2. Three Key Aggregate Markets

2.1 The Labor Market: Productivity, Output and Employment
2.2 The Goods Market: Consumption, Saving and Investment
2.3 The Asset Market: Money and Inflation
2.3 The Asset Market: Money and Inflation

- Determination of the **real wage** in labor market equilibrium
- Determination of the **real interest rate** in goods market equilibrium
- This chapter: Determination of the **price level** in asset market equilibrium.
# US Household Assets

<table>
<thead>
<tr>
<th></th>
<th>Amounts in trillions of dollars</th>
<th>Percentages of total assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real estate</td>
<td>25.0</td>
<td>18.9</td>
</tr>
<tr>
<td>Consumer durables</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>Currency and checkable deposits</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Time, savings, and other deposits</td>
<td>6.6</td>
<td>7.8</td>
</tr>
<tr>
<td>Bonds</td>
<td>5.1</td>
<td>6.1</td>
</tr>
<tr>
<td>Stocks</td>
<td>13.8</td>
<td>8.2</td>
</tr>
<tr>
<td>Proprietors’ investment in unincorporated businesses</td>
<td>9.2</td>
<td>7.3</td>
</tr>
<tr>
<td>Pension funds</td>
<td>12.8</td>
<td>9.9</td>
</tr>
<tr>
<td>Other assets</td>
<td>1.9</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>79.0</td>
<td>65.2</td>
</tr>
</tbody>
</table>

*Note: Numbers may not add to totals owing to rounding.*

Meaning of Money

**Money or money supply**: any asset that is generally accepted in payment for goods or services or in the repayment of debts (stock variable)

- People *believe* it will be accepted by others.
- Much broader than currency.
- Money is not:
  - Wealth: the total collection of pieces of property that serve to store value
  - Income: flow of earnings per unit of time
Functions of Money

Money is an asset that serves as

1. **Medium of exchange**: promotes economic efficiency by minimizing the time spent in exchanging goods and services
   - money economy vs. barter economy:
     - lowers transaction costs
     - avoids double coincidence of wants
   - Must be easily standardized, widely accepted, divisible, easy to carry, not deteriorate quickly

2. **Unit of account**: used to measure value in the economy

3. **Store of value**: used to save purchasing power; most liquid of all assets but loses value during inflation (or hyperinflation)

**Fiat money vs. commodity money**
Measuring Money: the Monetary Aggregates

Two common, but imperfect, measures: M1 and M2

<table>
<thead>
<tr>
<th></th>
<th>M1</th>
<th>M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency</td>
<td>1038.4</td>
<td>9892.8</td>
</tr>
<tr>
<td>Travelers’ checks</td>
<td>4.1</td>
<td></td>
</tr>
<tr>
<td>Transaction accounts</td>
<td>1218.5</td>
<td></td>
</tr>
<tr>
<td><strong>M1</strong></td>
<td>2261.0</td>
<td></td>
</tr>
<tr>
<td>Components of M1</td>
<td></td>
<td>2261.0</td>
</tr>
<tr>
<td>Savings deposits, including MMDAs</td>
<td></td>
<td>6279.0</td>
</tr>
<tr>
<td>Small-denomination time deposits</td>
<td></td>
<td>717.3</td>
</tr>
<tr>
<td>MMMFs (noninstitutional)</td>
<td></td>
<td>635.4</td>
</tr>
</tbody>
</table>

*Note: Numbers may not add to totals shown owing to rounding.*


Data are not seasonally adjusted.
How much is in your wallet?

- In 2012, U.S. currency averaged about $3300 per person!
- Some is held by businesses and the underground economy, but most is held abroad
- Foreigners hold dollars because of inflation in their local currency and political instability
Portfolio Choice and Asset Demand

The overall demand for assets depends on the factors that determine savings (see last chapter).

The demand for a particular asset involves a trade-off between:

1. **Expected return** the return expected over the next period on that asset *relative* to alternative assets

2. **Risk** the degree of uncertainty associated with the return on that asset *relative* to alternative assets

3. **Liquidity** the ease and speed with which the asset can be turned into cash *relative* to alternative assets
The Demand for Money

- The **demand for money** is the quantity of monetary assets people want to hold in their portfolios.
- Money demand depends on expected return, risk, and liquidity.
- Money is the most liquid asset.
- Money pays a low return.
- Peoples money-holding decisions depend on how much they value liquidity against the low return on money.
The Demand for Money

The money demand function

\[ M^d = P \times L(y, \bar{i} - \bar{i}^m) \]

Key macroeconomic variables that affect money demand

1. **Price level** \( P \): higher price, more dollars needed
2. **Real income** \( y \): high income, more transactions, more money needed
3. **Relative return on money** \( i - i^m \):
   - \( i = r + \pi^e \): Nominal interest rate on nonmonetary assets
   - \( i^m \): Nominal interest rate on monetary assets
   
   Note \( i^m \) is often very low and relatively constant and is often excluded. We will assume \( i^m = 0 \).
The Demand for Money

Other factors that affect money demand:

4. **Liquidity of alternative assets**: Deregulation, competition, and innovation have given other assets more liquidity, reducing the demand for money.

5. **Relative risk**
   - Increased riskiness in the economy may increase money demand.
   - Times of erratic inflation bring increased risk to money, so money demand declines.

6. **Wealth**: A rise in wealth may increase money demand.

7. **Payment Technologies**: Credit cards, ATMs, and other financial innovations reduce money demand.
Money Velocity

The velocity (V) of money measures how much money *turns over* each period:

\[ V = \frac{\text{nominal GDP}}{\text{nominal money stock}} = \frac{Py}{M^d} = \frac{y}{L(y, i)} \]

\[
\frac{\Delta M^d_t}{M^d_t} = \frac{\Delta P_t}{P_t} + \epsilon^y \frac{\Delta y_t}{y_t} + \epsilon^i \frac{\Delta (1 + i_t)}{1 + i_t}
\]

\[
\frac{\Delta V_t}{V_t} = (1 - \epsilon^y) \frac{\Delta y_t}{y_t} - \epsilon^i \frac{\Delta (1 + i_t)}{1 + i_t}
\]

**Elasticity** \(\epsilon^x\): The percent change in money demand caused by a one percent change in factor \(x\)
The **quantity theory of money**: Real money demand is proportional to real income

\[
\frac{M^d}{P} = L(y, i) = \kappa y
\]

Implication: \( V = \frac{y}{L(y, i)} = \frac{y}{\kappa y} = \frac{1}{\kappa} \), money velocity is constant and \( \epsilon^i = 0, \epsilon^y = 1 \).

Empirically however money velocity is not constant
Money Velocity $V_t$
Change in Money Velocity $\frac{\Delta V_t}{V_t}$

**Figure 1** Change in the Velocity of M1 and M2 from Year to Year, 1915–2005

Sources: Economic Report of the President; Banking and Monetary Statistics; www.federalreserve.gov/releases/h6/.
Elasticities of Money Demand

How strong are the various effects on money demand in reality?

- Statistical studies on the money demand function show results in elasticities:

\[
\frac{\Delta M^d_t}{M^d_t} = \frac{\Delta P_t}{P_t} + \epsilon^y \frac{\Delta y_t}{y_t} + \epsilon^i \frac{\Delta (1 + i_t)}{1 + i_t}
\]

1. **Income elasticity of money demand** $0 < \epsilon^y < 1$ Higher income increases money demand, but less than proportional
   Goldfelds results: income elasticity = $2/3$

2. **Interest elasticity of money demand** $\epsilon^i$ is negative: Higher interest rate on nonmonetary assets reduces money demand. The size of $\epsilon^i$ is under debate
The Money Supply

- The **money supply** $M^s$ is the quantity of money available in the economy.
- **Monetary policy** is the control over the money supply.
- Monetary policy is conducted by a country’s **central bank**.
  - Gold standard: money supply is physically constrained
  - vs. Fiat money: money supply is unconstrained
- In the U.S., the central bank is the Federal Reserve ("the Fed").
The Money Supply

How does the Fed control $M^s$?

- Fed controls the **monetary base**:  
  
  $$MB = \text{Currency } C + \text{Reserves } R$$

- **Fractional Reserve System**:  
  
  $$R = \rho \times \text{Deposits } D$$

  where $0 < \rho < 1$ is the legally required **reserve ratio**

  Assume households hold currency $C = cD$ where $0 < c < 1$ is the **currency ratio**

  $$M^s = D + C = (1 + c)D = \frac{1 + c}{\rho} R$$

  $$= \frac{1 + c}{c + \rho} MB$$

  $\frac{1+c}{\rho+c} > 1$ is the **money multiplier**.
Asset Market Equilibrium

**Assumption 1:** Money \( M \) and Bonds \( B \) are the only assets in the economy.

**Assumption 2:** Money pays no interest, bonds pay \( i > 0 \) interest.

- Total Wealth \( = B^d + M^d = B^s + M^s \)
- Bond market clearing \( B^d - B^s = 0 \)
  \( \Leftrightarrow \) Money market clearing \( M^d - M^s = 0 \)
- If the nominal interest \( i \) clears the bond market, the market for money is also in equilibrium.
- If the nominal interest \( i \) clears the market for money, the bond market is also in equilibrium.
- Hence, it suffices to look at equilibrium in one market only.
- We will look at equilibrium in the **market for money**.
Equilibrium in the Market for Money

Equilibrium in the market for money requires

$$\frac{M^s}{P} = L(y, r + \pi^e)$$

- $M^s$ is determined by the Federal Reserve
- The labor market determines the level of employment $N$;
- Investment and the real interest rate $r$ are determined in the goods market.
- Using $N$ and $K$ in the production function determines $y$
- We take $\pi^e$ as exogenous (for now)

Money market equilibrium determines the price level $P$!
Equilibrium in the Market for Money

\[ P = \frac{M^s}{L(y, r + \pi^e)} \]

- The price level is the ratio of nominal money supply to real money demand.
- All else equal:
  - Result 1: Doubling the money supply would double the price level.
  - Result 2: Higher \( y \) increases real money demand and lowers \( P \).
  - Result 3: Higher \( r \) or \( \pi^e \) lowers real money demand and increases \( P \).
Money Growth and Inflation in the Long Run

The inflation rate is closely related to the growth rate of the money supply:

$$ P = \frac{M^s}{L(y, r + \pi^e)} $$

$$ \Rightarrow \frac{\Delta P}{P} = \frac{\Delta M^s}{M^s} - \epsilon^y \frac{\Delta y}{y} - \epsilon^i \frac{\Delta(1 + i)}{1 + i} $$

In the long run, \( \frac{\Delta(1+i)}{1+i} \approx 0 \), such that

$$ \frac{\Delta P}{P} = \pi = \frac{\Delta M^s}{M^s} - \epsilon^y \frac{\Delta y}{y} $$

Average inflation \( \pi \) depends on average money supply growth and average real output growth

\( e.g. \) if \( \frac{\Delta y}{y} = 3\% \), \( \frac{\Delta M^s}{M^s} = 6\% \) and \( \epsilon^y = 2/3 \), then \( \pi = 4\% \).
Money Growth and Inflation in the Long Run

\[ \frac{\Delta P}{P} = \pi = \frac{\Delta M^s}{M^s} - \epsilon^y \frac{\Delta y}{y} \]

- Normal economic growth requires a certain amount of money supply growth to facilitate the growth in transactions.
- Money growth in excess of this amount leads to inflation: **Inflation is a monetary phenomenon.**
- Note $\epsilon^y = 1$ corresponds to the quantity theory.
Inflation and Money Growth Across Countries

Chart 1

Money Growth and Inflation: A High, Positive Correlation
Average Annual Rates of Growth in M2 and in Consumer Prices During 1960–90 in 110 Countries

Source: International Monetary Fund
Post-war US


- Inflation rate
- M2 growth rate
- Inflation rate trend
- M2 trend growth rate
To spend more without raising taxes or selling bonds, the government can print money.

The “revenue” raised from printing money is called **seigniorage**.

The **inflation tax**: Printing money to raise revenue causes inflation. Inflation is like a tax on people who hold money.

Often seigniorage during wars: e.g. American revolution, Napoleonic wars, civil war,...
Inflation and Nominal Interest Rates

For a given real interest rate $r$, expected inflation $\pi^e$ determines the nominal interest rate $i = r + \pi^e$.

- People could use
  $$\pi = \frac{\Delta M^s}{M^s} - \epsilon_y \frac{\Delta y}{y}$$
  to forecast inflation.
- Over the long run, people do not consistently over- or under-forecast inflation, therefore $\pi = \pi^e$.
- Indeed, inflation and nominal interest rates have tended to move together.
Inflation and Nominal Interest Rates
Measuring Expected Inflation

TIPS: Treasury Inflation-Protected Securities
Measuring Expected Inflation

interest rate differential = TIPS spread