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%
  - $5,000 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)

<table>
<thead>
<tr>
<th>Investment</th>
<th>Return %</th>
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<tbody>
<tr>
<td>Projects</td>
<td></td>
</tr>
<tr>
<td>500</td>
<td>18</td>
</tr>
<tr>
<td>3000</td>
<td>12</td>
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<td>5000</td>
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<td>10000</td>
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<td>18500</td>
<td>6</td>
</tr>
<tr>
<td>18501</td>
<td>0</td>
</tr>
</tbody>
</table>

What is the DR for 400? For 6500?
Answer: (a) 18% (b) = alternative return 6500
= (90 + 360 + 270)/6500 = 11.1%

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 ≥ 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)
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: \( r = p + i \)

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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:
  - \[ \text{WACC} = \text{R for equity (Equity %)} + \text{R on Bonds (Bond %)} \]
- 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%) 1000/1200 = 8.33%
  - Total value of Equity = “market capitalization”
    = (share price)(number of shares outstanding)
Calculating WACC (3)

\[ WACC = r_{equity} \frac{E}{V} + r_{debt} \frac{D}{V} \]

- \( D, E \) = 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%

- \[ WACC = \text{Equity R (Equity %)} + \text{Bond R (Bond %)} \]
  - 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**

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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