



## ***M&M Proposition II***

Conclusion of Ch. 15

## M&M Prop II

---

Previously, we obtained (setting  $T_c=0$ ),

$$R_{WACC} = \left( \frac{S}{S+B} \right) R_S + \left( \frac{B}{S+B} \right) R_B$$

M&M Proposition I: the value of the firm remains constant.

We also showed the WACC remains constant in the previous lecture.

If  $R_0$  is the cost of capital of a unlevered firm then  $R_0 = R_{WACC}$  for any debt to equity ratio. Starting with

$$R_0 = R_{WACC} = \left( \frac{S}{S+B} \right) R_S + \left( \frac{B}{S+B} \right) R_B$$

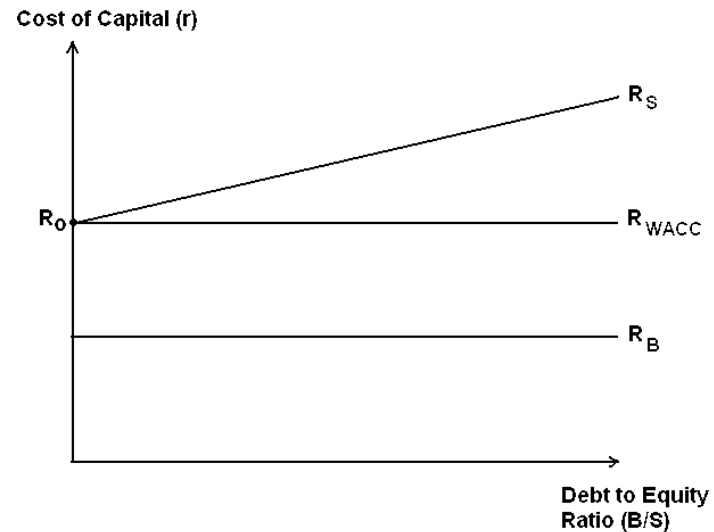
Solving for  $R_S$ , we get **M&M Prop II**:

$$R_S = R_0 + \frac{B}{S} (R_0 - R_B)$$

# M&M Graph

$R_0$  is the cost of capital to an unlevered firm, and  $R_S$  and  $R_B$  are the cost of equity and cost of debt respectively.

Note that the cost of equity rises to keep the weighted average cost of capital constant



## *M&M II with Taxes*

---

What if we add in taxes? (lots of algebra...)

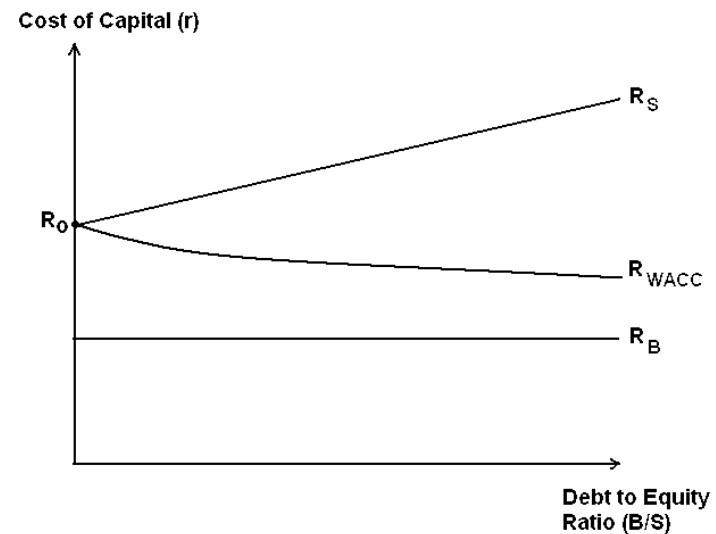
$$R_S = R_0 + \frac{B}{S} (1 - T_C) (R_0 - R_B)$$

The intuition here is that the necessary return on the equity increases slower than without taxes.

# Graph of M&M II (with Taxes)

This is the graph of M&M II with taxes.

With financial distress, we get a U shape.



# *Evidence for M&M Propositions:*

---

1). US D/V (debt to value ratio) are fairly low.

Comparing across countries:

- US: 45% (1989)
- Japan: 81%
- UK: 56%
- Germany: 61%
- France: 63%

2). Across industries, D/E ratios have different values, but within industries the ratios are comparable.

Steel industry:  $D/E = 1.665$ ,

Pharmaceutical industry:  $D/E = 0.079$ .

# Summary

---

## M & M Proposition I

$$V_L = V_U \quad (\text{without taxes})$$

$$V_L = V_U + T_C B \quad (\text{with taxes})$$

## M & M Proposition II

$$R_S = R_0 + \frac{B}{S} (R_0 - R_B) \quad (\text{without taxes})$$

$$R_S = R_0 + \frac{B}{S} (R_0 - R_B)(1 - T_C) \quad (\text{with taxes})$$

## *Examples: RWJ 15.16*

Gibson, Inc. expects perpetual EBIT of \$1.2 million per year. The firm's pretax cost of debt is 8% per annum, and its annual interest expense is \$200,000. Company analysts estimate that the unlevered cost of Gibson's equity is 12 percent. Gibson is subject to 35% corporate tax rate.

- a). What is the value of this firm?
- b). If there are no costs of financial distress or bankruptcy, what percentage of the firm's capital structure would be financed by debt?
- c). Is the conclusion in (b) applicable to the real world?

## *RWJ 15.17 (long...)*

---

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% annual coupon rate. Green is currently an all equity firm worth \$10 million with 500,000 shares of 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. The corporate tax rate is 40%.

## *The questions from that setup*

---

- 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 the sheet after the announcement.
- d). What is the price per share immediately after the announcement of the debt issue?
- e). How many shares will be repurchased? How many shares remain after the repurchase?
- f). Construct the balance sheet after restructuring. What is Greens price per share after restructuring?
- g). What is the required return on equity after restructuring?

## *Chapter 22, Options*

---

An option confers the right but not the obligation to make a transaction.

The buyer will have the option to do as they wish.

Options can be written on stocks, bonds, commodities, foreign currency and metals (and more). The discussion here will focus on stocks as the underlying asset.

# *Uses of options*

---

An option can be used to 'control' a larger number of shares than an investor could normally purchase.

We'll see a put option will allow the purchaser to lock in a profit (think of a farmer selling grain), so this is a form of insurance.

The price of an option will always be positive.

## *Option Terms:*

---

**Strike price:** The price at which the exchange will occur

**Expiry:** The date by which the exchange must take place—the option is no longer valid after.

**English Option:** exercised only on the expiration date

**American Option:** exercised on or before the expiration date

## *More terms:*

---

**Call Option:** Grants the holder (purchaser) the right to buy the asset at the strike price

**Put Option:** Grants the holder the right to sell the asset at the strike price

**In the Money:** The option if exercised at current prices has a positive value

**Out of the Money:** just the opposite of in the money.

# Valuing Options at expiration

---

Base decision on Stock price:

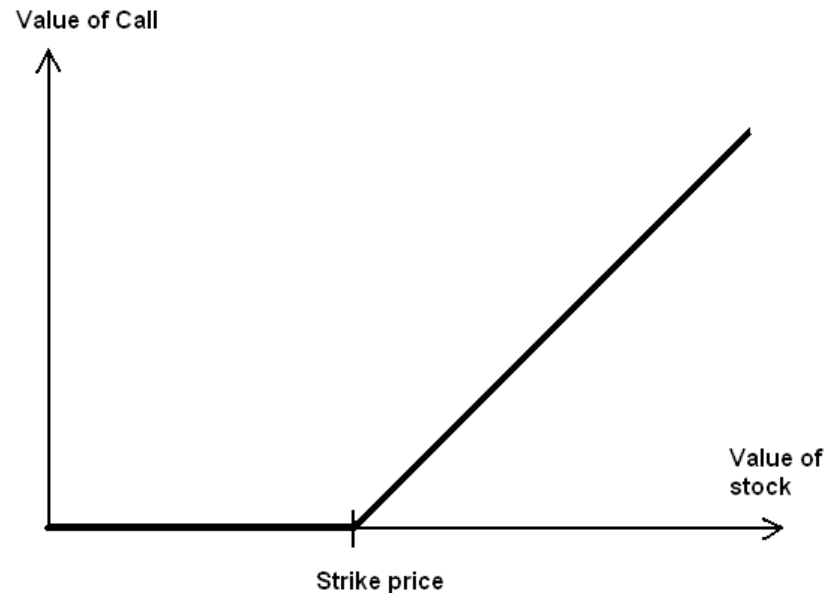
If it's above: buy at strike price  $X$ , sell at market price  $P_S$ . Profit is  $P_S - X$

If it's below: It's best to let the option expire unexercised.

Thus, the value of the option is:

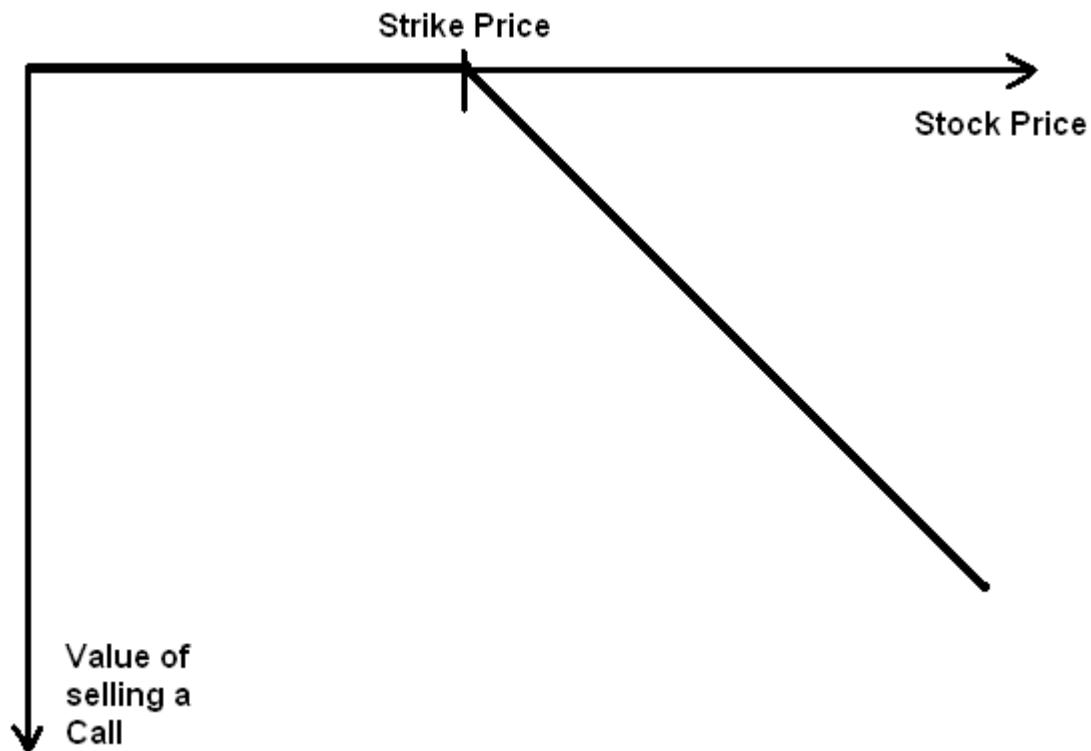
$$V_C(P_S) = \max \{P_S - X, 0\}$$

# Graphically,



The option is worthless until the stock's price is at least the strike price, and then increases exactly as fast as the stock's value increases.

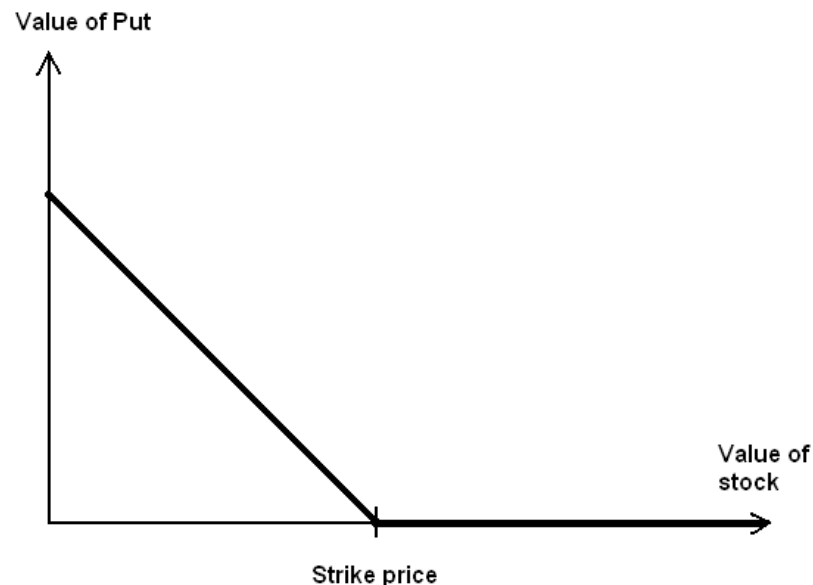
# *The value of the call to the seller*



## Value of a put

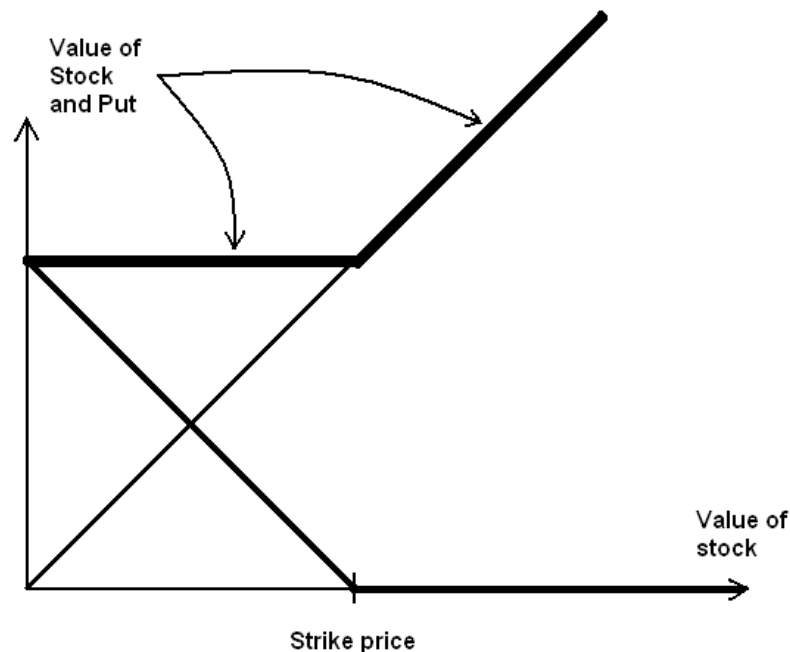
If the price  $P_S$  is higher than  $X$ , no transaction will take place, but if the price is lower, the option will be exercised. The profit is thus

$$V_P = \max\{X - P_S, 0\}$$



# Portfolio insurance

Suppose we own a stock, but buy a put on that stock. At the expiration date, the payoff from the combination will be the sum of the two payoffs:



# Covered Call

Note on terminology: Covered means you own the underlying security, naked means you don't.

