

Lecture notes on risk management, public policy, and the financial system

Introduction to financial intermediation and financial risk

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Financial intermediation

Financial risk taxonomy

Financial intermediation

Financial intermediaries

Financial instruments

Financial risk taxonomy

Functions of the financial system

Resource allocation under uncertainty, over time and geographically

- Gather resources from savers/lenders, transfer to investors/borrowers, or distribute among investors
 - Savers: person or firm with a surplus
 - “Investors”: person or firm using resources to add to society’s capital stock, e.g. machines, education, consumer durables
- Many steps along the chain, many multilateral connections

Reduction and sharing of risk via

- Insurance and diversification
- Trading and hedging

Identification of opportunities for investment or allocation of capital

Monitoring of agents, managers, e.g. **corporate control**

Facilitate exchange of goods and services, e.g. via money and **media of exchange**

- More generally, creation of (→)**liquid** assets

Financial innovation e.g. securitization, derivatives, cryptocurrencies

Constituents of the financial system

Human beings: also called i.a. **households, individuals, agents,** or **investors**

- May be organized into specialized firms called **financial intermediaries**
- Primarily banks and insurance companies, but also other types of firms
- Intermediaries *gather and create information*
 - Vetting, selecting and monitoring borrowers
- Information is costly: intermediaries are low-cost producers

Assets include

- **Financial instruments:** contracts such as equity, debt, derivatives contracts
- **Real assets:** real estate, commodities

Financial markets in which assets trade, prices set

Why is financial intermediation difficult?

- Who needs intermediaries? Intermediation should be easy through markets:
 - **Arrow-Debreu model:** contracts now for all future states and times; trade once at the beginning of history
 - **Modigliani-Miller theorem:** firm capital structure—mix of equity and debt financing—doesn't affect firm value
 - Households can adjust their own balance sheets
- But in the real world, costly due to
 - **Incomplete markets:** only a tiny fraction of the necessary **contingent claims** actually exist
 - **Economies of scale** → opportunities to specialize in carrying out every aspect, e.g. mortgage servicing, factoring
 - **Information costs** of distinguishing good from bad borrowers, monitoring
 - **Transaction costs** of contracting, including the costs of navigating conflicts of interest

Types of financial intermediaries

- **Institutional perspective:** types of firms
 - Depository institutions, e.g. banks
 - Investment companies, e.g. mutual funds, hedge funds
 - Broker-dealers
 - Insurance
 - And much more...
- **Functional perspective:** types of services
 - Asset transformation, e.g. maturity, liquidity, diversification
 - Production of information, e.g. advice, monitoring
 - Facilitating transactions, e.g. brokerage, payments, clearing and settlement
 - And much more...

Aspects of asset transformation

How financial firms “use their balance sheets” to intermediate:

Credit transformation: changing (not always raising!) the credit quality of a debt contract. For example:

- Monitoring may raise quality
- **Collateral:** borrower puts assets under control of lender
- Adding guarantees
- Tranching (→capital structure, structured credit)

Maturity transformation: changing the term to maturity of a debt contract by borrowing short-term and lending long

Liquidity transformation: make debt contract more like money

- Goes hand-in-hand with maturity transformation
- **Examples:** banks, **money market mutual funds** (MMMFs)

Operational aspects of intermediation

Also called financial system “**plumbing**” or **back-office** operations

Clearing includes

- Matching trade records with counterparties
- Reconciling trades with firm’s books and records

Settlement: transferring securities or other assets and making **final payments** via payments systems

- **Examples:** **Fedwire** for interbank U.S. dollar funds transfers, **Depository Trust and Clearing Corporation (DTCC)** for securities, some derivatives

Custodial services include record-keeping, managing cash flows from investments

Gross and net settlement

- **Netting:** cancelling offsetting trades when contractually mandated or permitted and appropriate
 - **Gross settlement** occurs via transfer of gross amounts due without netting
 - **Net settlement** occurs at specific times, e.g. end of day, via transfer of net amount due
- **Real-time gross settlement (RTGS)** system
 - Large-value interbank funds transfer
 - Final settlement effected continuously
 - Have become widespread worldwide, **examples** include Fedwire, **TARGET** in Europe

Bank intermediation

“What do banks do” a perennial question, no standard definitions

Commercial banks make loans to companies

- Funded by equity, **deposits** and other borrowing
- **Retail banking**: loans to households, e.g. **residential mortgages**

Investment banking: financial services to companies include

- Facilitate securities issuance by companies through **underwriting** and **syndication**
- Advice, esp. on corporate actions such as merges and acquisitions

Broker-dealers facilitate trading and investment in securities in two ways:

- As principal: **dealers** take positions, use equity and borrowed funds to finance security trading of other firms
 - Compensation through trading profits, interest
- As agents: **brokers** facilitate trades, provide trading infrastructure without taking position
 - Compensation through fees and commissions

A taxonomy of financial instruments

- Cash or **spot** versus **derivatives**: is the passing of time involved in the delivery of a payment or good?
- **Securities** versus bilateral contracts:
 - Securities are **fungible** (uniform) claims, can be bought, sold or transferred, documented via a certificate or book entry
- **Nominal** versus **real assets**:
 - Nominal assets are claims expressed in units of money
 - Real assets: claims expressed in units of purchasing power, e.g. **inflation-indexed bonds**, or on physical assets
- Debt versus equity instruments: who takes the first loss?
 - Long- versus short-term debt
- Over-the-counter (OTC) versus exchange-traded: do you find a counterparty at an organized exchange or at your dealer?
 - Standardization of OTC contracts via **master agreements**, defining payments, collateralization, termination conditions
- On- versus off-balance sheet, affecting tax and bankruptcy treatment, transparency
- Primary versus securitizations: is it a “claim on a claim”?

Cash forms of intermediation

Some important examples:

- Foreign exchange
- Shares
- Physical assets: real estate, commodities, artworks
- Short-term lending: money markets
- Long-term lending:
 - Bank loans, primarily mortgage loans, commercial and industrial (C&I) loans
 - Capital markets, great variety of bonds
- Even with cash forms, there is a time to **settlement** of trades

Money markets

- Forms of short-term lending:

Bank deposits: includes **interbank lending**, **certificates of deposit** (CDs)

- Distinguished by **par redemption**: ability of depositor to withdraw funds at par value
- On demand, i.e. instantaneously, for most deposit types

Commercial paper: short-term capital markets instrument

Repo and other **secured** forms (→collateral markets)

- Non-bank deposit-like lending also intermediated by MMMFs
 - Funds with **fixed net asset value** (NAV) offer a form of par redemption
 - No bank charter, par redemption via accounting rule (SEC's Rule 2a-7 under the Investment Company Act of 1940)
 - Fixed NAV restricted under postcrisis reforms to funds investing in government securities or with retail shareholders

Brokers and dealers

- **Broker-dealers** facilitate trading and investment in securities
- As principal: **dealers** take positions, use equity and borrowed funds to finance and execute security trading
 - Also called (esp. in regulatory context) **market makers** or **liquidity providers**
 - Bear market and credit risk of securities inventories
 - Compensation through trading profits, interest
- As agents: **brokers** facilitate trades, provide trading infrastructure without taking positions
 - Compensation through fees, commissions, **payment for order flow** by dealers

Derivatives forms of intermediation

Futures, forwards, and swaps: Linear and symmetric relation of value to underlying asset price

- **Static hedging:** can be hedged with a one-time trade in the underlying asset
- Value driven by underlying, not volatility \Rightarrow zero **net present value** (NPV) at initiation

Options Nonlinear and asymmetric relation of value to the underlying asset price

- **Dynamic hedging:** repeated trades are needed to stay hedged
- Value driven by volatility as well as underlying, asymmetric payoffs
- \Rightarrow Cannot have zero NPV at initiation.

Financial intermediation

Financial risk taxonomy

- Market risk

- Credit risk

- Operational risks

Varieties of market risk

- **Market risk:** risk of loss from changes in market prices or **risk factors**

- Some forms of market risk

Price risk: asset prices go the wrong way

Execution risk: cannot execute trades quickly or skillfully enough to avoid loss

- Example: **stop-loss risk**, the risk that you cannot exit a trade at the worst price you were willing to accept

Mark-to-market risk: losses may not be realized through sale or unwinding

- Losses may nonetheless be recorded in firm's accounts, publicly reported
- Use of models to value illiquid, infrequently traded assets → **model risk**

Categories of market risk

- Major categories of market risk include exposures to prices or values of
 - Equity:** ownership interests in or residual claims on firms
 - Interest rates:** fixed claims to cash flows
 - Foreign exchange:** one currency in terms of others
 - Physical assets:** commodities, real estate
- **Inflation rate risk** is the risk arising from changes in the general price level
 - Generally associated most closely with interest rate risk
 - But interacts closely with all risk factors
- Many single-position exposures are exposed to several categories of market risk
- **Examples:**
 - Foreign stock indexes values in local currency depends on both foreign exchange and equity risk factors
 - Commodity futures prices fluctuate with both commodity prices and short-term interest rates

Risk factors

- Market risk measurement generally decomposes exposures embedded in assets into exposures to **risk factors**
- Enables risk modeling of positions falling in several risk categories
- Accuracy: risk factors may help focus on predictable sources of variations in value
- Data on specific assets generally less available than than on factors
- Tractability: extremely large number of assets—securities, derivatives—but limited number of risk factors
- Dimensionality of larger sets of risk factors may be reduced via **principal components analysis** of their joint return behavior

Risk factor mapping

- Risk factor approaches require **mapping**: assignment of risk factors to positions
 - Including a measure—the **loading**—of the impact of each risk factor on each position
 - For **example**, option risk measured using price of underlying, with loading based on delta
- Risk factor mapping may combine intuition, statistical analysis and asset modeling
 - May include macroeconomic factors as well as asset prices
 - May be latent or unobservable
- **Factor models** that explain prices or values in terms of underlying and possibly unobservable variables
- **Examples** of risk mappings include
 - Equity prices as functions of stock market indexes or valuation measures
 - Long-term bond values as functions of key rates along curve
 - Foreign exchange rates as functions of major exchange rates, interest-rate differentials

Definition of credit risk

Risk that the creditworthiness of a debt obligation deteriorates:

Default risk: debtor becomes insolvent, i.e. unable to pay timely and in full

Credit migration risk: default *likelihood* rises→

- Issuer or security receives a lower **credit rating**
- Fall in market price of the security

Fixed income exposed to both market and credit risk

- Pure credit risk event: deterioration of firm's credit quality without credit spread widening
 - **Example:** previously AAA-rated company downgraded to AA
 - But no change in AAA spreads or in risk-free rates
- Pure market risk event: spread widening—decline in risky bond prices—without downgrades
 - **Example:** widening spread between AAA and risk-free rates
 - But no credit event or change in credit quality

Counterparty risk

- It's not just who you *lend* to, but also who you *trade* with
- **Counterparty risk:** trading counterparty does not fulfill an obligation to pay or deliver securities.
 - Exposure to credit risk, but size of exposure fluctuates with market prices
 - Challenging to disentangle market from credit risk
- Arises in derivatives trading
 - **Examples:** long option market value or swap NPV

Operational side of credit risk

Clearing risk includes

- Failure to record trades accurately in firm's books and records (e.g. Soc Gen 2008)

Settlement risk includes

- Counterparty fails to complete settlement
- An issue particularly in foreign exchange transactions
- Also known as **Herstatt risk** after 1974 failure of large German correspondent bank

Custodial risk: examples include

- Customer securities or cash may be commingled with custodian's assets, become unavailable in event of insolvency
- Examples: Lehman U.K. subsidiary 2007, MF Global 2011

Interactions between market and credit risk

Some examples:

- Counterparty risk: can arise from market or credit risk
 - Market risk: swaps and options on non-credit derivatives
 - Credit risk: CDS exposed to **double default risk**, both the underlying credit and counterparty default
- Credit quality depends in part on macroeconomic or specific market conditions
 - **Wrong-way risk**: interaction between counterparty and market risk
 - Presents itself when exposure greatest under market conditions putting counterparty at greatest default risk
- Sovereign debt convertibility risk: low default risk, but risk of
 - Redenomination at unfavorable exchange rate
 - E.g. if euro member leaves single-currency and converts debt to new local currency
 - Currency depreciation or inflation

Liquidity risk

Falls between market and credit risk: several meanings, interaction

Market liquidity risk The market is not deep enough, at the time you have to buy or sell, to trade without pushing price against you

- → Greater risk to lender

Funding liquidity risk Credit becomes unavailable, or offered only on more stringent terms

- → Forced unwinding, mark-to-market loss

Operational risk and other firm-killers

Model risk: potential for loss arising from incorrect model or use of a model, e.g. data, parametrization, omitted variables

Operational risk: “risk of loss resulting from inadequate or failed internal processes, people and systems or from external events”
(Basel Committee, 2011)

- Major regulatory capital component, alongside market and credit

Legal risk: firm may be sued for its financial practices, or a valuable contract cannot be enforced.

- Part of operational risk in Basel taxonomy

Regulatory and **compliance risk**, including prohibition of a currently-permitted activity

Reputational risk: potential for damage to firm goodwill or brand

Business or **strategic risk**

Operational risk examples

- Unauthorized trading: Nick Leeson at Barings Bank (1995), Jérôme Kerviel at Société Générale (2008)
- Squirrels and power lines: Nasdaq trading interruptions 09Dec1987 and 01Aug1994



The Knight Capital episode

Some examples:

- 01Aug2012: market-making firm Knight Capital places over 4 million erroneous orders in first 45 minutes of trading day
 - Resulting trades lead to losses of about \$460 mill., eventual forced sale of firm
- Operational risk: “error in the operation of its automated routing system” (SEC cease-and-desist order) drives erroneous orders
- Business risk: code changes in response to NYSEs Retail Liquidity Program (RLP), permitting sub-penny pricing for retail investors
- Model risk: an existing algorithm had been revised and a new one introduced to implement RLP
- Regulatory risk: RLP a response to Rule NMS eliminating sub-penny pricing
 - And firm pays \$12 mill. SEC fine for risk management failure
- Reputational risk: large customers cease trading with Knight
- Market risk: losses generated by changes in value of unintended positions taken