Money and Banking

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Money in Modern Economies

- Transition from Medieval to Modern:
  - Previously, we saw money as a simple, physical commodity (no banks).
  - In modern economies, the line between "money" and "non-money" assets is no longer clear-cut.
- There is **no unique measure** of money today.
- We use several definitions based on **Liquidity**: How easily an asset can be turned into a means of payment without losing value.
- By convention, economists draw somewhat arbitrary lines to categorize assets into different "monetary aggregates."

The Main Measures of Money

Component	Base	M0	M1	M2
Physical Currency	✓	✓	✓	✓
Central Bank Reserves	✓			
Demand Deposits			✓	✓
Savings Deposits and Money Market Funds				✓

Narrow Money: M0 and M1

- **M0: Physical Currency**
  - Only physical bills and coins.
- **M1: A Broader Measure**
  - Includes **Demand Deposits** (Checking Accounts).

Demand Deposits

Accounts where you can withdraw money "on demand" (via debit card). Because they are used for daily transactions, they have the highest liquidity but the lowest interest rates.

Broad Money: M2

- **M2** includes M1 plus assets with "intermediate moneyness":
- M2 Components:
  - **Savings Accounts:** Highly liquid, but usually cannot be used directly for payments at a store.
  - **Money Market Funds:** Pools of money invested in safe, short-term debt. They offer market-based returns and limited check-writing.
- These assets earn more interest than M1 but are less convenient for immediate spending.

The Monetary Base

- **Definition:** Currency in circulation + Central Bank Reserves.
- **Why is it called the "Base"?**
  - It is the only part of the money supply under the **direct control** of the government/Central Bank.
  - It forms the foundation upon which every other measure (M0, M1, and M2) is built.
  - To understand the link between the Base and other measures, we must look at the mechanics of how the quantity of money is determined.

How is Money Created? The Bank Balance Sheet

- Money aggregates are determined by both the government and the banking sector
- To understand this, we look at a bank's **Balance Sheet**.

Assets (What the bank *owns*)	**Liabilities + Net Worth** (What the bank *owes*)
Reserves (held at Central Bank)	**Deposits** (Household savings)
Government Bonds	Other Liabilities (Borrowing)
Loans (Mortgages, Business)	**Net Worth** (Equity/Capital)
Other Assets	

Central Bank Reserves

- **Definition:** Deposits held by commercial banks at the Central Bank.
- Reserves are an **asset** for the bank, but a **liability** for the Central Bank.

Two Reasons for Holding Reserves

1. **Liquidity:** To meet unexpected withdrawals (less common today due to deposit insurance).
2. **Regulation:** The main reason today. Banks are required by law to hold a Reserve Requirement .

Note: These reserves typically earn no interest or very low interest.

The Three-Entity Model: Balance Sheets

Central Bank

Assets	Liabilities
Bonds	Reserves
b	ρd
	Currency
	c
	Net Worth:
	$b - \rho d - c$

Private Bank

Assets	Liabilities
Reserves	Deposits
ρd	d
Bonds	
B	
Loans	
L	
	Net Worth:
	$\rho d + B + L - d$

Household

Assets	Liabilities
Currency	0
c	
Deposits	
d	
	Net Worth:
	$c + d$

- **Monetary Base:** $MB = c + \rho d$ (Total CB Liabilities)
- **Money Supply (M0):** $M0 = c$ (Total Household Assets)
- **Money Supply (M1):** $M1 = c + d$ (Total Household Assets)

Expanding the Monetary Base: Open Market Operations

- The traditional way, Central Banks (CB) changed the supply of money was using **Open Market Operations (OMOs)**.
  - We'll come to the reasons why the Central Bank might want to do that later on
- An OMO involves the CB buying or selling existing government bonds in the open market.
- To **increase** the money supply, the CB **buys** bonds from private banks or the public.
- To **decrease** the money supply, the CB **sells** bonds to private banks or the public.

Example: CB Buys Bonds from a Private Bank

- Assume the CB buys Δ bonds from a Private Bank .
- The CB pays by increasing the PB's reserves (Δ).
- The composition of the PB's assets changes (fewer bonds, more reserves).

Central Bank

Assets	Liabilities
Bonds	Reserves
$b + \Delta$	$\rho d + \Delta$
	Currency
	c
	Net Worth:
	$b - \rho d - c$

Private Bank

Assets	Liabilities
Reserves	Deposits
$\rho d + \Delta$	d
Bonds	
$B - \Delta$	
Loans	
L	
	Net Worth:
	$\rho d + B + L - d$

Household

Assets	Liabilities
Currency	0
c	
Deposits	
d	
	Net Worth:
	$c + d$

- **Monetary Base:** $MB = c + \rho d + \Delta$
- **Money Supply (M0):** $M0 = c$
- **Money Supply (M1):** $M1 = c + d$

The Money Multiplier Effect

- The initial $100M increase in reserves is "high-powered money".
- Private banks don't want idle reserves (they earn little interest)
- They want to make new loans: ℓ
- When a bank lends makes a new loan, those funds are deposited into another bank, creating new deposits.
  - **Example:** A bank issues a loan to Joao to buy a new surfboard. The owner of the surf shop (Maria) then deposits that money into her bank account as a new deposit.
- How large can the loan be so that the bank still meets the reserve requirement:

$$\rho = \frac{\text{Reserves}}{\textit{Deposits}} = \frac{\rho d + \Delta}{d + \ell}$$

$$\ell = \frac{\Delta}{\rho}$$

The Money Multiplier Effect

- Assume the CB buys Δ bonds from a Private Bank .
- The CB pays by increasing the PB's reserves (Δ).
- The composition of the PB's assets changes (fewer bonds, more reserves).

Central Bank

Assets	Liabilities
Bonds $b + \Delta$	Reserves $\rho d + \Delta$
	Currency c
	Net Worth: $b - \rho d - c$

Private Bank

Assets	Liabilities
Reserves $\rho d + \Delta$	Deposits $d + \frac{\Delta}{\rho}$
Bonds $B - \Delta$	
Loans $L + \frac{\Delta}{\rho}$	
	Net Worth: $\rho d + B + L - d$

Household

Assets	Liabilities
Currency c	Loans $\frac{\Delta}{\rho}$
Deposits $d + \frac{\Delta}{\rho}$	
	Net Worth: $c + d$

- **Monetary Base:** $MB = c + \rho d + \Delta$
- **Money Supply (M0):** $M0 = c$
- **Money Supply (M1):** $M1 = c + d + \dfrac{\Delta}{\rho}$

Calculating the Money Multiplier

- The potential maximum increase in M1 depends entirely on the Reserve Requirement.
- The **Money Multiplier** is defined as $m = 1/\rho$.
- It's called a multiplier because whenever the Central Bank changes the monetary base (which it controls directly), the magnitude of the change in M1 is the change in the monetary base times the multiplier.

The Origin and Fallacy of Reserve Requirements

- **Historical Context:** Originated in the US with the *National Banking Act of 1863*.
- **Original Rationale:** To ensure banks had enough liquidity to meet customer withdrawals.
- **The Liquidity Flaw:**
  - A dollar held to satisfy a **legal requirement** cannot be used to pay a customer.
  - **Example:** If a bank has $1,500 in reserves but a $1,000 requirement, it only has $500 of *usable* liquidity.

The Fire Tank Analogy (Alchian & Allen, 1967)

Relying on reserve requirements for withdrawals is like trying to protect a town from fire by requiring a water tank be kept **full at all times**—the water is useless if it can never be drawn from the tank.

Reserve Requirements and Monetary Policy

- **Rationale 2: Regulating Money Supply**
  - Higher ρ (reserve ratio) $\rightarrow$ Smaller Money Multiplier.
  - This makes the money supply less volatile (ceteris paribus).

- **Dependence on Policy Targets:**
  - **Base Targeting:** it is not clear that reserve requirements play a useful role for monetary policy if central banks target interest rates rather than monetary aggregates (more on this later)

The "Reserve Tax" and Seigniorage

- Historically, reserves held at the Central Bank **paid no interest**.
- The Opportunity Cost: Banks lost the interest they could have earned by lending that money out.
- **The Reserve Tax:**
  - This acted as a tax on banks, raising the cost of making loans.
  - This "tax" increased the Central Bank's profits.
  - These profits were handed to the Treasury as **Seigniorage Revenue**.
- This effect was most damaging in the 1970s when interest rates were very high.

Modern Trends: The End of Reserve Requirements?

- Many countries have dramatically reduced or eliminated requirements.
- The Shift to IOR (Interest on Reserves): Central banks now frequently pay interest on reserves to manage policy.

Jurisdiction	Requirement Status
United States	Eliminated in 2020 (Fed pays IOR since 2008)
UK, Canada, Australia	Eliminated
European Union	Very low (1%)
Japan	Very low (0.8%)

Bank Runs and Banking Panics

- The Inherent Fragility of Banks:
  - All banks, even the best capitalized and well-run, are naturally fragile.
  - This fragility arises from a **Maturity Mismatch** on the balance sheet.

Assets (Long-Term)	**Liabilities (Short-Term)**
Long-term loans and investment projects.	Demand deposits (can be withdrawn at any time).
Illiquid: Hard to sell quickly.	*Liquid:* Immediate obligation to pay.

- **Maturity Transformation:** Banks turn long-term, illiquid assets into short-term, liquid liabilities.
- This is socially valuable as it funds long-term investment while providing households with a liquid payment system.

The Mechanics of a Bank Run

- **Loss of Confidence:**
  - If enough depositors fear for their money and withdraw at once, the bank will run out of liquid funds (reserves).
  - Because assets (loans) are illiquid, the bank cannot "call them in" or sell them fast enough to meet the sudden demand.

- **Self-Fulfilling Prophecies:**
  - A run can occur even if the bank is fundamentally healthy.
  - If I believe *other* people will withdraw their money, I must withdraw mine first to ensure I get paid.
  - If everyone acts on this fear, the bank fails **solely because of the fear itself**.
  - The economists Diamond and Dybvig used game theory to develop a model that explains how bank runs can be self-fulfilling prophesies

- **Result:** Without external help (other banks, large investors, or the government), the bank will collapse.

Diamond-Dybvig as a Simple Game

- A bank provides liquidity insurance:
  - Depositors can withdraw early if they need cash.
  - The bank invests the rest in long-term, illiquid assets.
- The problem: Maria's best action depends on what she expects everyone else to do.
  - If everyone else keeps their money in the bank, Maria is better off waiting.
  - If everyone else runs, Maria is better off withdrawing before the bank runs out of liquid assets.
- This creates two possible equilibria:
  - **Good equilibrium:** Maria and everyone else wait, the bank survives.
  - **Bad equilibrium:** Maria and everyone else withdraw, the bank fails.

Diamond-Dybvig as a Simple Game

		Everyone Else	
		Wait	Withdraw
Maria	Wait	3	0
	Withdraw	2	1

- If everyone else waits, Maria is better off waiting too: $3 > 2$.
- If everyone else withdraws, Maria is better off withdrawing too: $1 > 0$.
- Therefore, there are two equilibria: everyone waits or everyone runs.
- Fear can make a run individually rational even when the bank is solvent.