Corporate Finance

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Learning Philosophy

Corporate finance studies the financial decisions facing corporations, including capital budgeting, financing, operation, and dividend policy. Throughout the course, lectures emphasize the economic intuitions and principles behind the concepts, theories and models. Applications are illustrated with business examples, case studies, market data, and industry practices.

- Facts: data, cases, and institutions
- Language: concepts and terminology
- Techniques: modeling and estimation
- Philosophy: framework and principles
- Applications: decision-making valuation

Themes and Topics

I. Corporate Decisions	II. Corporate Valuation
1. Financing: Mixture of Equity and Debt 2. Investing: Asset and Capital Budgeting 3. Operating: Working Capital Management 4. Dividend Payout and Retained Earnings	1. Capital Value 2. Cost of Capital 3. Capital Structure 4. FCFF & WACC

Principles in Corporate Finance

1. Market cap/value/wealth/price maximization of the business (projects)
2. Net Present Value: Choose the project with the highest net present value
3. Hurdle rate: Choose the project above the minimum acceptable rate of return
4. Return-Risk Tradeoff: Maximize expected return and minimize risk in the asset universe
5. Diversification: Don't put all the eggs in one basket, to build an all-weather portfolio
6. Weighted Average Cost of Capital: the opportunity cost of mixing equity and debt
7. Debt-Equity Financing Tradeoff: tax shield benefit against financial distress cost
8. Dividend payout: only after all positive NPV projects have been fully financed.

Separation Principle: If securities are fairly priced, then buying or selling securities has an NPV of zero and, therefore, should not change the value of a firm.

Conservation of Value Principle: With perfect capital markets, financial transactions neither add nor destroy value, but instead represent a repackaging of risk (and therefore return).

Lecture 1: The Big Picture

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I. Nature and Origin

1. Economics is the study of choice under scarcity. Finance is a subset of E (King's crown).
   1) Two traditional themes in Economics: resource allocation and income distribution
   2) The most important decision variable in Economics: market price (the invisible hand).
   3) Finance studies asset allocation and valuation. Two most essential variables: return and risk.
2. Corporate Finance (applied Economics) studies financial decisions facing corporations, including
   1) Financing decision: capital/financial structure (quantity, duration, and mixture)
   2) Investing decision: capital budgeting (planning and managing long-term assets)
   3) Operating decision: working capital management (short-term assets and liabilities)
   4) Dividend policy: dividend payout, stock buyback, stock splits, and retained earnings
3. Origin: Modigliani, Franco and Merton H. Miller. 1958. "The Cost of Capital, Corporate Finance, and the Theory of Investment." American Economic Review. June 48:4, pp. 261–97. (w)

II. Careers and Certifications

1. Careers: financial management, investment banking, VC & PE, financial analyst
2. Certifications: CFA, CPA, FRM, FMVA, CAIA designation, CFP designation

II. The Corporate Life Cycle: Six Stages

1. Start-up (lightbulb moment): have an idea for a business that meets an unmet need in the market.
2. Young growth (product test): create a biz model that converts ideas into future revenues & profits
3. High growth (bar mitzvah*): build the business, converting potential into revenues
4. Mature growth (scaling up test): grow the business, shifting from losses to profits
5. Mature stable (midlife crisis): defend the business from new competitors & find new markets
6. Decline (end game): scale down the business as market shrinks and technology revolves

III. Analytical Frameworks

1. Corporate governance vs corporate management
2. Financial statements: accounting data and rules
3. Financial markets: institutions and instruments
4. Asset valuation: philosophy and techniques
5. Financial assets performance: return and risk
6. Economic theory and model: CAPM and MM

IV. Principles and Decision Rules

1. Price theory: 1) opportunity cost; 2) marginal equalization; 3) optimality
2. Money theory: 1) flow vs stock; 2) money and liquidity; 3) quantity equation
3. Interest theory: 1) income; 2) capital; 3) interest; 4) asset valuation
4. Corporate finance first principle: maximize the value of the business
   1) The investment decision: invest in projects that earn a higher return than the hurdle rate
   2) The financing decision: find the right type of debt and capital structure to fund operations
   3) The dividend decision: return the cash to owners if investment cannot beat the hurdle rate

Lecture 2: Corporate Governance

I. Corporation: Definition and Origin

1. Lawyers: C is a legal business structure that establishes the business as being a separate entity from the owners. Essential characteristics: limited liability for investors, free transferability of investor interests, legal personality, centralized management.
2. Economists: C is a commercial/industrial organization tied by contractual arrangements.
3. The Origin of Corporations (2015): The mills of Toulouse in the Middle Ages. (w) (w)

II. Objectives in Decision Making

1. In traditional corporate finance, the objective in decision making is to max the value of the firm.
2. A narrower objective is to maximize stockholder wealth. When the stock is traded and markets are viewed to be efficient, the objective is to maximize the stock price.
3. ESG: in 2020, investors allocated over three times as many assets into ESG ETFS than in 2019
    1) Environmental: carbon emissions, water stress, opportunities in clean tech
    2) Social: privacy and data security, controversial sourcing, and community relations
    3) Governance: business ethics, pay figures and tax transparency

III. Governance Structure

1. Corporate governance deals with the mechanisms for aligning the interests of managers with those of (controlling) shareholders while protecting the interests of stakeholders (minority shareholders, debt holders, financial markets, employees, customers, supplier, and society at large). In short, good corporate governance prevents expropriation of outside investors.
2. Stakeholders: creditors, employees, customers, suppliers, government, competitors, "takeovers"
3. Old structure: shareholders → board of directors → managers (separation of o and m)
4. New structure: founder-managers control (e.g., FAMG, Tesla, Baidu, Alibaba, Tencent)
5. Voting rights control (share classification: common, executive, preferred, deferred, non-voting)
6. Anti-takeover strategies (greenmail, white knight, golden parachute, poisonous pill, crown pearl)
7. Case study: Baidu is a Chinese company incorporated in Caymen Islands and listed in Nasdaq
    1) Structured as a shell company to get around government restrictions of foreign investors holding shares in Chinese corporations.
    2) Founder-manager control: six directors including Mr. Robin Li who owns a majority of class B shares, which have ten times the voting right of class A, granting him effective control
    3) Legal system: Baidu's operating counterpart in China is structured as a Variable Interest Entity (VIE), and it is unclear how much legal power the shareholders in the shell company have.
8. Recent codes of good governance: 1) independent directors; 2) separation of chairman-CEO roles; 3) rotation of external auditor; 4) frequency of financial reporting; 5) comply requirement

IV. Economic Theory

1. Asymmetric information in the principal-agent problem: shareholders and managers
2. Moral hazard: insufficient effort, extravagant investment, entrenchment strategies, self-dealing
3. Board of directors: lack of independence, insufficient attention and incentives, conflict avoidance
4. Contract design for managerial incentives: monetary incentives, market incentives, and monitoring

Lecture 3: Financial Statements: Fundamentals

I. Function and Necessity

1. Financial transaction records: managers/customers/suppliers
2. Financial performance measures: creditors and investors
3. Financial information disclosure: IPO stock exchange
4. Financial regulatory requirements: SEC lawsuits (SABOX)
5. Tax obligation and social responsibility: IRS (US CIT 21%)

II. Financial Statements: Information

1. Balance sheet: solvency and structure (A>L or SE>0)
2. Income statement: profitability (gains and losses) & Cash flow statement: liquidity
3. Free cash flow = cash flow from assets (net out working capital or fixed asset investment)

III. Accounting Identities: Foundations and Principles

1. Foundations in Microeconomics: historical costs vs opportunity costs
   1) Shareholder is the owner of the corporation (accounting entity)
   2) Accounting cost: all explicit costs incurred by business activities
   3) Economic cost: the opportunity cost of capital (equity) investment
   4) Accounting profit: net income (dividend payout and retained earnings)
   5) Economic profit: dividend paid to shareholders minus the cost of equity
   6) Cost is tied to a decision. Historical cost (CapEx) is not a cost. Cost is forward-looking.
2. Foundations in Macroeconomics: 1) stock vs flow; 2) money and liquidity; 3) real vs nominal
3. Foundations in Finance: 1) income; 2) capital; 3) interest; 4) asset value; 5) return and risk
4. Accounting Principles: 1) recognition principle; 2) matching principle

Balance sheets identity: Total asset = Total liability + Owner's equity (capital)

Net income = Sales revenue – Cost (production + operation + depreciation + interests + taxes)

Cash flow from asset (operate + invest + finance) = Cash flow to creditor + Cash flow to shareholder

IV. Financial Statements: The Links

1. Balance sheet and income statement
   1) BS: capital asset (+) → IS: depreciation (–)
   2) IS: net income/earnings → BS: retained earnings
2. Balance sheet and cash flow statement
   1) BS: ending cash – beginning cash → net cash flows over the period
   2) BS: capital expenditure (–) → net cash flow is not affected
3. Income and cash flow statements (matching principle)
   1) Depreciation is added back to EBIT to generate operating cash flow
   2) Depreciation is an investment cost but not actual cash flow in the fiscal year
4. Highlight: the difference between profit and cash flows is the change in non-cash items.
5. Question: how does a capital expenditure of affect the financial statements for its life cycle? Show it in a timeline over the capital utilization.

Lecture 4: Financial Statements: Applications

I. Performance Evaluation

1. Comparison: 1) over time; 2) within groups; 3) between groups
2. Techniques: 1) indexing; 2) benchmarking; 3) ranking; 3) standardization
3. Measurements and metrics
    1) Absolute value (firm size/market cap)
    2) Rate (percentage change or growth)
    3) Ratio (relative importance)

II. Standardized Financial Statements

1. Purpose: facilitate comparison, track performance over time, identify key factors
2. Common-size balance sheets: express all BS items as a percentage of total assets
3. Common-size income statements: express all IS items as a percentage of total sales

III. Financial ratio analysis

1. Profitability ratios (#1 metric): gross margin, EBIT m, operating m, after tax om, net profit m
2. Turnover ratios (operating efficiency): asset turnover, capital turnover, working capital turnover
3. Liquidity ratios (short-term solvency): current ratio (CA/CL) & quick ratio (inventory excluded)
4. Coverage ratios (financing commitment): interest coverage ratio and fixed charge ratio
5. Leverage ratios (long-term financing solvency): D/E, D/(D+E), EBIT/interest, D/EBITDA
6. Dividend policy ratios (stockholder's interest)
    1) Net income NI (or earnings or accounting profit) = dividend + retained earnings
    2) Payout ratio=dividend/earnings; 3) Retention (plowback) ratio=retained earnings/earnings
7. Stock market ratios: 1) P/E; 2) P/S; 3) M/B; 4) EV/EBITDA (Enterprise Value=MC+D–Cash)

IV. DuPont Identity and Growth Analysis

1. ROA=NI/A=(Net Income/Sales)•(Sales/Asset)=profit margin • asset turnover
2. ROE=NI/E=(NI/A)•(A/E)=(NI/S)•(S/A)•(A/E)=profit margin • asset turnover • equity multiplier
3. Internal growth rate (no external financing) = ROA•b/(1–ROA•b), where b is retention ratio
4. Sustainable growth rate (no equity financing) = ROE•b/(1–ROE•b)

V. Corporate Life Cycle View of Cash Flows and Financial Ratios

Metrics	Start-up	Young growth	High growth	Mature growth	Mature stable	Decline
Revenue	Small	High growth	Large, grow	Large, growth	Large stagnant	Drops
Assets	Small	Grows quickly	Smaller grow	Grow with profit	Stabilize	Decline
Equity	Often –	Turn positive	Starts grow	Grow quickly	Cash dependent	Decline
Operating CF	Negative	Negative	Turn positive	Increasing	Positive stable	Decline
Investing CF	Large	Continued	Growth slow	Stabilizes	Maintenance	Asset S
Financing CF	Equity	New equity	Not much	Debt + Equity–	D ++, E--	D–, E–
Accounting R	Very –	Negative	Turn positive	Grow	Stable	Decline
Profit margin	Very –	Negative	Turn positive	Improve	Stabilize	Decline
Debt ratios	Close 0	Stay low	Low	Start rising	Converge	Vary

Lecture 5: Time Machine of Finance

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I. The Nature of Interest (Irving Fisher, 1930)

1. Income is the alpha and omega of economic life.
2. Income deducting consumption is saving. Y=C+S
3. Saving is investment for future consumption. S=I
4. Investment is the balancing of consumption over time.
5. Capital generates income. Income is derived from capital asset.
6. The value of the capital is derived from the value of income.
7. Interest (rate) is the cost of borrowing and return to lending.
8. Nominal interest rate equals real interest rate plus a risk premium.
9. Interest is determined by impatience to consume and opportunity to invest.
10. The present value of an asset is the discounted sum of all its expected future cash flows, adjusting for risks. The rate of interest links all future incomes (cash flows) to the present value of capital.
11. Market interest rates and asset prices are ex-ante risk signals.

II. Space Machine and Time Machine

1. Spatial transfer of income and resources (via the medium of exchange)
2. Intertemporal consumption smoothing through borrowing (debt) and lending (credit)
3. Intergenerational consumption smoothing through pension funds and securities markets

III. The Time Value of Capital Asset

1. Which income is more valuable, $100 today or $100 next year? $101 next year?
2. Future value $FV=PV\bullet(1+i)$ vs Present value $PV=FV/(1+i)$
3. Simple interest $FV=PV+i\bullet T$ vs Compound interest $FV=PV\bullet(1+i)^T$
4. Compounding vs Discounting: $PV=FV/(1+i)^T$ where discount rate i and discount factor $1/(1+i)^T$
5. Compounding frequency $(1+i/n)^{nT}$ continuous compounding $\lim=e^{it}$, effective annual rate (EAR)

IV. Fundamental Equation: $PV_0 = \sum_{t=1}^{T} CF_t/(1+i)^t$

1. Future cash flows or incomes: expected CF at t=0, more sizable more valuable: CF↑ → PV↑
2. Future time periods: the longer, the more valuable: T↑ → PV↑; the distant future is less valuable
3. The discount rate(s) match the timing of and reflect the (risk) nature of future CF_t: i↑ → PV↓
4. PV is the fundamental/intrinsic/model/theoretical value, which is not equal to the market price.

V. Applications to Simple Financial Contracts

1. Perpetuity $=C/(1+i)+C/(1+i)^2+\ldots+C/(1+i)^{inf}=C/(1+i)\bullet[1+1/(1+i)+\ldots+1/(1+i)^{inf}]=C/i$
2. Perpetuity due $=C+C/(1+i)+C/(1+i)^2+\ldots+C/(1+i)^{inf}=C\bullet(1+i)/i$ & Perpetuity due in t years?
3. Annuity $PV=C\bullet\{1/i-[1/i(1+i)^T]\}$ & Annuity $FV=C\bullet[(1+i)^T-1]/i$ where T is the starting time
4. Annuity due $PV= C\bullet\{1/i-[1/i(1+i)^t]\}\bullet(1+i)$ & Annuity due $FV= C\bullet\{[(1+i)^T-1]/i\}\bullet(1+i)$

Lecture 6: Financial Markets: Return and Risk

I. Financial Markets: Functions and Efficiency

1. Direct vs indirect finance: intermediary
2. Financial structure: the mix of direct vs indirect financing
3. Efficient market hypothesis (EMH): Stock market is informationally efficient and prices reflect all available information. It implies returns are unpredictable relative to some required return.
    1) Weak from: current prices reflect all historical information such that no one can earn abnormal profits from trading strategies based on past prices alone (technical analysis is voodoo)
    2) Semi-strong: all public information (past prices, financial reports, macroeconomic releases, earnings forecasts) is reflected in stock prices such that one cannot generate abnormal profits from trading strategies based on public information (fundamental analysis is useless)
    3) Strong form: all private and public information is fully reflected in current stock prices such that one cannot earn abnormal profit from any trading strategy (price is unpredictable)

II. Metrics for Asset Returns and Risk (R&R)

1. Period-to-period rate of return: $R_t=(P_t–P_{t-1})/P_{t-1}=(P_t/P_{t-1})–1$and $P_t/P_{t-1}=1+R_t$
2. Arithmetic average return: $E(R)=\sum_{t=1}^{T} R_t /T$ where R_t is p-2-p return
3. Geometric average return: $(1+R)^T=(1+R_1)(1+R_2)…(1+R_T)=\prod(1+R_t)$
4. Aggregate return: $(1+R_{0T})=(1+R_{0,1})(1+R_{1,2})…(1+R_{T-1,T})=\prod(1+R_{t-1,t})$
5. Continuous compounded rate of return $R_t=Ln(P_t/P_{t-1})$ and $P_t/P_{t-1}=e^{Rt}$
6. Mon $R_1=Ln(P_1/P_0)$, Tue $R_2=Ln(P_2/P_1)$, and return over the week: $R_{0,5}=Ln(P_5/P_0)$
7. Annualized returns: daily data R•250, weekly data R•52, monthly data R•12, quarterly data R•4

III. Statistical Approach to Return and Risk (R&R)

1. Historical return: $E(R_t)=\sum_{t=1}^{T} R_t /T$ which is just simple average or unconditional expectation
2. Historical variance: $V(R_t)=\sigma^2=1/(T-1)\sum_{t=1}^{T}[R_t - E(R)]^2$ where σ is the standard deviation
3. Conditional expected return: $E(R|S)=P_1R_1+P_2R_2+…+P_s•R_s$, where P_s is the state probability
4. Conditional variance of return: $V(R|S)= \sum_{i=1}^{S} Pi\ [R_i - E(Ri)]^2$ where Pi is the state probability

III: Financial Markets Measurements: Return and Risk (R&R)

1. Risk-free rate R_f: T-bill, EFFR, Repos (collateralized), LIBOR (unsecured)
2. Yield to maturity YTM: RoR holding the asset to expiration (annualized)
3. Dividend yield D/P: dividend per share over stock price per share
4. Excess return: $R-R_f$ or R-E(R), which is also unconditional
5. Abnormal return: R-E(R|X), which is conditional on X
6. Risk premium: $E(R)-R_f$ or $E(R|X)-R_f$ (bond/equity/forex)
7. Volatility risk: 1) V(R), SD, MAD; 2) VIX; 3) GARCH
8. Liquidity risk: Credit spread $R-R_f$ (TED: LIBOR–T-bill)
9. Inflation & recession risk: Yield curve spread ($Y_1 – Y_s$)
10. Total risk=systematic/market risk + unsystematic/individual risk
11. Higher return must compensate investors for bearing higher risk

Lecture 6: Debt Markets and Bond Valuation

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Bonds are debt market contracts/instruments that specify fixed payments of cash at specific future dates.

I. Debt Markets Introduction

1. The debt market is the market where debt instruments are traded. Debt instruments are assets that require a fixed payment to the holder, usually with interest (FRBSF, 2005).
2. Classification by maturity: Money markets (< 1Y) vs bond markets (>=1Y)
3. Money market instruments: Certificates of Deposit, Commercial Paper, BA, Repo, MMF, T-bills
4. Bond market instruments: government, corporate, Federal agency, ABS (MBS, CDO)
5. Debt market interest rates: FRB H.15 statistics

II. Bond Markets Classification and Instruments

1. Issue entity: sovereign, municipal (tax-exempt), corporate, agency (government guarantees)
2. Coupon payment: zeros (pure discount bonds), coupon bonds (periodic fixed payment)
3. Foreign entity: Eurobonds (foreign currency), Yankee (non-U.S.), Samurai (non-Japanese)
4. Option features: callable bonds (firm's option) vs convertible bonds (holder's option)
5. U.S. Treasury securities: T-bills (<=1Y), T-notes (2-10 Years), T-bonds (>10Y), TIPS

III. Bond Pricing Models

1. Bond elements: issuer entity, par value (face value), coupon, maturity, tax, options
2. Zero coupon bonds: $P=FV/(1+i)^T$ final period principal payment (FV) without interest
3. Coupon bonds: $P = \frac{CP}{(1+i)^1} + \cdots + \frac{CP}{(1+i)^T} + \frac{FV}{(1+i)^T}$ periodic coupon payment plus the principal
4. Yield to maturity (YTM): the rate of return when investors hold the bond until maturity.
5. YTM is backed out from the market price of the bond via the bond pricing model for the zeros
6. Term structure of interest rates: the relationship between short-, median- and long-term rates
7. Yield curve: a graphical representation of the interest rate term structure (benchmark pricing)

*IV. Bond Risk Premium: What are the Sources of Bond Price Volatility?

1. Credit default risk structure of interest rates depends on creditworthiness of the issuer.
2. Term structure of interest rates: the long-term interest rate equals short rate plus a risk premium.
3. Market interest rate risk: bond prices are inversely affected by changes in market interest rates.

https://www.federalreserve.gov/releases/h15/
https://home.treasury.gov/policy-issues/financing-the-government/interest-rate-statistics
https://www.frbsf.org/education/publications/doctor-econ/2005/october/debt-equity-market/

Lecture 7: Equity Markets and Stock Valuation

The equity market (often referred to as the stock market) is the market for trading equity instruments. Equity securities represent an ownership interest in a corporation (Fabozzi, 2019). Stocks are securities that are a claim on the earnings and assets of a corporation (Mishkin 1998).

I. Equity Market Structure

1. Stock exchange floor trading vs electronic and automated trading system
2. Primary (initial public offering) vs Secondary market
3. Intermediaries: Broker (agents), Dealer (market maker), and specialists (both)
4. Order-Driven (naturals; continuous vs call auction) vs Quote Driven (intermediaries)
5. Regulation: SEC (1934), FINRA (2007), State "blue sky laws"
6. Market regulation: 1) volatility rules; 2) trading limit rules; 3) circuit-breaker rules; 4) short selling rules; 5) insider trading rules

II. Stock Classification and Dividend

1. Common stock: equity carrying voting right but lower priority than the preferred stocks when it comes to dividend payment and liquidation compensation.
2. Preferred stocks: promises to pay a fixed amount each year, carries no voting power, and has priority over the common stock in a claim on assets in a liquidation.
3. Depository receipts: negotiable certificates issued by banks as evidence of ownership of the underlying stock of a foreign corporation that the bank holds in trust. DRs provides opportunities to invest equities traded in a foreign market. (unsponsored ADRs vs sponsored ADRs)
4. Dividend: a share of the after-tax profit of a company, distributed to its shareholders according to number and class of shares held by them. Today, roughly 422 of the S&P 500 stocks pay dividends.
5. Dividend source: Earnings= Dividend + Retained Earnings
6. Dividend payout ratio=Dividend/Net Income
7. Dividend yield=Dividends for the period/Initial Price

III. Stock Pricing Models

Constant dividend: PV=D/R where R is the required rate of return by the shareholders
Constant dividend growth: PV=D/(R-g) where g is the growth rate of the dividend
Non-constant dividend growth (dividend growth after T years): PV=
Required rate of return R=D/P+g
No dividend: PV=(Price/Earnings)*•EPS
No earnings: PV=(Price/Sales)*•SPS

*IV. Equity Risk Premium (Relationship between Expected Return and Risk)

1. Fama and McBeth (1973): market risk premium $E(R_M)–R_f$
2. Fama and French (1992): small cap vs large cap stocks
3. Fama and French (1993): value stock (high BtM or PE ratios) vs growth stocks (low BtM ratio)
4. Carhart (1997): stock with momentum (recent price increases) measured as the difference between the returns on the best performing stocks over the past year and the worst performing stocks

Lecture 9: Portfolio Theory and CAPM

I. Portfolio Construction and Optimization

1. Definition: A bundle/collection of assets. The risk-return trade-off for a portfolio is measured by the portfolio expected return and standard deviation, just as with individual assets.
2. Why do investors demand for a portfolio? What is the main benefit? Answer: Diversification.
3. Two-asset setup: $R_P=w_1R_1+w_2R_2$, $E(R_P)=w_1E(R_1)+w_2E(R_2)$, $V(R_P)=(w_1\sigma_1)^2+(w_2\sigma_2)^2+2w_1w_2Cov(R_1,R_2)=(w_1\sigma_1)^2+(w_2\sigma_2)^2+2w_1w_2\rho\sigma_1\sigma_2=\sigma_R^2$ where $w_1+w_2=1$ the weights/proportions invested in R_1 and R_2
   1) When $\rho=+1$, $\sigma_R=w_1\sigma_1+w_2\sigma_2$ (weight average of individual assets' risks, on a line between them)
   2) When $\rho=0$, $\sigma_R=(w_1^2\sigma_1^2+w_2^2\sigma_2^2)^{0.5}<w_1\sigma_1+w_2\sigma_2$ (uncorrelated assets diversifies the risk, bend the line)
   3) When $\rho=-1$, $\sigma_R=w_1\sigma_1-w_2\sigma_2$ or $w_2\sigma_2-w_1\sigma_1$ and set $\sigma_R=0$ → $w_1/w_2=\sigma_2/\sigma_1$ (risk elimination to zero)
4. N-asset portfolio: $E(R_P)=\sum_{i=1}^{N} w_iE(R_i)$, $V(R_P)=\sum\sum w_iw_jCov(R_i, R_j)$ where $\sum_{i=1}^{N} w_i=1$
5. Market portfolio proxy: S&P500, Russell 2000, Nikkei225 https://finance.yahoo.com/world-indices/
6. Mean-variance efficient portfolio: maximize return given a risk or minimize risk given a return

II. Capital Asset Pricing Model (CAPM): the expected return equals the risk-free rate plus a risk premium.

1. Capital Market Line (CML): with the risk-free asset, **the mean-variance efficient frontier** is a straight line determined by the risk-free asset and one fund of risky assets.
   1) Proof: $R_P=\alpha R_f+(1-\alpha)R_i$ → $E(R_P)=\alpha R_f+(1-\alpha)E(R_i)$ & $\sigma_R^2=(1-\alpha)^2\sigma_i^2$ → $\boxed{E(R_P)=R_F+\{[E(R_i)-R_F]/\sigma_i\}\bullet\sigma_p}$
   2) Any efficient portfolio must be on the line: $E(R_i)=R_f+\lambda\bullet\sigma_i$ where $\lambda=\{E(R_M)-R_f\}/\sigma_M$ is called the market price of risk. The CML intercept is the R_f and the slope is the market price of risk.
2. CAPM: the equilibrium **expected return** of a risky security depends only on its beta, and securities (portfolios) with a higher beta should offer a higher expected return. $\boxed{E(R_i|R_M)=R_f+\beta_i\bullet[E(R_M)-R_f]}$
3. CAPM Regression Model: $R_i-R_f=\alpha+\beta\bullet(R_M-R_f)+\varepsilon_i$ where is a white noise
   1) Excess rate of return of stock i: $r_i=R_i-R_f$ or security i excess return
   2) Excess rate of return of market $r_M=R_M-R_f$ or market excess return
   3) Regression coefficient $\beta_i=cov(R_i, R_M)/var(R_M)=\sigma_{i,M}/\sigma_M^2$
   4) CAPM test: $\alpha=0$ (abnormal return is zero) vs $\alpha>0$ (relative to expected market return)
4. Securities Market Line (SML): in CAPM equilibrium all securities and portfolios must fall on the SML: $\boxed{E(R_i)=R_f+[E(R_M)-R_f]\bullet\beta}$ where slope is $E(R_M)-R_f$ and intercept is R_f and market $\beta_M=1$.
5. CAPM market practice
   1) Jensen index: alpha (or its estimates). A positive J.I. means that a security is performing better than CAMP prediction and may be underpriced. Weakness: lack of indication of risk level.
   2) Treynor index: $[E(R_i)-R_f]/\beta_i$ if the index of a security is greater than $E(R_M)-R_f$ then the security is performing better than it should according to the CAPM
   3) Sharpe index: $[E(R_i)-R_f]/\sigma_i$ the higher the index of a security, the better the security, in the M-V sense. In the CAPM, optimal investment is bet on the CML, which corresponds to the Sharpe index of the market portfolio $[E(R_M)-R_f]/\sigma_M$

III. CAPM Return-Risk Implications

1. Total risk = market risk + specific risk $\boxed{V(r_i)=\sigma_i^2=\beta_i^2\sigma_M^2+\sigma_\varepsilon^2}$
2. Market risk is systematic whereas specific risk is nonsystematic or idiosyncratic
3. Diversification via portfolio construction can eliminate idiosyncratic risk
4. The risk premium on an asset depends only on its systematic risk: β_i

Lecture 10: Capital Budgeting Decisions

I. Capital Budgeting Decision

1. Short-term operation: working capital and liquidity management
2. Long-term investment: capital budgeting – fixed assets investment

II. Investment Decision Rules

1. Net Present Value NPV
2. Internal Rate of Return
3. Modified Internal Rate of Return
4. Payback Period is the amount of time for the project to break even
5. Average Accounting Return=Average Earnings/Average Book Value
6. Profitability Index=Present Value of Cash Flows/Initial Investment

III. Discounted Cash Flow Valuation (DCFV)

Non-cash Working Capital = Inventory + Other C.A.s + Receivables – Payables – Other C.L.s

Net Working Capital (NWC) = (Current Asset – Cash) – (Current Liability – Interest-bearing Debt)

Operating Cash Flow = Earnings Before Interest and Tax (EBIT) + Depreciation – Tax

Net Income (unlevered) = Revenue – Sales Costs – Depreciation – Tax = EBIT • (1– τ)

Project Cash Flow = project operating cash flow – project capital spending – project ΔNWC

EBITDA is Estimated by adding depreciation and amortization back to operating income (EBIT)

Free Cash Flow to Firm = EBIT • (1– τ) – (Capital Expenditure – Depreciation) – Change in NWC

Free Cash Flow to Firm (FCFF) = EBIT – Tax + Depreciation – Capital Spending – Change in NWC

Free Cash Flow to Equity (FCFE) = Free Cash Flow to Firm – (Principals Repaid – New Debt Issued)

Modified Accelerated Cost Recovery System (MACRS): current tax depreciation system in the U.S.

Net Debt = Total Debt – Excess cash and Short-term Investment

Enterprise Value = Market Value of Debt + Market Value of Equity – Excess Cash

IV. Scenario Analysis and Sensitivity Analysis

1. Scenario analysis: what would happen to earnings and cash flows under a variety of scenarios
   1) Base case: P_0, Q_0, $TC_0=VC_0+FC_0$, NPV_0=? IRR_0=?
   2) Worst case: $P<P_0$, $Q<Q_0$, $TC>TC_0=VC_0+FC_0$
   3) Best case: $P>P_0$, $Q>Q_0$, $TC<TC_0=VC_0+FC_0$
2. Sensitivity analysis: change of the outcome as a result of the change of one or multiple inputs.

Lecture 11: Capital Financing Decisions

Lecture 12: The Costs of Capital

Biwei Chen

The cost of capital is the best expected return available in the market on investments with similar risk. Evaluating financing and investment opportunities requires financial managers to estimate the cost of capital for the project in order to determine its net present value. The cost of capital includes a risk premium that compensates investors for taking on the risk of new project (Berk & DeMarzo, 2020).
KEY WORDS: cost of capital, required rate of return, appropriate discount rate, minimum hurdle rate

I. The Cost of Equity

1. Security market line (SML) approach: under the CAPM, the market portfolio is a well-diversified efficient portfolio representing the non-diversified risk in the economy.
    1) CAPM provides a practical way to identify an investment with similar risk if they have the same sensitivity to market risk, as measured by their beta with the market portfolio
    2) Investors will require a risk premium comparable to what they would earn taking the same market risk through an investment in the market portfolio
    3) $E(R_i)=R_f+\beta_i\bullet[E(R_M)-R_f]$ where $E(R_i)-R_f=\beta_i\bullet[E(R_M)-R_f]$ is the risk premium of asset i
    4) Individual stock's beta is estimated via a time-series linear regression of R_i-R_f on R_M-R_f
    5) CAPM provides much more accurate estimates of expected returns than its historical average
2. Dividend growth model: $R_E=D_1/P_0+g$, where $D_1=D_0(1+g)$ and g is the expected dividend growth
3. Industry average or market proxy approach
4. The cost of preferred stock R=D/P

II. The Cost of Debt

1. YTM investment grade: newly issued or outstanding corporate bonds yield to maturity (not CPR)
2. Bond portfolio with various maturities: weighted average over market share of different maturities
3. YTM high yield debt (default risk adjustment):
4. Credit-rating adjustment:
5. SML debt beta approach:
6. Weighted average cost of debt: $WACD=\sum_{t=1}^{T} Wt \bullet YTMt = \sum_{t=1}^{T} Wt \bullet MVt$ where t is the maturity

III. The Weighted Average Cost of Capital

1. Capital value = equity value + debt value or V=E+D
2. Capital structure weights: equity share = E/V and debt share D/V
3. Weight average cost of capital: $WACC=(E/V)\bullet R_E+(D/V)\bullet R_D$
4. WACC including preferred stocks: $WACC=(E/V)\bullet R_E+(P/V)\bullet R_P+(D/V)\bullet R_D$
5. Unlevered cost of capital (pretax WACC): $R_U=(E/V)\bullet R_E+(D/V)\bullet R_D$
6. Effective after-tax WACC=$(E/V)\bullet R_E+(1-\tau)(D/V)\bullet R_D$ where τ is the corporate tax rate

$$\boxed{V=E+D \rightarrow V\bullet R_C=(E+D)\bullet R_C=E\bullet R_E+D\bullet R_D \rightarrow R_C=(E/V)\bullet R_E+(D/V)\bullet R_D= R_{WACC}}$$

IV. Corporate Valuation with the WACC

Lecture 13: Capital Structure Decisions

The relative proportion of debt, equity, and other securities that a firm has outstanding constitute its C.S.

I. Financial Leverage: Return and Risk

1. Unlevered equity: equity in a firm with no debt
2. Levered equity: equity in a firm that also has debt outstanding
3. Scenarios analysis: R_F=5%, best case (P_B=50%, R_B=40%), worst case (P_W=50%, R_W=–10%). Assume perfect capital market (zero transaction cost) and no corporate tax.
   1) Under expected scenarios, leverage increases the returns to the shareholders
   2) Under expected scenarios, shareholders are exposed to more risk (leverage acts to magnify gains and losses to shareholders even when there is no risk that the firm will default)
   3) $PV_E=(0.5•875+0.5•375)/(1+R_E)$ =625/1.25=500 where R_E=25%>15% or (D/E) ↑ → R_E↑
   4) Whether leverage is beneficial to shareholders depends on the company's EBIT
   5) Cost of capital: the unlevered is 15% and the levered is 0.5•5%+0.5•25%=15%

Capital Structure	Asset T=0	Cash Flows T=1		One-Period Return		Expected Return	Max Retreat	Risk Premium
	Market Value	Best Case	Worst Case	Best Case	Worst Case	E(R) or $P_BR_B+P_WR_W$	$R_B – R_W$	$E(R) – R_F$
Unlevered F	$1000	$1400	$900	40%	–10%	15%	50%	10%
Levered Equity	PV_E (?)	$875 (?)	$375 (?)	75% (?)	–25% (?)	25% (?)	100% (?)	20% (?)
Debt (loan)	$500	$525	$525	5%	5%	5%	0 (?)	0 (?)

Source: Berk & DeMarzo (2020) CH14. Note: When E=800, D=200, $E(R_E)$=17.5; E=200, $E(R_E)$=?

II. Modigliani-Miller Theorem: Capital Structure and Valuation (perfect capital market and no tax)

1. Theorem I: In a perfect capital market, the total value of a firm's securities is equal to the market value of the total cash flow generated by its assets and independent of its capital structure. As long as investors can borrow or lend at the same interest rate as the firm, **homemade leverage** is a perfect substitute for the use of leverage by the firm.
2. Theorem II: The cost of capital of levered equity increases with the firm's market value debt-to-equity ratio. With perfect capital markets, a firm's WACC is independent of its capital structure and is equal to its equity cost of capital if it is unlevered, which matches the cost of capital of its asset. Equity, debt, and WACC for different amounts of leverage: The rate of increase of RD and RE and thus the shape of the capital costs, depends on the characteristics of the firm's cash flows.

$$\boxed{R_E = R_U + (R_U – R_D)•(D/E) \;\&\; R_U = R_{WACC} = R_A}$$

Capital Structure	Equity	Debt	R_E	R_D	$R_{WACC}=(E/V)•R_E+(D/V)•R_D$
Scenario I	1000	0	15%	5%	15%
Scenario II	800	200	17.5%	5%	15%=0.8•17.5%+0.2•5%
Scenario III	500	500	25%	5%	15%=0.5•25%+0.5•5%
Scenario IV*	200	800	?%>25	?%>5	15%=0.2•? +0.8•?
Scenario V*	100	900	75%	8.3%	15%=0.1•75%+0.9*8.3%

III. Corporate Tax and Capital Structure

1. The interest rate tax shield effect on earnings: perpetual D=\$1000, EBIT=\$1000, R_D=8%, τ=21%, zero depreciation, capital spending and additions to net working capital.
2. Interest rate shield (τ•D•R_D): Interest is tax deductible and has generated a tax savings of 21%•80

Capital Structure	EBIT (O.I.)	Interest (R_D=8%)	Taxable Income	Corporate Tax (21%)	Net Income	Cash Flow	Tax Shield
Unlevered F	1000	0	1000	210	790	790	0
Levered F	1000	80	920	193	727	807	16.8

3. M-M Theorem with tax: **$V_L=V_U+PV_{TS}=V_U+\tau$•D & $R_{WACC}=(E/V)$•$R_E+(D/V)$•$R_D(1-\tau)$**
   1) Debt financing is advantageous and a firm's optimal capital structure is 100% debt
   2) A firm's R_{WACC} decreases as the firm relies more heavily on debt financing
   3) The optimal level of leverage from a tax saving perspective is the level such that interest just equal the income limit (tax benefits limits).

P&L	No Leverage	Moderate Leverage	Excess Leverage
EBIT	1000	1000	1000
Interest Expenses	0	300	500
30% income limit	300	300	300
Interest deduction	0	300	300
Taxable income	1000	700	700
Taxes (20%)	210	147	147
Net Income	790	553	353
Tax shield saving	0	63	63

Source: Berk & DeMarzo (2020) CH15

4. M-M Theorem with financial stress and bankruptcy costs: **$V_L=V_U+PV_{TS}-PV_{FD}$**
   1) Financial distress happens when a firm has trouble meeting its debt obligations.
   2) Total value of the firm is the same whether it is levered or not, verifying M-M I.
   3) When securities are fairly priced, the shareholders pay the present value of the costs associated with bankruptcy and financial stress. Financial stress costs lower the value of the levered firm.
   4) Tradeoff theory: The total value of a levered firm equals the value of the firm without leverage plus the present value of the tax shield, less the present value of financial distress cost.

Capital Structure	Without Leverage		Leverage and financial distress	
	Best Case	Worse Case	Best Case	Worse Case
Debt Value	–	–	100	80
Equity Value	150	80	50	0
Total Value	150	80	150	80

V_U=(0.5•150+0.5•80)/1.05=109.52 (assume zero beta or risk premium)

V_{LE}=(0.5•50+0.5•0)/1.05=23.81, V_{LD}=(0.5•100+0.5•80)/1.05=85.71, V_L=109.52

Capital Structure	Without Leverage		Leverage and bankruptcy costs	
	Best Case	Worse Case	Best Case	Worse Case
Debt Value	–	–	100	60=80-20
Equity Value	150	80	50	0
Total Value	150	80	150	60

V_{LD}'=(0.5•100+0.5•60)/1.05=76.19, V_L'=23.81+76.19=100, PV_{FD}=(0.5•0+0.5•20)/1.05=9.52

Lecture 14: Dividend Payout Decisions

I. Dividends and Dividend Policy

1. Dividend=Earnings (Net Income) – Retained Earnings (Reinvestment)
2. Dividend category: cash, repurchase, stock dividend (percentage) or split (ratio)
3. Dividend payment procedure: announcement, ex-dividend, record, payment

II. Dividend Policy and Valuation

Assumptions: All-equity firm with 10M shares outstanding, $20M excess cash, FCF $48M/Year, R_U=12%.

1. Policy I: Cash dividend (current cash dividend per share=20/10=$2)
   1) Cum-dividend price: P_{cum}=cash dividend+PV(future dividend)=$42
   2) Ex-dividend price: P_{ex}=PV(future dividend)=4.8/0.12=$40
2. Policy II: Stock repurchase (repurchase 20M/42=0.476M shares)
   1) Before repurchase: P=$42=$P_{cum}$ and V=42•10M=$420M
   2) After repurchase: P'=400/(10-0.467)=400/9.524=$42
3. Policy III: High dividend (pay 48M>20M cash dividend now)
   1) Additional 28M is needed via issuing new shares: n=28M/42=0.67M
   2) Dividend per share each year in the future will be $48/(10+0.67)=$4.5
   3) Under high dividend policy P_{cum}=48/10.46+4.5/0.12=4.5+37.5=$42
4. M-M dividend irrelevance: In perfect capital markets, holding fixed the investment policy of a firm, the firm's choice of dividend policy is irrelevant and does not affect the initial share price.

	Initial Share Price	Dividend Paid ($ per share)			
		Year 0	Year 1	Year 2	. . .
Policy 1:	$42.00	2.00	4.80	4.80	. . .
Policy 2:	$42.00	0	5.04	5.04	. . .
Policy 3:	$42.00	4.50	4.50	4.50	. . .

   1) In a perfect capital market, when a dividend is paid, the share price drops by the amount of the dividend when the stock begins to trade ex-dividend.
   2) In perfect capital markets, an open market share repurchase has no effect on the stock price, and the stock price is the same as the cum-dividend price if a dividend were paid instead.
   3) In perfect capital markets, investors are indifferent between the firm distributing funds via dividends or share repurchases. By reinvesting dividends or selling shares, they can replicate either payout method on their own.

III. Optimal Dividend Policy

Dividend policy is irrelevant when there are no taxes or other imperfections. With taxes and new issue costs, the firm should pay out dividends only after all positive NPV projects have been fully financed.

https://www.rapidtables.com/math/symbols/greek_alphabet.html

Corporate bond yield curve
https://home.treasury.gov/data/treasury-coupon-issues-and-corporate-bond-yield-curve/corporate-bond-yield-curve

How and when is a dividend issued?

Both the amount and timing of dividends is determined by the Board of Directors
Usually for public companies, dividends happen on a quarterly or annual basis
Most dividends are declared by large and established "blue chip" companies (i.e. P&G, McDonald's)
Dividends are often paid if a company is unable to reinvest its cash at a higher rate than shareholders
https://www.visualcapitalist.com/power-dividend-investing/

1. Start-up (lightbulb moment): very negative margins and accounting returns, very low leverage
2. Young growth (product test): negative margins and returns, low leverage (debt-equity ratio)
3. High growth (bar mitzvah): margins and returns turn positive but may be low, leverage stays low
4. Mature growth (scaling up test): margins and returns continues to grow, leverage starts rising
5. Mature stable (midlife crisis): margins and returns stabilize, leverage converges on steady state
6. Decline (end game): margins and returns decline, leverage depends on debt repayment

Nobel Prize in Finance

Eugene Fama, Lars Peter Hansen, Robert Shiller
https://www.nobelprize.org/prizes/economic-sciences/2013/summary/

Harry Markowitz, Merton Miller, William Sharpe
https://www.nobelprize.org/prizes/economic-sciences/1990/summary/

Franco Modigliani (The Modigliani-Miller Theorems)
https://www.nobelprize.org/prizes/economic-sciences/1985/summary/