15.401 Finance Theory

MIT Sloan MBA Program

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Course Summary

Motivation

Mathematics + $$$ = Finance

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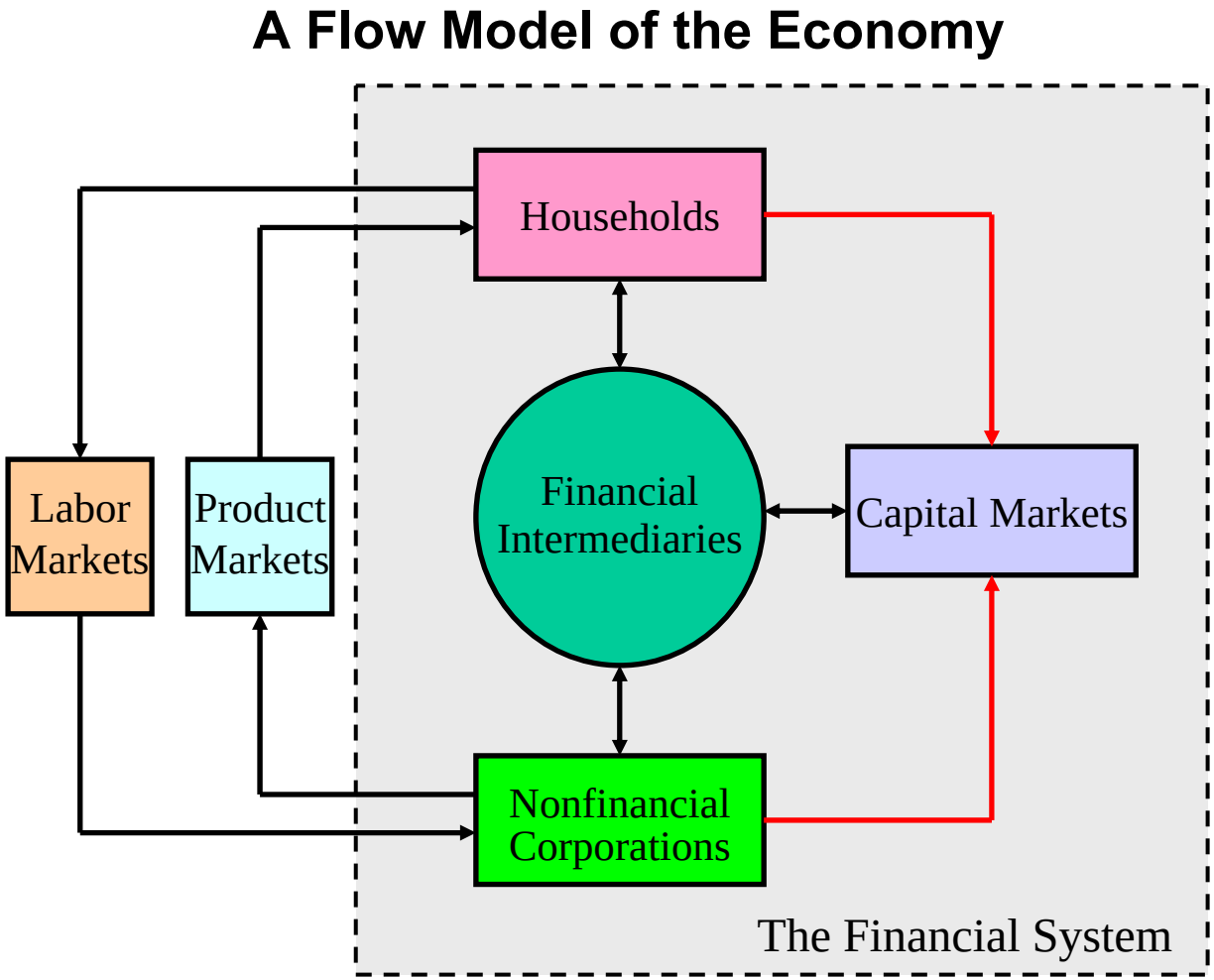
James Simons
Renaissance Technologies

Jack Welch
General Electric

Warren Buffett
Berkshire Hathaway

Dramatis Personae



Six Fundamental Principles of Finance

P1: There Is No Such Thing As A Free Lunch

P2: Other Things Equal, Individuals :

- **Prefer more money to less (non-satiation)**
- **Prefer money now to later (impatience)**
- **Prefer to avoid risk (risk aversion)**

P3: All Agents Act To Further Their Own Self-Interest

P4: Financial Market Prices Shift to Equalize Supply and Demand

P5: Financial Markets Are Highly Adaptive and Competitive

P6: Risk-Sharing and Frictions Are Central to Financial Innovation

Course Overview

Four Sections

A. Introduction
- Fundamental challenges of finance
- A framework for financial analysis
- Six principles of finance
- Cashflows and the time-value of money

B. Valuation
- Discounting and the mathematics of net present value
- Pricing stocks, bonds, futures, forwards, and options

C. Risk
- Measuring risk
- Managing risk (portfolio theory)
- Incorporating risk into valuation methods

Course Overview

Four Sections

D. Corporate Finance
   - Capital budgeting and project finance

Final Lecture: Market Efficiency (putting it all together)

- Do financial markets always work well in discovering prices?
- What about behavioral biases and human psychology?
- How should finance theory be used in practice?

Key Points: Present Value

- Assets are sequences of cash flows
- Date-t cashflows are different from date-(t+k) cashflows
- Use "exchange rates" to convert one type of cashflow into another
- PV and FV related by "exchange rates"
- Exchange rates are determined by supply/demand
- Opportunity cost of capital: expected return on equivalent investments in financial markets
- For NPV calculations, visualize cashflows first
- Decision rule: accept positive NPV projects, reject negative ones
- Special cashflows: perpetuities and annuities
- Compounding
- Inflation
- Extensions and Qualifications

Key Points: Fixed-Income Securities

- Valuation of riskless pure discount bonds using NPV tools
- Coupon bonds can be priced from discount bonds via arbitrage
- Current bond prices contain information about future interest rates
- Spot rates, forward rates, yield-to-maturity, yield curve
- Interest-rate risk can be measured by duration and convexity
- Corporate bonds contain other sources of risk

Key Points: Equity Securities

- The Dividend Discount Model
- The Gordon Growth Model
- Discount rate, cost of capital, required rate of return
- Estimating discount rates with D/P and *g*
- EPS, P/E, and PVGO
- Definitions of growth stocks and growth opportunities

Key Points: Futures and Forwards

- Forward and futures contracts are zero-NPV contracts when initiated
- After initiation, both contracts may have positive/negative NPV
- Futures contracts are “marked to market” every day
- Futures and forwards are extremely liquid
- Hedging and speculating are important applications of futures/forwards

Key Points: Options and Other Derivatives

- Options have nonlinear payoffs, as diagrams show
- Some options can be viewed as insurance contracts
- Option strategies allow investors to take more sophisticated bets
- Valuation is typically derived via arbitrage arguments (e.g., binomial)
- Option-pricing models have a long and illustrious history

Key Points: Introduction to Risk and Return

Anomalies:

- **Size Effect**: Smaller stocks typically outperform larger stocks, especially in January.
- **January Effect**: Returns in January tend to be abnormally high.
- **Value Effect**: Low P/B (value) stocks typically outperform high P/B (growth) stocks.
- **Momentum**: Stocks with high returns over the past 12 months typically continue to outperform stocks with low past returns.
- **Accruals and Issuances**: Stocks with high past accruals and/or recent stock offerings typically underperform stocks with low past accruals and no stock offerings.

Key Points: Portfolio Theory

- Diversification reduces risk. The standard deviation of a portfolio is always less than the average standard deviation of the individual stocks in the portfolio.
- In diversified portfolios, covariances among stocks are more important than individual variances. Only systematic risk matters.
- Investors should try to hold portfolios on the efficient frontier. These portfolios maximize expected return for a given level of risk.
- With a riskless asset, all investors should hold the tangency portfolio. This portfolio maximizes the trade-off between risk and expected return.

Key Points: The CAPM

- Tangency portfolio is the market portfolio
- This yields the capital market line (efficient portfolios)

$$\mathsf{E}[R_p] \;=\; R_f \;+\; \frac{\sigma_p}{\sigma_m}\,(\mathsf{E}[R_m] - R_f)$$

- The CAPM generalizes this relationship for any security or portfolio:

$$\mathsf{E}[R_i] \;=\; R_f \;+\; \beta_i\,(\mathsf{E}[R_m] - R_f)$$

- The security market line yields a measure of risk: beta
- This provides a method for estimating a firm's cost of capital
- The CAPM also provides a method for evaluating portfolio managers
  - Alpha is the correct measure of performance, not total return
  - Alpha takes into account the differences in risk among managers
- Empirical research is mixed, but the framework is very useful

Key Points: Capital Budgeting

- Use the NPV rule for capital budgeting decisions: take all projects with positive NPV, or take highest-NPV project if mutually exclusive
- Consider project interactions separately
- Use after-tax cashflows for NPV calculations, not accounting earnings
- Use the CAPM to estimate cost of capital with project beta
- Be careful about risks that change over time or across different stages
- Be wary of alternative to NPV:
  - Payback rule, discounted payback rule
  - Profitability index
  - Internal rate of return

Key Points: Market Efficiency

- Several types of market microstructure
- Markets have several functions
- Markets work well most of the time
- Price discovery process is not costless nor effortless
- Convergence of market prices to rational expectations equilibria
- Bubbles, crashes, excess volatility, are part of normal markets
- Emotional state of the market matters
- The Adaptive Markets Hypothesis integrates rational and behavioral