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

What is the difference with microeconomic analysis?

- 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

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?

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

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

Exotic options

- Bermudan option
- Exchange option: $\max(S_A-S_B, 0)$
- Binary option: $I\{S_T-X>0\}$
- Asian option: $\max(S_{avg}-X, 0)$
- 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:
  - $R(A,fix) < R(B,fix)$, $R(A,fl) < R(B,fl)$
  - $R(B,fix) - R(A,fix) > R(B,fl) - R(A,fl)$

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

What are the main types of market participants?

- 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 !

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

Why is the organization of trading process important for investors?

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

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

<u>In which market:</u>
-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 sertification (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/(# 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 / ЦБРФ
  - Bank regulation
  - Monetary policy
- FDIC / АСВ
  - Deposit insurance
- SEC / ФСФР
  - 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 sertification
  - 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: $P_0 = \Sigma_t CF_t/(1+r)^t$
- Bonds: $P_0 = \Sigma_{t=1:T} C/(1+r_t)^t + F/(1+r_T)^T$
  - Assuming same discount rate: $P_0 = \Sigma_{t=1:T} C/(1+r)^t + F/(1+r)^T$
- Stocks: $P_0 = (P_1+Div_1)/(1+r) = \Sigma_{t=1:\infty} Div_t/(1+r)^t$
  - 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: Fwd Rate > Zero Rate > 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 $P = \Sigma_{t=1:T}\, c_t\, (a_0+a_1t+a_2t^2+\dots) = a_0[\Sigma_{t=1:T}c_t]+a_1[\Sigma_{t=1:T}\, tc_t]+a_2[\Sigma_{t=1:T}\, t^2c_t]+\dots$

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

Macaulay's duration:

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

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

- Wtd-avg maturity of bond payments
  - Generalized maturity for coupon bonds, $D \le T$
- Elasticity of a bond's price wrt *ytm*
  - 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: $D = -\Sigma_{t=1:T}\, t\, C_t / (P\, y_t^t)$

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

Convexity:

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

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

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* = -[ΔP/P] / Δy for SR and LR%

Immunization (wrt interest rate risk)
- Duration matching: D(assets) = D(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: $NPV = \Sigma_t CF_t/(1+R)^t$
  - 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

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

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?

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?