

Unit 6. Investment-Financing Relationship

- 6.1. Business Risk and Financial Risk
- 6.2. Weighted Average Cost of Capital
- 6.3. Adjusted Present Value (APV)
- 6.4. The Effects of Leverage on Expected Cash Flows and Discount Rates

Basic bibliography:

ROSS, S; WESTERFIELD, R; JAFFE, J. (2010)
 Chapters 3.2 (formulas 3.15 and 3.16), 16.3-5, 17.1, 17.4, 18.1, 18.3-4

6.2 Weighted Average Cost of Capital

Remember: In Unit 6 we are illustrating the effect of capital structure $B/S = \text{Debt/Equity}$ on risks and returns, and now we start by introducing the effects of B/S on the cost of debt (R_B), on the cost of equity (R_S), and on the cost of the whole company's financial structure (R_{WACC}).

We start by illustrating, with the second part of Problems 1 and 2, the definition and effects of the **weighted average cost of capital (R_{wacc})**.

Problem 1. Weighted Average Cost of Capital

Company X, Company Y and Company Z are identical firms in all matters except for their capital structure. X is all-equity financed; Y and Z use both stock and long-term debt:

Company	X	Y	Z
<i>Debt</i>	0	250	400
<i>Equity</i>	500	250	100

The interest rate of debt is 6% (constant) for the three companies.

Calculate the cost of equity (R_S), the cost of debt (R_B), and the weighted average cost of capital (R_{WACC}).

Represent the cost of equity (R_S), the cost of debt (R_B), and the weighted average cost of capital (R_{WACC}) as a function of the company's leverage (B/S).

Let's start by getting the R_{wacc} formula:

Video 6.2 a → Important: watch the video with paper and pencil while working on the R_{wacc} formula

$$R_{wacc} = \frac{R_b \times B + R_s \times S}{B + S}$$

B = Firm's debt = Market value of bonds, in the organized financial markets = Debt

R_B = cost of debt (%) for the firm, i = return on debt for the creditors

S = Firm's equity = Market value of stocks, in the organized financial markets = Equity

R_S = cost of equity (%) from the firm's point of view = return on equity from the owners' point of view = ROE

$V = B + S$ = Total market value of the company

Rwacc

	X	Y	Z
EBIT	$R_0 = R_{wacc}$	R_{wacc}	R_{wacc}
10	$[0.06*0+0.02*500]/500=0.02$	$[0.06*250-0.02*250]/500=0.02$	$[0.06*400-0.14*100]/500=0.02$
20	$[0.06*0+0.04*500]/500=0.04$	$[0.06*250+0.02*250]/500=0.04$	$[0.06*400-0.04*100]/500=0.04$
30	$[0.06*0+0.06*500]/500=0.06$	$[0.06*250+0.06*250]/500=0.06$	$[0.06*400+0.06*100]/500=0.06$
40	$[0.06*0+0.08*500]/500=0.08$	$[0.06*250+0.1*250]/500=0.08$	$[0.06*400+0.16*100]/500=0.08$
50	$[0.06*0+0.1*500]/500=0.1$	$[0.06*250+0.14*250]/500=0.1$	$[0.06*400+0.26*100]/500=0.1$

$R_B = 0.06 =$ cost of debt

$R_S =$ cost of equity (%) = ROE

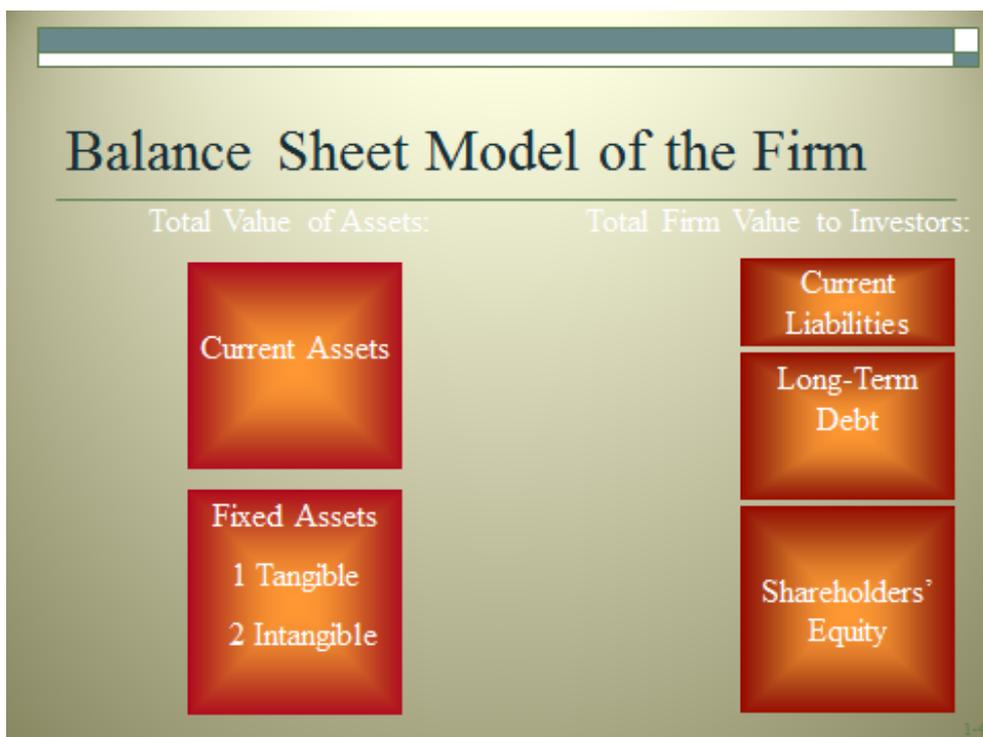
Cost = Return The use of one name or the other depends on who you are, the one paying (cost) or the one receiving (return).

=> What do we learn from this table?

1) R_{WACC} doesn't change with B/S => $R_{WACC} X = R_{WACC} Y = R_{WACC} Z$

2) $R_{WACC} = ROA$ **in a world with NO corporate tax**
(please, check ROA Table in 6.1)

How is this possible?



$Assets = Liabilities \text{ and } equity$

Return on assets = Return on liabilities and equity for the firm's investors: creditors and owners
= Cost of liabilities and equity (R_{WACC}) for the firm

The firm is paying creditors and owners (check the income statement). In total the firm can pay exactly what the firm got with its assets = return on assets. Some of this ROA goes to the creditors and the rest, to the owners. (Remember: no corporate tax)

=> Why using two names, ROE and R_s , for the return on equity?

Generally, ROE is calculated from the income statement information, and R_s is calculated from returns in the financial markets.

Remember, we already learned: $\Delta Leverage \left(L = \frac{B}{S} \right) \rightarrow \Delta ROE = \Delta R_s$

Let's see another way to get R_s , focusing on financial markets equilibrium:

Denote $R_0 = R_{WACC}$ of a firm with no debt; an all-equity firm; unlevered company = Return owners receive in a company with no debt and no corporate tax = ROA = Cost of capital of an all-equity firm.

Let's reorganize the R_{WACC} formula

$$R_{wacc} = \frac{R_b \times B + R_s \times S}{B+S}, \text{ FOR AN ALL-EQUITY FIRM: } R_o = \frac{R_b \times B + R_s \times S}{B+S}$$

$$(B + S) R_o = R_b \times B + R_s \times S$$

$$R_s = \frac{R_o (B + S) - R_b B}{S}$$

$$R_s = \frac{R_o S}{S} + R_o \frac{B}{S} - R_b \frac{B}{S}$$

$$R_s = R_o + (R_o - R_b) \frac{B}{S} \qquad \text{Modigliani and Miller Proposition II}$$

Nobel Prize in Economics 1985

MM Proposition II: The return that the owners get (the stockholders require) is the return they would get in a similar firm with no debt, that is to say, **the economic return** ($R_o = R_s$ in an-all equity firm) **plus a premium of $R_o - R_b$ multiplied by the financial risk (B/S) they are bearing.**

No debt $\rightarrow B/S = 0 \rightarrow$ No financial risk $\rightarrow R_s = R_o = ROA$

However:

$\Delta Leverage \left(L = \frac{B}{S} \right) \rightarrow \Delta ROE = \Delta R_s \rightarrow R_s > ROA$ in economic expansion ($R_o > R_b$)
 $\rightarrow R_s < ROA$ in economic recession (Answer in Table R_s below, in red $\rightarrow R_b > R_o$)

Given that stockholders are facing higher financial risk ($\uparrow B/S$), then they require higher stock returns (R_s), otherwise they will sell the stock. If they sell the stock, the price will decrease (supply and demand law) and then, the return R_s will rise. (We will learn this last part better in Unit 8: stock price vs. return)

R_s			
EBIT	X	Y	Z
10	$0.02 + (0.02 - 0.06)0/500 = 0.02$	$0.02 + (0.02 - 0.06)250/250 = -0.02$	$0.02 + (0.02 - 0.06)400/100 = -0.14$
20	$0.04 + (0.04 - 0.06)0/500 = 0.04$	$0.04 + (0.04 - 0.06)250/250 = 0.02$	$0.04 + (0.04 - 0.06)400/100 = -0.04$
30	$0.06 + (0.06 - 0.06)0/500 = 0.06$	$0.06 + (0.06 - 0.06)250/250 = 0.06$	$0.06 + (0.06 - 0.06)400/100 = 0.06$
40	$0.08 + (0.08 - 0.06)0/500 = 0.08$	$0.08 + (0.08 - 0.06)250/250 = 0.1$	$0.08 + (0.08 - 0.06)400/100 = 0.16$
50	$0.1 + (0.1 - 0.06)0/500 = 0.1$	$0.1 + (0.1 - 0.06)250/250 = 0.14$	$0.1 + (0.1 - 0.06)400/100 = 0.26$

Example of the relationship between R_b and R_o in video: Economic expansion, economic recession

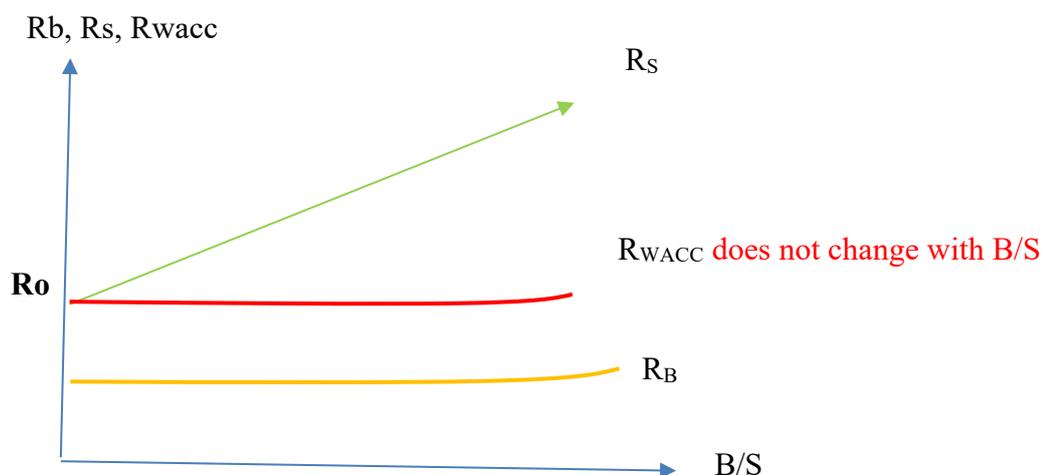
If $R_o > R_B \rightarrow \Delta B/S \rightarrow \Delta R_S$ (return) \rightarrow Healthy economy

If $R_B > R_o \rightarrow \Delta B/S \rightarrow \nabla R_S$ (return) \rightarrow Recession situation

Video 6.2 b \rightarrow Important: watch the video with paper and pencil while working on the Proposition II

Problem 1 (continued)

Represent the cost of equity (R_S), the cost of debt (R_B), and the weighted average cost of capital (R_{WACC}) as a function of the company's leverage (B/S).



What do we see with this graph? **Rwacc does not change with B/S**

Remember: Our goal is to increase the firm's value

How do we measure value? With the net present value formula:

(R_{wacc} is the opportunity cost of capital in equilibrium)

So, if we want to \uparrow value = \uparrow NPV = -Initial investment + $\sum_{k=1}^n \frac{NCF_k}{(1+R_{wacc})^k}$

We should either:

a) \uparrow NCF: By selling more shoes, having more and better clients, more reputation: Increasing EBIT; Investing in a better combination of assets. Economic-investment decisions

or

b) \downarrow Rwacc: In an economy with no corporate tax, R_{wacc} does not get reduced by increasing the leverage: it does not change with B/S (see R_{wacc} table in page 2)

Rwacc does not change with B/S

Video 6.2 c \rightarrow MM Proposition I: Modern Finance Approach

Why does the average cost of capital R_{wacc} not get reduced by adding more of the cheap funds (Debt: $R_b < R_o$ in healthy economies)?

See R_s in the graph: We cannot reduce R_{WACC} by increasing leverage (B/S) because higher B/S means higher financial risk and, if owners suffer higher financial risk, they're going to ask for higher return R_s .

CONCLUSION:

Don't focus on increasing debt policies in order to increase the firm's value because: By increasing debt, financial risk increases and we have to pay more to the owners.

With +/- debt we cannot Δ market value of the company, so forget about +/- debt and focus on your investment decisions (assets) to get more EBIT!!

Live session in Blackboard Collaborate (with Kahoot questions!!!)

See Problem 2 and solution to get more practice:

Problem 2. Business Risk and Financial Risk. Weighted Average Cost of Capital

Vinchi Company, Klinike Company and Lankom Company are identical firms in all aspects except for their capital structure:

Company	Klinike	Vinchi	Lankom
Debt	0	2,000,000	5,000,000
Equity	?	4,000,000	?

The interest rate of debt is 10% (constant) for the three companies. Earnings before interest and taxes (EBIT) are 720,000 monetary units.

Indicate the economic return- financial return relationship (ignore taxes).

Represent the return on equity as a function of the EBIT.

Calculate the cost of equity (R_S), the cost of debt (R_B), and the weighted average cost of capital (R_{WACC}).

Solution to Problem 2

Company	Klinike	Vinchi	Lankom	
Debt	0	2,000,000	5,000,000	
Equity	6,000,000	4,000,000	1,000,000	
TOTAL	6,000,000	6,000,000	6,000,000	Identical firms, same size

ROA = Economic return = R_0 = Earnings before interest and taxes (EBIT) / Assets

$$ROA_{Klinike} = ROA_{Vinchi} = ROA_{Lankom} = 720,000 / 6,000,000 = 0.12 = 12\%$$

$R_{WACC} = (S \times R_S + B \times R_B) / (B + S) \Rightarrow$ If we ignore taxes (no tax shield) $R_{WACC} = ROA = R_0$
 [If considering corporate taxes \Rightarrow (debt tax shield) R_{WACC} decreases with leverage]

a) Economic return vs. financial return (ignore taxes).

$$ROE = R_S =$$

$$\text{If no taxes, from } R_{WACC} = R_0 \Rightarrow ROE = R_S = [R_0 (B + S) - B \times R_B] / S = R_0 + (R_0 - R_B) B / S$$

$$ROE_{Klinike} = R_{S_{Klinike}} = 0.12 + (0.12 - 0.10) 0 / 6,000,000 = 0.12 = 12\%$$

$$ROE_{Vinchi} = R_{S_{Vinchi}} = 0.12 + (0.12 - 0.10) 2,000,000 / 4,000,000 = 0.13 = 13\%$$

$$ROE_{Lankom} = R_{S_{Lankom}} = 0.12 + (0.12 - 0.10) 5,000,000 / 1,000,000 = 0.22 = 22\%$$

b) Represent the return on equity as a function of the EBIT.

See Problem 1.

c) Calculate the cost of equity (R_S), the cost of debt (R_B), and the weighted average cost of capital (R_{WACC})

$$ROE_{Klinike} = R_{S_{Klinike}} = 0.12 + (0.12 - 0.10) 0 / 6,000,000 = 0.12 = 12\%$$

$$ROE_{Vinchi} = R_{S_{Vinchi}} = 0.12 + (0.12 - 0.10) 2,000,000 / 4,000,000 = 0.13 = 13\%$$

$$ROE_{Lankom} = R_{S_{Lankom}} = 0.12 + (0.12 - 0.10) 5,000,000 / 1,000,000 = 0.22 = 22\%$$

$R_B = 0.10$ for Klinike, Vinchi and Lankom

$$R_{WACC_{Klinike}} = R_{WACC_{Vinchi}} = R_{WACC_{Lankom}} = 12\%$$