Preview

- Defining money
- Policy control of the money supply
- Determinants of the demand for monetary assets
- Interest rate determination
  - equilibrium in the money market
- Exchange rate determination redux
  - Linking the money market and FX market
- Long run effects of money supply changes
  - prices, interest rates, and exchange rates
Different groups of assets may be classified as money.

**Money**: assets that are commonly used as a means of payment.
Currency and checking accounts form a useful definition of money.
Bank deposits in the foreign exchange market are excluded from this definition.

**M1**: currency held by public + checkable deposits

http://research.stlouisfed.org/fred2/categories/24
Source: http://research.stlouisfed.org/fred2/series/M1SL?cid=25
Monetary Authority

**Monetary authority**: the institution authorized to set monetary policy. most often a central bank

A monetary authority can fairly directly control

- the high-powered money stock
- the interbank lending rate (e.g., Fed funds rate)

These policy actions determine "the supply of money" (e.g., M1)
Fed Funds

Source: Board of Governors of the Federal Reserve System (US)
Monetary Base

Source: Federal Reserve Bank of St. Louis
fred.stlouisfed.org
Money Multiplier

Shaded areas indicate U.S. recessions

Source: Federal Reserve Bank of St. Louis

myf.red/g/kKO
Two Views of Monetary Policy

https://fred.stlouisfed.org/graph/fredgraph.png?g=dWP3
Monetary Policy

US: Federal Open Market Committee (FOMC) of the Fed  The seven members of the Board of Governors of the Federal Reserve System plus five Fed bank presidents (including NY).
http://www.federalreserve.gov/monetarypolicy/fomc.htm

EU: Governing Council of the ECB  The Executive Board of the ECB, which is analogous to the Fed’s Board of Governors, plus the governors of national central banks (like the FOMC)

JP: the Policy Board of the Bank of Japan  The BoJ’s highest executive body, comprising the Governor, Deputy Governors, and others.
http://www.boj.or.jp/en/about/organization/policyboard/index.htm/
Jerome Powell (16th Chair of the Fed’s BoG)

JD from Georgetown 1979
Investment Banker 1984-1990
Partner, Carlyle Group Feb 1997-Aug 2005
Member, Board of Governors 2012-2017
Chair, BoG of Fed Jan 2018-present
Janet Yellen (15th Chair of the Fed’s BoG)

<table>
<thead>
<tr>
<th>Position</th>
<th>Dates</th>
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<tbody>
<tr>
<td>PhD from Yale</td>
<td>1971</td>
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<tr>
<td>Member, BoG of Fed</td>
<td>1994-1997</td>
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<tr>
<td>Chair, CEA</td>
<td>Feb 1997-Aug 1999</td>
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<tr>
<td>President, SF Fed</td>
<td>June 2004-2010</td>
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<tr>
<td>Vice Chair, BoG of Fed</td>
<td>2010-2014</td>
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<tr>
<td>Chair, BoG of Fed</td>
<td>Feb 2014-present</td>
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# Ben Bernanke (14th Chair of the Fed’s BoG)

<table>
<thead>
<tr>
<th>Ph.D. from MIT 1979</th>
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<tr>
<td>Chair, Princeton Econ Dpt 1996 - 2002</td>
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<tr>
<td>Member, Fed BoG 2002 - 2005</td>
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<tr>
<td>Chair, CEA June 2005 - Jan 2006</td>
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<tr>
<td>Chair, BoG of Fed Feb 2006 - Feb 2014</td>
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Alan Greenspan (13th Chair of the Fed’s BoG)

1977    PhD from NYU
1982--1988    Director, Council on Foreign Relations
1987--2006    Chair, BoG of Fed
Haruhiko Kuroda (31st Governor, Bank of Japan)

President, Asian Dev. Bank
Feb 2005 - March 2013

Governor, Bank of Japan
March 2013 - present
Masaaki Shirakawa (30th Governor, Bank of Japan)

B.A. in Economics, 1972  The University of Tokyo
M.A. in Economics, 1977  University of Chicago
Professor, July 2006  Kyoto University School of Government
Governor, Bank of Japan  Apr. 9, 2008 - present
Established 1882 the Bank of Japan Act of 1882.

Reorganized 1942 Bank of Japan Act of 1942

1949: Policy Board established one of several amendments after World War II

PB = highest decision-making body


principles: independence and transparency

The BoJ has an explicit *price* stability goal in its bylaws.
Bank of England

Governor and Company of the Bank of England

1694  established as a private institution, granted a royal charter by William III
1734  moved to Thread-needle Street
1931  policy making subordinated to the Treasury
1946  nationalized
1997  granted operational independence; formalized in 1998 Bank of England Act

Source: http://www.bankofengland.co.uk/about/history/index.htm
Court of Directors  Governor, 2 Deputy Governors, 9 Non-Executive Directors

Monetary Policy Committee  chaired by BoE governor, sets monetary policy
Mark Carney: 120th Governor of the BoE

1965 born (in Canada)
1995 PhD in Econ, Oxford

**various (13 years)** Goldman Sachs (incl. 1998 financial crisis)

2003-2004 Deputy Governor, Bank of Canada
2004-2007 Department of Finance, Canada
2008-2013 Governor, BoCA

**July 2013-present** BoE (!) Governor (first non-Briton governor)
Mervyn Allister King: 119th Governor of the BoE

1948 born
1969 MA in Economics, Cambridge
1984-1991 LSE, Professor of Economics
1991-1998 BoE Chief Economist and Executive Director
1998-2003 BoE Deputy Governor
2003-2013 BoE Governor
European Central Bank (ECB)

Figure: ECB Logo
Mario Draghi, 3rd President of the ECB

PhD in Economics  MIT, 1976
University of Florence  Professor, 1981 - 1991
World Bank  Executive Director, 1984 - 1990
Italian Treasury  Director General, 1991 - 2001
Goldman Sachs  Vice-President and Managing Director, 2002 - 2005
ECB  President, 2011 - present  (also: Chair of 10 Governors)
Jean-Claude Trichet, 2nd President of the ECB

European Monetary Committee
Chair, 1992-1993

Banque de France Governor,
1993 - 2003

ECB President, 2003 - 2011
(also: Chair of 10 Governors)
ECB Governing Council

- six members of the Executive Board, plus
- governors of the national central banks of the 16 euro area countries.
- the main decision-making body of the ECB.

The ECB GC formulates monetary policy for the euro area.
The ECB Governing Council usually meets twice a month at the Eurotower in Frankfurt am Main, Germany.
ECB Deposit Rate

Interest Rates over Time

Policy rates have remained at a low level

Interest Rates over Time

Source: https://research.stlouisfed.org/publications/review/13/01/Fawley.pdf
Eurosystem

- historical novelty
  - supranational monetary union
  - Euro launched 1 Jan 1999
  - Physical euros since 1 Jan 2002
- European Central Bank (ECB)
  - led by Governing Council
- National central banks (NCBs)
  - EU member states that have adopted the Euro
money supply \((M)\): the quantity of money that circulates in an economy,
\[ M = C + D \]
currency help by public plus checkable deposits

monetary base \((MB)\): currency held by public + reserves of banks
\[ MB = C + R \]
influences broader measures of the money supply
  - e.g., checkable deposits (including debit card accounts)

- The monetary authority can roughly control the money supply.
- US monetary authority is a central banking system: Federal Reserve System.
- The Fed can directly regulate the monetary base
Money demand: the amount of money individuals and businesses are willing to hold (instead of illiquid assets).

Real money demand (L): the amount of purchasing power individuals and businesses are willing to hold in the form of money (instead of illiquid assets).
Influences on the Demand for Money

1. Expected returns: rates of returns on non-monetary assets (compared to monetary assets)
   monetary assets pay little or no interest
   the interest rate on non-monetary assets is the opportunity cost of holding monetary assets: $\uparrow R \rightarrow \downarrow L$

2. Risk
   the risk of holding $M$ is largely inflation risk, which reduces the purchasing power of money.
   but other assets have this risk too, so this risk is not very important in defining the demand for monetary assets

3. Liquidity:
   $M$ is the most liquid asset: it is the asset with the lowest cost of turning it into other assets or commodities

4. Prices and income $\uparrow P - \uparrow$ need for $M; \uparrow Y - \uparrow$ need for $M$;
Prices and Income

- A higher level of average prices means a greater need for liquidity to buy the same amount of goods and services -> higher **nominal** demand for money.

- A higher real national income (GNP) means more goods and services are being produced and bought in transactions, increasing the need for liquidity -> higher **real** demand for money.
Money Demand

**Aggregate money demand**

- real: $L(R,Y)$
- nominal: $P \times L(R,Y)$

**where:**

- $P$ is the price level
- $Y$ is real national income
- $R$ is a measure of interest rates on non-monetary assets

Aggregate demand for real monetary assets is influenced by

- transactions demand (national income)
- opportunity cost (interest rates)
Real Money Demand and the Nominal Interest Rate

\[ L(R, Y_1) \]

\[ Q_1 \]

\[ R_1 \]

\[ R \rightarrow L \text{ (move along schedule)} \]

Note: compare KOMIF Fig 4-1 (KOM 15-1)
The real money supply does not respond to $R$. 
Money Demand = Money Supply in Equilibrium

\[ M/P = L \text{ in equilibrium} \]

Note: compare KOMIF Fig 4-3 (KOM 15-3)
The money market markets for trading monetary (very liquid) assets, which are loosely called “money”. Interest rates on monetary assets are low compared to interest rates on less liquid assets (such as bonds, loans, and deposits of currency in the foreign exchange markets).
Money Market Equilibrium  no shortages (excess demand) or surpluses (excess supply) of monetary assets.

In nominal terms  \( M = P \cdot L(R, Y) \)

In real terms  \( M/P = L(R, Y) \)
Interest Rate Effect of Increase in Money Supply (given P)

\[ L(R, Y_1) \]

\[ R \]

\[ Q \]

↑ M → ↓ R (given P)

Note: compare KOMIF Fig 4-3 (KOM 15-3)
Increase in Income Shifts Money Demand Schedule

\[ L(R, Y_1) \rightarrow L(R, Y_2) \]

\( Q_1 \rightarrow Q_2 \)

\( R_1 \)

\( R \)

\( Q \)

↑ income → ↑ L (at each R)

Note: compare KOMIF Fig 4-2 (KOM 15-2)
Interest Rate Response to a Rise in Real Income

Given the price level: an increase in Y raises L, increasing the equilibrium interest rate.

Note: compare KOMIE Fig 4.6 (KOM 15.5)
Money Market/Exchange Rate Linkages

Domestic Central Bank
Determines $M$ (e.g., the Fed)

Foreign Central Bank
Determines $M^*$ (e.g., the ECB)

Domestic Money Market
Determines $R$ (given $M$)

Foreign Money Market
Determines $R^*$ (given $M^*$)

Foreign Exchange Market
Determines $E$ (given $R$ and $R^*$)

Note: compare KOMIF Fig 4-7 (KOM 15-7)
Simultaneous Equilibrium (Money Market and FX Market)

\[ R^* + \frac{E^e - E}{E} \]

Note: compare KOMIF Fig 4-6 (KOM 15-6)
Increase in the Foreign Money Supply ($R^*$)

1. $\uparrow M \rightarrow \downarrow R$, reducing the expected rate of return on dollar deposits.

2. As FX mkt participants flee the USD for the EUR, the USD depreciates. (i.e., the EUR appreciates.)
   
   **How far?** Until expected rates of return are again equal.

3. Since the US sets its interest rate independently, there is no change in the U.S. money market.
Graphing the Shock: Increase in M

Note: compare KOM Fig 4-8 (KOM 15-8)
Summarizing the Shock: Increase in M

**Initial state:**
- \( R = R^* \)
- \( E^e = E_1 \)
- \( E = E_1 \) (zero expected future depreciation)
- \( Q = Q_1 \) (with \( M = M_1 \) and \( P = P_1 \))

**Short state:**
- \( R = R^* \)
- \( E^e = E_1 \)
- \( E = E_2 > E^e \) (negative expected future depreciation)
- \( Q = Q_2 \) (with \( M = M_2 \) and \( P = P_1 \))
Increase in the Foreign Money Supply ($R^*$)

1. $\uparrow M^* \rightarrow \downarrow R^*$, reducing the expected rate of return on euro deposits.

2. As FX mkt participants flee the EUR for the USD, the EUR depreciates. (I.e, the USD appreciates.)

   **How far?** Until expected rates of return are again equal.

3. Since the US sets its interest rate independently, there is no change in the U.S. money market.
Expansionary Monetary Policy Abroad ($\downarrow R^*$)

Note: compare KOMIF Fig 4-9 (KOM Fig 15-9)
Impact Effect of $\uparrow E^e$

\[
E = R^* + \frac{E^o - E}{E} + \frac{E^2 - E}{E}
\]

\[
E_1 = R^* + \frac{E^o - E}{E} + \frac{E^2 - E}{E}
\]

\[
E_2 = R^* + \frac{E^o - E}{E} + \frac{E^2 - E}{E}
\]

\[
Q_1 = L(R, Y_1)
\]
What is the long run? Long enough for a change in the money supply to produce its full effect on the economy.

Long-run neutrality of money: In the long run, a change in $M$ produces a proportional change in all nominal stock variables (e.g., $P$, $E$, etc)

In the long run, a change in $M$ does not change any real variables (e.g., $M/P$, $EP^*/P$, etc)

Long run: monetary policy influences prices
Short run: monetary policy influences interest rates
Inflation in Zaire

Source: IMF
Get Zaire data: here
Get Zaire data documentation: here
Up to now, we have considered short-run analysis. In the long run, prices of factors of production and of output have sufficient time to adjust to market conditions.

**Short Run**
- Prices do not have enough time to adjust to market conditions.

**Long Run**
- Wages adjust to equate the demand for and supply of labor.
- Real output (income) is determined by the economy’s productive capacity—factor supplies (e.g., the supply of labor) and technology. (*Not* by the quantity of money.)
- Real interest rates depend on the supply of saved funds and demand for these funds.
Long-run prediction for $\uparrow M$:

- no change in $Y$
- no change in (real) interest rate
- no change in $L(R,Y)$, the aggregate demand for real monetary assets $L(R,Y)$.
- proportional $\uparrow P$
Equilibrium condition: \( \frac{M}{P} = L(R, Y) \)

- now predicts that \( P \) adjusts proportionally when \( M \) changes.

In the long run, there is a direct relationship between the inflation rate and changes in the money supply.

\[
\frac{M}{P} = L(R, Y) \\
P = \frac{M}{L(R, Y)} \\
\Delta \frac{P}{P} = \Delta \frac{M}{M} - \Delta \frac{L}{L}
\]

The inflation rate is predicted to equal the growth rate in money supply minus the growth rate in money demand.
Inflation in Zaire

Alan G. Isaac

Money Supply and Money Demand
Money and Prices in the Long Run

How does a change in the money supply cause prices of output and inputs to change?

- Excess demand for goods and services: a higher quantity of money supplied implies that people have more funds available to pay for goods and services.
  - To meet high demand, producers hire more workers, creating a strong demand for labor services, or make existing employees work harder.
  - Wages rise to attract more workers or to compensate workers for overtime.
  - Prices of output will eventually rise to compensate for higher costs.
  - Alternatively, for a fixed amount of output and inputs, producers can charge higher prices and still sell all of their output due to the high demand.
Inflationary expectations:

- If workers expect future prices to rise due to an expected money supply increase, they will want to be compensated.
- And if producers expect the same, they are more willing to raise wages.
- Producers will be able to match higher costs if they expect to raise prices.
- Result: expectations about inflation caused by an expected increase in the money supply causes actual inflation.
Average Money Growth and Inflation in Western Hemisphere Developing Countries, by Year, 1987–2007

Source: KOM fig 4-10 (15-10)
Data Source: IMF, World Economic Outlook, various issues. Regional aggregates are weighted by shares of dollar GDP in total regional dollar GDP.
Average Money Growth and Inflation, by Country (1960–1990)

Average Annual Rates of Growth in M2 and in Consumer Prices During 1960–90 in 110 Countries
Combine two previous experiments:

↑ **M (given \( E^e \)):** drives down R, producing a depreciation.

↑ **\( E^e \) (given M):** At each E, the expected return on euro deposits rises because of \( Ee \) rises, producing additional depreciation.

\( E^e \) changes because the change in M is *permanent*.

Note: Y remains exogenously fixed.
Short-Run Effects of a Permanent Increase in M

\[ R^* + \frac{E_e^2 - E}{E} \]

Note: compare KOMIF Fig 4-12 (KOM 15-12)

Alan G. Isaac
Money Supply and Money Demand
Long-Run Effects of a Permanent Increase in M

Note: compare KOMIF Fig 4-12 (KOM 15-12)
Overshooting

Permanent $\uparrow M$:

→ a proportional $\uparrow E$ in LR

**BUT**: the dynamics involve a large initial depreciation and then a smaller subsequent appreciation.

Permanent $\downarrow M$:

→ a proportional $\downarrow E$ in LR

**BUT**: the dynamics involve a large initial appreciation and then a smaller subsequent depreciation.
Rudiger Dornbusch (1942–2002)

1971 PhD from U of C
1975–2002 MIT’s econ dpt
1976 "Expectations and Exchange Rate Dynamics" (JPE)
1999 prediction: “This expansion will run forever.” (re the 1991–2001 expansion)
Permanent Increase in M: Changes Over Time

Note: compare KOMIF Fig 4-13 (KOM 15-13)
We say that the exchange rate *overshoots* when its SR response to a change is greater than its LR response.

- Our model predicts exchange rate overshooting because $M$ has an immediate effect on $R$, but not on $P$ (nor expected inflation).
- This overshooting prediction helps explain why exchange rates are so volatile.

Source: KOMIF Fig 4-11 (KOM 15-11)