

Lecture notes for the course
FOUNDATIONS OF FINANCE
September-October 2005

Lecture 1. Introduction

What is finance?

- Real vs financial investments
- Management of risks
 - Intertemporal vs cross-sectional
- Asset pricing
- Portfolio management
- Performance evaluation
- Financial engineering

Typical issues / myths

- Mutual fund X has the highest annual return. Does X have the best portfolio manager?
 - *Performance evaluation*
- Speculators bring excessive volatility to stock markets. Should we limit speculation?
 - *Arbitrage, market efficiency*
- How to support local financial market? Russian companies should make IPO at home, pension funds should not invest abroad
 - *Cost of capital, portfolio management*
- Central Bank's reserves are mostly invested in foreign government bonds
 - *Diversification, inter-temporal insurance*
- Russia's stabilization fund has accumulated more than \$15 bln. Why not invest in domestic projects?
 - *Risk insurance, agency problem*

Investment environment vs investment process

Financial institutions

- Basic questions
 - Existence
 - History
 - Evolution
 - Convergence
- Financial markets
 - Investors vs borrowers
 - Listing requirements
 - Depositary receipts
 - Counterparty risk
 - Information transparency and insiders
- Financial instruments
 - Cash flow vs control rights
 - First vs second level
 - Indices
- Financial intermediaries
 - Private vs institutional investors
 - Solving agency problem
 - Asset transformation

Asset pricing / project evaluation

- Time dimension: analysis under certainty
 - Fixed income
 - Capital budgeting
- Cross (risk) dimension: analysis under uncertainty
 - States of nature
 - Arbitrage pricing
- Portfolio optimization
 - Diversification
 - Selectivity vs timing
- Equilibrium models
 - Risk factors: expected returns vs volatility

What is the difference with microeconomic analysis?

Further topics / courses

- Corporate finance
 - Capital structure
 - IPO, M&A
 - Corporate governance
- Econometrics of financial markets
 - Market efficiency
- Risk management
 - Market vs credit risk
- Behavioral finance
- Law and finance

Lectures 2-4. Financial instruments

Forms of business organization

- Sole proprietorship
- Partnership
- Corporation

Evaluate by

- The life of the entity
- The ability to raise capital
- The owners' liability

Modern corporation

- Advantages
 - Limited liability
 - ❖ 1811: general act of incorporation in NY
 - Easy transfer of ownership
 - Unlimited life
 - Ability to raise large amounts of money
- Disadvantages
 - Start-up can be costly
 - Earnings subject to double taxation
 - The agency problem
 - ❖ Separation of control and ownership
 - ❖ The leverage effect of debt

Equity vs Debt

- Shareholders
 - Control rights (e.g., elect directors)
 - Limited liability
 - Residual claim on assets (after paying up liabilities)
 - Dividends (fully taxable)
- Debtholders
 - Fixed contractual claim against the corporation
 - No voting power unless debt is not paid
 - Interest on debt is tax-deductible

What would happen if creditors had control over corporation?

Securities

- Characteristics
 - Contingent contractual claim
 - Marketability
 - Necessary conditions:
 - ❖ Record-keeping technology
 - ❖ Legal infrastructure (contracting and enforcement)
- Derivatives: second level
 - Payoff depends on the value of other (underlying) securities

Why is it important for a security to be liquid?

Bond characteristics

- Amount / date of issue, maturity, currency, par value
- Coupon payments
 - Frequency, floating vs fixed rate
- Security (attachment to the property)
 - Debenture/note vs bond
- Protective covenants
 - Restrictions on further indebtedness, max dividends
- Seniority
 - Subordinated debt paid after senior debt

What is the price of a floating rate bond right after the coupon payment?

Fixed Income instruments

- Money market: maturity below 1 year
 - Treasury / corporate bills
 - ❖ Zero-coupon / pure discount bonds
 - Repos (repurchase agreements)
 - ❖ Collateralized loan
 - Interbank rates
 - ❖ E.g., LIBOR
- Capital market
 - Treasury notes and bonds
 - ❖ Considered risk-free
 - Federal agency and municipal securities
 - ❖ No explicit guarantee
 - Corporate bonds
 - ❖ Subject to default risk, may be callable and with collateral

Options

- Right to buy/sell at strike price in the future
 - Call / put
 - European / American
 - Long / short
- Asymmetric payoff
- Driven by volatility of the underlying asset
- Intrinsic value vs time value

How is option price related to maturity?

Is European or American option more expensive?

Embedded options

- Common equity
 - Call on the value of the firm with strike equal to the face value of debt
- Convertible bonds
 - Hybrid instrument
 - Mitigate the problem of excessive risk taking
- Executive options
- Real options

What is the main difference between equity and financial call option?

Exotic options

- Bermudan option
- Exchange option: $\max(S_A - S_B, 0)$
- Binary option: $I\{S_T - X > 0\}$
- Asian option: $\max(S_{\text{avg}} - X, 0)$
- Barrier option:
 - Knock-in / knock-out
 - Call / put

Interest rate options

- Cap (on r with strike x): $\max(r - x, 0)$
 - Call on %
- Floor: $\max(x - r, 0)$
 - Put on %
- Collar of the borrower: $r - x$
 - Long cap and short floor
 - Forward on %

Preferred stock

- Preference over common stock in cash rights:
 - in the payments of dividends
 - in the assets in case of bankruptcy
- No voting rights, unless no dividends
- Is it really debt in disguise?
 - Fixed dividend: usually, *cumulative*

- Stated liquidating value
- Call provision:
 - Can be converted to common shares

How to create synthetic forward with options?

Forward

- Obligation to buy/sell at pre-specified (delivery) price at certain time in the future
 - Long/short position
 - The forward price = delivery price that would make the contract worth exactly zero
- Symmetric payoff
- Low liquidity
- Must be offset by the counter deal
- Credit risk

How to manipulate forward market?

Futures

- Standardized exchange-traded contract
 - Amount, quality, delivery date, place, and conditions of the settlement
- Credit risk taken by the exchange
 - The exchange clearing-house is a counter-party
 - Collateral: the initial / maintenance margin
 - Daily marking to market
- Open interest vs trading volume

Swap

- Interest rate swap
 - Exchange of fixed-rate and floating-rate interest payments for a fixed par value
- Currency swap
 - Exchange of interest payments in different currencies
- Motivation: comparative advantage
 - E.g., company A has a higher credit rating and comparative advantage for fixed rate debt:
 - $R(A, \text{fix}) < R(B, \text{fix}), R(A, \text{fl}) < R(B, \text{fl})$
 - $R(B, \text{fix}) - R(A, \text{fix}) > R(B, \text{fl}) - R(A, \text{fl})$

Different types of swaps

- Step-up / amortizing
 - Changing par
- Extendable / puttable
 - Changing maturity
- Equity swap
 - To avoid taxes
- Deferred/forward swap
- Swaption
 - Option on an interest rate swap

How to replicate swaption with call/put on a fixed rate bond?

Major derivative instruments

- Stocks: options
- Stock index: futures
- Commodities: futures, forwards, options
- Currency (FX): forwards, swaps, options
- Interest rates: swaps, forwards, options
- New: weather / insurance / electricity / credit derivatives

Indices

- Aggregate picture of a particular market segment
 - Should be replicable by investors
 - Benchmark to evaluate portfolio performance
- Weighting
 - Equal vs market cap
 - Free-float adjustment: exclude strategic stakes
- Equity indices:
 - Small-cap vs large-cap
 - Value vs growth
- Fixed income indices
 - Short-term vs long-term
 - High vs low credit rating

Credit derivatives

- Separate credit risk management from the underlying asset
- Types of insured credit risk:
 - Credit event, value of the underlying asset, recovery rate, maturity
- Total return swap
 - Fixed or floating payments in exchange for the current income from the underlying asset
- Credit default swap
 - Regular premium payments in exchange for a one-time premium in case of the credit event

Role of derivatives

- To hedge risks
 - Make risk-offsetting bets
- To speculate
 - Take a view on the future direction of the market
- To lock in arbitrage profit
 - Long-short (self-financed) portfolio
- To change the nature of liability/investment
 - Without a need to remove it
- ...at low cost !

What are the main types of market participants?

Investment strategies

- Naked forward
- Forward spread
 - Calendar / cross
- Naked option
- Covered option
- Spread: options of one type
 - Bear / bull / butterfly / calendar
- Combination: options of different type
 - Straddle / strip / strap / strangle

Lectures 5-6. Market microstructure

Examples

- Ticks
 - 1/8 vs 1/32 vs decimal
- Price over 100
 - Stock splits
- Analyst recommendations
 - Conflict of interests
- Failure of LTCM
 - Advanced models did not account for the liquidity crisis

Why is the organization of trading process important for investors?

Market participants

- Brokers
 - Trading on behalf of a client
- Dealers
 - Trading for their own account
- Market-makers
 - Providing bid-ask quotes

What are the functions of a market-maker?

Placing an order:

- Market
- Limit
- Short sale
 - 'Selling a cow, which you don't own'
 - Borrow a stock from (another client of) your broker
- Stop loss/buy
 - Conditional market order: to lock in gains

What are the risks for each type of order?

What are the objectives of short selling?

Margin trading:

- Initial / maintenance margin
 - % of MV(assets) kept in the account as collateral
 - The rest is borrowed from the broker
- Margin call
 - If the amount in the account drops below maintenance margin
- Leverage effect: $r = (\Delta P - \text{interest}) / (P_0 \text{margin})$

Classification of financial markets

- Bank credits
 - Commercial vs Interbank
- Foreign exchange (FX)
 - Spot / forward exchange
 - Deposit-loan
 - ❖ National markets
 - ❖ Euro markets
- Security market
 - Primary
 - Secondary
 - ❖ Exchange: NYSE, LSE (stocks), CBOT, LIFFE (derivatives)
 - ❖ OTC (over-the-counter): NASDAQ

Desirable characteristics

- Informational transparency
- Min transaction costs
- Liquidity
 - Ability to open or close large positions without strong effect on prices
 - Tightness / depth / resiliency
- Informational efficiency
 - Speed of incorporating information to prices

Market types

- Degree of continuity
 - Periodic vs continuous systems
- Reliance on market makers
 - Auction / order-driven market
 - Dealer / quote-driven market: market maker takes the opposite side of every transaction
- Degree of automation
 - Floor vs screen-based electronic systems
- Protocols
 - Rules regarding program trading
 - Choice of minimum tick
 - Rules to halt trading, circuit breakers
- Transparency: providing info before (quotes, depths) and after (actual prices, volumes) the trades
 - Extent of dissemination: brokers, customers, or public
 - Speed of dissemination: real time / delayed feed
 - Degree of anonymity: hidden orders, counterparty disclosure
 - Permitting off-exchange / upstairs trading

Three basic trading systems

- Batch auction / call market: NYSE open
 - Agents submit demands to the auctioneer who sets common market clearing price
- Continuous auction: NYSE intraday, Euronext
 - Floor: brokers trade with each other on behalf of their clients
 - Electronic: the system displays the best limit orders and automatically executes incoming market orders
- Dealership market: NASDAQ
 - Market-makers provide bid and ask prices at which other agents may trade

	Nasdaq-NMS	NYSE Open	NYSE Intraday
Market Type			
Continuous	×		×
Floor-based		×	×
Dealer Presence	×	×	×
Multilateral		×	
Transparency			
Pre-trade Quotes	×		×
Post-trade Reports	×	×	×

Stock exchange	OTC
Auction	Dealer market
One center	Different locations
Access only for members	Much wider membership
Listing with strong requirements for companies	No or weaker requirements
Quoting: a single price	Bid/ask quotes or limit order book

In which market:
-Do the prices adjust quicker to new info?
-Is it harder to trade anonymously?
-Are the transaction costs lower?
-Is the execution risk lower?

Recent developments

- Trading online
- Exchange-traded funds (ETFs)
 - Mimick indices
 - E.g., Cubes, Spiders, Diamonds
- Electronic Communication Networks (ECNs)
 - Automated systems for disclosing / executing trades
- Program trading

How is program trading related to stock volatility?

Structural shifts

- Technological innovations
- Substantial increase in trading volume
- Competition between exchanges and ECNs
- Proliferation of new financial instruments

Regulation of stock trading

- Circuit breakers
 - Restrictions on trading if prices reach a threshold
- Legislation
 - Firms: public disclosure of relevant info
 - Employees: no insider trading
 - Market participants: fair trading
- Monitoring by SEC
 - Key divisions: CorpFin, MktRegulation, Enforcement

Market microstructure models: process by which investors' latent demands are ultimately translated into prices and volumes – *'looking inside the black box'*

- Price formation / discovery
 - How prices impound info over time
 - Determinants of trading costs
- Market structure and design
 - Trading process vs price formation
- Transparency
 - Info and disclosure
- Interaction with other areas in finance
 - CorpFin: IPO underpricing, stock splits
 - Asset Pricing: liquidity as risk factor, anomalies vs trading costs
 - IntlFin: ADRs, cross-border flows

Selected issues

- What are the components of the bid-ask spread?
 - Risk aversion / Inventory control / Info asymmetry
- Why is trading concentrated at the opening and closing?
 - Optimal choice of timing the trade by uninformed
- Is continuous bilateral system better than periodic multilateral one?
- Is it good for a stock to be traded in several markets?
 - Gravitation vs stratification
- Should the limit order book be displayed in public?
- How to execute block trades optimally?

Lectures 7-9. Financial intermediaries

Rationales for the existence of FI

- Transaction costs and economies of scale
 - Special human and technological skills
 - Cross-sectional and temporal reusability of information
- Information-based rationales
 - Market mechanisms may be unable to efficiently resolve information problems
 - Info asymmetry: ex ante prospects / ex post return of the borrower
 - Free-rider problem among investors
 - FIs acquire information about the borrowers and monitor their performance
 - Diversification benefits
 - Who monitors the monitor?
 - Debt contract: bank deposits
 - Equity claim (in case of easily priced assets): mutual funds

Services of Financial Intermediaries

- Brokerage: bringing together providers and users of capital without modifying the claim
 - Transactions services (e.g., check-writing)
 - Financial advice (e.g., portfolio management)
 - Screening and certification (e.g., bond ratings)
- Qualitative asset transformation: transforming the financial claims borrowers prefer into claims that savers prefer to hold
 - Liquidity and payment intermediation
 - Maturity intermediation
 - Denomination intermediation
 - Diversification intermediation
 - Information intermediation

Commercial banks

- Long-term illiquid assets financed by short-term liquid deposits
 - Interest rate risk
 - ❖ Refinancing / reinvestment risk
 - Credit risk
 - ❖ Firm-specific / systematic / country risk
 - Off balance sheet risk (e.g., letter of credit)
 - Operational risk
 - Liquidity risk
- Danger of bank runs
 - Sequential service constraint
- Eliminating bank runs
 - Capital requirements
 - ❖ But: may induce more risks
 - Deposit insurance / lender of last resort
 - ❖ But: may induce excessive risk-taking by the banks
 - Interbank market
 - ❖ But: coordination problem among banks
- Securitization: selling claims against a specific part of the bank's assets
 - Reducing info distortions
 - Better risk sharing
 - But: weaker monitoring incentives

Why are deposits typically short-term?

Which types of loans are better suited for securitization?

Financing: Banks vs Capital Markets

Banks	Capital Markets
The intermediary charges an additional layer of costs	Lower interest, but larger initial (time / financial) costs
	Tough info requirements
Close monitoring of the borrower	Free-rider problem
Usually, not very large (except for syndicated loans)	Usually, large size
The form of credit may be very flexible and project-specific (e.g., credit line)	Usually, standard contract
May restructure the credit in the future	Harsh budget constraint
May extract information rent	

*What will choose firms:
 -with unestablished credit reputation?
 -with good prospects for future profits?
 -with severe intra-firm incentive problems?*

Do banks have a future?

- Only the largest firms have access to bond markets
 - Tough information requirements to corporations issuing bonds
- Large companies rely on syndicated bank loans to finance large projects
 - Info requirement / greater control
- Banks are well-suited for the transfer of the control from shareholders
 - Banks restructure and recapitalize firms in financial distress
- Banks provide sophisticated financial products

Is more competition always good?

- Recent trends in banking:
 - EU: integration and cross-country competition
 - USA: lifting restrictions on universal banking
 - Russia: allowing entry of foreign banks?
- Intensified competition in banking regarded with suspicion:
 - Lower rents => excessive risk taking and failures
 - Larger winner's curse in bidding for loans => undue conservatism
 - Higher systemic risks

Investment banks

- Securities intermediation:
 - Issuance by companies and governments (e.g., IPO)
 - Purchase by investors
 - Financial advice on M&A, project finance, structured products, etc.
- Cyclical nature of earnings
 - Large profit in a strong market

Insurance companies

- Transfer risks from clients to themselves for a fee
 - Life / health / property and casualty insurance
- Fixed liabilities: annuity
 - Long-term investments: bonds, RE, etc.
- Rising demand
 - Aging of the population
- Reinsurance: e.g., Lloyds
- Suffered from recent terror acts and catastrophes

Banking in the US

- 1927: the McFadden act
 - Prohibiting interstate banking
- 1933: the Glass-Steagall act
 - Separation of commercial and investment banking
 - CBs cannot own voting equity
- 1999: the Gramm-Leach-Bliley act
 - Allowed consolidation of CB, IB, and insurance companies

Banking outside of the US

- Large universal banks
 - Full range of financial services
 - Nationwide branch network
 - E.g., Fuji, Sumitomo, Credit Lyonnais, Deutsche, HSBC, ABN-AMRO
- Substantial stock (cross) ownership
 - Active role in corporate management
- Smaller, but rising importance of security markets

Money managers: investing money into a portfolio of assets

- Specific risk-return profile
 - Stocks vs bonds (vs derivatives)
 - Conservative vs aggressive
 - Domestic vs intl
- Nature of liabilities
 - Equity vs debt
- Managerial compensation
 - Asset-based vs performance-based
- Methods of distribution
 - Direct vs via broker
- Regulation

Mutual funds

- Role of the management company
 - Fund family (complex)
- Management fee:
 - Asset-based: proportional to TNA
 - Performance-based: must be symmetric around the benchmark
- Open vs closed funds
 - Shares are “marked to market” daily: $NAV = TNA / (\# \text{ shares})$
- Active vs passive (index) funds
- Load vs no-load funds (A/B/C)
 - Sales loads: front-end / back-end / 12b-1 fee

Benefits of investing via MF

- Low transaction costs
 - Easy way to buy a diversified portfolio
- Customer services
 - Liquidity insurance
- Professional management
 - Selecting right stocks at right time?

Stylized facts about MFs

- Largest FI in the US
- There are over 8,000 MFs (more than stocks)
- On average, MFs do not earn positive performance adjusted for risk and expenses
- (Mostly bad) performance persists
- New money flows mostly in top performers,
 - ...but does not really flow out from poor performers
- Many funds deviate from their stated objectives

Does bad average MF performance imply that investors should avoid MFs?

What incentives for MFs are created by convex flow-performance relationship?

Pension funds

- 'Fixed' liabilities
 - Defined contribution vs defined benefit plans
- More conservative strategy
- US: 401(k) plans
 - Investors themselves select PFs

Hedge funds

- More aggressive strategy
 - Long-short / macro / event-driven
 - High leverage
 - Usually, low systematic risk
- Strict entrance restrictions
- Management fee:
 - Typically, 20% of profit, with high watermark provision
- High attrition rate

Wealth management: providing personalized services to high net worth customers

- Wealth management: mass segment (\$100,000-\$1mln)
 - Portfolio management
 - E.g., Citibank, ING
- Private banking: for new riches
 - Financial (e.g., tax and estate) planning, cash and asset management
 - E.g., HSBC, UBS
- Family office: for old wealthy families
 - E.g., Piktet, Courtz

Recent scandals with FIs

- Insider trading
 - October 31, 2001: Goldman Sachs economist received info about 30y US Treasuries before the official release, traders earned \$3.8 mln in 8 minutes
 - September 2003: Goldman Sachs paid \$9.3 mln to SEC
- Investment banks: analysts' conflict of interests
 - Analysts gave overoptimistic recommendations on IB clients' stocks
 - December 2002: top 10 banks paid \$1.4 bln as compensation
 - NASD required to separate analytical and IB depts of the same company
- Mutual funds, 2003: late trading
 - Some clients could trade at NAV fixed at 4pm on the same day
- Brokers' pre-emptive trading
 - Brokers made own trades before executing their clients' orders
 - December 2004: 5 top NYSE market-makers paid \$240 mln to settle

Regulators in the US and Russia

- FRS / ЦБ РФ
 - Bank regulation
 - Monetary policy
- FDIC / ACB
 - Deposit insurance
- SEC / ФКПР
 - Securities operations

The “too big to fail” issue

- Continental Illinois Bank, one of the largest US banks
 - 1983-84: many defaults on loans
 - May 1984: massive deposit withdrawals
- Help from regulators:
 - FRS: credits via the discount window
 - FDIC: guarantee on all deposits, even beyond \$100,000 limit
 - July 1984: FDIC purchased some loans and provided over \$5 bln in capital
- At the same time, many smaller banks were not rescued
- *“The rescue effort was less expensive than dealing with CIB’s failure”*
- Arguments for
 - Direct costs of the bank’s failure
 - Domino effect: chain reaction
- Arguments against
 - Direct costs: FDIC recovered \$1.1 bln of the \$2.8 bln troubled loans it bought from CIB
 - Unfair competition
 - Incentive effects

Unification of intl banking regulation

- 1978: the Intl Banking Act in the US
 - Similar regulation for domestic and foreign banks operating in the US
- 1987: Single European Act
 - Free capital flow and expansion across the countries
 - Similar regulations on competition, mergers, taxes, etc. for European and foreign banks
- 1988: uniform capital adequacy guidelines for banks of 12 developed countries
 - Similar regulation for domestic and foreign banks operating in the US

Rating agencies

- Independent certification
 - Credit quality
 - Corporate governance
- Major players:
 - S&P, Moody’s, Fitch

Global trends

- Consolidation
- Increase in competition => declining margins
 - Both intl and across different types of FIs
- Traditional banking is shrinking
- New financial services and products growing
- Deregulation and unification of the regulation

Lectures 10-11. Analysis under certainty

Asset valuation

- Discounted cash flow approach: $P_0 = \sum_t CF_t / (1+r)^t$
- Bonds: $P_0 = \sum_{t=1:T} C / (1+r_t)^t + F / (1+r_T)^T$
 - Assuming same discount rate: $P_0 = \sum_{t=1:T} C / (1+r)^t + F / (1+r)^T$
- Stocks: $P_0 = (P_1 + Div_1) / (1+r) = \sum_{t=1:\infty} Div_t / (1+r)^t$
 - Constant dividends: $P_0 = Div_1 / r$
 - Dividends growing at rate g : $P_0 = Div_1 / (r-g)$

Definitions of rates

- Reinvestment:
 - Simple vs compound interest: $P_T = P_0(1+r_s T) = P_0(1+r_c)^T$
- Frequency of compounding:
 - Nominal (coupon) rate (payments m times a year)...
 - vs effective (annual) rate: $r_E = (1+r_N(m)/m)^m - 1$
- Continuous compounding:
 - Log-return: $r_C = m \log(1 + r_N(m)/m) = \log(1+r_E)$
- Yield to maturity / internal yield / bond yield
 - Rate that equates cash flows on the bond with its market value
 - Internal rate of return earned from holding a bond to maturity
 - ❖ Assuming reinvestment at same rate
- Par yield
 - Coupon rate that causes the bond price to equal its face value
- Current yield
 - Annual coupon payment divided by the bond's price
 - Often quoted but useless
- Zero rate (at t for payment at T): $y(t, T) = [1 / P(t, T)]^{1/(T-t)}$
 - YTM of a zero-coupon bond maturing at T , with current price $P(t, T)$ and face value of 1
 - How to get zero rates from coupon bond prices?
 - ❖ Bootstrapping method: coupon bond as a ptf of zero-coupon bonds
- Spot rate: $r(t) \equiv y(t, t+1)$
 - One-period zero rate
- Forward rate: $f(t, T) = P(t, T) / P(t, T+1)$
 - Rate on a one-period credit from T to $T+1$

Are yields additive?

What is YTM of a coupon bond traded at par?

What is the relation between YTM and price?

Term structure of interest rates

- Relationship between yields and maturities
 - For bonds of a uniform quality (risks and taxes)
 - E.g., Treasury / Baa
- Equivalent ways to present TSIR:
 - Discount curve: $P(t, T)$, with $P(T, T) = 1$
 - Zero curve: $y(t, T) = [1 / P(t, T)]^{1/(T-t)}$
 - Forward curve: $f(t, T) = P(t, T) / P(t, T+1)$
- Upward sloping yield curve: $\text{Fwd Rate} > \text{Zero Rate} > \text{Par Yield}$

How to write the discount rate for CF_t via zero rates, forward rates, and zero bond prices?

Theories of the term structure: why different yield curves?

- Expectations theory:
 - Unbiased expectations hypothesis: $f(t, T) = E_t[r(T)]$
 - Term structure is explained by expected spot rates
 - Upward sloping yield curve: signal that spot rate will increase

- Liquidity preference theory:
 - Investors demand a premium for bonds with higher risk
 - Long-term bonds require a liquidity premium
 - Upward sloping yield curve: forward rates higher than expected future zero rates
- Preferred habitat:
 - Investors try to match the life of their assets with liabilities
 - There is a premium for maturities with insufficient demand
- Market segmentation:
 - Short, medium and long rates are determined independently of each other
 - SR%: D – corporations financing their sr obligations (e.g., trade credit), S – banks
 - LR%: D – corporations financing lr inv projects, S – insurance co-s, pension funds
 - Investors don't react to yield differentials between the maturities

Empirical estimation of TSIR:

- Discrete rates:
 - Regression $P = cD_1 + cD_2 + \dots + (c+F)D_T$, where $D_t = 1/P(0,t) = 1/y(0,t)^t$
- Continuous rates:
 - Regression $P = \sum_{t=1:T} c_t (a_0 + a_1 t + a_2 t^2 + \dots) = a_0 [\sum_{t=1:T} c_t] + a_1 [\sum_{t=1:T} t c_t] + a_2 [\sum_{t=1:T} t^2 c_t] + \dots$

Modeling changes in bond prices:

- Due to passage of time:
 - E.g., flat yield curve: $\Delta P = r P_0$
- Unanticipated shift in the TSIR:
 - Need to approximate the function $P = f(y)$
 - Duration: sensitivity of a bond's price to the change in the interest rates

Macauley's duration:

$$P_0 = \sum_{t=1:T} C_t / y^t \Rightarrow \partial P / \partial y = -\sum_{t=1:T} t C_t / y^{t+1}$$

$$\text{Let } D = -[\partial P / P] / [\partial y / y] = -\sum_{t=1:T} t C_t / (P y^t) = \sum_{t=1:T} t w_t, \text{ where } \sum_{t=1:T} w_t = 1!$$

- Wtd-avg maturity of bond payments
 - Generalized maturity for coupon bonds, $D \leq T$
- Elasticity of a bond's price wrt *ym*
 - The larger the duration, the riskier is the bond
- For small changes in %: $\Delta P \approx -D P \Delta y / y = -[D/y] P \Delta y$
 - $D^* = D/y$: modified duration
- Properties:
 - C, coupon: -
 - Y, %: -
 - T, maturity: +
- Limitations:
 - Assumes horizontal TSIR
 - Applies only to small changes in %

Fisher-Weil duration: $D = -\sum_{t=1:T} t C_t / (P y^t)$

- Fisher-Weil duration
- For parallel shifts of (non-horizontal) TSIR

Convexity:

$$\partial^2 P / \partial y^2 = -\sum_{t=1:T} t(t+1) C_t / y^{t+2} \text{ and } C = -\sum_{t=1:T} t(t+1) C_t / (P y^t)$$

$$\Delta P / P \approx -D \Delta y / y + \frac{1}{2} C (\Delta y / y)^2$$

Non-parallel shifts:

- Two types: LR% usually more stable than SR%
- Analytical approach:
 - E.g., assume $d \ln y(t,T) = K^{T-t+1} d \ln r(t)$
- Empirical approach:
 - Separate estimation of duration $D^* = -[\Delta P/P] / \Delta y$ for SR and LR%

Immunitization (wrt interest rate risk)

- Duration matching: $D(\text{assets}) = D(\text{liabilities})$
 - This is active strategy, since both duration and TSIR change with time
 - Exact immunization requires frequent rebalancing (and large transaction costs)
 - Need correct measure of duration (and possibly convexity)
 - Does not insure against large shifts in the yield curve
- Typical strategies:
 - Cash flow matching
 - Exact immunization
 - Barbell: ptf of the shortest and the longest bonds
 - Can use same bonds for different liabilities
 - Focused: one bond with the required duration
 - Has similar convexity to that of the liabilities

How can one achieve exact immunization?

Capital budgeting: analysis of investment projects

- Evaluate a given project:
 - Consider incremental cash flows
 - Use opportunity cost of funds as discount rate
- Net Present Value: $NPV = \sum_t CF_t / (1+R)^t$
 - Accept projects with $NPV > 0$
- Internal Rate of Return: IRR = discount rate that sets NPV to zero
 - Accept projects with $R < IRR$?

Investment decision rules: IRR vs NPV

- IRR may not exist or there may be multiple IRR
- IRR ignores the term structure of interest rates
- Mutually exclusive projects
 - $IRR_A > IRR_B$ does not imply that A is preferable
 - Value additivity broken: can be $IRR_{A+C} < IRR_{B+C}$
 - Need to compute incremental IRR
- Projects of unequal lives
 - Annualized NPV
- Capital rationing
 - Linear programming: max NPV under budget constraints
- Sensitivity analysis

Lecture 12. Behavioral finance

Selected issues

- What are the typical patterns of the irrational behavior?
- How does it affect financial markets?
- Can one use the knowledge of behavioral biases to profit from it?

Is presence of one non-satiated arbitrageur sufficient to guarantee fair prices?

Behavioural theories

- Prospect theory
 - Loss aversion
 - Overstatement of low probabilities
- Overconfidence
- Regret
- Cognitive dissonance
- Reference points
- Representative heuristics
 - Diversification: 1/N bias
- Herding and informational cascades

Lecture 13. Law, finance, and growth

Selected issues

- How to measure country's financial development?
- How is it related to legal system and industrial growth?
- What are typical financial systems?
- How do they differ in vulnerability to crisis?

Measures of Russia's financial development

- Stock market
 - Size and liquidity of the domestic market
 - ❖ Market equity cap to GDP
 - ❖ # instruments (actively) traded locally
 - ❖ # IPOs
 - ❖ Free float
 - ❖ Trading volume / turnover rate
 - ❖ Transaction costs / bid-ask spread
 - Global integration
 - ❖ Share of foreign currency denominated obligations
 - ❖ # IPOs / trading volume abroad
 - ❖ Share of foreign investors in trading volume / ownership
 - ❖ Correlation (degree of co-integration) between Russian and foreign indices
 - Returns and risks
 - ❖ Mean return / st.dev. / Sharpe coefficient
 - ❖ Synchronicity of individual stock prices
 - ❖ Sensitivity to domestic / global risk factors
 - ❖ Duration / credit rating / YTM of bonds
 - ❖ Default / term spread
- Corporate sector
 - Corporate governance
 - Financial policy
- Banking system

Lecture 14. FSFR strategy

FSFR: Why do we need developed financial market?

- Contributes to economic growth
- Increases allocation efficiency
- Allows longer-term investment projects
- Makes the cost of capital lower
- Stimulates innovations
- Having a large number of financial instruments helps to achieve macro stability
- Makes the economy less sensitive to external shocks and systemic crises

What is the market cap of Russian stock market?

- Equity: from 17% of GDP in 2000 to 42% (7 trln rub) in 2004
- Corporate bonds: from 0.5% in 2000 to 2% in 2004
- Derivatives: 8 bln rub in 2004
- Insurance: 1400 companies, premiums of 0.5 trln rub,
- Investment funds: 286, over 100 bln rub in 2004, 85 thous investors

Characteristics of Russian fin market:

- Low free float: 5-25%
- Trading volume migrates to foreign stock exchanges via ADRs (75% in 2004)
- The bulk of pension money is still in the State Pension Fund investing only in state bonds
- Still narrow, concentrated and mostly illiquid market

Why do large companies choose to issue stocks or bonds abroad?

- Local legislation is less developed
- Foreign investors: high transaction costs and insufficient protection in Russia
- Local demand is not sufficient

Main directions of FSFR strategy

- Developing market infrastructure
 - Central depository, clearing, monitoring of risks, taxation, promoting pension reform and life insurance
- Easier regulation for companies entering the capital market
 - Derivatives market, securitization, mortgages, laws
- Legislation protecting investor rights
 - Info transparency (IAS), insider trading, CG (esp at reorganization)
- Reform the fin regulation system
 - Mega-regulator

Sample exam questions

- Scope of financial markets
 - Which country has the highest ratio of total fin assets to GDP?
 - ❖ Luxembourg (over 4000%), UK, Neth, US, Switzerland (over 200%)
 - How does the ratio of bonds to stocks vary across the countries?
 - ❖ LDCs have more bonds
 - What is the largest inst investor in the world judging by fin assets?
 - ❖ Insurance companies (\$12 trln), pension funds, investment companies (both 10)
 - What inst investor has the fastest growth of assets in the world?
 - ❖ Investment companies (17%), pension funds (11), insurance companies (9)

- FSFR
 - Why need mega-regulator?
 - How to attract trading to domestic exchanges?
- Margin
 - What is the benefit from trading on margin?
 - Which type of traders / FIs usually uses high leverage?
 - Why don't others trade with high leverage?
- Which type of order minimizes the time risk?
- What are the components of the bid-ask spread?
- What can help to prevent bank runs?
- What is the purpose of securitization?
- Should the central bank rescue a large bank in trouble?
- What is the risk of long forward position?
 - For hedger / speculator
- How to replicate forward with options?
- How to replicate swaption with option on a bond?
- Which strategy brings small stable income most of the time and sometimes huge losses?
 - How can hedge funds fool investors looking for high past returns?
- How to replicate call option with stock and bond?
 - Binomial tree
- Is there need for new Russian stock/bond indices? If yes, which ones would you suggest?
- What is the interest rate risk of a risk-free zero-coupon bond? Redeemable bond?
- What is the duration of a floating-rate bond?
- Which type of indices would you construct for Russian bonds?