

# **FIN 521: Problem Set #3**

Due on Wednesday, April 11, 2018

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## Question 1

- a. Since the risk is idiosyncratic, discount rate of the firm is 0. Because all the possibilities of future value is equally likely, Gladstone's current equity value is equal to  $0.25 \times (150 + 135 + 95 + 80) = 115$  million dollars.
- b. If the firm earns \$150 or \$135 million in the future, debt holder would get 100% of face value. However, if the firm earns \$95 or \$80 million dollars in the future, debt holder would get \$95, \$80 million dollars, respectively. Since risk is diversifiable, current value of the debt is equal to  $0.25 \times 100 + 100 + 95 + 80 = 93.75$ .
- c. Yield is a discount rate affected to "promised" payoff. Expected return, in contrast, is a discount rate affected to "expected" payoff. Therefore, yield of the debt satisfies  $\frac{100}{1+y} = 93.75$ . Therefore  $y = \frac{100-93.75}{93.75} = 6.67\%$ . In order to calculate expected return, it needs to calculate expected payoff of the debt, from b. it is calculated as 93.75. Therefore, in this case, expected return is equal to 0. It is because there is no systematic risk.
- d. From a, expected present value of the future value is equal to 115. Since debt value is equal to 93.75, equity value is equal to  $115 - 93.75 = 21.25$ , and firm's total value is 115, which is same as a. Therefore, Modigliani & Miller I holds here.

## Question 2

- a. Since the firm is unlevered, cost of capital of the firm is equal to unlevered cost of capital, which is 15%. Therefore, the firm value (present value of future free cash flow) is equal to as follows.

$$\begin{aligned} PV(FCF) &= \frac{5}{1.15} + \frac{5}{(1.15)^2} + \frac{5}{(1.15)^3} + \dots \\ &= \frac{5}{0.15} = 33.33 \end{aligned}$$

- b. In this case, we can calculate firm's value by adding present value of income tax shield to unlevered firm's value. Since the debt lasts permanently, present value of interest is same as current debt value. Therefore, interest tax shield is equal to (tax rate)  $\times$  (current debt value), so the firm value is equal to  $33.33 + 0.35 \times 19.05 = 40$ .

## Question 3

- a. Before the announcement, since Kurz has 20 million outstanding shares and price per share is \$7.50, total value of the firm is equal to  $7.50 \times 20 = 150$  million dollars because it is all-equity firm.

- b. Since investors know the effect of income tax shield, total value of the firm will be increased after the announcement, and the amount of increase is equal to amount of income tax shield. Assuming there is no excess cash in Kurz, because the debt is expected to be maintained permanently, the present value of income tax shield will be equal to  $0.40 \times 50 = 20$  million dollars. Therefore, firm value will be increased to 170 million dollars, and it is all-equity.
- c. Since firm value is increased to 170 million dollars and there are 20 million outstanding shares, price per share increases to  $170/20 = 8.5$ . Therefore, Kurz will purchase about  $50/8.5 = 5.89$  million shares.
- d. Since 50 million amount of shares are repurchased, equity value will decrease by 50 million, so equity value will be 120 million after repurchase. Since number of outstanding share also decreased, price per share is not changed. The price is  $\frac{120}{20-5.89} = 8.5$ , which is same as the price before repurchase.

## Question 4

- a. Table 1 shows income tax shield and cost of financial distress and NPV, when cost of financial distress is equal to 2 million. In this case, the optimal debt is equal to \$80 million because NPV is the largest.

Debt Level	0	40	50	60	70	80	90
PV of Income Tax Shield	0	0.76	0.95	1.14	1.33	1.52	1.71
Probability of Financial Distress	0	0	0.01	0.02	0.07	0.16	0.31
Present Value of Financial Distress	0.000	0.000	0.019	0.038	0.133	0.305	0.590
NPV	0.000	0.760	0.931	1.102	1.197	1.215	1.120

Table 1: Income tax shield and cost of financial distress: 2 million

- b. Table 2 shows income tax shield and cost of financial distress and NPV, when cost of financial distress is equal to 5 million. In this case, the optimal debt is equal to \$60 million.

Debt Level	0	40	50	60	70	80	90
PV of Income Tax Shield	0	0.76	0.95	1.14	1.33	1.52	1.71
Probability of Financial Distress	0	0	0.01	0.02	0.07	0.16	0.31
Present Value of Financial Distress	0.000	0.000	0.048	0.095	0.333	0.762	1.476
NPV	0.000	0.760	0.902	1.045	0.997	0.758	0.234

Table 2: Income tax shield and cost of financial distress: 5 million

- c. Table 3 shows income tax shield and cost of financial distress and NPV, when cost of financial distress is equal to 25 million. In this case, the optimal debt is equal to \$40 million. From a, b, c, we can find that optimal debt decreases as cost of financial distress increases.

Debt Level	0	40	50	60	70	80	90
PV of Income Tax Shield	0	0.76	0.95	1.14	1.33	1.52	1.71
Probability of Financial Distress	0	0	0.01	0.02	0.07	0.16	0.31
Present Value of Financial Distress	0.000	0.000	0.238	0.476	1.667	3.810	7.381
NPV	0.000	0.760	0.712	0.664	-0.337	-2.290	-5.671

Table 3: Income tax shield and cost of financial distress: 25 million

## Question 5

- a.  
b.  
c.

## Question 6

## Question 7

- a.  
b.

## Question 8

- a.  
b.