Debt-to-Value ratio is (0.4) / (1.4) = 28.57%.

Therefore Debt is 28.57% × $15 million = $4.29 million.

c. Discounting at r_u gives unlevered value. r_u = (1 / 1.4)11.3% + (.4 / 1.4)5% = 9.5%

V^u = 0.75 / (9.5% – 4%) = $13.64 million

Tax shield value is therefore 15 – 13.64 = 1.36 million.

Alternatively, initial debt is $4.29 million, for a tax shield in the first year of 4.29 × 5% × 0.35 = 0.075 million. Then PV(ITS) = 0.075 / (9.5% – 4%) = 1.36 million.

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18-9. Consider Lucent's project in Problem 5.

a. What is Lucent's unlevered cost of capital?

b. What is the unlevered value of the project?

c. What are the interest tax shields from the project? What is their present value?

d. Show that the APV of Lucent's project matches the value computed using the WACC method.

a. $$r_U = \frac{10.8}{14.4}10\% + \frac{14.4-10.8}{14.4}6.1\% = 9.025\%$$

b. $$V^U = \frac{50}{1.09025} + \frac{100}{1.09025^2} + \frac{70}{1.09025^3} = 184.01$$

c. Using the results from problem 5(c):

Year	0	1	2	3
FCF	–100	50	100	70
VL	185.86	151.64	64.52	0
D = d*VL	46.47	37.91	16.13	0.00
Interest		2.83	2.31	0.98
Tax Shield		0.99	0.81	0.34

The present value of the interest tax shield is

$$PV(ITS) = \frac{0.99}{1.09025} + \frac{0.81}{1.09025^2} + \frac{0.34}{1.09025^3} = 1.85$$

d. V^L = APV = 184.01 + 1.85 = 185.86

This matches the answer in problem 5.

18-10. Consider Lucent's project in Problem 5.

a. What is the free cash flow to equity for this project?

b. What is its NPV computed using the FTE method? How does it compare with the NPV based on the WACC method?

a. Using the debt capacity calculated in problem 5, we can compute FCFE by adjusting FCF for after-tax interest expense ($D \times r_D \times (1 - tc)$) and net increases in debt ($D_t - D_{t-1}$).

Year	0	1	2	3
D	46.47	37.91	16.13	0.00
FCF	-$100.00	$50.00	$100.00	$70.00
After-tax Interest Exp.	$0.00	-$1.84	-$1.50	-$0.64
Inc. in Debt	$46.47	-$8.55	-$21.78	-$16.13
FCFE	-$53.53	$39.60	$76.72	$53.23

b. $\text{NPV} = -53.53 + \dfrac{39.60}{1.10} + \dfrac{76.72}{1.10^2} + \dfrac{53.23}{1.10^3} = \$85.86$

18-12. Prokter and Gramble (PG) has historically maintained a debt-equity ratio of approximately 0.20. Its current stock price is $50 per share, with 2.5 billion shares outstanding. The firm enjoys very stable demand for its products, and consequently it has a low equity beta of 0.50 and can borrow at 4.20%, just 20 basis points over the risk-free rate of 4%. The expected return of the market is 10%, and PG's tax rate is 35%.

a. This year, PG is expected to have free cash flows of $6.0 billion. What constant expected growth rate of free cash flow is consistent with its current stock price?

b. PG believes it can increase debt without any serious risk of distress or other costs. With a higher debt-equity ratio of 0.50, it believes its borrowing costs will rise only slightly to 4.50%. If PG announces that it will raise its debt-equity ratio to 0.5 through a leveraged recap, determine the increase in the stock price that would result from the anticipated tax savings.

a. E = $50 × 2.5 B = $125 B

D = 0.20 × 125 B = $25 B

V^L = E +D = $150 B

From CAPM: Equity Cost of Capital = 4% + 0.5(10% – 4%) = 7%

WACC = (125 / 150) 7% + (25 / 150) 4.2% (1 – 35%) = 6.29%

$V^L = FCF/(r_{wacc} - g) \Rightarrow g = r_{wacc} - FCF/V = 6.29\% - 6/150 = 2.29\%$

b. Initial Unlevered cost of capital (Eq. 18.6) = (125 / 150) 7% + (25 / 150) 4.2% = 6.53%

New Equity cost of capital (Eq. 18.10) = 6.53% + (.5)(6.53% – 4.5%) = 7.55%

New WACC = (1 / 1.5) 7.55% + (.5 / 1.5) 4.5% (1 – 35%) = 6.01%

$V^L = FCF / (r_{wacc} - g) = 6.0 / (6.01\% - 2.29\%) = 161.29$

This is a gain of 161.29 – 150 = $11.29 B or 11.29/2.5 = $4.52 per share.

Thus, share price rises to $54.52/share.

18-17. You are on your way to an important budget meeting. In the elevator, you review the project valuation analysis you had your summer associate prepare for one of the projects to be discussed:

	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				

Looking over the spreadsheet, you realize that while all of the cash flow estimates are correct, your associate used the flow-to-equity valuation method and discounted the cash flows using the *company's* equity cost of capital of 11%. However, the project's incremental leverage is very different from the company's historical debt-equity ratio of 0.20: For this project, the company will instead borrow \$80 million upfront and repay \$20 million in year 2, \$20 million in year 3, and \$40 million in year 4. Thus, the *project's* equity cost of capital is likely to be higher than the firm's, not constant over time—invalidating your associate's calculation.

Clearly, the FTE approach is not the best way to analyze this project. Fortunately, you have your calculator with you, and with any luck you can use a better method before the meeting starts.

a. What is the present value of the interest tax shield associated with this project?

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

c. What is the best estimate of the project's value from the information given?

a. First,

Interest Payment = Interest Rate (5%) × Prior period debt

From the tax calculation in the spreadsheet, we can see that the tax rate is 2.4/6 = 40%. Therefore,

Interest Tax shield = Interest Payment × Tax Rate (40%)

Because the tax shields are predetermined, we can discount them using the 5% debt cost of capital.

$$\text{PV(ITS)} = \frac{0.40(0.05)(80)}{1.05} + \frac{0.40(0.05)(80)}{1.05^2} + \frac{0.40(0.05)(60)}{1.05^3} + \frac{0.40(0.05)(40)}{1.05^4}$$
$$= \$4.67 \text{ million}$$

	Year 0	Year 1	Year 2	Year 3	Year 4
Debt	80	80	60	40	0
Interest at 5.0%		4	4	3	2
Tax shield 40.0%		1.6	1.6	1.2	0.8
PV 5.0%	\$4.67				

b. We can use Eq. 7.5:

	0	1	2	3	4
EBIT		10	10	10	10
Taxes		-4	-4	-4	-4
Unlevered Net Income		6	6	6	6
Depreciation		25	25	25	25
Cap Ex	-100				
Additions to NWC	-20				20
FCF	-120	31	31	31	51

FCF = EBIT × (1 – T_c) + Depreciation – CapEx – ΔNWC

Alternatively, we can use Eq. 18.9:

FCF = FCFE + Int×(1 – T_C) – Net New Debt

	Year 0	Year 1	Year 2	Year 3	Year 4
FCFE	-40	28.6	8.6	9.2	9.8
+ After-tax Interest		2.4	2.4	1.8	1.2
- Net New Debt	-80	0	20	20	40
FCF	-120	31	31	31	51

c. With predetermined debt levels, the APV method is easiest.

Step 1: Determine r_U. Assuming the company has maintained a historical D/E ratio of 0.20, we can approximate its unlevered cost of capital using Eq. 18.6:

$$r_U = (1 / 1.2)\ 11\% + (.2 / 1.2)\ 5\% = 10\%$$

Step 2: Compute NPV of FCF without leverage

$$\text{NPV} = -120 + \frac{31}{1.10} + \frac{31}{1.10^2} + \frac{31}{1.10^3} + \frac{51}{1.10^4} = -8.1$$

Step 3: Compute APV

$$APV = NPV + PV(ITS) = -8.1 + 4.7 = -3.4$$

So the project actually has negative value.

Chapter 15
Debt and Taxes

15-20. Suppose the corporate tax rate is 40%, and investors pay a tax rate of 15% on income from dividends or capital gains and a tax rate of 33.3% on interest income. Your firm decides to add debt so it will pay an additional \$15 million in interest each year. It will pay this interest expense by cutting its dividend.

a. How much will debt holders receive after paying taxes on the interest they earn?

b. By how much will the firm need to cut its dividend each year to pay this interest expense?

c. By how much will this cut in the dividend reduce equity holders' annual after-tax income?

d. How much less will the government receive in total tax revenues each year?

e. What is the effective tax advantage of debt τ^*?

a. \$15 × (1 – .333) = \$10 million each year

b. Given a corporate tax rate of 40%, an interest expense of \$15 million per year reduces net income by 15(1 – .4) = \$9 million after corporate taxes.

c. \$9 million dividend cut ⇒ \$9 × (1 – .15) = \$7.65 million per year.

d. Interest taxes = .333 × 15 = \$5 million

Less corporate taxes = .40 × 15 = \$6 million

Less dividend taxes = .15 × 9 = \$1.35 million

⇒ Govt tax revenues change by 5 – 6 – 1.35 = \$2.35 million

(Note this equals (a) – (c)).

e. $$\tau^* = 1 - \frac{(1-0.40)(1-0.15)}{1-0.333} = 23.5\%$$

15-22. Markum Enterprises is considering permanently adding \$100 million of debt to its capital structure. Markum's corporate tax rate is 35%.

a. Absent personal taxes, what is the value of the interest tax shield from the new debt?

b. If investors pay a tax rate of 40% on interest income, and a tax rate of 20% on income from dividends and capital gains, what is the value of the interest tax shield from the new debt?

a. PV = $\tau_C D$ = 35% × 100 = \$35 million.

b. $$\tau^* = 1 - \frac{(1-0.35)(1-0.20)}{1-0.40} = 13.33\%$$

PV = $\tau_C D$ = 13.33% × 100 = \$13.33 million

Chapter 16

Financial Distress, Managerial Incentives, and Information

16-13. Your firm is considering issuing one-year debt, and has come up with the following estimates of the value of the interest tax shield and the probability of distress for different levels of debt:

	Debt Level ($ million)						
	0	40	50	60	70	80	90
PV (interest tax shield, $ million)	0.00	0.76	0.95	1.14	1.33	1.52	1.71
Probability of Financial Distress	0%	0%	1%	2%	7%	16%	31%

Suppose the firm has a beta of zero, so that the appropriate discount rate for financial distress costs is the risk-free rate of 5%. Which level of debt above is optimal if, in the event of distress,the firm will have distress costs equal to

a. $2 million?

b. $5 million?

c. $25 million?

a. 80

b. 60

c. 40

	Debt Level ($ million)								Tax
	0	40	50	60	70	80	90		40%
PV(interest tax shield)	0.00	0.76	0.95	1.14	1.33	1.52	1.71		Vol
Prob(Financial Distress)	0%	0%	1%	2%	7%	16%	31%		20%
Distress Cost	5	5	5	5	5	5	5		Rf
PV(distress cost)	0.00	0.00	0.05	0.10	0.33	0.76	1.48		5%
Gain	0.00	0.76	0.90	1.05	1.00	0.76	0.24		
Optimal Debt		60							

16-20. Zymase is a biotechnology start-up firm. Researchers at Zymase must choose one of three different research strategies. The payoffs (after-tax) and their likelihood for each strategy are shown below. The risk of each project is diversifiable.

Strategy	Probability	Payoff ($ million)
A	100%	75
B	50%	140
	50%	0
C	10%	300
	90%	40

a. Which project has the highest expected payoff?

b. Suppose Zymase has debt of $40 million due at the time of the project's payoff. Which project has the highest expected payoff for equity holders?

c. Suppose Zymase has debt of $110 million due at the time of the project's payoff. Which project has the highest expected payoff for equity holders?

d. If management chooses the strategy that maximizes the payoff to equity holders, what is the expected agency cost to the firm from having $40 million in debt due? What is the expected agency cost to the firm from having $110 million in debt due?

a. E(A) = $75 million

E(B) = 0.5 × 140 = $70 million

E(C) = 0.1 × 300 + 0.9 × 40 = $66 million

Project A has the highest expected payoff.

b. E(A) = 75 – 40 = $35 million

E(B) = 0.5 × (140 – 40) = $50 million

E(C) = 0.1 × (300 –40) + 0.9 × (40 – 40) = $26 million

Project B has the highest expected payoff for equity holders.

c. E(A) =$0 million

E(B) = 0.5 × (140 – 110) = $15 million

E(C) = 0.1 × (300 –110) = $19 million

Project C has the highest expected payoff for equity holders.

d. With $40 million in debt, management will choose project B, which has an expected payoff for the firm that is 75 – 70 = $5 million less than project A. Thus, the expected agency cost is $5 million.

With $110 million in debt, management will choose project C, resulting in an expected agency cost of 75 – 66 = $9 million.

16-30. "We R Toys" (WRT) is considering expanding into new geographic markets. The expansion will have the same business risk as WRT's existing assets. The expansion will require an initial investment of $50 million and is expected to generate perpetual EBIT of $20 million per year. After the initial investment, future capital expenditures are expected to equal depreciation, and no further additions to net working capital are anticipated.
WRT's existing capital structure is composed of $500 million in equity and $300 million in debt (market values), with 10 million equity shares outstanding. The unlevered cost of

capital is 10%, and WRT's debt is risk free with an interest rate of 4%. The corporate tax rate is 35%, and there are no personal taxes.

a. **WRT initially proposes to fund the expansion by issuing equity. If investors were not expecting this expansion, and if they share WRT's view of the expansion's profitability, what will the share price be once the firm announces the expansion plan?**

b. **Suppose investors think that the EBIT from WRT's expansion will be only $4 million. What will the share price be in this case? How many shares will the firm need to issue?**

c. **Suppose WRT issues equity as in part (b). Shortly after the issue, new information emerges that convinces investors that management was, in fact, correct regarding the cash flows from the expansion. What will the share price be now? Why does it differ from that found in part (a)?**

d. **Suppose WRT instead finances the expansion with a $50 million issue of permanent riskfree debt. If WRT undertakes the expansion using debt, what is its new share price once the new information comes out? Comparing your answer with that in part (c), what are the two advantages of debt financing in this case?**

a. NPV of expansion $= 20 \times \frac{0.65}{0.1} - 50 = \$80$ million

Equity value $= \frac{500+80}{10} = \$58 / \text{share}$

b. NPV of expansion $= 4 \times \frac{0.65}{0.1} - 50 = -\$24$ million share price $= \frac{500-24}{10} = \$47.6 / \text{share}$

New shares $= \frac{50}{47.6} = 1.05$ million shares

c. Share price $= \frac{500+50+80}{11.05} = \$57 / \text{share}$

The share price is now lower than the answer from part (a), because in part (a), share price is fairly valued, while here shares issued in part (b) are undervalued. New shareholders' gain of $(57-47.6) \times 1.05 = \$10$ million = old shareholders' loss of (58 – 57) × 10.

d. Tax shield = 35%(50) = $17.5 million

Share price $= \frac{500+50+80+17.50-50}{10} = \$59.75$ per share.

Gain of $2.75 per share compared to case (c). $1 = avoid issuing undervalued equity, and $1.75 from interest tax shield.