

## Financial Justification: Risk & Discount Rates

### **Financial Justification**

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- Evaluative Process


What Is A Project/Action "Worth?"

- Factors To Take Into Consideration
  - Economic Consequences For The Firm
    - *Costs*
    - *Benefits*
  - Distribution Of Those Consequences
    - *Institutionally*
    - *Temporally*
  - Strategic Implications

## Project Evaluation

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- Purpose:  
To help decision makers choose among alternatives by estimating how much any choice is worth
  - Possible Results:
    1. The identification of worthwhile choices
    2. The ranking of choices


  - Dilemma:  
The precision required to obtain the preferred choice (#2) involves assumptions and simplifications which may be excessive
- **The more you can assume away or ignore, the more precise the analysis**

## Nature of Assumptions

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- Comparability
  - over time
  - for various quantities of the same item
  - different objects
  - different people
- Degree of uncertainty
- After Death & Taxes, The Only Real Certainty Is:

**Forecasts Are Wrong!**
- The Problem: We Persist In Driving This Uncertainty Out Of Our Decisionmaking
  - Through Assumptions
  - Through Through False Precision
  - Through Faulty Analytical Techniques

## **Basic Financial Justification**

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- **Objective:**  
To provide economic comparison of benefits and costs that occur over time
  
- **Assumptions:**
  - All benefits, costs measured in money
  - Single point of view

## **Principal Evaluation Criteria**

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- **Net Present Value**
  
- **Benefit-Cost Ratio**
  
- **Internal Rate of Return**
  
- **Cost-Effectiveness Ratio**
  
- **Pay-back Period**

## Issue

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- Value over time

Money today has a different value than the same amount of money at a different date

Comparable to	interest rate
Not equivalent to	

Proper name: Discount rate,  $r$   
(because future benefits/costs are reduced compared with the present)

Discount Rate Is A Statement of **Strategic Intent**:  
*The Intertemporal Value Of Money*

## Formulas for N Periods

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- Single amounts

a) Future Amount =  $P (1 + r)^N = P (\text{caf})$

caf = Compound Amount Factor

b) Present Amount =  $F/\text{caf}$

$1/\text{caf}$  = Present Worth Factor

- Finite Series

c)  $F = \sum_i R (1 + r)^i = R [(1 + r)^N - 1] / r$

d)  $R = P (\text{crf}) = P [r (1+r)^N] / [(1 + r)^N - 1]$

crf = Capital Recovery Factor

## Formulas for N Periods (continued)

- Infinite Series

$1 \ll (1+r)^N$  therefore;

$$\text{crf} = [r (1+r)^N] / [(1+r)^N - 1] \implies r$$

(can use this fact as a way to remember the general crf)

- Short Time Periods ("continuous compounding")

Say  $r$  = annual rate of discounting, so  $r/12$  = monthly rate, etc.

Now, if the number of subdivisions in our time period is  $X$ , then, as  $X$  gets very large

$$(1 + r/X)^{NX} \implies e^{rN}$$

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## Net Present Value

- NPV = Benefits - Costs (Present values)
- Objective: Maximize NPV
- Advantage: Focuses on result
- Disadvantages:
  - Interpretation of NPV
  - Does not account for scale, therefore difficult to use for ranking

Project	Benefit	Cost	Net value	NPV as % of Cost
A	\$2,002,000	\$2,000,000	\$2,000	0.1%
B	\$2,000	\$1,000	\$1,000	100%

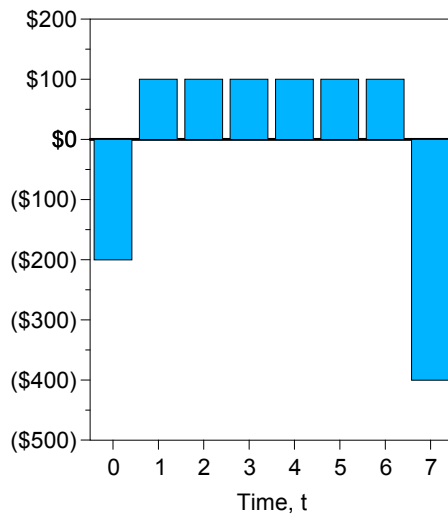
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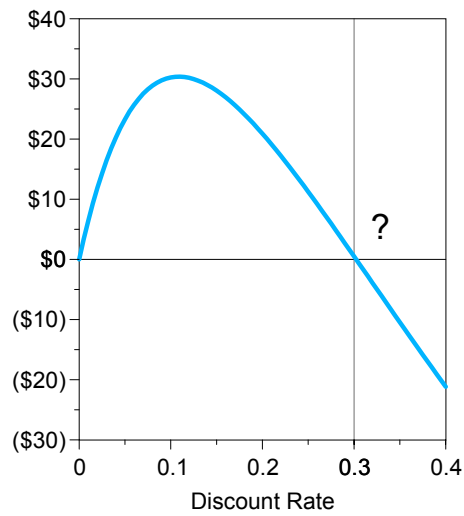
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## IRR vs. NPV - Example

Cash Flow



Net Present Value



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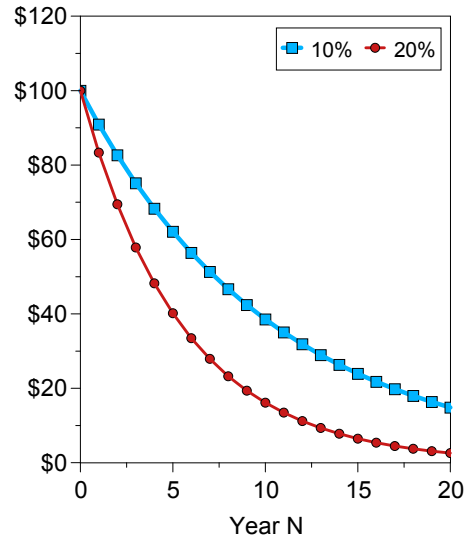
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## Effect of Different Discount Rates on Projects

- Higher  $r \Rightarrow$  smaller value of future benefits
- Higher  $r$  discourages projects whose benefits pay back costs over long time periods
- Thus, project advocates should try to minimize  $r$  so projects will look good!

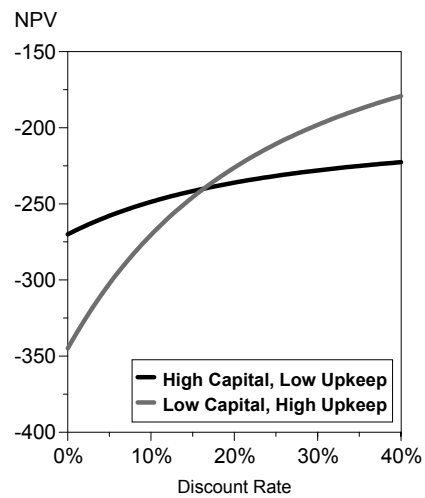
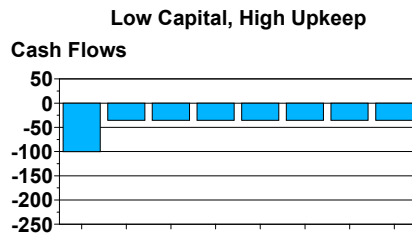
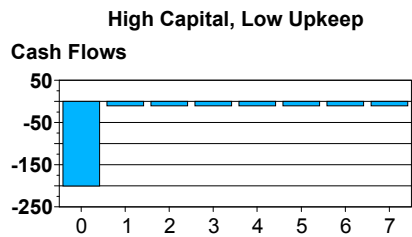
Present Value of \$100 from Year N



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## Two Types Of Cash Flows



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## To appreciate the effect of discounting:

- "Rule of 72" or "Rule of 70"
- $e^{rN} = 2.0$  when  $rN = 0.72$  (actually 0.693)
- Therefore, present amount doubles when future amount halves when  $rN = 72$  and  $r$  expressed in percent
- Examples
  - When would \$1000 invested at 10% double?
  - What is, at 9%, the value of \$1000 after eight years of compounded interest?

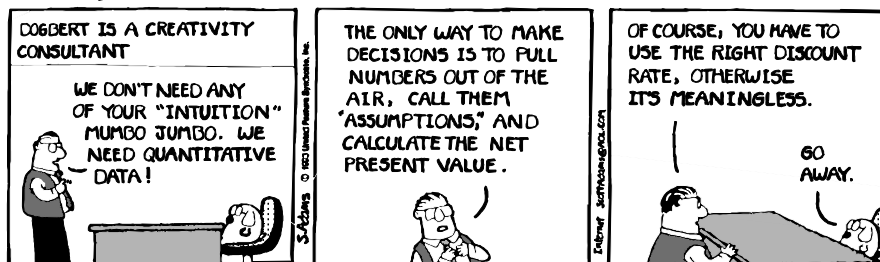
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## How Is The Discount Rate Determined?

- A Critical Notion In Theory
- Current Thinking Is Potentially Misleading
- A BIG Effect On Analysis!!
  - Actual
  - Perceived

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## **Choice of DR: Principle**

- DR should reflect the rate at which money can increase in available productive investments  
=> productivity of capital
- An empirical definition: not theory  
– Based On A Combination Of Preferences & Strategy
- Test: what is the rate at which current investments are producing, at the margin?

- Example:

You have loans:           \$2,000 on VISA     -   18%  
                                  \$150,000 for house -   6%

Could save money today in a money market fund at 6%

DR for \$ 100?  
      \$ 1,000?  
      \$10,000?

## **DR Used in Practice**

- A nice round number, generally  
– recognition of imprecision in measurement
- Usually Dictated By Financial Officers
- Where rate must be defended legally, as to regulatory groups, formulas used  
– not subjective  
– illusory precision
- Research has shown that available profitability, with no inflation, is roughly 10% to 15% worldwide
- Examples:  
    US OMB for federal government           10%  
    British Airports Authority               14%  
    Many companies allege                     20%

## **Consequences of Principle**

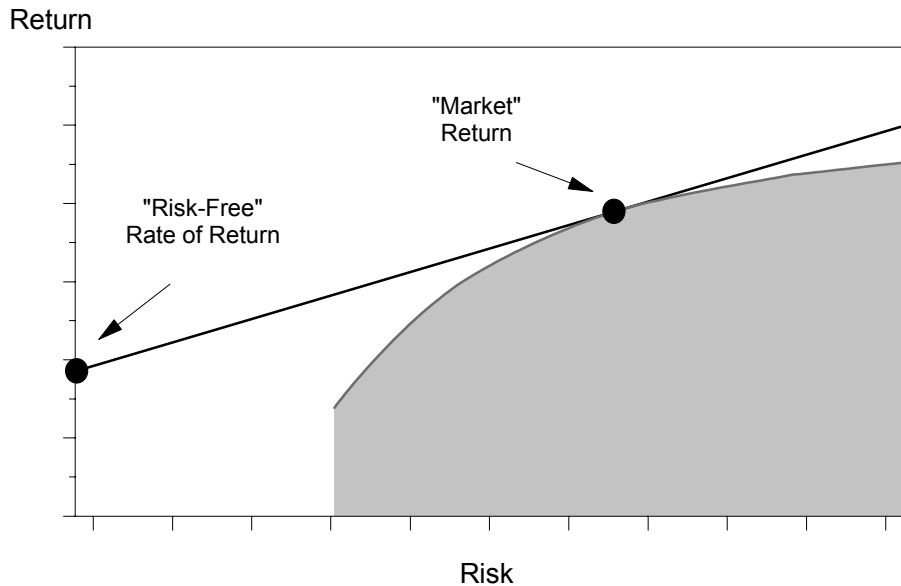
- DR peculiar to situation of decision-making unit
  - depends on opportunities
- DR not a precise measure
  - except in classroom examples, exact return difficult to obtain precisely
- DR greater than or equal to interest rate paid
  - repaying debt always one possible investment, so DR at least equals interest
  - actually you borrow because the value of money is greater than interest
- Since DR is the minimum acceptable profitability,  

NPV > 0 indicates a good project, but not necessarily the best one
- **BUT: DR is NOT about risk!!!!!!**

## **Risk and Discount Rate -- Together?**

- **Consequence of (Relatively) Recent Research Into The Behavior Of Financial Markets**
  - **The Capital Asset Pricing Mode (CAPM)**
- **Translates Empirical Behavior Of Financial Markets Into A Strategy For Portfolio Management**
- **Primary Conclusion:**
  - **Financial Markets Require Higher Rates Of Return With Increases In The Uncertainty About The Actual Value Of A Financial Asset**
- **Effective Consequence:**
  - **The Net Present Value Of Project With Higher 'Risk' Should Be Evaluated Using The Rate Of Return Established By The CAPM**
- **OK?**

## Capital Asset Pricing Model



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## NO! -- Risk Is Distinct From Discount Rates

### ■ Intuitive Argument:

If High Risk Means That High DR Should Be Applied:

Then Future Events Are Relatively UNINTERESTING!  
(Recall, Increasing The DR Decreases The Value Of Future \$\$)

In Effect, High DR Makes The Uncertainty Moot, Because It  
Becomes Irrelevant!

### ■ Analytical Argument:

Uncertainty About Outcomes Means That  
Each Has An Associated Probability

$$\frac{1}{(1+r)^t}$$

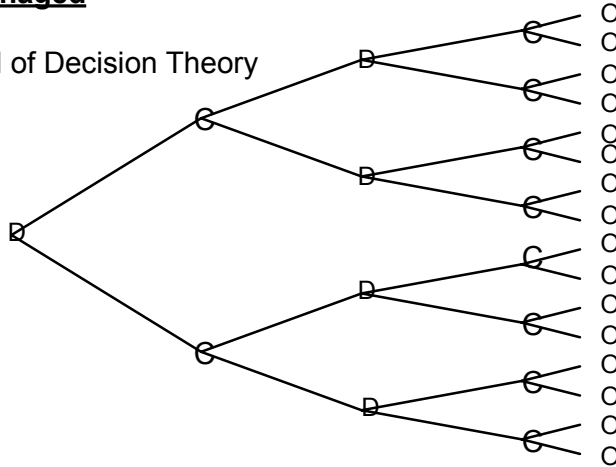
How Does Probability Relate To The NPV Formula?

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## Financial Justification With Risk Management

- Risk Must Not Be Assumed (Or Analyzed) Away
- Rather, It Must Be **Managed**
- Tools Do Exist -- Field of Decision Theory
- Core Element:  
The Decision Tree



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## Summary

- **Discount Rates Are A Statement Of Preference:**  
**How Dollars In The Future Are Valued In Comparison With Dollars Today**
- **Thus, DR Is A Statement Of A Firm's (Or Individual's) Strategic Intent**  
– Therefore, **NO SUCH THING AS THE "RIGHT" DISCOUNT RATE!**  
– Only A Strategically Appropriate Discount Rate
- **Discount Rates Are NOT About Risk!**  
– Risk Is An Issue To Be Managed Separately From The Analysis Of Present Value
- **Consider:**  
**If Risk Can Be Taken Care Of Through The Use Of Discount Rates,  
Who Needs Managers??**

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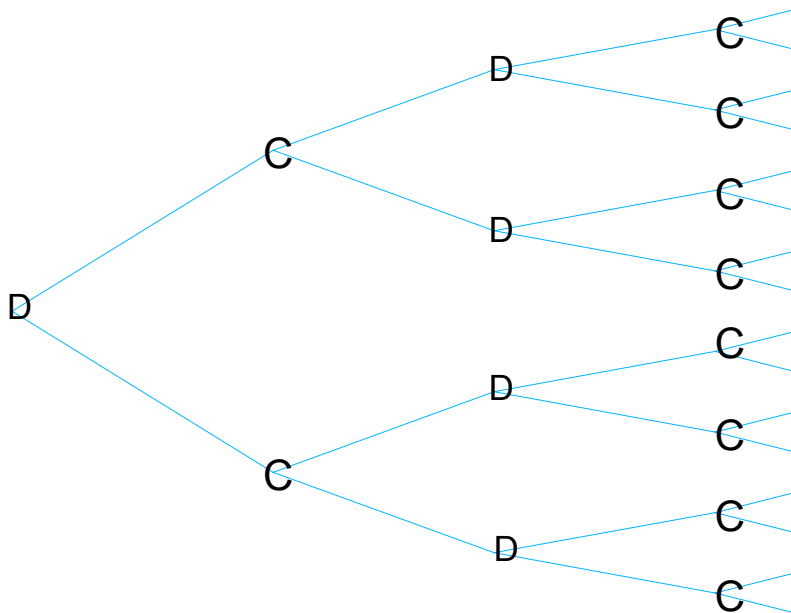
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## Implications For Financial Justification

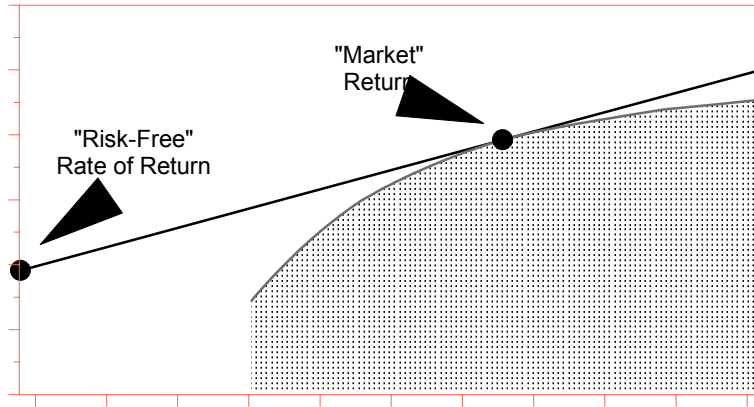
- Net Present Value Is Only A Part Of The Justification
- Uncertainties Underlying Analysis Must Be Articulated
- Strategies To Minimize Impact Of These Uncertainties Must Be Developed
- Planning For Disaster, So That Disaster Can Be Avoided
  
- Don't Let Your Computer/Calculator Make Your Decisions For You!

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Return



Risk

Return



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