

- Fixed-income Securities: Defining Elements
- Fixed-income markets: Issuance, trading, funding

### Fixed-income Securities: Defining Elements

#### Bond Indenture 债券契约

- A **Legal contract** between issuer (borrower) and bondholder (lender)
  - Called a **trust deed** (or **bond indenture** in US and Canada)
- Bond parameters
  - issuer, maturity, par value, coupon, currency
- **Covenant**
  - Actions must take, and actions prohibited
- Legal information about the entity issuing the bond
- Legal and regulatory issues
- **Collateral**: Any assets (collateral) pledged to support the repayment of the bond
- **Credit enhancement**: any additional features that increase the probability of repayment
- **contingency** provisions

#### Bond, yields, ratings

- Pay a series of interest payments in fixed amounts and repay the principal at maturity
- Market Interest rate (i.e., yields on bonds) increase, bond value decrease
- Rating is based on probability of default, low quality -> high yield

#### Parameters

- Issuer 发行者
  - Corporation 公司债
    - Financial and nonfinancial companies
  - Sovereign national government 政府债
    - US Treasury bonds, but many countries issue sovereign bonds
  - Non-sovereign government 地方政府债
    - Government entities that are not national government
  - Quasi-government entities
    - Not a direct obligation of a country's government or central bank
  - Supranational entities
    - Globally: world bank, IMF
- Maturity date 到期日
  - **Tenor**/Term to maturity: the time remaining until maturity
  - **Perpetual bond** 永续年金
    - no maturity date, pay interest but no promise to pay principal
  - **Money market** 货币市场
    - original maturity is one year or less
  - **Capital market** 资本市场
    - original maturity is more than one year

- Par value 票面价值
  - Principal amount will be paid at maturity, also called face/maturity/redemption/principal value
  - Price and coupon rate are **quoted** as percentage of par
  - **Premium**: Selling price > par 溢价
  - **Discount**: selling price < par 折价
  - **At par**: selling price = par 平价
- Coupon rate and frequency 票面利率
  - Plain vanilla / **conventional** bond: **fixed** coupon rate 常规债券
  - **Zero-coupon** / pure discount bonds 零息债券/存折价债券
    - no interest prior to maturity and sold at discount
- Currency in which payments will be made
  - Single-currency 单币值债券
  - **Dual-currency** 双币值债券
    - coupon interest in one currency and principle in another currency
  - **Currency option** bond 可以选择本金和利息的币种
    - can choose which of two currencies they like to receive

### Covenants 债券合约规定

- Provisions
  - Negative: prohibitions on the borrower
  - Affirmative: actions the borrower promises to perform
- Negative 否定条款
  - Asset sales (cannot sell assets pledged as collateral) 不能卖抵押的资产
  - Negative pledge of collateral (cannot pledge assets to multiple bondholders) 不能重复抵押
  - Additional borrowing (cannot borrow additional money unless certain conditions are met) 不能借新债
- Affirmative 肯定条款
  - Make timely interest and principal 及时还利息和本金
  - Insure and maintain assets 保险和维护资产
  - Comply with applicable laws and regulations 遵守法规

### Bearer or registered bond

- **Bearer** 不记名
  - processing it means ownership
  - avoid tax, better liquid
- **registered** 记名
  - ownership is recorded

### Bond Issue, Currency, and Trade

- **National bond market - Domestic bonds**
  - Issued by a **domestic** firm and traded in the **local** currency
  - 发行人 = 发行货币 = 发行地

- **National bond market - Foreign bonds**
  - Issued by a **foreign** firm and traded in the **local** currency on the national bond market of the **local** country
  - 发行人  $\cong$  发行货币 = 发行地
  - Panda bonds
    - Bond issued by foreign firms traded in China and are denominated in yuan
  - Yankee bonds
    - Bond issued by foreign firms traded in US and are denominated in US
- **Eurobond Market - Eurobonds**
  - Properties
    - Outside the jurisdiction of any country
    - currency country and trade country are different
    - subject to **less regulation** than domestic bond in most jurisdictions
    - initially introduced to **avoid** US regulation
    - Most of in **bearer** form to avoid tax
    - 发行货币  $\cong$  发行地
  - Example
    - Chinese firm, issue bond in **yen** and traded **outside** Japan
  - Referred to by the currency
    - Eurodollar: US
    - Euroyen: yen
- Global bonds (Eurobonds + at least one domestic bond)
  - **Eurobonds** trade in **national bond** market of a country other than the currency country, in the Eurobond market

	Issue	Currency	Trade
Domestic	Local	Local	Local
Foreign	Foreign	Local	Local
Eurobonds	A	B	<b>Not B</b>
Global	Global bond = Eurobond + Domestic bond market		

### Issuing Entities

- Sovereign
  - **Treasury** of the issuing country
- Corporate
  - Well-known corporation, subsidiary or holding company
- Quasi-government
  - Agency bond
- SPE/SPV 特殊目的载体
  - Owning specific assets and issuing bond
  - **Bankruptcy remote** entities/vehicles
  - **Securitized** bonds
  - At **lower** interest rate
  - Off-balance sheet for originator

## Source of Repayment

- Supranational
  - Repayment of previous loan
  - Paid-in capital from members
- Sovereign / national government
  - Tax and print money
- Non-sovereign government/ local government
  - General taxes, project revenue, specific taxes
- Corporate
  - cash flow from operation
- SPE
  - Cash flow of financial asset

Issuer	Bond	Repay	Feature
Supranational		Repayment of previous loan  Paid-in capital from members	Multilateral agency
Sovereign/national government	Sovereign	Tax  Print money	
Non-sovereign/local government	Non-sovereign	General taxes  project revenue  specific taxes	
Quasi-government	Agency		
Corporate		Cash flow from operations	
SPE/SPV	Securitized	Cash flow from financial assets	Bankruptcy remote lower interest rate Off-balance sheet for originator
Most European companies	Covered		Bankruptcy remote On-the-balance sheet recourse

## Secured and unsecured bonds

- Unsecured bonds 无担保债券
  - A **claim** to the **overall** assets and cash flow of the issuer
- Secured bonds 担保债券
  - Backed by a claim to **specific** assets
  - reduced the risk of default
  - **Lower** yields

## Collateral

- **Collateral**
  - Assets **pledged** in secured bonds
- **Seniority**
  - **Priority** in the event of **bankruptcy or liquidation**
  - Secured bond > unsecured bond
  - Senior unsecured debt > subordinated/junior debt

## Secured Debt/Bonds

- Equipment trust certificates
  - Backed by equipment
- **Collateral trust bonds**
  - Backed by **finance** assets (stocks and bonds)
- Debenture
  - refers to **unsecured** debt in US
  - bonds collateralized by **specific** assets in Great Britain and some other countries
- MBS
  - A pool of mortgages

## Covered bonds

- Most in European countries
- **on the** balance sheet
  - Similar to asset-backed securities, but the asset remains **on the** balance sheet
- **bankruptcy remote**
  - Special legislation protects the assets in the event insolvency
- **Recourse**
  - Provide recourse to the issuing firm
  - Replace or augment non-performing assets in the cover pool

## Credit enhancement 信用增信

- Internal (built-in features) or external, increase credit quality and decrease yield
- Internal
  - Overcollateralization – hard 超额担保
    - Collateral **pledged** value > debt **par** value
  - Cash reserve fund 准备金
    - Make up credit losses
  - Excess spread account – soft 超额利差
    - Yield on the underlying assets > Yield on the bond
    - Excess cash flow-> excess spread trust account
  - Tranches 分级
    - Tranches with different seniority
    - **waterfall** structure
    - Senior > junior/mezzanine > equity
- External
  - Surety bond – insurance 保险担保

- Issued by insurance company, promise to make up shortfall
- Bank guarantees 银行担保
  - Issued by bank, similar to surety bond
- Letters of credit 第三方担保
  - Promise to lend money to the issuing entity
- External limitation
  - **Deterioration** of credit quality of the guarantee will **reduce** the credit quality of the covered issues
  - Subject to third-party (**counterparty**) risk
- External limitation Solution - **Cash collateral account**
  - Issuer immediately borrows the credit enhancement amount and invest it in highly rated short-term commercial paper.
  - Mitigate counterparty risk

## Taxation

- Interests income - **ordinary taxable income** 利息税
  - Most are **ordinary taxable income**
  - Some municipal government in US are tax **free**
- Capital gain or loss – **capital gains income** 资本利得税
  - Sell it prior to maturity
  - Capital gains rate is **lower** tax rate than ordinary income
  - Long-term capital gains income
    - Hold it for a long time, lower tax rate
- Original issue discount (OID) – only amortized interest income tax
  - **Pure-discount bond**
    - sold at a **significant discount** to par
    - Gains over tenor as price moves towards par -> **interest income**
  - Amortization 摊销法
    - A portion of discount from par is **taxable** interest income
    - Tax basis **increase** each year
    - **No** capital gains tax liability at maturity
- **Bond issued at a premium**
  - A symmetric treatment similar to OID
  - **Reduce** the **taxable** portion of coupon interest payment 减少税基

## Cash flow Structure 现金流结构

- Bullet structure
- amortizing loan
- Sinking fund provisions

## Bullet structure 子弹结构（定期付息、到期还本）

- **coupons**: periodic interest payment
- **balloon** payment 气球型支付
  - principle (a lump sum) and final interest at maturity

## amortizing loan 摊销债券（等额本息，定期付息还本）

- **periodic payment = interest + some principal**
- full amortizing 完全摊销 (等额本息, 最后本金为 0)
  - principal is **fully** paid off at maturity
- partially amortizing 部分摊销 (等额本息, 最后还有一笔本金)
  - some remaining principle at maturity
  - a **balloon** payment at maturity
    - unlike bullet structure, pay only outstanding **principal**
  - The **coupon** payment is **higher or equal** than full amortizing
    - Because less principle is paid, so interest is higher
    - The first interests are the same

### Sinking fund provisions – prepayment - 加速偿债基金条款 (提前还本金)

- repayment of **principal** through a series of payment over the life of issue
- redeem amount
  - the amount can decline or increase each year
- redeem price
  - can be different from par
  - interest rate rise -> market price fall -> issuer buy bond from market
- Advantages
  - **Reduce credit risk** because of periodic redemption and reduced principal
- Disadvantages (similar to call feature, **increase reinvestment risk**)
  - Interest rate **fall** -> market price increase
  - Issuer: randomly select outstanding bonds to redeem
  - Bondholder: suffer a loss because redeem price < market price
    - More **reinvestment** risk, invest a lower yield

### Coupon-payment structure 息票利率结构

- Floating-rate coupon
- Step-up coupon
- Deferred coupon
- Credit-linked coupon
- Payment-in-kind coupon
- Index-linked coupon

### Floating-Rate notes (FRN) or floaters 浮动利率

- Floaters: interest depend on current market rate of interest
- **Reference** rate 基准利率
  - Market rate of interest
- Margin/spread 利差
  - **interest rate = reference rate + margin (or spread) in basis points**
- Variable-rate note 可变利率
  - **Margin** above reference rate is not **fixed**
- Cap and floor 上限和下限
  - The upper rate or lower rate of the interest rate regardless of reference rate
- Collar – both a cap and a floor

- Inverse floater 逆浮动利率
  - Coupon rate **increases** when reference rate decreases or expected interest rate will decline
  - Interest rate = fixed-rate – floating rate

#### Step-up coupon 递增债券（利率增加、市场利率上升保护、但是可以被赎回）

- Coupon rate **increases** over time according to predetermined schedule
- call feature
  - allows the firm to redeem bond at a set price at each step-up date
  - if new coupon rate > market yield -> call it
- higher yield
  - when credit rating fall -> high yield to compensate high risk
- market rate **increase** -> protect bondholder
- market rate decrease -> issuer will **call** it, increase **reinvestment** risk

#### Deferred/split coupon bond 递延债券 (**delay to pay coupon**)

- regular coupon does not **begin** until a period of time after issuance
- use to finance a large project
- offer bondholder tax advantages in some jurisdictions
- example
  - zero-coupon bond

#### Credit-linked coupon bond 信用挂钩

- coupon rate **increase** when rating fall
- protect against credit downgrade, but could have wrong-way risk, leading to high probability of default

#### Payment-in-kind (PIK) bond 实物支付债券（借新债偿旧债）

- pay bond **interest** with more **bonds** 发额外债券用于支付利息
- make coupon payments by increasing the principal amount of outstanding bonds
- high leverage and high level of debt
- higher yields

#### Index-linked bond 指数挂钩

- **coupon** payment and/or **principle** value is based on index
  - Commodity index, equity index
- Equity-linked notes (ETN)
  - No periodic payment
  - Payment at maturity is based on an equity index
- Inflation-linked bonds (linker) 通胀指数
  - Most common, payment based on an inflation index (i.e., CPI)
- Principal **protected** bonds 本金保护
  - Will pay not less than par value at maturity even if index has decreases

#### Inflation-linked bonds 通胀挂钩债券



- Indexed-annuity bonds 年金
  - **Fully amortizing** bonds with the periodic payments directly adjusted for inflation or deflation
- Indexed zero-coupon bonds 零息债券
  - Payment at maturity is adjusted for inflation
- **interest**-indexed bonds 利息 – 非摊销
  - **Coupon rate** is adjusted for inflation while the principle value remains unchanged
- **Capital**-indexed bonds (most common) 本金 – 非摊销
  - Treasury inflation protected securities (TIPS)
  - Coupon rate remains constant, principal value is increased by the rate of inflation (or decreased by deflation)
  - Once the capital is adjusted, subsequent coupon is calculated using the new principle.
    - $\text{new principal} = \text{principle} \times \text{inflation rate} \times t$
    - $\text{new coupon} = \text{new principal} \times \text{coupon rate}$
  - Example
    - 1000 par with 8% semi-annual coupon rate, if the CPI increase by 6%, what is the new principle and coupon?
      - $\text{Principle} = 1000 \times (1 + 6\%/2) = 1030$
      - $\text{interest} = 1030 \times (1 + 8\%/2) = 41.2$

#### contingency provision/embedded options

- contingency provision
  - a contract describes that an action that may be taken if an event actually occurs
- straight/option-free bonds
  - bonds with no contingency provisions
- embedded options
  - contingency provisions in bond indentures
- types
  - callable bonds
  - puttable bonds
  - convertible bonds
  - warrants
  - contingent convertible bonds (CoCo)

#### Callable bonds

- call option
  - issuer has the right to **redeem all or part** of bond at specific price (**call price**)
- call schedule
  - a series of date and price that can be redeemed
- call protection/lockout period 锁定期
  - the first few years
  - the period is called lockout period, cushion, deferment period
- first **call** date 首次赎回日

- first date which can be callable
  - call premium: call price – par value
- first **par** call date 首次平价赎回日
  - first date which call price equals to par value
- when to call
  - market interest rate **decrease**
  - credit quality has **increased**
- **risk**
  - more **reinvestment** risk for bondholder
- pricing from bondholder 低价格、高收益
  - **callable bond price = bond price – call option price**
  - callable bond means the investor sells a callable option to issuer
  - **low price and higher yield**
- exercise style
  - American: **any time** after the first call date
  - European: only called **on the specified call** data
  - Bermuda: can be called on specified dates **after** the first call date, often on coupon payment dates
- **Make-whole** call provision
  - Goal
    - Reduce the higher interest on callable bond
    - Still preserve the option to redeem
  - Call price
    - Not fixed
    - a lump-sum based on PV of future coupon not received
  - callable price  $\geq$  market value
  - call is unlikely except special situations (acquisition or restructuring)
  - interest rate fall
    - no upper limit prices
    - Actually, penalize the issuer for calling the bond

### Puttable bonds

- Put option
  - Bondholder can sell to investor at specified price
- when to call
  - market interest rate **increase**
  - credit quality has **decreased**
- pricing from bondholder 高价格、低收益
  - **puttable bond price = bond price + put option price**
  - puttable bond means the investor buys a puttable option
  - **high price and lower yield**

### Convertible Bonds

- convertible
  - gives the bondholder to exchange bond for common stocks
- pricing from bondholder 高价格、低收益

- convertible bond price = bond price + convert option price
- convertible bond means the investor buys a convertible option
- high price and lower yield
- conversion
  - conversion price
    - the price per share at which bond (at its **par** value) may be converted to common stock
  - conversion ratio
    - $\text{conversion ratio} = \frac{\text{bond par value}}{\text{conversion price}}$
  - conversion value
    - $\text{conversion value} = \frac{\text{bond par value}}{\text{conversion price}} \times \text{stock market price}$
  - conversion parity
    - at parity: conversion value = bond's price
    - above parity: conversion value > bond's price
    - below parity: conversion value < bond's price
- problem
  - may not convert even if conversion value is higher than bond's par value
- solution – call provision
  - call price less than conversion value
  - force bondholder to convert

## Warrants

- give bondholder chance to **buy** additional common shares
- sweetener, make debt more attractive because potential upside profit

## Contingent convertible bonds (CoCo)

- bond that convert to common equity **automatically** if a specific event occurs
- issued by some European banks
- banks must maintain equity financing to meet regulation
- automatically convert -> reduce debt and increase equity

	Callable	Puttable	Convertible	Warrants	CoCo
<b>Option</b>	Call	Put	Conversion		conversion
<b>Exercise</b>	Manual	Manual	Manual	Manual	<b>Automatic</b>
<b>Who benefit</b>	<b>Issuer</b>	bondholder	Bondholder	Bondholder	Issuer
<b>Price</b>	<b>Lower</b>	Higher	Higher	Higher	
<b>Callable price</b>	<b>callable bond price = bond price – call option price</b>				
<b>Puttable price</b>	<b>puttable bond price = bond price + put option price</b>				
<b>Yield</b>	Higher	Lower	Lower	Lower	
<b>Exercise when interest</b>	Decrease	Increase			
<b>Exercise when credit quality</b>	Increase	Decrease			

<b>New Common equity</b>			Convert	<b>Buy</b>	Convert
<b>Risk to bondholder</b>	<b>Reinvestment</b>				
<b>Penalize or force</b>	Make-whole		Call provision		

## Fixed-income markets: Issuance, trading, funding

### Global fixed-income market

- **type of issuer**
  - Government, corporate, structured finance
  - Corporate: financial and non-financial
  - Largest issuer: financial corporation and government
- **Credit quality**
  - S&P, Moody's, and Fitch
  - Investment grade
    - S&P and Fitch: AAA, AA, A, BBB
    - Moody: Aaa, Aa, A, Baa3
  - Noninvestment grade: junk bond, speculative bond, high-yield bond
- **Original maturity**
  - Money market: original maturity  $\leq$  one year
    - Treasury bills (by government)
    - commercial paper (by corporation)
    - Certificate of deposit (bank banks)
    - negotiable certificates of deposit
  - Capital market: original maturity  $>$  one year
- **Coupon structure**
  - Fixed-rated
  - Floating-rate
    - Depend on short-term market reference rate
    - Attractive to variable-rate sources of funds (liabilities), such as banks
- **Currency denomination**
  - Majority: dollar or euros
- **Geography**
  - Domestic, foreign, Eurobond, global
  - Developed markets
  - Emerging market
    - Less well-established, higher yields
- Indexing
  - Index-linked bonds
    - Cash flow on some bonds are based on index.
  - Inflation-linked bonds
    - Issued primarily by governments and some high credit quality corporations
- Tax status
  - US tax exempt bond: municipalities, munis
    - Lower yield

### Reference rate

- London Interbank Offer rate (LIBOR)
  - For several currencies and maturities
- **Expected** rate for **unsecured** loans between banks in the interbank money market
- Reference rate must match the frequency of the coupon rate

### Primary markets

- Sale of **newly issued** bonds
- Public offering
  - Sale to public
  - By investment bank
- Private placement
  - Sold to qualified investors

### Primary market Offering

- **Underwritten offering**
  - Buy from firms and sell them
  - Large issuer, **lead underwriter** heads a **syndicate** of investment banks
- Grey market
  - The trading prior to offering date provides additional information about demand and market clearing price
- **Best efforts offering**
  - Based on commission, do not commit to purchase
- **Auction**
  - **Government** bonds
  - US Treasury securities
- **Shelf registration**
  - Registered with regulator in its aggregated value with a master prospectus
  - Issued over time when needs to raise funds
  - Only financially sound companies are granted this option

### Secondary markets

- Trading of previously issued bonds
- Some in Exchange, most in **dealer** or **OTC** market
- Clearing and settlement system
  - Money market: day
  - Government bond: day or T+1
  - Corporate: T+2 or T+3

### Sovereign bonds

- By sovereign governments backed by taxing power
- Highest credit quality
  - free of default risk
  - Collect taxes and print money
- Credit rating
  - Local currency bond > foreign currency bond
  - Cannot print foreign money and it depends on exchange rate
- On-the-run vs off-the-run
  - Trading is active for on-the-run, liquid, **benchmark** bonds
  - On-the-run: most recent issue

### Non-sovereign government bonds

- Issued by states, provinces, counties
- Payment supported by
  - Project revenue, general tax, special tax

### Agency or quasi-government

- US, government-sponsored enterprises (GSEs)
- Some are backed by national government

### Supranational bonds

- Multilateral agencies: World banks, IMF, Asian Development banks
- High credit quality and liquid

### Corporation

- Bank debt
- Commercial paper
- Corporate bonds

### Bank Debt 银行债务

- Most are Libor-based, variable-rate loans
- **Bilateral** loan: only one bank
- **Syndicated** loan: more than one bank, a group of banks

### Commercial paper 商业票据 – corporation (short-term unsecured 短期非担保)

- **Short-term unsecured** debt securities, larger **creditworthy** corporations
- **Interest rate < bank loan interest 比银行利率低**
- More credit risk and less liquidity
- Yield: Discount yield or add-on-yield
- Maturities
  - US, maturity ≤ 270, exempt from SEC registration
  - Eurocommercial paper (ECP), maturity ≤ 364
  - One day: overnight paper
  - Most in 90 days
- **Rollover** risk
  - Most are rolled over for longer term
  - Credit quality decrease or systemic financial distress
- **Liquidity enhancement or backup liquidity lines 流动性增强**
  - To get acceptable rate on commercial paper, corporations maintain backup lines of credit with banks
  - Banks agree to provide funds when paper matures except in case of **material** adverse change
- **US commercial paper**
  - Currency: denominated in US dollar
  - Yield: **Discount** basis
  - Maturity: overnight to 270 days, exempt from SEC registration
  - Settlement: T+0

- Can be sold, it is negotiable
- **Eurocommercial paper (ECP)**
  - Currency: denominated in any currency
  - Yield: add-on yield
  - Maturity: overnight to 364 days
  - Settlement: T+1
  - Can be sold, it is negotiable

### Corporate bonds 公司债券

- **Serial bond issue 系列债券发行/分期偿还债券**
  - Issued with **several maturity** dates 不同的到期日期
  - Similar to sinking fund provision, principle is redeemed periodically
  - Difference: serial bond **knows** specific bonds will be redeemed
  - sinking fund provision: more **risk** of redemption
- **Term maturity structure 同时到期**
  - A bond that **does not** have a serial maturity structure
  - All bonds maturing on the same date
- **Maturity**
  - Short-term:  $\leq 5$  years
  - Medium:  $5 < \text{maturity} \leq 12$  years
  - Long:  $> 12$  years
- **Medium-term notes (MTN) 满足投资者不同期限需要**
  - Issued in **various maturities**, ranging from 9 months to 100 years
  - Fixed-or floating-rate coupon
  - Longer-maturity is typically fixed-rate bonds
  - Most are issued by financial **corporation** that are bought by financial **institutions**

### Structured financial instrument 结构化金融工具 (debt + derivative)

- Change the risk profile of an underlying debt security
- Often combined with a **debt** security with a **derivative**
- **Yield enhancement instruments - Credit-linked note (CLN) (bond - CDS) 信用挂钩**
  - Regular coupon payments
  - **Investor buy bond and sell CDS**
  - Transfer credit risk to investor
  - Redemption
    - depends on whether a credit event occurs (i.e. credit default or rating downgrade)
    - if credit event does not occur, pay cash flow as scheduled (interest + par value at maturity)
    - otherwise, make a lower redemption payment
  - yield is higher
- **capital protected instrument 本金保护 (debt + call option)**
  - guarantee a **minimum value** at maturity as well as potential upside gain
  - if promise less principal, upside gains are **greater** because more calls can be purchased



- **participation instrument 参与型**
  - payment based on reference rate or equity index
  - no capital protection
  - floating-rate note 浮动型
- **leveraged instruments 杠杆型 - inverse floater 逆浮动**
  - pay floating, receive fixed
  - $\text{pay rate} = \text{fixed} - L \times \text{LIBOR}$ 
    - $L > 1$ : leveraged inverse
    - $0 < L < 1$ : deleveraged inverse floater

### Bank Short-term funding

- **Customer (retail) deposit**
  - **Checking** account
    - provide transaction service, pay no interest
  - Money market mutual funds
    - Less liquidity or less transaction service, pay periodic **interest**
  - **saving** account
    - Less liquidity or less transaction service, pay periodic **interest**
- **Certificate of deposits (CDs) 存款凭证**
  - Mature on specific dates, a range of short-term maturities
  - Interest bearing, can be sold in **wholesale** market
  - **Nonnegotiable CDs**
    - Cannot be **sold**
    - **withdrawals** of funds often incur a significant **penalty**
  - **negotiable certificate of deposit**
    - can be **sold**
    - large denomination (>1 million) negotiable CDs are an important funding source
    - less than one year, traded in domestic and Eurobond markets
- **Central bank funds market 央行准备金**
  - borrow excess **reserves** from other banks
  - central bank funds rate
    - affected by central bank's **open market** operations
    - US, it is called **fed funds rate**, affect short-term debt securities
- **Interbank funds**
  - Non-reserve on deposit with central bank
  - Unsecured, liquidity may decrease
  - Up to one year

### Repo 逆回购协议 (short-term, secured 短期有担保)

- One sells a security to another and will buy it back at a higher price
  - Use collateral
  - Repurchase price > selling price
- not regulated by Federal Reserve
- most comparable to a **collateralized** loan
- Maturity

- Overnight: one day
  - Term repo: longer
- Repo date
  - The date to purchase the asset back
- Repo margin / Haircut
  - $\text{credit or loan} = \text{collateral market value} \times (1 - \text{haircut})$
  - longer term -> higher
  - high credit quality or collateral or borrower -> lower
  - high demand or low supply of the security -> lower
- Repo rate
  - $\text{repo price} = \text{selling price} \times (1 + \text{repo rate} \times t)$
  - less than rate on bank loans or other short-term borrowing
  - longer term -> higher
  - high credit quality or collateral or borrower -> lower
  - collateral is delivered to the lender -> lower
  - interest rate of alternative funds is higher -> higher
- reverse repo agreement
  - from the stand point of the fund lender