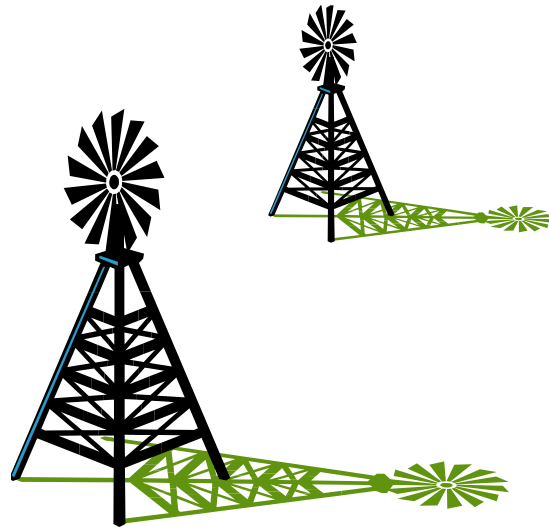


# Lecture 10 Capital Structure (2)



# **6 Modigliani and Miller: Proposition I**

## **(With Taxes)**

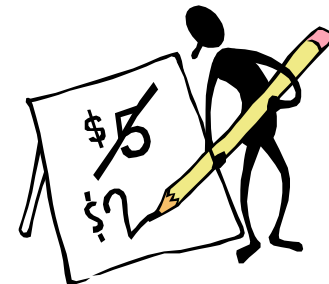
- Consider the all equity firm. Both the equityholders and the government have claims on the firm. The value of the all equity firm is the part of the pie owned by the equityholders.
- While for the levered firm, it has three claims: equityholders, bondholders and the government. The value of the levered firm is the sum of the value of the debt and the value of the equity.

- Assuming that the total area is the same for both pies, value is maximized for that capital structure paying the least in taxes. In other words, the managers should choose the capital structure that the government hates the most.
- We will show that, the proportion of the pie allocated to taxes is less for the levered firm than it is for the unlevered firm. Thus managers should select high leverage.



## 6.1 Present Value of the Tax Shield (税盾的现值)

- There is a tax advantage to debt, or equivalently, a tax disadvantage to equity.
- **Interest is tax deductible;** Interest totally escapes corporate taxation, whereas earnings after interest but before corporate taxes (EBT) are taxed at the corporate tax rate.



### **Example 7:**

The Water Products Company has a corporate tax rate,  $T_C$  of 35 percent and expected earnings before interest and taxes (EBIT) of \$1 million. Its entire earnings after taxes are paid out as dividends.

The firm is considering two alternative capital structures.

Under plan I, Water Products would have no debt in its capital structure. Under plan II, the company would have \$4,000,000 of debt,  $B$ . The cost of debt  $r_B$  is 10 percent.

The chief financial officer for Water Products makes the following calculations:

	Plan I	Plan II
<b>Earnings before interest and corporation taxes (EBIT)</b>	\$1,000,000	\$1,000,000
<b>Interest (<math>r_B B</math>)</b>	0	400,000
<b>Earnings before taxes (<math>EBT</math>) = (<math>EBIT - r_B B</math>)</b>	1,000,000	600,000
<b>Taxes (<math>T_C = 0.35</math>)</b>	350,000	210,000
<b>Earnings after corporate taxes (<math>EAT</math>) = [<math>(EBIT - r_B B) \times (1 - T_C)</math>]</b>	650,000	390,000
<b>Total cash flow to both stockholders and bondholders [<math>EBIT \times (1 - T_C) + T_C r_B B</math>]</b>	<b>\$650,000</b>	<b>\$790,000</b>

For each year, the dollar interest is

$$\text{Interest} = r_B \times B$$

All this interest is tax deductible. *That is, whatever the taxable income of the firm would have been without the debt, the taxable income is now  $r_B \times B$  less with the debt.*

Then the reduction in corporate taxes is

$$\text{Reduction in Corporate Tax} = T_C \times r_B \times B$$

*Then whatever the taxes that a firm would pay each year without debt, the firm will pay  $T_C \times r_B \times B$  less with the debt of  $B$ . It is also called the **tax shield from debt**.*

Note that it is annual amount.

In our example,

$$\text{Interest} = r_B \times B = 10\% \times 4,000,000 = \$400,000$$

and since corporate tax rate is 35%,

$$\text{Reduction in Corporate Tax} = T_C \times r_B \times B = 35\% \times 400,000 = \$140,000$$

We can assume that the cash flow  $T_C \times r_B \times B$  has the same risk as the interest on the debt. Thus its value can be determined by discounting at the interest rate,  $r_B$ .

Assuming that the cash flows are perpetual, the present value of the tax shield is

$$\text{Present value of tax shield} = \frac{T_C \times r_B \times B}{r_B} = T_C B$$



## 6.2 Modigliani and Miller: Proposition I (With Taxes)

The value of an unlevered firm is the present value of  $EBIT \times (1 - T_C)$  .

$$V_U = \frac{EBIT \times (1 - T_C)}{r_0}$$



Where  $V_U$  is present value of an unlevered firm.

$EBIT \times (1 - T_C)$  is firm cash flows after corporate taxes.

$T_C$  is corporate tax rate.

$r_0$  is the cost of capital to an all equity firm.

The leverage increases the value of the firm by the tax shield, which is  $T_C B$  for perpetual debt. Thus we can just add this tax shield to the value of the unlevered firm to get the value of the levered firm.

This equation is MM proposition I with taxes.

$$V_L = \frac{EBIT \times (1 - T_C)}{r_0} + \frac{T_C r_B B}{r_B} = V_U + T_C B$$

Because tax shield increases with the amount of debt, the firm can raise its total cash flow and its value by substituting debt for equity.

### **Example 8:**

Divided Airlines is currently an unlevered firm. The company expects to generate \$153.85 in earnings before interest and taxes (EBIT), in perpetuity. The corporate tax rate is 35 percent, implying after tax earnings of \$100. All earnings after tax are paid out as dividends.

The firm is considering a capital restructuring to allow \$200 of debt. Its cost of debt capital is 10 percent. Unlevered firm in the same industry have a cost of equity capital of 20 percent.

What will the new value of Divided Airlines be?

The value of Divided Airlines will be equal to

$$\begin{aligned} V_L &= \frac{EBIT \times (1 - T_C)}{r_0} + T_C B \\ &= \frac{153.85 \times (1 - 0.35)}{0.2} + (0.35 \times 200) \\ &= 500 + 70 = 570 \end{aligned}$$

Because  $V_L = B + S$ , the value of levered equity  $S$  is  $\$570 - 200 = \$370$ .



## **Example**

Suppose the Maxwell Company has \$1 million in debt with an 8 percent coupon rate. If the debt matures in two years and the cost of debt is 10 percent. The debt is amortized in equal installments over two years.

What is the present value of the tax shields if the corporate tax rate is 21 percent?

## 7 Modigliani and Miller: Proposition II (With Taxes)

MM proposition II is that:

$$r_S = r_0 + \frac{B}{S} \times (1 - T_C) \times (r_0 - r_B)$$

Since equity is risky, it should have an expected return greater than that on the less risky debt.  $r_0 > r_B$ ,  $r_S$  increases with leverage.

The value of levered equity is given in this formula:

$$S = \frac{(EBIT - r_B B) \times (1 - T_C)}{r_S}$$

In our previous example:

$$\begin{aligned} r_S &= r_0 + \frac{B}{S} \times (1 - T_C) \times (r_0 - r_B) \\ &= 0.2 + \frac{200}{370} \times (1 - 0.35) \times (0.2 - 0.1) = 0.2351 \end{aligned}$$

In our example

$$S = \frac{(\$153.83 - 0.1 \times \$200) \times (1 - 0.35)}{0.2351} = \$370$$

Now we look at the weighted average cost of capital.

$$r_{WACC} = \frac{B}{V_L} r_B (1 - T_C) + \frac{S}{V_L} r_S$$

We know from MM proposition II without taxes that  $r_{WACC}$  is not affected by leverage. But in the world with tax, since debt is tax advantaged relative to equity,  $r_{WACC}$  declines with leverage.



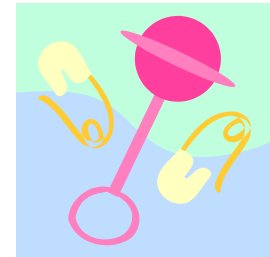
In our example:

$$r_{WACC} = \frac{200}{570} \times 0.1 \times 0.65 + \frac{370}{570} \times 0.2351 = 0.1754$$

So Divided Airlines has reduced its  $r_{WACC}$  from 0.2 with no debt to 0.1754 with reliance on debt. So it suggests that when a firm lowers its  $r_{WACC}$ , the firm's value will increase.

Using  $r_{WACC}$  approach, we can confirm the value of the firm is \$570.

$$V_L = \frac{EBIT \times (1 - T_C)}{r_{WACC}} = \frac{\$100}{0.1754} = \$570$$



Now we calculate the stock price of Divided Airlines both before and after the exchange of debt for stock.

The market value balance sheet for the company in its all equity form can be represented as

Divided Airlines Balance Sheet (all equity firm)	
<b>Physical assets:</b> $\frac{\$153.85}{0.2} \times (1 - 0.35) = \$500$	<b>Equity</b> <b>\$500</b> <b>(100 shares)</b>

Next imagine that the company announces that, in the near future, it will issue \$200 of debt to buy back \$200 of stock.

We know that the value of the firm will rise to reflect the tax shield of debt. If we assume that the capital market is efficient, and then the increase occurs immediately.

The market value balance sheet becomes

Divided Airlines Balance Sheet (upon announcement of debt issue)			
<b>Physical assets:</b>	<b>\$500</b>	<b>Equity</b>	<b>\$570</b>
<b>Present value of tax shield:</b>			<b>(100 shares)</b>
$T_c B = 35\% \times \$200 = 70$			
<b>Total Assets</b>	<b>\$570</b>		

Divided Airlines Balance Sheet (after exchange has taken place)			
Physical assets:	\$500	Equity	\$370 (100-35.09=64.91 shares)
Present value of tax shield:	70	Debt	200
Total Assets	\$570	Debt plus equity	\$570

Moreover, without taxes, price per share of stock isn't affected by leverage. With taxation, leverage increases price per share, with the assumption that no new investment opportunities are made and only the capital structure changes.



### **Example 9:**

Locomotive Corporation is planning to repurchase part of its common stock by issuing corporate debt. As a result, the firm's debt to equity ratio is expected to rise from 40 percent to 50 percent.

The firm currently has \$7.5 million worth of debt outstanding. The cost of this debt is 10 percent per annum. Locomotive expects to earn \$3.75 million per annum in perpetuity. Locomotive pays no taxes.

- A What is the market value of Locomotive Corporation before and after the repurchase announcement?
- B What is the expected return on the firm's equity ( $r_s$ ) before the announcement of the stock repurchase plan?
- C What is the expected return on the equity of an otherwise identical all equity firm ( $r_0$ ) ?
- D What is the expected return on the firm's equity ( $r_s$ ) after the announcement of the stock repurchase plan?

### **Example 10:**

Green Manufacturing, Inc. plans to announce that it will issue \$2 million of perpetual debt and use the proceeds to repurchase common stock. The bonds will have a 6 percent annual coupon rate.

Green is currently an all equity firm worth \$10 million with 500,000 shares of common stock outstanding. After the sale of the bonds, Green will maintain the new capital structure indefinitely.

Green currently generates annual pretax earnings of \$1.5 million. This level of earnings is expected to remain constant in perpetuity. Green is subject to a corporate tax rate of 40 percent.

A What is the expected return on Green's equity before the announcement of the debt issue?

B Construct Green's market value balance sheet before the announcement of the debt issue. What is the price per share of the firm's equity?

C Construct Green's market value balance sheet immediately after the announcement of the debt issue.

D What is Green's stock price per share immediately after the repurchase announcement?

E How many shares will Green repurchase as a result of the debt issue? How many shares of common stock will remain after the repurchase?

F Construct the market value balance sheet after the restructuring. What is Green's stock price per share after the restructuring?

G What is the required return on Green's equity after the restructuring?