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Financial Management

Weighted Average Cost of Capital

1

Weighted Average Cost of Capital (WACC)

- This lecture answers the following questions:
 - What is the “opportunity” cost of funds for a firm, and thus the firm’s discount rate used in NPV calculations?
 - What is a firm’s Asset Beta & how do we lever Asset Betas and unlever Equity Betas?
 - Link to previous lectures - No longer use a “given” discount rate. We **will calculate the correct discount rate** for our NPV calculations.

1.0 The Cost of Capital: Some Preliminaries

A. Required (rate of) Return versus Cost of Capital

- *Cost of capital - required return - appropriate discount rate* all denote the same opportunity cost of using capital in one way as opposed to an alternative investment in the financial market having the **same** systematic risk.
 - required return: is from an investor's point of view
 - cost of capital: is the same return from the firm's point of view
 - appropriate discount rate: is the same return yet again to be used in a present value calculation

B. Required (rate of) Return

- COMBINING BOTH INVESTORS' AND FIRMS' PERSPECTIVES:
 - A FIRMS COST OF CAPITAL OR DISCOUNT RATE IS GIVEN BY INVESTORS REQUIRED RATE OF RETURN.
 - RETURN TO INVESTMENT DECISION!!
 - NPV of a project is dependent on:
 - (1) EXPECTED CASH FLOWS
 - (2) RISK

3 Determinants of Required (Rate of) Return

- What are investors' concerned with? (and thus firms should also be concerned with.)
 - (1.) Real or inflation-adjusted rate of interest to compensate for the TIME VALUE OF MONEY.
 - (2.) An inflation premium - equal to expected inflation.
 - (3.) A Premium for systematic risk.
 - (4.) Amount of systematic risk (β)

WACC - 4

5

C. Rates of Return are Set in the Market

- ON THE BASIS OF AN INTERACTION OF:
 - - (1) VOLUME AND RISK-EXPECTED RATE OF RETURN OF PRODUCTIVE INVESTMENTS IN THE ECONOMY - DEMAND FOR CAPITAL.
 - (2) SUPPLY OF CAPITAL AVAILABLE TO TAKE INTO ADVANTAGE THESE OPPORTUNITIES.
 - (3) RISK PREFERENCES OF INDIVIDUALS.
 - KEY: These items are given in the market place
 - Firms can take these as exogenous - outside of their control

WACC - 5

6

D. Financial Policy and Cost of Capital

- Capital structure - the particular combination of debt and equity which is taken as given. Choosing a capital structure is discussed in subsequent lectures.
 - A firm's cost of capital will reflect the average riskiness of all its securities, which individually may be less risky (bonds) or more risky (common stock)
 - It will simply be a weighted average of the various components.
 - Thus: WACC - Weighted Average Cost of Capital is what the firm uses as its discount rate to value investment projects.

WACC - 6

7

2.0 Weighted Average Cost of Capital (WACC)

A. The Weighted Average Cost of Capital (WACC)

- WACC - the overall return the firm must earn on its assets to maintain the value of its stock.
- E - the market value of the firm's equity (# shares x price per share)
- r_e = required rate of return for equity - (Expected Return).
- D - the market value of the firm's debt (# bonds x price per bond)
- r_d = required rate of return for debt (YTM).
- V = the combined market value of the firm's equity and debt,
 $V = E + D$, Capital structure weights - E/V and D/V
- t_c = marginal corporate tax rate (used given after-tax cash flows).

$$WACC = \frac{E}{V}r_e + \frac{D}{V}r_d(1-t_c)$$

WACC - 7

8

Example: Water's Beginning

- Water's Beginning has
 - 1 million shares of common stock outstanding: price \$12 per share.
 - The firm's outstanding bonds have ten years to maturity, a total face value of debt = \$5 million, face value per bond of \$1,000, current price = \$985 with a coupon rate of 10%.
 - The risk-free rate is 7%, and analysts' expected return for the market is 14%.
 - Water's Beginning stock has a beta of 1.2 and is in the 34% marginal tax bracket.
 - What's the WACC?

WACC - 8

9

SOLUTION:

- Capital structure weights:
 - market value of equity = $1,000,000 \times \$12 = \$12,000,000$
 - market value of debt = $\$5,000,000 \times .985 = \$4,925,000$
 - $V = \$12,000,000 + \$4,925,000 = \$16,925,000$
 - $D/V = \$4,925,000 / \$16,925,000 = .29$ or 29%
 - $E/V = 1 - D/V = 1 - .29 = .71$ or 71%
- Cost of equity:
 - Using the SML approach:
 - $E(r_e) = r_f + \beta_e \times [E(r_m) - r_f]$ so,
 - $E(r_e) = 7\% + 1.2 \times (14\% - 7\%) = 7\% + 8.4\% = 15.4\%$
- Cost of debt:
 - The yield-to-maturity on the debt is 10.25% before taxes.
- Weighted average cost of capital:
 - $WACC = .71 \times 15.4\% + .29 \times 10.25\% \times (1 - .34) = 12.9\%$

WACC - 9

10

3.0 Divisional and Project Costs of Capital

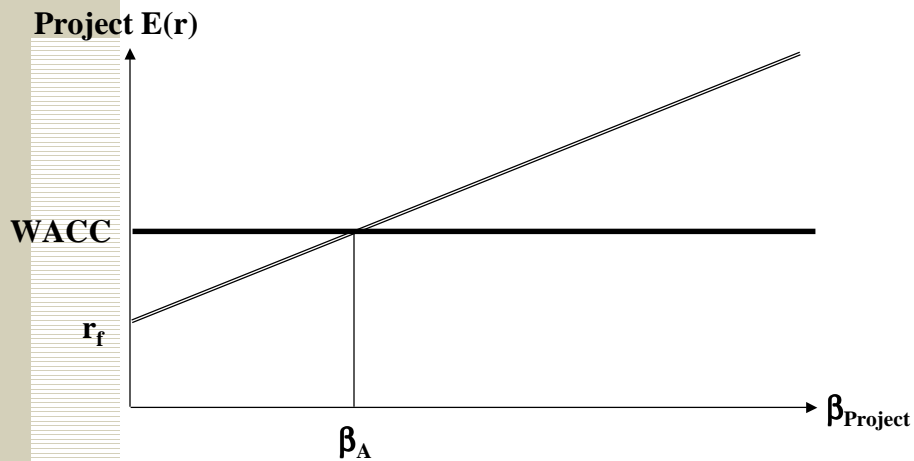
- A. The SML and the WACC
 - The WACC is the appropriate discount rate only if the proposed investment is similar to the overall existing business.
 - The WACC for a project that is much like to the rest of the firm is the same as that for the firm.
- The SML and the WACC: Graph

WACC - 10

11

Problems with WACC

What happens if you use a company wide WACC for all projects?



- 11

12

B. Divisional Cost of Capital

- When a firm has different operating divisions with different risks, its WACC is an average of the divisional required returns. In such cases the cost of capital for different risks within the same firm needs to be established.
 - Example: Consider an investor holding a portfolio of T-bills, corporate bonds and common stocks. Suppose there is an equal amount invested in each and further suppose that the securities have an average returned 5%, 10%, and 15% respectively. The average portfolio return will have been 10%.
 - Question: Should we use the portfolio's average return of 10% to evaluate new security acquisitions, say T-bills offering 7% and common stocks expected to return 13%????

B. Divisional Cost of Capital – 2

- **Solution: The Pure Play Approach**
 - Pure play - a company that has a single line of business
 - The idea is to find the required return on a near substitute investment.

C. Levering and unlevering Betas:

- Using the Pure-Play approach we find a similar company.
 - **Problem:** That “similar” company may have different amounts of debt. Thus, equity risk is different.
- SOLUTION: Lever and Un-lever Betas and get “asset” Beta:
Notation: m is for the market, d is for debt, e is for Equity, A is for Assets
- Focus on returns:
 - Goal is use competitor’s asset beta to get our divisional asset beta –

$$\beta_A^{GE\ engines} = \beta_A^{PW}$$
 - and then “re-lever” at OUR target debt ratio?:
 - **Example: GE engine division and Pratt-Whitney (PW) aircraft engines. Assume they have the same Asset Beta.**

Question: What is the β_A , the Asset Beta for PW?

Solution: Use asset beta of “comparable firm”

However, all we know is the equity beta of PW. Can we solve for the relationship between asset and equity beta?

$$\begin{aligned} \beta_A^{PW} = ASSET\ BETA &= \frac{Cov(r_A, r_m)}{Var(r_m)} \\ &= \frac{Cov((r_d(\frac{D}{V}) + r_e(\frac{E}{V})), r_m)}{Var(r_m)} = (\frac{D}{V})\beta_d + (\frac{E}{V})\beta_e \\ &= (\frac{E}{V})\beta_e^{PW} \end{aligned}$$

The last step follows because we are **Assuming** $\beta_d = 0$ (Riskless debt)

==> Given we can derive the equity Beta for Pratt-Whitney using stock market data we can BACK OUT the Asset Beta (β_A) for Pratt Whitney

- Assume equal asset betas for GE and Pratt-Whitney:
i.e. equivalently

$$\beta_A^{GE \text{ engines}} = \beta_A^{PW}$$

==> Final step to get GE's divisional **equity** beta: lever the asset beta at GE's target capital structure.

$$\beta_e^{GE \text{ engines}} = \frac{V}{E} \beta_A^{GE} \text{ or equivalently } (1 + \frac{D}{E}) \beta_A^{GE}$$

Note the previous does not include taxes. To include taxes simply add a (1- corporate tax rate) (1- t_c) to the formula:

$$\beta_e^{GE} = (1 + (\frac{D}{E})(1 - t_c)) \beta_A^{GE}$$

D. WACC and Capital Budgeting

- WACC represents the appropriate discount rates for projects that:
 - are similar systematic risk to the whole firm.
(Carbon Copies) - not likely in most cases.
- In addition, differential project maturities, risks will require differential rates
- Remember WACC is the rate that must be earned on investments to repay providers of capital.

E. The Subjective Approach

- What happens when no “pure play” exists?
- Answer: Use the SML and a subjective approach. Assign investments to "risk" categories that have higher and higher systematic risk.
 - Recall that the market is concerned with systematic or undiversifiable risk. If a firm is considering an investment's total risk in assigning it to a risk category, the risk categories may not line up with the SML.

E. The Subjective Approach - 2

– BE CAREFUL!

- For example, consider a firm that has high systematic risk in its usual business that is considering adding a new product line with low systematic risk.
- A conventional subjective scheme might assign a higher discount rate to the new product line and a lower one to any expansion of existing business, just the opposite of the financial market's evaluation.

Conclusions

- What an individual firm considers a risky investment and what the financial market considers a risky investment may not be the same.
- When a firm has different operating divisions with different risks, its WACC is an average of the divisional required returns.
- **HOWEVER**, to find the NPV of individual projects use a discount rate appropriate for that projects level of risk - not the whole company discount rate.