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Introduction to Financial Economics

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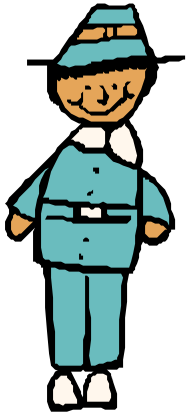
What is Financial Economics?

- Mathematical Finance
  - Relatonships between Asset Prices in Efficient Markets
  - eg pricing of options, futures and other derivatives
- Asset Pricing Models
  - Valuation of Financial Assets
  - eg dividend discount, CAPM, APT, etc
- Corporate Finance
  - Optimal Financial Management of Companies
  - eg capital structure, dividend policy, management remuneration

Key Underlying Principles



- Investor Perspective
  - consider the world from the perspective of an individual investor, not from the perspective of a company
  - rational behaviour of individual investors drives the rational behaviour of the market
  - value creation depends on actions that individual investors cannot replicate themselves

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Key Underlying Principles

- Founded on theoretically rigorous principles
  - efficient markets
  - rational behaviour
  - perfect information
  - no arbitrage
- Modified in accordance with real world imperfections
  - transaction costs
  - regulation and taxation
  - bankruptcy and financial distress costs
  - asymmetric information and signalling effects
  - agency effects

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Highlights of Financial Economics

- Principle of No Arbitrage
- Risk Neutral Pricing
- Market Price of Risk
- Capital Structure and Dividend Irrelevance
- The Impact of Market Imperfections

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Principle of No Arbitrage

- It is not possible to make risk-free profits
  - demand for / supply of assets required to earn risk-free profits drives relative asset prices to an arbitrage-free equilibrium
- Principle of no arbitrage drives *relative* asset prices
  - a reference point for asset pricing is required
  - a risk-free investment must earn a risk-free rate of return
  - the reference value of risky assets is determined by the market price of risk

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Risk Neutral Pricing

- Determine the relative value of assets with the same underlying risk by constructing risk-free "replicating portfolios"
- Expected return on risk-free replicating portfolio is the risk-free rate of return
- No requirement for variables concerning the risk-return preferences or perceptions of investors

  Therefore "risk-neutral"

Risk Neutral Pricing

- Example - Binomial Option Pricing Model

Underlying Share S

$100 → $120 p
$100 → $80 1-p

Call Option C with $100 Strike

C → $20 p
C → $0 1-p

- Replicating Portfolio to match value of C

Buy x shares @$100, Borrow $Y at risk-free rate r

Value of Replicating Portfolio

$100x - $Y → $120x - $Y(1+r) p
$100x - $Y → $80x - $Y(1+r) 1-p

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Risk Neutral Pricing

- Equate value of replicating portfolio with option value

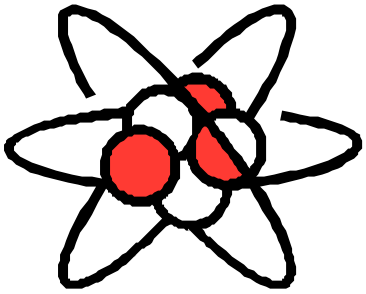
$120x - $Y(1+r) = $20
$80x - $Y(1+r) = $0

x = 0.5
Y = 40 / (1+r)

C = $100x - $Y
= $50 - $40 / (1+r)

- The value of C is independent of p (risk perceptions)
- The value of C depends on
  - r (risk free rate)
  - starting share price S ($100 in this case)
  - share price increase (+$20) and decrease (-$20) (volatility)

Risk Neutral Pricing



- Extensions
  - Distribution of Expected Asset Price Returns
    - Normal Distribution (eg Black Scholes)
    - Mean Reverting Distributions (eg Interest Rates)
    - Stochastic Volatility
    - Jump Models
  - Synthetic Options and Portfolio Insurance
  - Exotic Options
  - Derivatives with Multiple Underlying Variables
  - Numerical Methods for Solving Risk Neutral Equations

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Market Price of Risk

- Consider a quantity B (traded or non-traded) whose value depends solely on a non-traded variable A
  - eg Life Office VIF depends on Company Profits

  A has expected growth of m and volatility of s

- Consider two traded securities C and D whose value also depends solely on the same non-traded variable A
  - eg Price of Company Shares and Futures on Company Shares depend on Company Profits

  C has expected return of μ_c and return volatility of s_c
  D has expected return of μ_d and return volatility of s_d

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Market Price of Risk

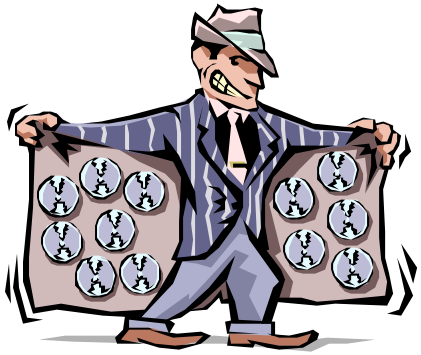
- Construct a risk-free replicating portfolio using C and D
- Market price of risk for traded securities C and D

$$? = \frac{\mu_c - r}{s_c} = \frac{\mu_d - r}{s_d}$$

(μ - r) = excess return over risk-free rate
s = volatility of return

- ? estimated from the trading history of the traded securities C or from Asset Pricing Models
- Set the expected value of A using risk neutral techniques
  - replace expected growth rate of m by (m - ?s) (changing the growth rate is also known as the "price deflator" method)
  - discount at risk free rate of return

Market Price of Risk



- Example
  - Expected Return on Company Shares = 10% pa
  - Volatility of Share Returns = 20% pa
  - Risk Free Rate is 5% pa
  - Market Price of Risk

$$? = \frac{0.10 - 0.05}{0.20} = 0.25$$

  - Expected Growth in Company Profits = 30% pa
  - Volatility of Company Profits = 15% pa
  - Risk Neutral Growth Rate = 0.30 – 0.25 x 0.15 = 0.18
  - Therefore for Risk Neutral VIF, assume growth of 18% pa in profits and discount at risk free rate

Market Price of Risk

- The only underlying variable is the value of the market portfolio with expected return (μ_M) and risk (σ_M)
  - excess returns on security A are proportional to the excess returns on the market portfolio ($\mu_M - r$)
  - volatility of security A is proportional to volatility of the market portfolio (σ_M)

$$? \propto \frac{\mu_M - r}{s_M}$$

$$\mu_A - r = ß(\mu_M - r)$$

$$s_A \propto ß s_M$$

- Similar to Capital Asset Pricing Model (CAPM)

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Market Price of Risk

- For quantities that depend on multiple underlying variables

$$\mu_A - r = \sum ?_i s_i$$

$\mu_A - r$ = excess return over risk-free rate for security A
σ_i = volatility of return for variable i
$?_i$ = market price of risk for variable i

- Analogous to Arbitrage Pricing Theory (APT)

Capital Structure and Dividend Irrelevance

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- Miller and Modigliani (1958 and 1961)
- Irrelevance of Capital Structure
  - Traditional approach assumed that increasing debt to equity ratio can lower a company's cost of capital
  - M&M argue that total risk in company is not affected by changes in capital structure (debt vs equity financing)
  - Investors can substitute "homemade" leverage (through personal borrowing) for company leverage
  - Company leverage is not valued by investors, otherwise arbitrage would be possible

Capital Structure and Dividend Irrelevance

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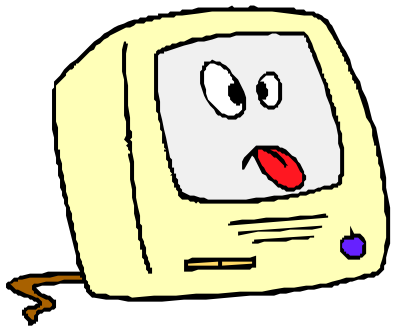
- Irrelevance of Dividends
  - Traditional dividend discount models attribute value to dividends, extrapolating payments into the future
  - M&M argue that dividend payments are irrelevant to investors
    - those who prefer cash can sell shares
    - those who prefer capital gains can reinvest dividends
  - Changes in dividend policy do not affect the value of the company, otherwise arbitrage would be possible

The Impact of Market Imperfections



- Transaction Costs
  - reduce the opportunities for arbitrage
  - different forms of financing have different costs
- Regulation and Taxation
  - in many jurisdictions, interest on debt financing is tax deductible, while dividend payments suffer double taxation
  - in many jurisdictions, dividend payments are taxed more heavily than capital gains
- Bankruptcy and Financial Distress Costs
  - large amounts of debt increase the likelihood of bankruptcy and financial distress

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The Impact of Market Imperfections

- Asymmetric Information and Signalling Effects
  - asymmetry of information between management and shareholders
  - actions by management suggesting that company is over or undervalued may have signalling effects
- Agency Costs
  - managers and shareholders have different interests creating conflict and possibly destroying value for shareholders
  - attempts to align the interests of managers with those of shareholder should increase company value
  - high levels of debt act as a disciplinary tool for managers

Implications of Financial Economics for Actuaries

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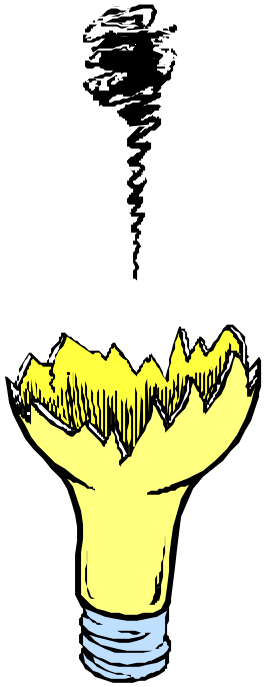

- Investors do not place a value on investment strategies, otherwise arbitrage would be possible through "homemade" asset allocation
- Risk neutral methods can be used to keep actuarial calculations consistent with market values
- Options have a significant and quantifiable cost which is independent of individual risk perceptions
- Market imperfections have a potentially large impact on the values of companies