

Choice of Discount Rate

Discussion in 2 Parts

1. Basic Theory

2. A Common Practical Approach: Weighted Average Cost of Capital

Choice of Discount Rate: Basic Theory

- **The Principle**
- **Consequences**
- **Practice**
- **Application to Government**
- **Inflation**
- **Is Critical!**

Choice of DR: Principle

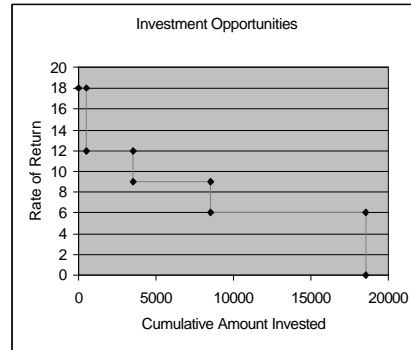
- **DR should reflect rate at which money can increase in productive investments = productivity of capital**
- **An empirical definition -- answer depends on circumstances**
 - Are there good opportunities? What are they?
 - If on desert island, no investments possible, DR = 0
- **Test: What is rate at which current investments are producing, at margin?**

Example of Application (1 -- Opportunities)

- **A person could invest up to**
 - \$ 3,000 in an enterprise to get 12%
 - \$ 10,000 in saving account at 6%
- **This person also has loans, and can repay up to:**
 - \$500 at store 18%
 - \$,5000 for tuition 9%
- **What are investment opportunities?**
- **Important to recognize that paying off a debt is a form of investment -- it leads to a similar increase in cash flow compared to new investment**

Example of Application (2 -- Calculation)

	Investment	Return %
Projects	500	18
	3000	12
	5000	9
	10000	6
Cumulative	0	18
	500	18
	501	12
	3500	12
	3501	9
	8500	9
	8501	6
	18500	6
	18501	0



What is the DR for 400? For 6500?

Answer: (a) 18% (b) = alternative return 6500

$$= (90 + 360 + 270)/6500 = 11.1\%$$

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Consequences of Principle

- DR peculiar to situation of decision-making unit
 - depends on opportunities
- DR not a precise measure
 - except in classroom examples, exact return difficult to obtain precisely; ± 1 or 2% quite acceptable
- DR \geq interest rate paid
 - repaying debt always one possible investment, so DR at least equals interest
 - actually you borrow because: value of money > interest
- Since DR = minimum acceptable profitability, NPV > 0 indicates a good project (may not be best)

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DR Used in Practice

- **A nice round number, generally**
 - recognition of imprecision in measurement
 - For example 7% that US Government has used
- **Where rate must be defended legally, as to regulatory groups - by formula**
 - not subjective
 - illusory precision
- **Research has shown that available profitability, with no inflation \approx 10 to 15%/year worldwide**

Application to Government

- **Where does Government Money come from?**
 - Taxes: One of Government's possible investments is to reduce taxes
- **Recall, DR to be used for economic investments.**
 - Many government actions not measured in money (e.g.: defense, justice, ...)
- **DR not particularly appropriate to decide if schools should be built at all; is appropriate for choice of design**

Discount Rate and Inflation

- **Issue is Comparability**
 - the idea is to place all B, C on current basis of value
- **Two factors**
 - Productivity, $p\%$ / year
 - Change in purchasing power, $i\%$ / year
 - Inflation, same item costs more each period
 - Deflation, same item costs *less* each period
- **Procedure depends on whether B, C stated in constant or changing purchasing power**
 - If constant: $r = p$
 - If varying: $r = p + i$

Examples: Which DR?

1) Build Bridge, Tolls \$1/car

$r = p + i$ Tolls unlikely to adjust with inflation

2) Build Hospital, Fee \$100/bed/day

$r = p$ Rates here do (in US) adjust with inflation,
therefore you get \$ equal to current \$

3) Buy New Furnace, Save 2000 gallons fuel / year

$r = p$ So long as fuel costs vary with inflation

Choice of DR Critical

- **DR indicates if any investment is minimally acceptable**
- **Ranking of investments changes with DR which are:**
 - less capital intensive
 - shorter lives (example: VW vs. Mercedes)
- **Choice of DR very political. Low rates favored by**
 - project enthusiasts
 - believers in government control

Part 2 : A Common Practical Method

Weighted Average Cost of Capital (WACC)

How do Companies Estimate Cost of Money?

- **Weighted Average Cost of Capital (WACC)**
 - Aggregate, current cost of raising new money
 - Based on estimated returns expected by investors
- **A common starting point -- BUT limited use as Discount Rate**
 - May represent a minimum rate
 - Does not reflect Opportunity Cost
 - Does account for RISK of project

Issues to Address Now

- How do companies raise money?
- What do investors expect?
- Mechanics of Calculations for WACC
- Uses and Mis-uses of WACC
- Treatment of risk comes later

How do Companies Raise Money?

- **Debt -- they borrow money**
 - General bank loans and bond issues
 - Company uses immediate proceeds, and repays over time with interest
- **Equity -- they sell shares in the company**
 - Company uses proceeds
 - Shareholders gain ownership in the company
 - Shareholders expect future earnings and growth
 - **Note: Most trades of stock occur in “secondary market”, company gets money only once**

What do Investors Expect?

- **Holders of Debt and Equity expect to make money**
 - Explicit for Debt: Equals interest rate
 - Implicit for Equity: Investors anticipate combination of growth and earnings, realized as dividends or higher stock prices
- **To Company, these expectations represent cost of money**
 - Either back back loan with interest
 - Or giving up part of future earnings and stock growth

What Affects Cost of Money?

- **Confidence in Company**
 - Either interest company pays to borrow
 - Or value of Shares in company
- **Factors that Affect Confidence**
 - Start-up vs. Well-established company
 - Weak vs. Strong company (financially or strategically)
 - Risky vs. Safe Industries or Regions of World
 - Other?

Calculating WACC (1)

- **Basic Idea: Average Expected Return**
- **First-order formula:**
 - $WACC = R \text{ for equity (Equity \%)} + R \text{ on Bonds (Bond \%)}$
- **Return on Equity difficult to estimate**
 - Estimate future growth and earnings, based on track record (if any) and prospects
 - Examine historical returns for similar companies in similar situations
- **A more sophisticated formula takes into account local tax issues, not relevant to current presentation of principle**

Simple Example: Electron-X Corporation

- **A hypothetical start-up company**
 - First money raising effort
 - No outstanding debts
- **Equity:**
 - Will sell \$10 million worth of shares; estimated return = 15%
- **Debt:**
 - Will issue \$5 million in debt, will pay 10% interest a year
 - Note: Bonds cheaper than stock -- WHY?
- **Total money raised = debt + equity = \$15 million**
- **WACC = 15% (2/3) + 10% (1/3) = 13.33%**

Calculating WACC (2)

- **For Established Companies**
 - Procedure similar in concept,
 - more difficult to do because of variety of securities
- **Estimated debt and equity returns estimated from current MARKET prices of securities**
 - A \$1000 bond paying 10% on face value may, for example, be selling at \$1200 so that its actual return = $(10\%) \frac{1000}{1200} = 8.33\%$
 - Total value of Equity = “market capitalization” = (share price)(number of shares outstanding)

Calculating WACC (3)

$$\text{WACC} = r_{\text{equity}} (E/V) + r_{\text{debt}} (D/V)$$

D,E = current market value of debt and equity

V = D + E = sum of debt and equity value

r_{debt} = current rate of borrowing

r_{equity} = current expected rate of return on stock

- Again, return on equity includes earnings and growth

Electron-X Corporation -- Continued

- Company is 10 years old, has a proven record
- Current market value of its securities
 - Debt = 50 million; Annual payments = 4 million
 - Stock = 100 million; expected return = 20%
- $\text{WACC} = \text{Equity R (Equity \%)} + \text{Bond R (Bond \%)}$
 $= 20\% (2/3) + 8\% (1/3) = 16\%$
- Represents Current Average:
 - Expectations of investors
 - Cost of capital Electron-X could expect

Potential Use and Mis-Use of WACC as DR

- **Uses as a Metric**
 - Performance: cost of money over time
 - Comparison:: within and between companies in industry
- **Use as a reasonable discount rate**
 - if project is an average investment for company
 - example: the 10,000th McDonald store
- **Often, WACC is an inappropriate discount rate**
 - Many projects not average (some more risky than others)
 - WACC is cost of money, not necessarily opportunity cost
- **Will explore these issues more deeply later on**

WACC Summary

- **WACC is an average cost of raising money;
proportional average of investor expectations**
- **Useful metric for some activities**
- **A starting point for project analyses**
- **HOWEVER, use WACC as DR with caution**
 - Is the investment “typical” for the organization?
 - If not, WACC is probably not applicable