LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

Corporate Investment Appraisal

Masters in Finance

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Problem Set 8:
Capital Structure: Personal Taxes, Costs of Financial Distress, Agency Problems, Asymmetric Information
TO CHECK AT HOME

1. Personal Taxes

Markum Enterprises considers a permanent increase in its debt of $100 million. The tax rate on Markum's income is 35%.

a. Without considering personal taxes, what is the present value of the interest tax shield of the new debt?

This being a permanent level of debt:

$$PV(ITS) = T_C \times D = 0.35 \times \$100 = \$35\ million.$$

b. If investors pay a tax rate of 40% on income from bonds and a tax rate of 20% on income from shares (dividends and capital gains), what is the present value of the interest tax shield?

Considering personal taxes:

$$PV(ITS) = \left[1 - \frac{(1-T_C)\times(1-T_E)}{(1-T_i)}\right] D =$$

$$= \left[1 - \frac{(1-0.35)\times(1-0.2)}{(1-0.4)}\right] \times \$100 = \$13.33\ million.$$

2. Trade-off Theory: Interest Tax Shield and Financial Distress Costs

Suppose that your company considers issuing debt with maturity of 1 year, having reached the following estimates of interest tax shield and probability of financial 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 company has a beta equal to zero, which justifies discounting the costs of financial distress at a risk-free rate of 5%. What is the optimal level of debt, assuming a loss of $5 million when financial distress occurs?

We must trade-off the benefit of debt (taxes and the interest tax shield) with the costs of financial distress, recalling:

$$V^L = V^U + PV(ITS) - PV(Costs\ of\ Financial\ Distress)$$

Loss in case of Distress	$ 5,00	million
R	5%	
Tc (by assumption)	40%	

Debt	0	40	50	60	70	80	90
PV(ITS)	0	0,761905	0,952381	1,142857	1,333333	1,52381	1,714286
Probability of Financial Distress	0%	0%	1%	2%	7%	16%	31%
PV (Financial Distress Costs)	0	0	0,047619	0,095238	0,333333	0,761905	1,47619
PV(ITS) - PV(FDC)	0	0,761905	0,904762	1,047619	1	0,761905	0,238095

Optimal Level

$$PV(ITS\ when\ D = 50) = \frac{0.4 \times 5\% \times 50}{1 + 5\%} = 0.952\ million$$

$$\boldsymbol{PV(FDC\ when\ D = 80) = \frac{0.16 \times 5}{1 + 5\%}}$$

3. Agency Costs of Debt

Zymase is a start-up in the biotechnology industry. Zymase researchers must choose one of three research strategies. The (after tax) payoffs and their probabilities are described in the following table. Each project's risk 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?

Project A has the highest expected payoff:

$$Expected\ Payoff(A) = \$75\ million$$

$$Expected\ Payoff\ (B) = 0.5\times140 + 0.5\times0 = \$70\ million$$

$$Expected\ Payoff(C) = 0.1\times300 + 0.9\times40 = \$66 million$$

b. Suppose Zymase has debt of $40 million maturing when the payoff is realized. Which project has the highest expected payoff from the point of view of the shareholders?

Strategy	Probability	Payoff	Creditors	Shareholders
A	100%	75	40	35
B	50%	140	40	100
B	50%	0	0	0
C	10%	300	40	260
C	90%	40	40	0

$$Expected\ Payoff\ for\ Shareholders\ (A) = 35$$

$$Expected\ Payoff\ for\ Shareholders(B) = 0.5\times100 + 0.5\times= 50$$

$$Expected\ Payoff\ for\ Shareholders\ (C) = 0.1\times260 + 0.9\times= 26$$

From the shareholders point of view, the project with the largest expected payoff is Project B.

c. Suppose now that Zymase has debt of $110 million. Which projecthas the highest expected payoff from the shareholders' point of view?

Strategy	Probability	Payoff	Creditors	Shareholders
A	100%	75	75	0
B	50%	140	110	30
B	50%	0	0	0
C	10%	300	110	190
C	90%	40	40	0

$$Expected\ Payoff\ for\ Shareholders\ (A) = 0$$
$$Expected\ Payoff\ for\ Shareholders\ (B) = 0.5\times 30 + 0.5\times 0 = 15$$
$$Expected\ Payoff\ for\ Shareholders\ (C) = 0.1\times 190 + 0.9\times = 19$$

From the shareholders' viewpoint, the project with the highest expected payoff is Project C.

d. If the company chooses the strategy preferred by its shareholders, what is the agency cost of having debt of $40 million? And the value of this cost if debt were $110 million?

In this example, the agency cost consists in the global loss associated with choosing sub-optimal projects in terms of value generation.

In case D=$40 m, the agency cost of debt is the loss associated with choosing project B instead f project A: 75-70=$5 million.

In case D=$110 m, the agency cost is the loss from choosing project C instead of project A: 75-66=$9 million.

4. Asymmetric Information: Pecking order theory

WRT considers expanding into new geographic areas. Expansion implies the same business risk that the firm currently has. The expansion implies an initial investment of $50 million and is expected to generate a perpetual annual EBIT of $20 million. After the initial investment, capex will be equal to depreciation and we expect no changes in net working capital.

WRT's capital structure currently corresponds to $500 million equity and $300 million debt (market values), for a total of 10 million shares outstanding. The unlevered cost of capital of WRT is 10%, and debt is riskless, with a cost of 4%. The tax rate on corporate income is 35%, and there are no personal taxes.

Data about the Expansion:

$$Initial\ Investment = \$50\ m$$
$$EBIT = \$20m; perpetuity$$
$$FCF_t = EBIT(1 - T_C); t > 0$$

Data about WRT corporation:

$$E = \$500m$$
$$\#\ of\ Shares = 10m$$
$$Share\ Price = \$50$$
$$D = \$300m$$
$$R_U = 10\%$$
$$R_D = R_F = 4\%$$
$$T_C = 35\%$$

a. Initially WRT proposes to finance the expansion with an equity offering. If, before, shareholders did not anticipate this expansion, and if they share the

corporation's expectations about the profitability of this project, what is the expected share price after the announcement?

$$NPV(Expansion) = -50 + \frac{20(1-0.35)}{0.1} = -50 + 130 = \$80\ million$$

This NPV should "belong" to the old shareholders. We would expect the market capitalization to rise immediately in order to reflect this increase in value to old shareholders:

$$Total\ Value\ Old\ Shareholders = \$500 + \$80 = \$580\ million$$

The stock price would increase:

$$Share\ Price = \frac{\$580\ m}{10m} = \$58$$

b. Suppose now that investors think that the annual EBIT associated with the expansion would be only $4 million. What would the share price be in this case? What number of shares would WRT have to issue?

$$EBIT = \$4\ m$$

$$NPV(Expansion) = -50 + \frac{4(1-0.35)}{0.1} = -50 + 26 = -\$24\ million$$

The expected loss in value would be reflected in theprice of "old" shares:

$$Total\ Value\ Old\ Shareholders = \$500 - \$24 = \$476\ million$$

$$Share\ Price = \frac{\$476\ m}{10m} = \$47.60$$

The number of shares required to raise the $50 million:

$$\#\ New\ Shares = \frac{\$50million}{\$47.60} = 1.05\ million$$

c. Suppose WRT issues shares as described in part b. A little after the issue, new data arrives that convinces investors that WRT's managers were initially right in the projection of annual EBIT equal to $20 million. What is the new share price? Compare it to the price in part a.

We find later that, effectively, EBIT=$20 million. The market capitalization will then increase to:

$$Market\ Capitalization = E = \$500 + \$50 + \$80 = \$630\ million$$

The stock price will also increase:

$$Share\ Price = \frac{\$630\ m}{10m + 1.05m} = \$57$$

This stock price is lower than the one in part (a) because at the time of the equity offering the new shares were undervalued, with excessive dilution of the old shareholders' equity.

d. Suppose that, in the end, WRT decides to finance the project with na issuance of $50million risk-free debt. What is the share price in this case? What is the advantage of issuing debt in these circumstances?

With Debt of $50 million we have the usual advantage of the Interest Tax Shield:

PV(ITS)=TcD=0.35($50)=$17.5 million.

Besides, in the situation described in part b) we have the additional advantage of no dilution effect in the equity of the firm. At the time of issue, if the market expects EBIT=$4 million:

$$NPV(Expansion) = -50 + \frac{4(1-0.35)}{0.1} + 0.35\times\$50$$
$$= -50 + 26 + 17.5 = -\$6.5\ million$$

We would find a lower decrease in the market capitalization (versus $476 milhões):

$$Market\ Capitalization = E = \$500 - \$6.5 = \$493.5\ million$$

And in the share price (versus $47.6):

$$Share\ Price = \frac{\$493.5\ m}{10m} = \$49.35$$

Finally, when the market revises upwards the estimate of EBIT to $20 million, the capitalization would go up (compared to $630 million of part d, but without having experienced the rise in equity and in the number of shares):

$$Market\ Capitalization = E$$
$$= \$500 + (-50 + \frac{20(1-0.35)}{0.1} + 0.35\times 50)$$
$$= \$597.5\ million$$

The stock price would also go up (compared to $57) not just because of the interest tax shield ($1.75 per share), but also due to the no-dilution of equity capital when shares were undervalued ($1 per share):

$$Share\ Price = \frac{\$597.5\ m}{10m} = \$59.75$$