

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

# Central banks and the financial system

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**Lender of last resort**

**The framework of monetary policy**

**Conduct of monetary policy in normal times**

## Lender of last resort

- Emergence of central banking

- Crises and the lender of last resort function

## The framework of monetary policy

## Conduct of monetary policy in normal times

# The first central banks and what they did

- The earliest central banks:
  - 1668** Sverige Riksbank
  - 1694** Bank of England
    - Semi-public institutions: privately owned, but fiscal obligations
    - Note-issuing privileges, e.g. exclusive rights within City, but not (yet) full monopoly
- Original purpose: support government borrowing
  - Fragmentation reduced, uniform issuance in then-emerging capital markets
  - U.K.: liquid government bond secondary market by mid-18th c. (3 percent consol of 1751)
- Key functions of central banks emerge
  - Bank becomes banker to city banks/merchants during 18th c. → birth of **monetary policy**
  - Bank plays stabilizing role in financial crises of 1797 and after → **lender of last resort** function

## Emergence of monetary policy

- Note-issuance and other privileges → Bank key counterparty for all other banks
  - Supports both major functions of central bank
- 18th c.: discovery of Bank influence over interest rates
  - U.K.: **Bank rate** at which Bank rediscounts commercial bills
  - Country and City banks treat Bank notes as reserves
  - Gold and liquidity reserves centralized at Bank
- Bank rate in turn influences
  - Outstanding volume of banknote issues, money supply, general business conditions and prices
  - Gold flows, international balance and maintenance of reserves under still-informal gold standard
- **Peel's Act** (1844) institutionalizes gold standard, monetary control
  - Bank to be sole issuer of banknotes in fixed volume and backed by gold reserve
  - Institutional separation of note issue from lending to City banks

## Federal Reserve: one of the last central banks

**Establishment of the Fed** in 1913 in response to 1907 financial panic

**Gold exchange standard** between and after wars: U.S. dollar emerges as international reserve currency

**Banking Acts** of 1932, 1935 shifts power to Board of Governors, widens lending authority

**Fed-Treasury Accord** 1951 abandons long-term bond price support since 1942→central bank independence

**The (first) Keynesian moment** 1960-, emphasis on fiscal policy

**Great Stagflation** of the 1970's, interest rates always one step behind rise in inflation

**Volcker disinflation** 1979-1982 demonstrates role of expectations and value of active monetary policy

**Financial crisis** from 2007: unconventional monetary policy

# Central banking without a central bank

- Federal Reserve established only in 1913
  - But private insurance arrangements among private commercial banks throughout 19th century
- Lender of last resort function carried out in part via **private bank clearinghouses**
  - Established to clear, net and settle commercial bank payments
  - Key role esp. during Panic of 1907
- Operations of clearinghouses during crises:
  - Address problem of depletion of reserves
  - Member banks deposit good collateral with clearinghouse
  - Clearinghouse issues certificates (liabilities) that can be used to settle debts between members, circulate as money

# The Bank of England as lender of last resort

- Formulation of “Bagehot’s Rule” assigning special role in crises to Bank of England
  - Bank failures and financial panics: 1825, 1836, 1866 (Overend Gurney)
  - Peel’s Act viewed as limiting Bank’s proper role in panic → **Responsibility Doctrine**
- Distinction between appropriate Bank response to presentation of banknotes for gold under
  - Internal drain** or increased desire for liquidity associated with panic: lend freely
  - External drain** or gold flows out of U.K. to foreign countries: increase Bank rate
- If both internal and external drain, lend freely at penalty rate



## Bagehot's Rule for a lender of last resort

- Liquidity support only (but can it involve credit support?)
- To specific institutions (or just, or in addition, markets?)
- Lend against “good collateral” (but can't be too selective in crisis)
- To solvent firms only (if you can clearly and quickly distinguish them)
- On a large scale
- But at penalty rate (but there is stigma problem)
- In a systemic risk event (or for efficiency, or to avert a possible systemic risk event?)
- By the “holder of the reserve” (central bank? private clearinghouse?)
- With rules set out in advance (though it's hard to plan for the unforeseeable)

## Lender of last resort: institutional framework

- Role of central banks
  - Generally exclusive responsibility for monetary policy
  - Often shared responsibility for financial-sector regulation
  - Provide emergency liquidity to financial sector
- Role of Treasury/finance ministry
  - Shared responsibility for financial-sector regulation
  - Recapitalization of banks if deemed necessary
  - Problem of credit policy and credit allocation
- Credit policy vs. monetary policy
  - Dilemma of implementing large-scale liquidity support without supporting specific sectors
  - Example of support for housing market through LSAPs
- Cross-border lender of last resort:
  - Foreign entities large participants in USD financial markets as borrowers and lenders
  - **Foreign bank offices** (FBOs): high use of Fed facilities, e.g. Term Asset Facility
  - Issues: lending with less supervisory focus, home-country responsibility

# Lender of last resort and market intermediation

- Traditional central bank tools: standing lending facilities
  - Involve lending to banks, which in turn lend—or don't cease lending—to nonfinancial sector
  - E.g. Fed discount window, ECB marginal lending facility
- Considered drastically insufficient during GFC and Covid crises
  - Intermediation via banks less effective in increasingly capital-market intermediated system
- The doctrine updated: **market-maker of last resort**
  - Support specific markets in market-intermediated system
  - Too-big-to-fail and “sins of the past”

## Lender of last resort

### **The framework of monetary policy**

The monetary policy framework is focused on market expectations  
How monetary policy impacts and influences the economy

## Conduct of monetary policy in normal times

# Monetary policy framework before the crisis

Instruments → Intermediate targets → Objectives

**Objectives** or **targets**: ultimate goals enshrined in **dual mandate** (actually triple)

- Federal Reserve Act, sec. 2A, as amended 1977
- "...[M]aximum employment, stable prices, and moderate long-term interest rates."

**Intermediate target**: prices or quantities the Fed ties to influence in pursuit of objective

- **Effective** (realized) **federal funds rate**: key money market rate
- Money stock almost nowhere and never an intermediate target

**Instruments**: tools fully under central bank control, usually

- Via its balance sheet: vary **reserves**, banks' deposits at Fed

**Communication and signaling**: consistency of public's expectations with policy intentions

# A simple model of the economy

- Key variables

**Nominal interest rate** or money-market rate  $i$ .

**Inflation**  $\pi$

**Real interest rate:** difference  $i - \mathbf{E}[\pi]$  between nominal and *expected* inflation

**Output**  $x$ : GDP growth or employment, measured relative to full-employment or potential or natural-rate

- Two key relationships describe the economy

**Aggregate demand** or “IS” curve: an increase in real interest rate depresses output

**Aggregate supply** or *short run Phillips curve*:

- Inflation rises with output and expected inflation
  - $\Rightarrow$  Tradeoff lower inflation for higher unemployment
- Price/wage rigidity plays a key role

## Key characteristics and results of the model

- Current values of each variable—i.e. state of the economy—depend on entire expected future path of each variable
- Gradual adjustment over time to shocks/surprises/news/data
- But can monetary policy influence real variables?
  - Short-term trade-off between output and inflation (and their volatilities)
  - Long term **neutrality of money**
- Near-complete absence from model of financial system: leverage, credit conditions, etc.
- Centrality of expectations in executing strategy
  - → importance of **communication**
  - Past performance and track record also crucial to expectation formation
- **Rules** (↔**discretion**) as commitment mechanism
- → Strategy for carrying out monetary policy

## Strategy execution via an interest-rate rule

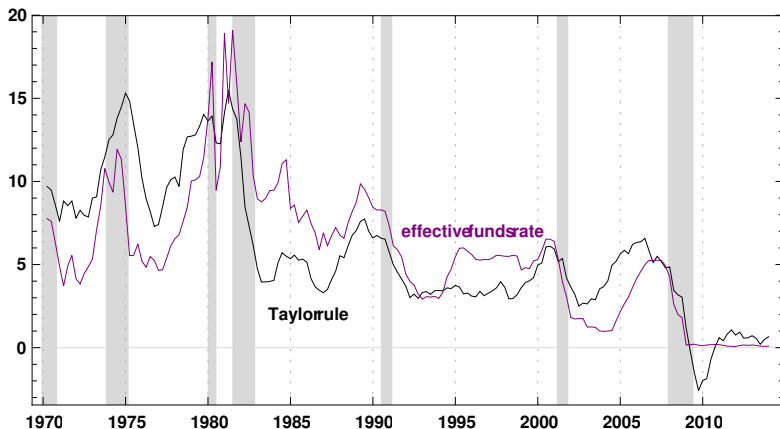
- Central bank sets short-term nominal interest rate  $i$ 
  - Closes up model, i.e. determines—together with key relationships—paths of inflation and growth
  - Thus an **intermediate target**
  - In U.S., **federal funds rate** at which banks lend to one another
- Conceptually: set target rate to adjust market interest rates to unobservable long term **natural** or **equilibrium real interest rate**
- **Taylor rule**: raise interest rate if inflation or growth > goal

$$i = \underbrace{0.02}_{\text{natural rate}} + \underbrace{0.02}_{\text{target } \pi} + 1.5 \cdot (\pi - \underbrace{0.02}_{\text{target } \pi}) + 0.5 \cdot x$$

- Contains an inflation- and an employment-targeting component
- Symmetric rule: “lean against the wind”
  - Coefficient on actual vs. target inflation  $> 1 \rightarrow$  raise interest rates above long-term equilibrium if inflation above target
- Not an official **policy rule**, but *looks* like one
  - But central bank actions from 1980’s on resemble the rule
  - Hence also called **reaction function**



## Actual and Taylor-rule Fed funds rate 1970–2013



Taylor-rule prescription (black plot):  $0.04 + 1.5 \cdot (\pi - 0.02) + 0.5 \cdot x$ , with  $\pi$  measured as the year-over-year log change in the PCE deflator and  $x$  as the log difference between actual GDP and the Congressional Budget Office estimate of potential GDP, quarterly. Actual (purple plot): effective Fed funds rate, quarter-end.

# The inflation target

- Since 2012 a Fed “goal”, rather than formal target
  - Set to 2 percent over the longer run
  - Measured by PCE price index excl. food and energy
- Low positive number intended to accommodate some **downward price rigidity**, esp. of wages
  - Targeting zero inflation with price rigidity→risk of deflationary spiral
- Symmetry: ambiguity about whether
  - Meant to be an upper limit or longer-term average
  - Deviations in either direction equally to be avoided

## Alternative monetary-policy rules

**Gold standard** and its **rules of the game** 1870–1914:

- Raise (lower) rates in response to gold outflow (inflow)
- Asymmetric in practice
- Controversies: macroeconomic track record, impact on central bank credibility

**Interest-rate rule** such as Taylor rule

- Employed 1982–2008
- Target  $i$  rather than money supply

**Monetarism:** money-supply targets

- Employed 1979–82
- Difficulties: choice of aggregate in innovated financial system, estimating money demand function

**Inflation targeting:** differs from dual mandate in two respects

- Firm target rather than goal/benchmark/aspiration
- Central bank not officially concerned with growth
- **European Central Bank:** single mandate of price stability

**Nominal GDP targeting:** transitory above-target inflation in slump

# Transmission channels of monetary policy

- How does policy effect on the economy and on the goals of policy, prices and growth?
- Within the framework, transmission “channels” must connect  $i$  to  $x$  and  $\pi$
- Transmission channels interact with one another: only conceptually distinct

## Transmission channels in normal times

**Interest rates** influence investment, residential house purchase, and other consumption decisions

**Asset values** are influenced by interest rates via the impact of discounting on present values

**Wealth effects:** As interest rates drop, for example, equity values may rise, inducing higher consumption

**Financial accelerator:** As asset prices change, business and household balance-sheet strength, value of borrowers' collateral influence creditworthiness

**Bank lending channel:** changes in reserves affect banks' desired loan volume; many borrowers lack direct access to capital markets

**Exchange rates** also influenced by interest rates. As interest rates drop, U.S. dollar may weaken, inducing higher net exports

Lender of last resort

The framework of monetary policy

**Conduct of monetary policy in normal times**

Normal monetary operations

Money markets before the crisis

Institutions

Central bank and government

# Framework for normal monetary operations

- Federal Reserve targets short-term interest rates
  - Via transactions with commercial banks
  - Fed sets (“targets”) **federal funds rate**—interest rate on **federal funds transactions** (“**fed funds**”)
- Operations vary supply of **reserve balances with Federal Reserve**
  - Deposits at (loans to) Federal Reserve of **depository institutions** (DIs, mainly commercial banks)
  - Paid no interest pre-crisis (→IOR, IOER)
- Banks’ demand for reserves decreases as federal funds rate rises
  - Reserves desired to meet reserve requirements, liquidity, withdrawals, currency demand, facilitate clearing and payments
  - But banks reluctant to pay opportunity cost—eschewing alternative, interest-bearing money market instruments

## Tools of normal monetary operations

**Target federal funds rate:** where Fed aims to set overnight rate

- Realized or **effective fed funds rate** the **intermediate target** of policy

**Discount window:** Short-term collateralized loans by Fed to DIs

- **Primary Credit Facility:** a **standing facility**, no formal limit on borrowing by DIs, though generally low
- **Discount rate** set higher than target fed funds → *ceiling* on fed funds rate

**Reserve requirements:** minimum ratio of reserves to loan assets; contribute to demand for reserves on part of banks

- $\approx 10$  percent of demand deposits over 2-week **maintenance period**

**Open market operations** (OMOs) add or drain reserves from the money market

- Conducted via **primary dealers**, including some non-banks
- Fed assets consisted almost entirely of U.S. Treasury bills and bonds



# Monetary operations in normal times

Funds rate → Money markets → Long-term rates → State of economy

- Vary reserve supply to bring effective close to target funds rate
  - **Federal funds market**: Secondary market in reserve balances
  - Keep fed funds market a bit tight (**structural deficiency** of reserves) and supply reserves day-to-day to hit target
  - Structural deficiency → banks borrow funds from one another, active funds market
- Type of operating framework called **corridor system**
  - Shift vertical supply curve to remain close to target as demand shifts
  - Discount window puts **ceiling** on rates in case of transitory liquidity shortage
  - Fed reserve balances were paid no interest, so **floor** equal to zero

# Types of open market operations

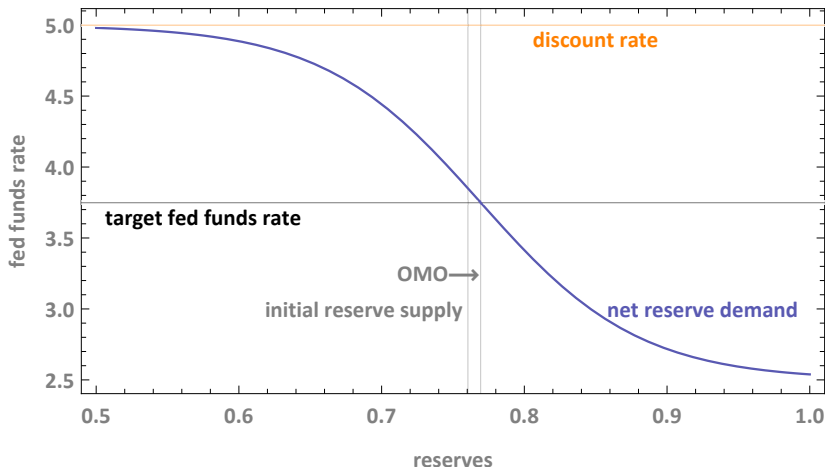
**Outright operations** via *secondary market* purchases (adding) and sales (draining) of bonds:

- Medium-term growth of reserves, e.g. demand for currency as economy grows

**Temporary operations** via

- **Repurchase** (adding) and **reverse repurchase agreements** (draining)
- Terminology from point of view of primary dealers
- Address shorter-term fluctuations in liquidity demand

## Normal monetary operations

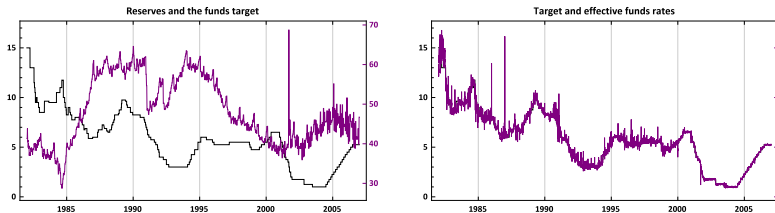


Purple plot shows the net demand of all depository institutions for reserves. The initial reserve supply permits the funds market to clear above the target rate of 3.75 percent. Following an expansionary OMO, the funds rate falls to 3.75 percent.

## Some pre-crisis monetary operation puzzles

- Weak relationship (“**liquidity effect**”) between funds rate and reserves
  - Market in which price is fixed clears with little quantity variation
  - Low quantity of reserves in view of strong control over rates
  - Weak evidence of negative interest elasticity of bank demand for reserves
- But how is control of interest rates then exercised?
  - Reserve requirements measured over weeks, not daily
  - High persistence of target rates
  - Strong relationship between target announcement and market rates
  - →Role of credibility, communication in moving market rates
- Transmission of monetary policy to economy
  - Among transmission channels, reserves most directly related to banks’ asset portfolios
  - But weak evidence on *how* funds rate influences bank loan rates, volumes
- Puzzles took on added significance in crisis→exit

## Reserves and the fed funds rate 1982–2006



Left panel: target fed funds rate (black plot, left axis), percent, daily. Nonborrowed reserves of depository institutions (purple plot, right axis), not seasonally adjusted, \$ bill., weekly. Nonborrowed reserves equal total reserves less total discount window borrowings from the Federal Reserve.

Right panel: target (black plot) and effective (purple plot) fed funds rates, percent, daily. *Sources:* Bloomberg LP; Board of Governors of the Federal Reserve System, H.3 release, Table 3.

## Why target interest rates, not money supply?

- The preceding helps understand biggest puzzle of all: interest rates rather than money as intermediate target
  - Predominant practice among central banks past 30 years
  - Partial exception: **nonborrowed reserves** (NBR) targeting 1979-82, but discount window open
- Central bank has less control over money supply than reserves
  - Direct control only over reserves, other components (e.g. currency) of **monetary base** or **high-powered money**
  - ↔ **Money stock**, e.g. **monetary aggregates** M1, M2
  - Money stock depends also on behavior of households (demand for currency) and banks (reserve ratios)
- Weak relationship between monetary base and money stock
  - Financial innovation, substitution among money-like assets
- Weak relationship between money stock and price level
  - Uncertain short-term lags, tight long-term relationship
- Can central bank set any other rate than natural rate?
  - Unlimited inflation or price level collapse

# Money market taxonomy

- Many and varied instruments' risks, participants, liquidity
  - → Incomplete “arbitrage” among them
  - Complex interaction with Fed operations in rate determination
- **Secured** versus **unsecured** by collateral
- **Demandable**—must be repaid at par without delay—versus **non-demandable**
- **Term structure**: overnight to  $\approx 1$  year
  - Overnight loans rolled over until notice are demandable
- **Administered**—set by central banks—versus **market-adjusted** rates
- **Derivatives** and **underlying instruments**
- **Negotiable**—can be sold or transferred, e.g. **commercial paper**, T-bills—versus **non-negotiable** instruments
- **Money market mutual funds** (MMMFs) invest in money market instruments and create demandable liabilities

## Reserves and federal funds

- Fed funds are not identical to reserves
- Reserve balances: *unsecured* claim on a Federal Reserve district bank
  - But negligible credit-risk vis-à-vis obligor, the Fed
- Reserve balance are held by
  - DIs: subject to reserve requirements, may hold excess reserves
  - DIs may hold **excess reserves** in addition to **required reserves**
  - Some non-banks eligible to hold deposits at Fed:  
**Government-sponsored enterprises** (GSEs), e.g. Fannie Mae; banks in **Federal Home Loan System**
- Fed funds: *unsecured* claim on a DI or GSE lending reserves
  - Fed funds generally present low credit risk
  - But credit risk can become—or be perceived as—material during stress events



# Federal funds market

- **Federal funds market:** secondary market in reserve balances, traded among DIs and GSEs eligible to hold reserve balances
- Same-day settlement via **Fedwire**
- On-shore market ↔ off-shore **Libor** or **Eurodollar markets**
- Trades change holders but not aggregate volume of reserves
- Are themselves subject to regulatory capital rules (**leverage ratio**)
  - But are not themselves subject to reserve requirements
- Term structure anchored by Fed control of overnight rate
- Liquid futures and options markets
  - **Overnight interest swaps** (OIS) pay realized compounded return on funds rate minus strike or “fixed rate”

## Other key money market instruments

**Demand deposits:** demandable; unsecured

**Repurchase agreements** or **repo:** short-term loan collateralized by securities in possession of lender or third-party custodian

**Interbank lending:** Unsecured, non-negotiable

- Liquid derivatives markets, esp. futures, options
- Rate fixings, e.g. **LIBOR**, serve as benchmarks

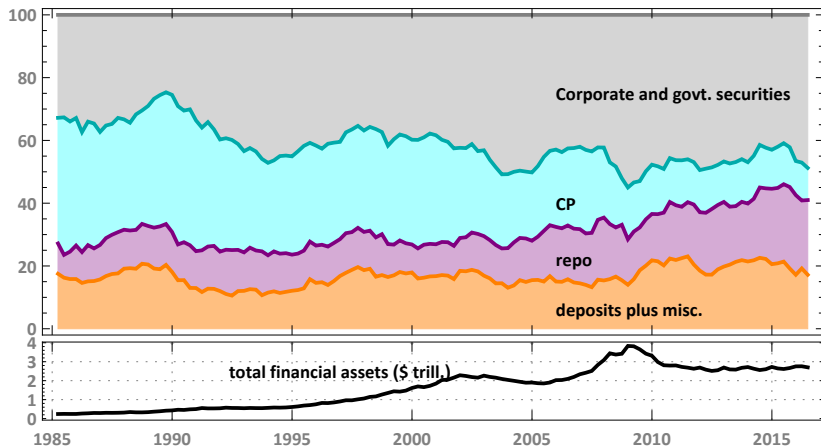
**Commercial paper:** Unsecured, negotiable, highly-rated; financial and nonfinancial issuers

- Banks issuers make markets in own paper→demandability
- Key source of non-U.S. banks' dollar funding
- **Asset-backed commercial paper** (ABCP): issued by securitization vehicles holding commercial paper

## Money market mutual funds before the crisis

- Origin 1970–71, evade Regulation Q interest-rate ceilings
- Largest single investor group in short-term debt
  - **Institutional funds:** corporate investors (↔**retail**)
  - **Prime funds:** invest in corporate debt, commercial paper, repo
  - ↔**Government** (Treasury debt) and ↔**non-taxable** (municipal) funds
- Issue shares redeemable at par on demand
  - No material liquidity reserve, bank charter, access to lender of last resort, deposit insurance
  - Explicit or implicit guarantee by sponsor
  - Implicit government guarantee
- Rapid growth after 1983 SEC **Rule 2a-7** rule
  - **Fixed** or **stable net asset value** (NAV) at par plus accrued
  - Unless mark-to-market losses above threshold ( $\frac{1}{2}$  percent): “breaking the buck”
- MMMF reform proposals: “floating NAV,” gates

# Money market mutual fund assets 1974–2016



Total assets of U.S. MMMFs, \$ bill., quarterly. *Source:* Federal Reserve Board, Financial Accounts of the United States (Z.1), Table L.121.

# Institutional setup of Federal Reserve

**Legal authorization** via Acts of Congress

**Federal Reserve Act** 1913

**Federal Reserve Reform Act** 1977

**Humphrey-Hawkins Full Employment Act** 1978

**Monetary Control Act** 1980

**Dodd-Frank Act** 2010: restricts lender of last resort powers

**Federal Open Market Committee** (FOMC)

- 8 meetings annually
- 12 members:
  - All 7 members of the Board of Governors
  - President of the New York Fed
  - 4 of the 11 non-N.Y. Reserve Bank presidents, serving 1 year in rotation
  - Remaining Reserve Bank presidents attend FOMC meetings, referred to as “participants”

# Pre-crisis communication

**FOMC meeting** decisions publicized via

**Statements** including target fed funds rate published immediately after meetings from 04Feb1994

**Minutes** released after 3 weeks

**Transcripts** released after 5 years

**Monetary Policy Report to the Congress** in form of semi-annual written report and oral testimony

**Speeches** by FOMC members

**Data** in regular and ad hoc forms

**Monetary aggregates** via H.4.1, as well as other statistical releases

**Freedom of Information Act** and other legally-mandated releases

# Implicit Federal Reserve inflation targeting

- Closely related to developments in communication
- Publication of medium-term forecasts
- 24Jan2012 principles (long-term goal)
- “Constrained discretion”
- But no primacy of price stability within dual mandate

## Relationship between Federal reserve and Treasury

- Historically, central banks private-sector entities, but some form of government control
  - Federal Reserve district bank stock owned by member banks, but public has power to appoint boards, senior management
- Federal Reserves net earnings generally positive: liabilities (reserves) earn zero or low interest relative to assets (securities and loan portfolio)
  - Maintains **surplus capital** account
  - Surplus size had been discretionary but held equal to member banks' capital
  - Now limited to \$10 bill. by **Fixing America's Surface Transportation Act** (FAST)
- Net earnings not paid into surplus remitted to Treasury, reduce amount of debt it must raise from public
  - Negative net earnings→remittances cease, **deferred asset** booked
  - When net earnings turn positive, deferred asset drawn down before remittances resume
- Net earnings not a goal of policy, but a byproduct
- Net earnings not paid into surplus remitted to Treasury



# Central bank credibility and independence

- Dependence of current state on future and on expectations → Utility of **credibility** and **commitment**
- **Time consistency** problem
  - Surprise inflation boosts output in short term
  - Detracts from credibility of central bank commitment to low inflation, raises expected inflation
  - Time inconsistency raises long-term inflation (**discretionary inflation bias**)
- ⇒ Preference for policy rules over discretion
- Effectiveness of rules enhanced by transparency, communication
- **Independence**: imperviousness to political influence
  - Rules and independence are mechanism to commit central bank to optimal lower-inflation policy