Money Supply and Money Demand

Slides for International Finance (KOMIF4/KOMIE15)

Alan G. Isaac
American University

2023-02-01

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

Monetary Authority

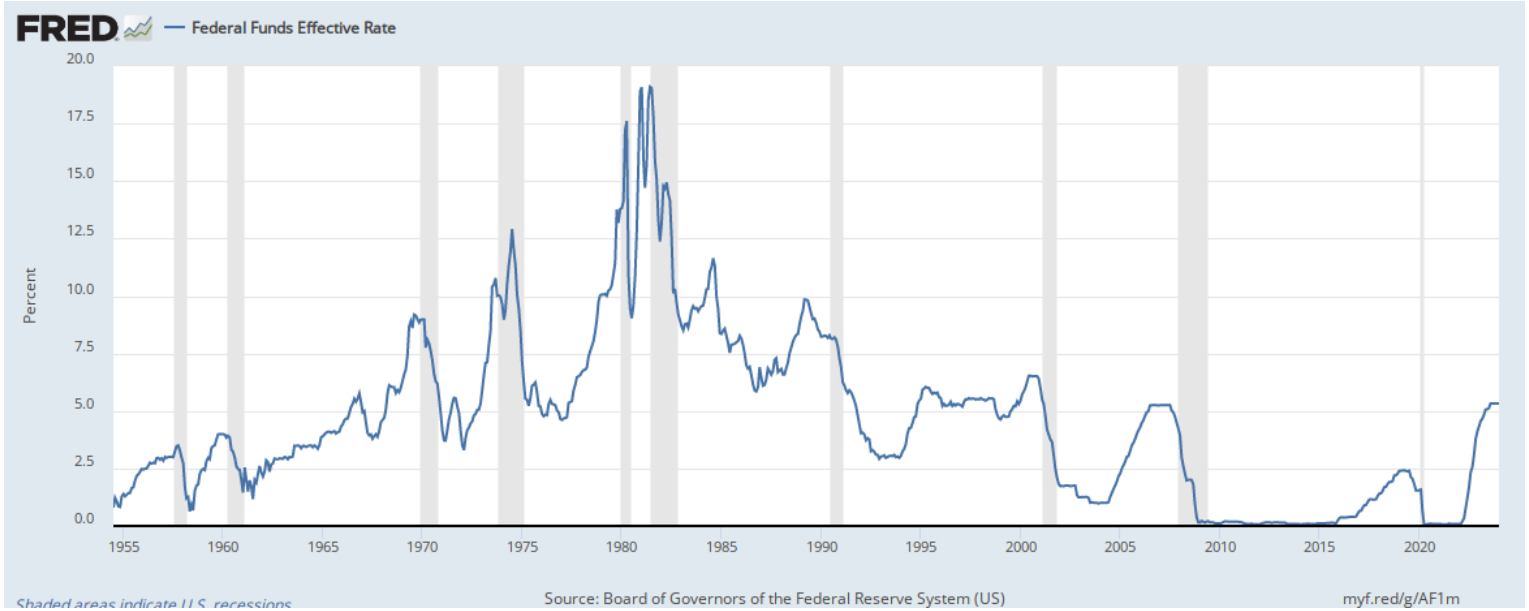
Monetary authority: institution authorized to set monetary policy.
(Most often a central bank.)

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


FRED
Federal Funds Effective Rate
Percent
20.0
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
Shaded areas indicate U.S. recessions
Source: Board of Governors of the Federal Reserve System (US)
myf.red/g/AF1m

Money

Money: assets that are commonly used as a means of payment.

Currency and checkable deposits are often used in transactions.
Bank deposits in the foreign exchange market are excluded from this definition.

Defining Money

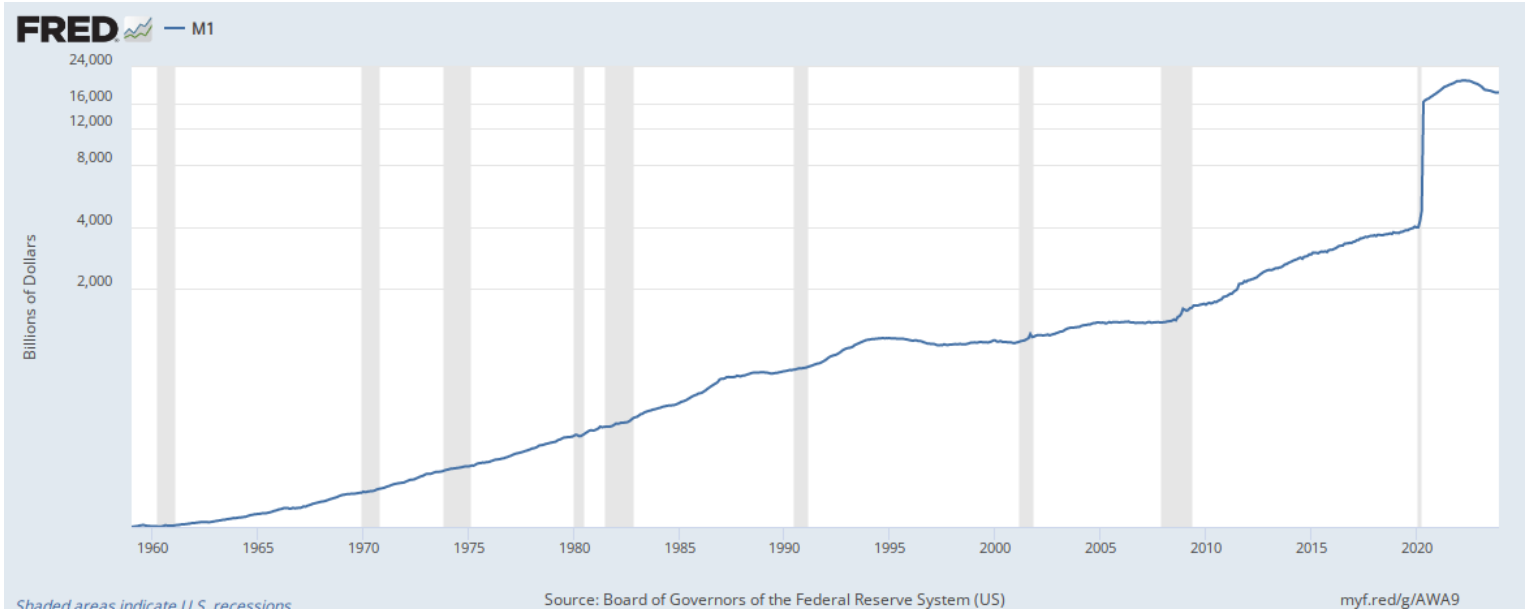
Different groups of assets may be classified as money.

Examples: `http://research.stlouisfed.org/fred2/categories/24`

Definitions: `https://www.federalreserve.gov/releases/h6/current/default.htm`

M1

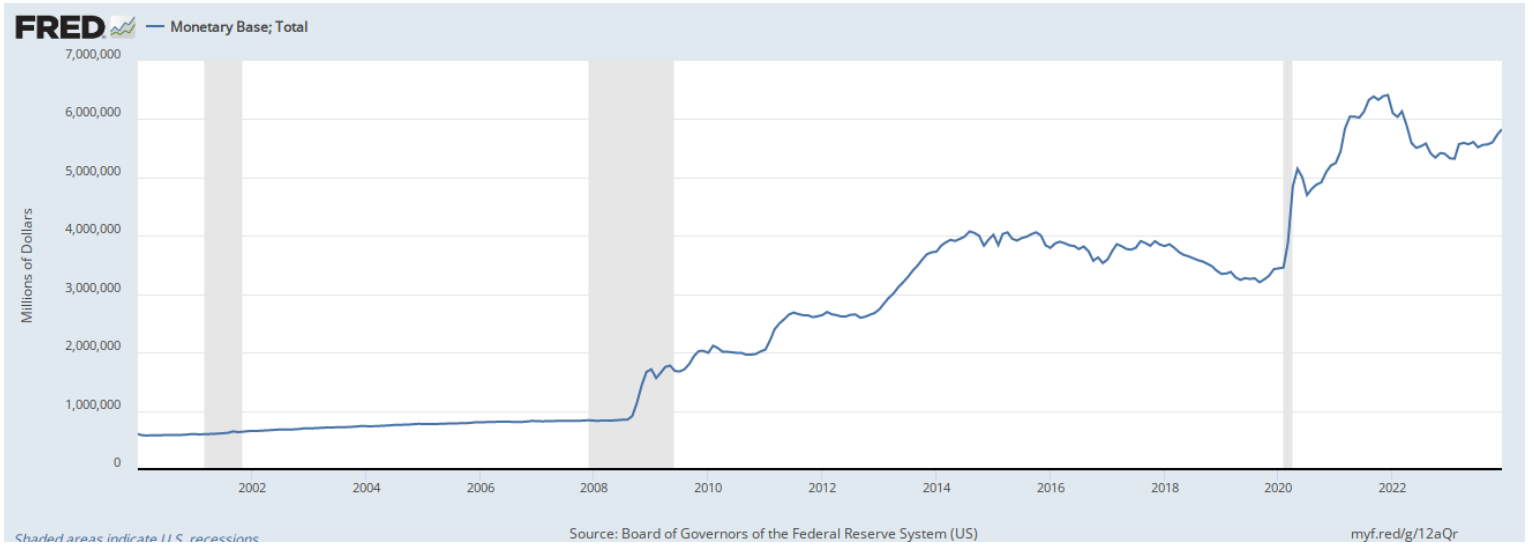
M1: currency held by public + checkable deposits



Source: `http://research.stlouisfed.org/fred2/series/M1SL?cid=25`

All FRED® Graphs appear courtesy of Federal Reserve Bank of St. Louis. `https://fred.stlouisfed.org/`

Monetary Base



Money Supply

- 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 Supply (cont.)

money supply (M): the quantity of money that circulates in an economy, currency held by public plus checkable deposits

$$M = C + D$$

monetary base (MB): currency held by public + reserves of banks

$$\mathrm{MB} = C + R$$

influences broader measures of the money supply

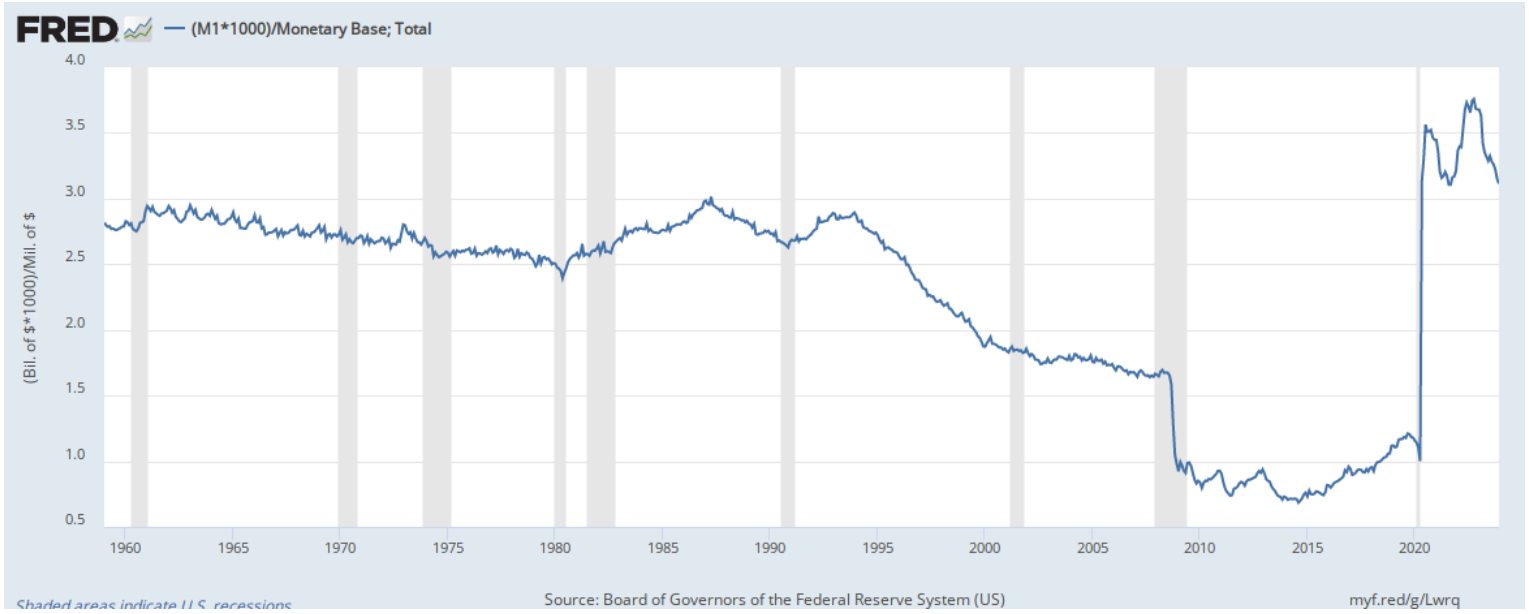
- e.g., checkable deposits (including debit card accounts)

Money Multiplier

$$
\begin{aligned}
M &= C + D \\
\mathrm{MB} &= C + R \\
M/\mathrm{MB} &= (C + D)/(C + R) \\
M/\mathrm{MB} &= (c + 1)/(c + r)
\end{aligned}
$$

where $c = C/D$ and $r = R/D$.

Money Multiplier (US)

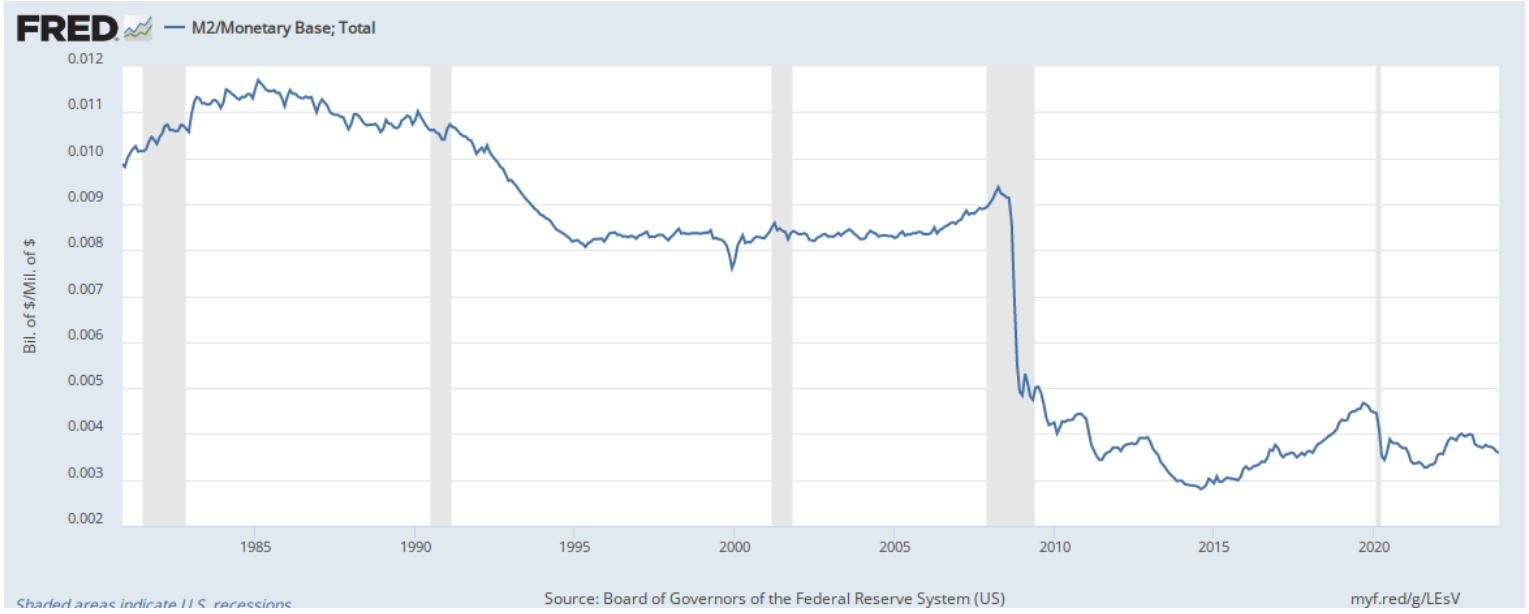


Wait! Something must be wrong! There has been a ...

Change in M1 Definition

The Board's Statistical Release H.6, "Money Stock Measures" now recognizes savings deposits as a type of transaction account, but the data are revised only back to May 2020!
https://www.federalreserve.gov/releases/h6/20210223/

M2 Money Multiplier



Two Views of Monetary Policy

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

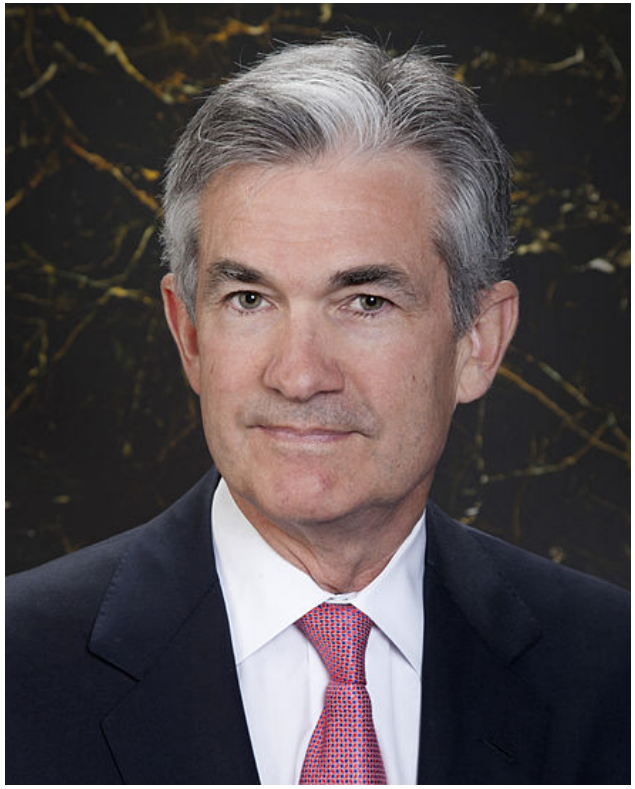
Monetary Policy

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)
`http://www.ecb.int/ecb/orga/decisions/govc/html/index.en.html`

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)

PhD from Yale 1971

Member, BoG of Fed 1994-1997

Chair, CEA Feb 1997-Aug 1999

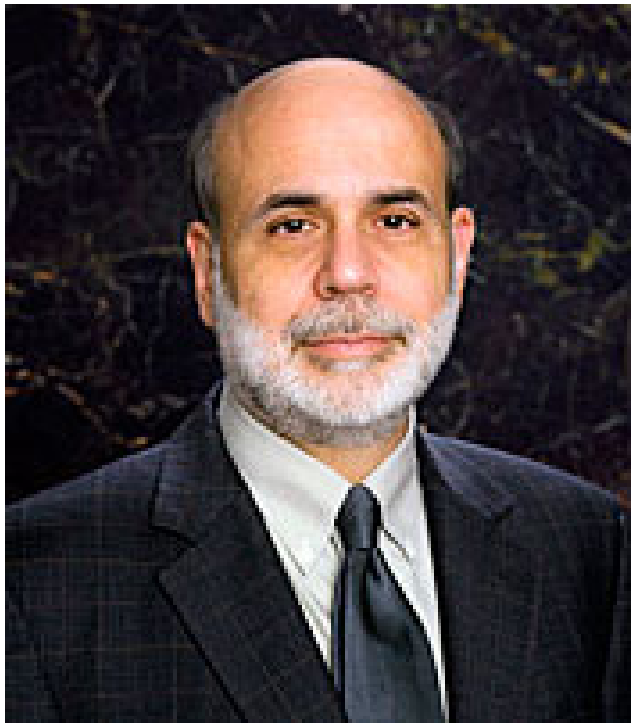
President, SF Fed June 2004-2010

Vice Chair, BoG of Fed 2010-2014

Chair, BoG of Fed Feb 2014-2018

Secretary of the Treasury 2021 - present

Ben Bernanke (14th Chair of the Fed's BoG)



PhD from MIT 1979

Chair, Princeton Econ Dpt 1996 - 2002

Member, Fed BoG 2002 - 2005

Chair, CEA June 2005 - Jan 2006

Chair, BoG of Fed Feb 2006 - Feb 2014

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

Kazuo Ueda (32nd Governor, Bank of Japan)

PhD in Economics MIT 1980
(under Stanley Fischer)

Dean of Economics 2005 - 2007, University of Tokyo

Dean of Business 2007 - 2023, Kyoritsu Women's University

Governor, Bank of Japan April 2023 - present
first academic BoJ governor

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`

BoE Monetary Policy

Court of Directors Governor, 2 Deputy Governors, 9 Non-Executive Directors

Monetary Policy Committee chaired by BoE governor, sets monetary policy

Andrew Bailey: 121st Governor of the BoE

1985 PhD in History, University of Cambridge

2016-2020 Chief Executive Officer, Financial Conduct Authority

2020 - present BoE Governor

European Central Bank (ECB)

Figure: ECB Logo

Responsible for euro area monetary policy since 1 January 1999.

Christine Lagarde, 4th President of the ECB (since Nov 2019)

1980 Law Degrees, University Paris X Law School

2007-2011 Minister of Economy and Finance (France)

2011--2019 Managing Director, IMF

2019--present ECB President

ECB Governing Council

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.

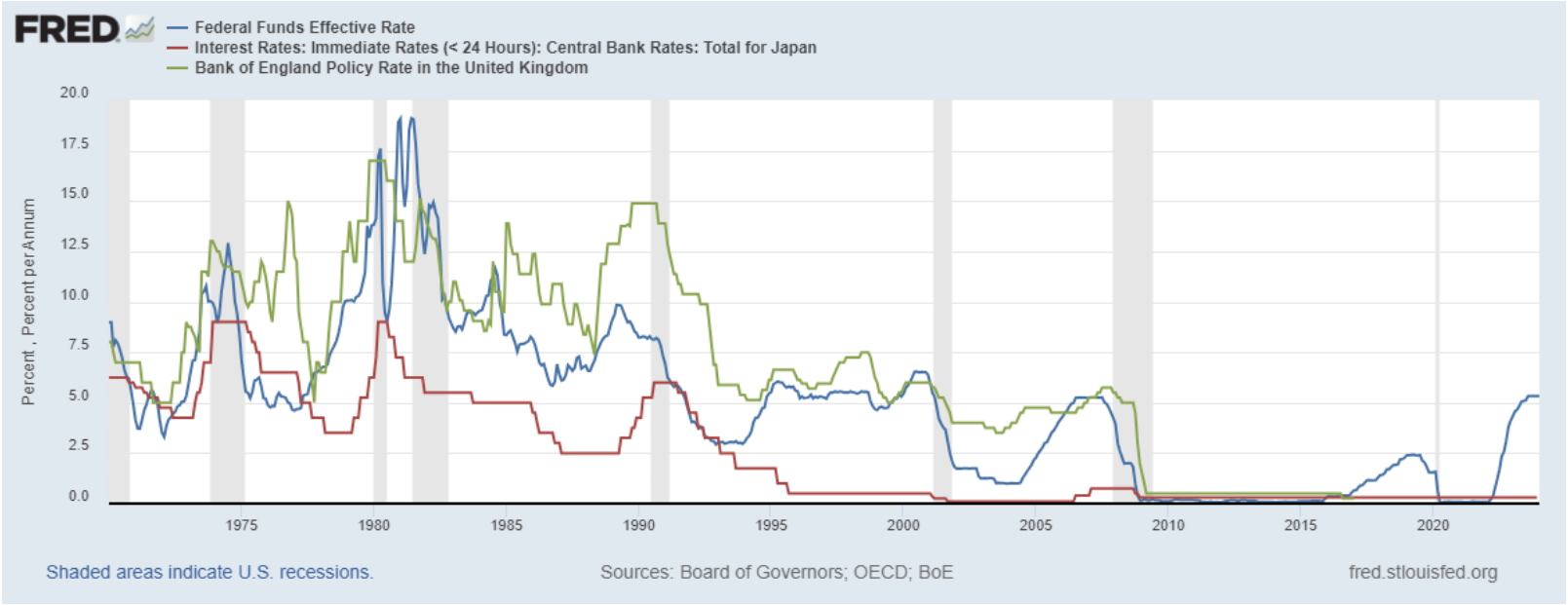
ECB Deposit Rate

The Eurosystem offers credit institutions two standing facilities:

- Marginal lending facility in order to obtain overnight liquidity from the central bank, against the presentation of sufficient eligible assets;
- Deposit facility in order to make overnight deposits with the central bank.

In addition, banks pay the main refinancing operations (MRO) rate to borrow money (collateralized) from the ECB for one week.
`https://www.ecb.europa.eu/press/govcdec/mopo/html/index.en.html`

Interest Rates over Time



Source: FRED

Eurosystem

- historical novelty
  - supranational monetary union
  - Euro launched 1 Jan 1999 (replacing ECU as accounting currency)
  - 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 (the euro area, or “eurozone”)

Money Demand

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: $P \times L[R, Y]$

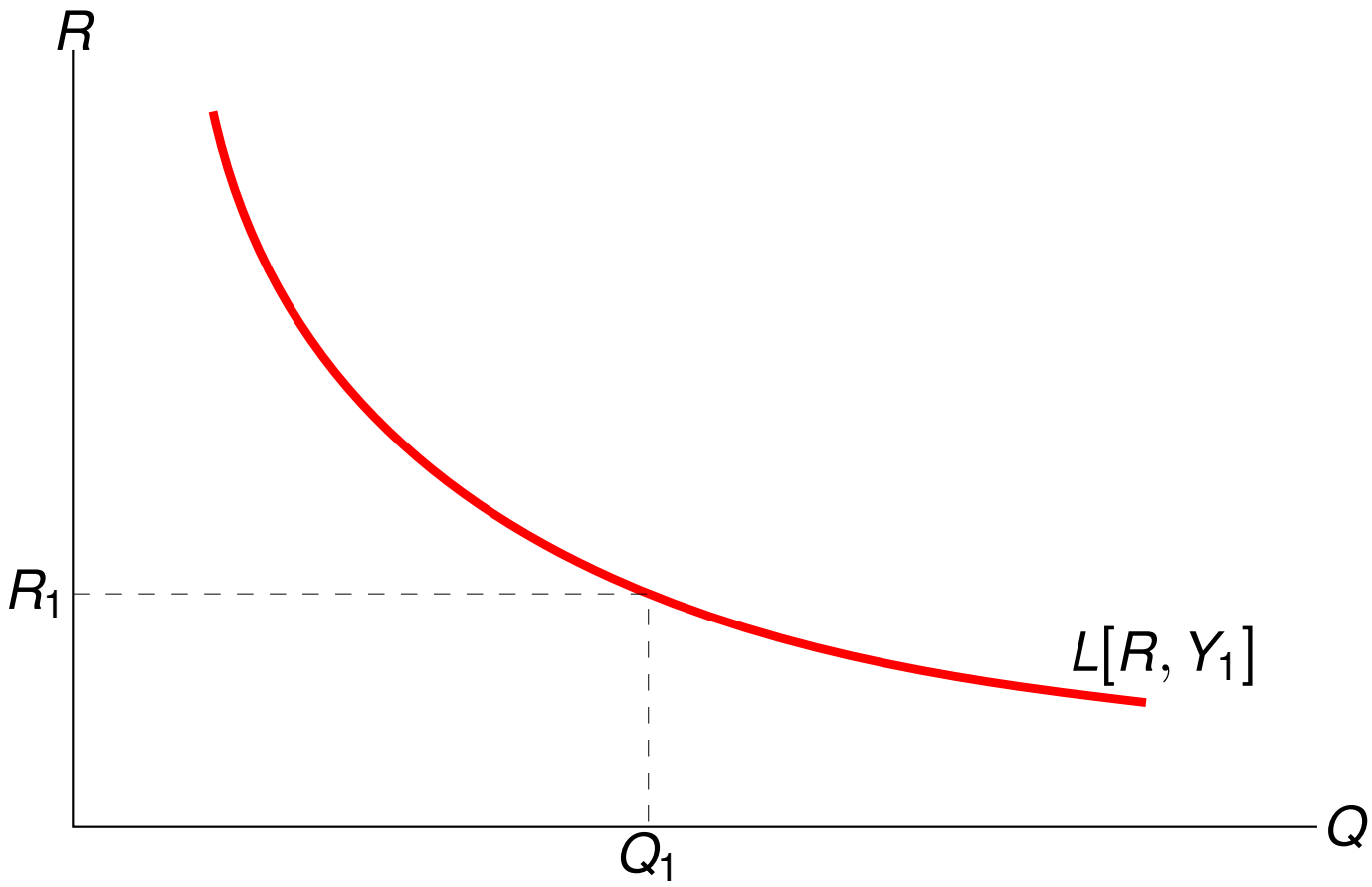
where:

- 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)

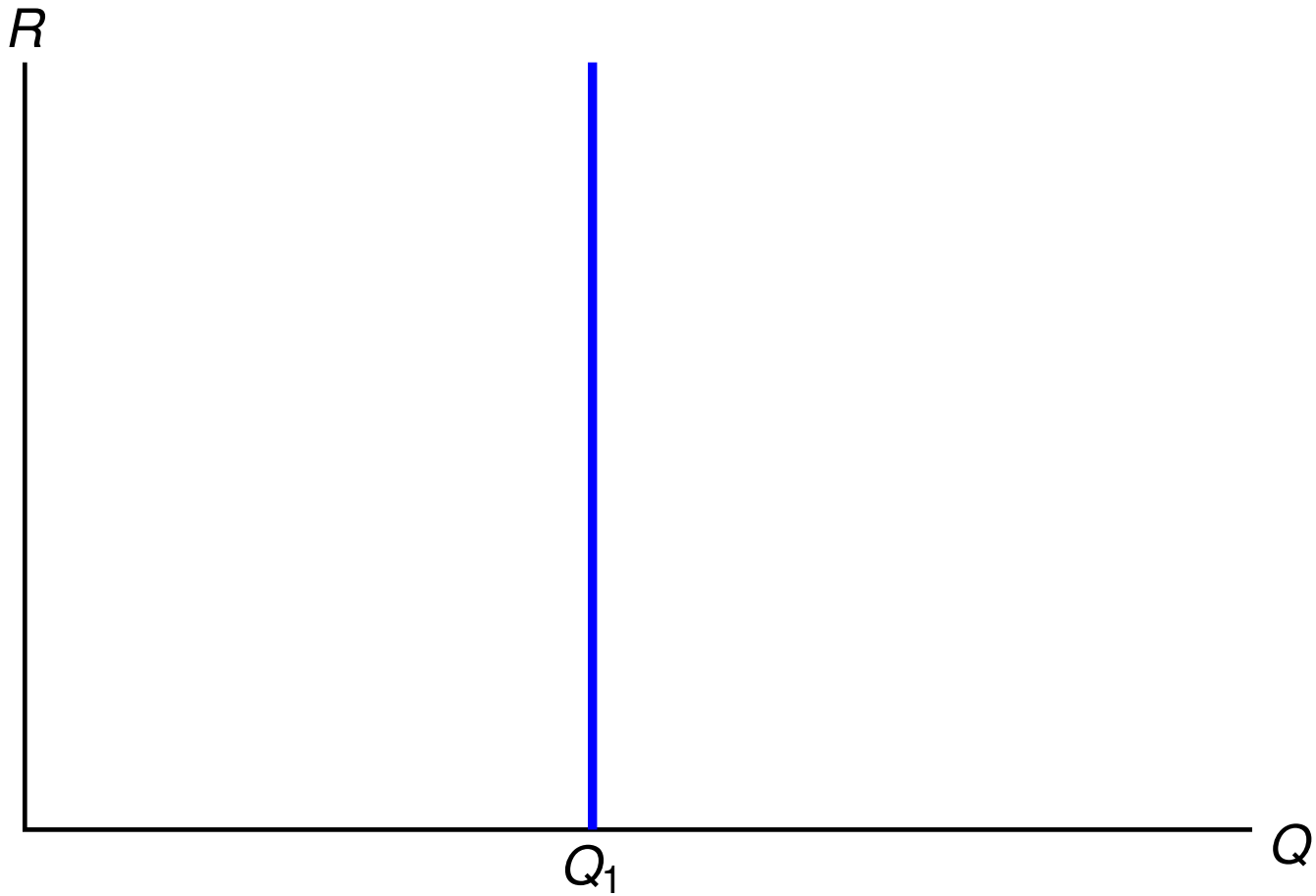
Real Money Demand and the Nominal Interest Rate



$\uparrow$ R $\rightarrow$ $\downarrow$ L (move *along* schedule)

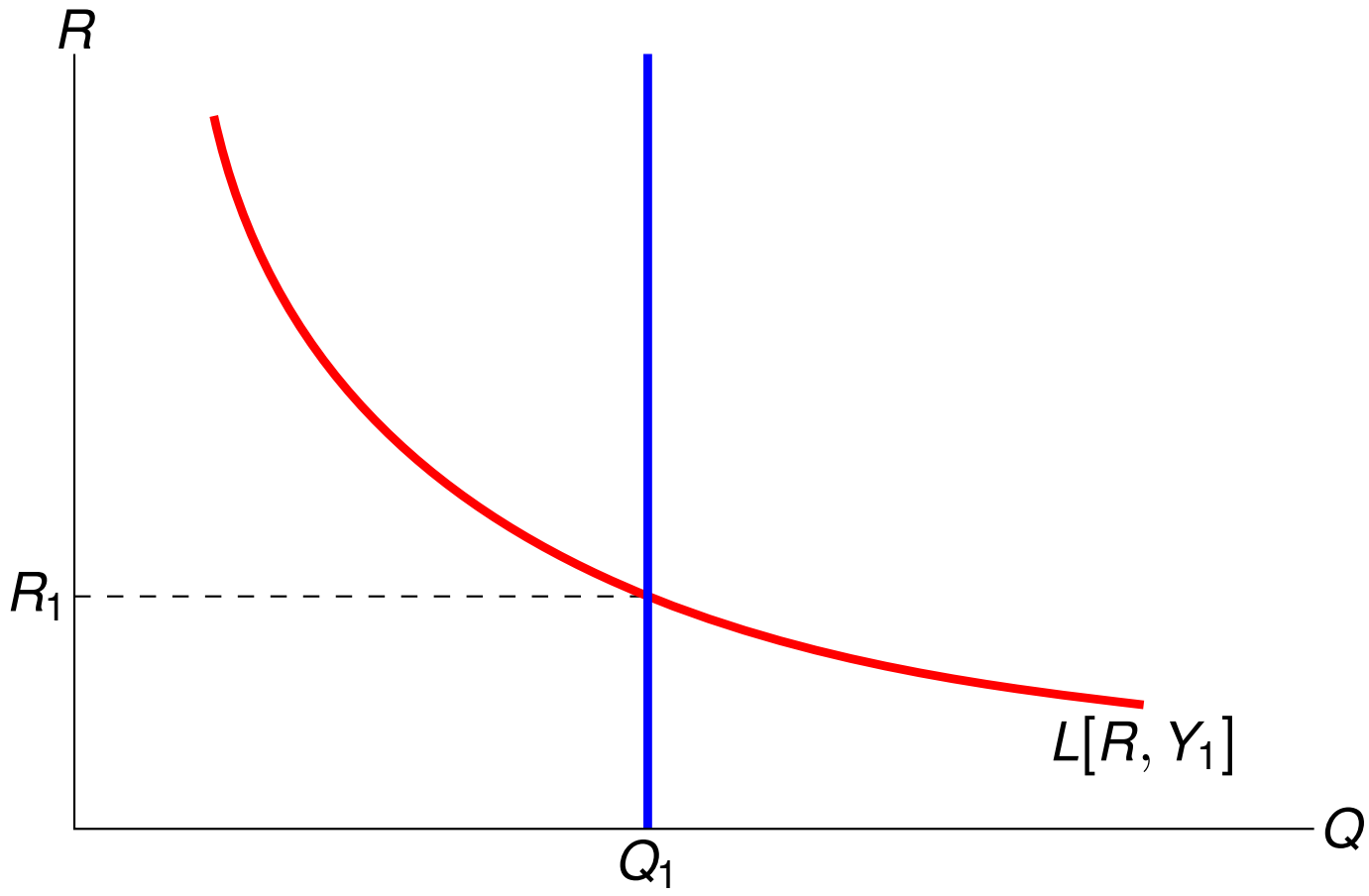
Note: compare KOMIF Fig 4-1 (KOM 15-1).

Real Money Supply and the Nominal Interest Rate



The real money supply does not respond to R.

Money Demand = Money Supply in Equilibrium



Note: compare KOMIF Fig 4-3 (KOM 15-3).
M/P = L in equilibrium

A Model of the Money Market

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).

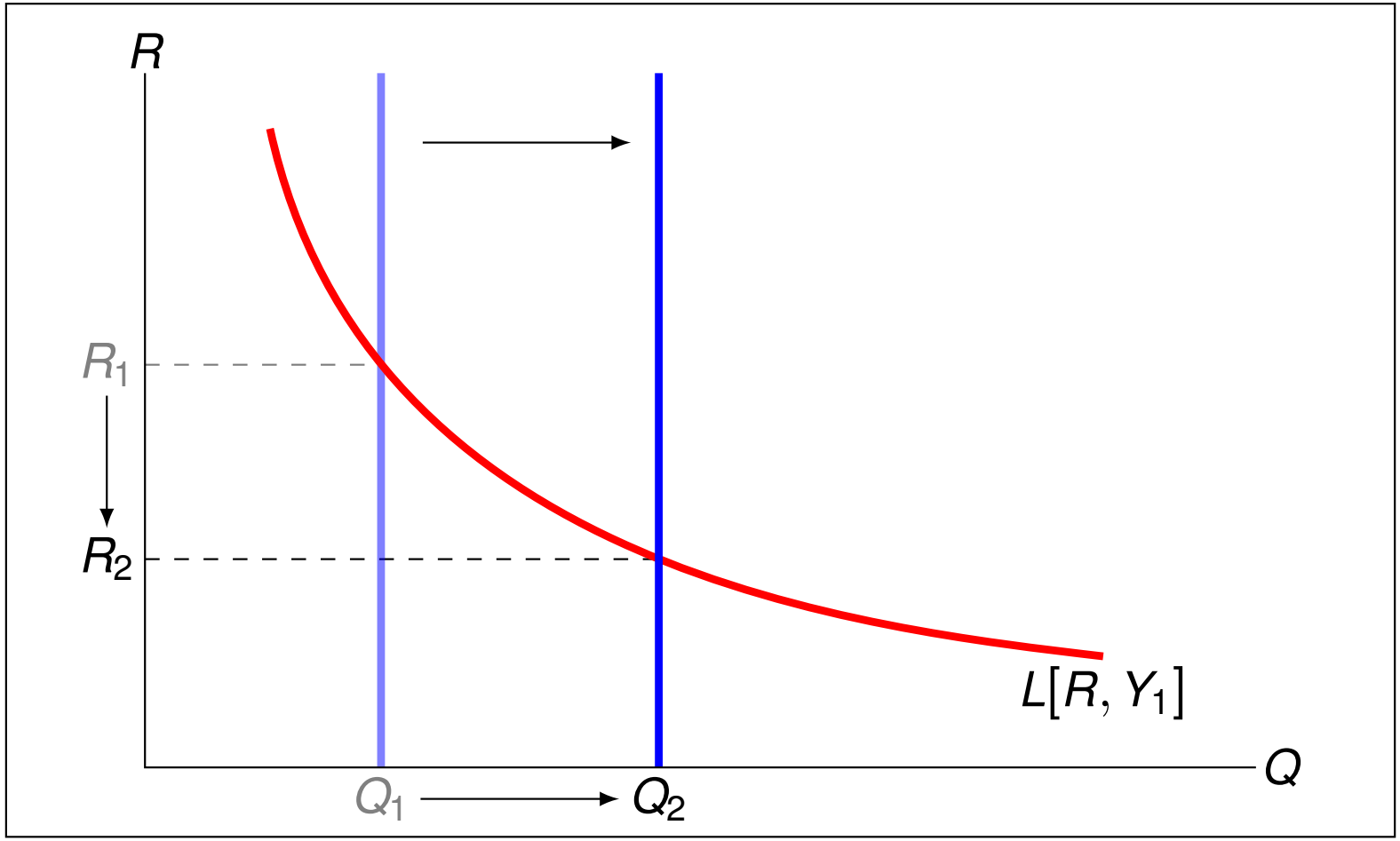
A Model of the Money Market

Money Market Equilibrium no shortages (excess demand) or surpluses (excess supply) of monetary assets.

In nominal terms $M = PL[R, Y]$

In real terms $M/P = L[R, Y]$

Interest Rate Effect of Increase in Money Supply (given P)



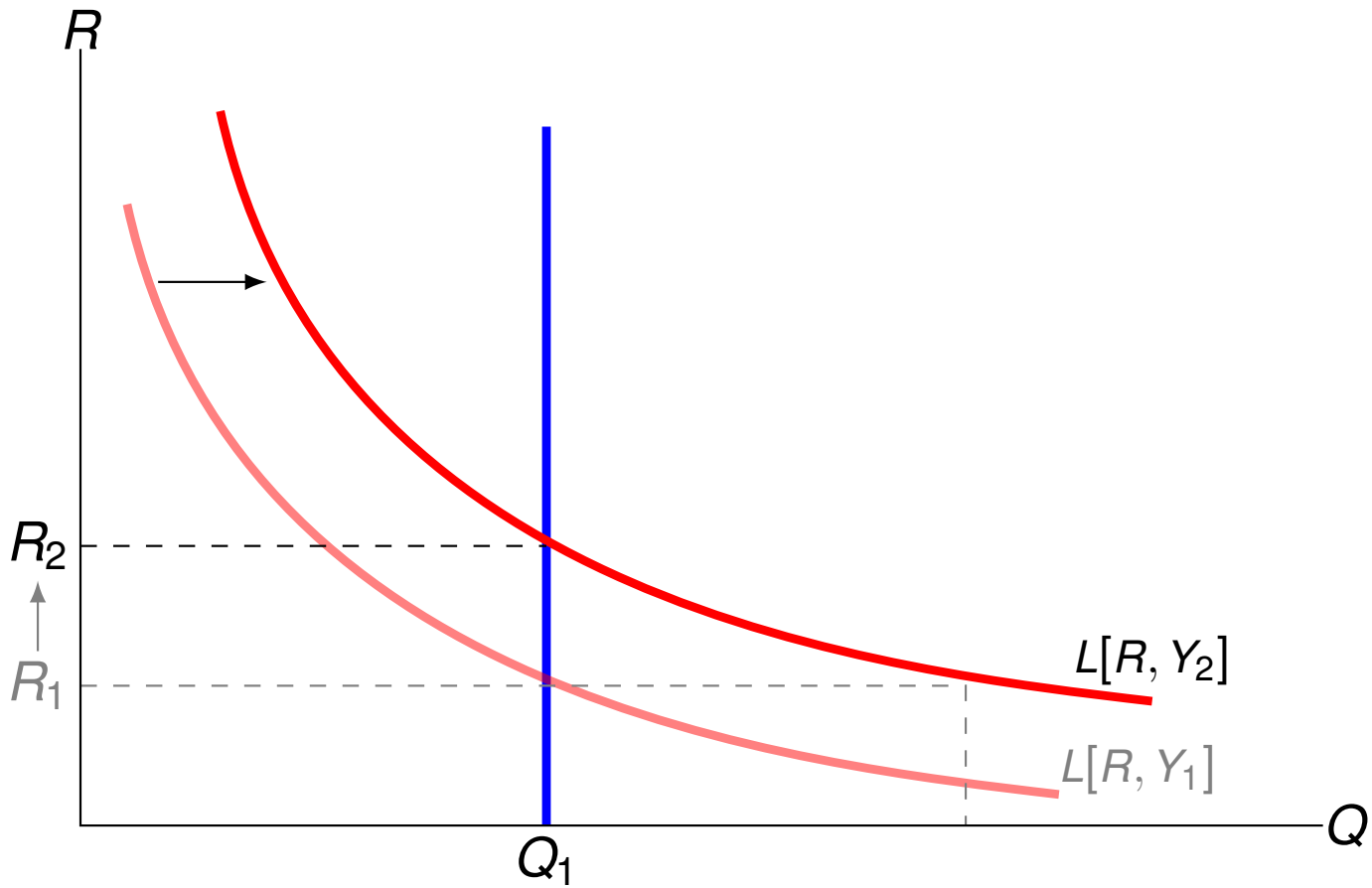
Note: compare KOMIF Fig 4-4 (KOM 15-4)
An open market purchase increases the money supply:
$\uparrow$ M $\rightarrow$ $\downarrow$ R (given P)
`https://www.federalreserve.gov/monetarypolicy/openmarket.htm`

Increase in Income Shifts Money Demand Schedule

$\uparrow$ income $\rightarrow \uparrow$ L (at each R)

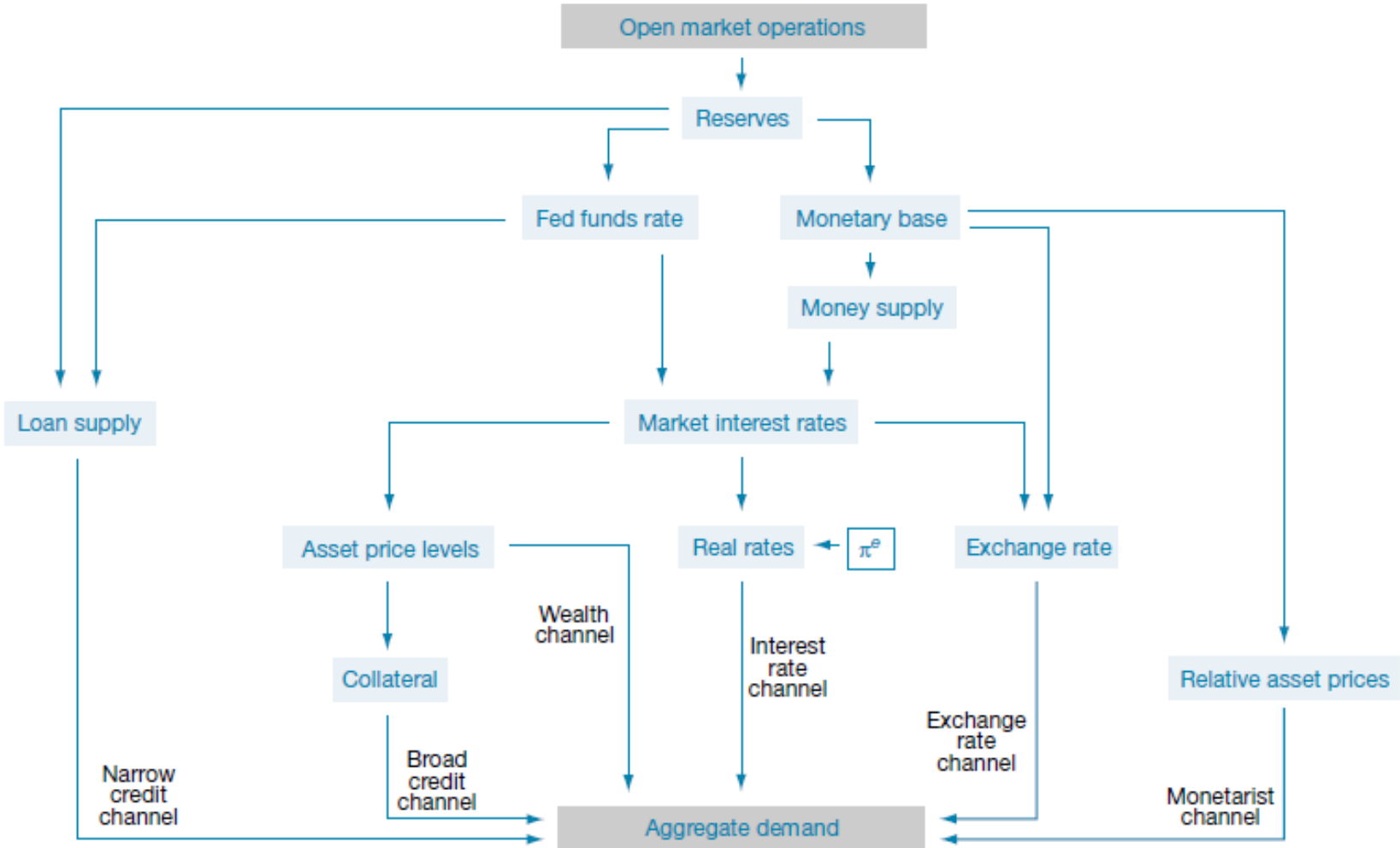
Note: compare KOMIF Fig 4-2 (KOM 15-2)

Interest Rate Response to a Rise in Real Income



Note: compare KOMIF Fig 4-5 (KOM 15-5).
$Y_2 > Y_1$. An increase in Y raises L, increasing the equilibrium interest rate.

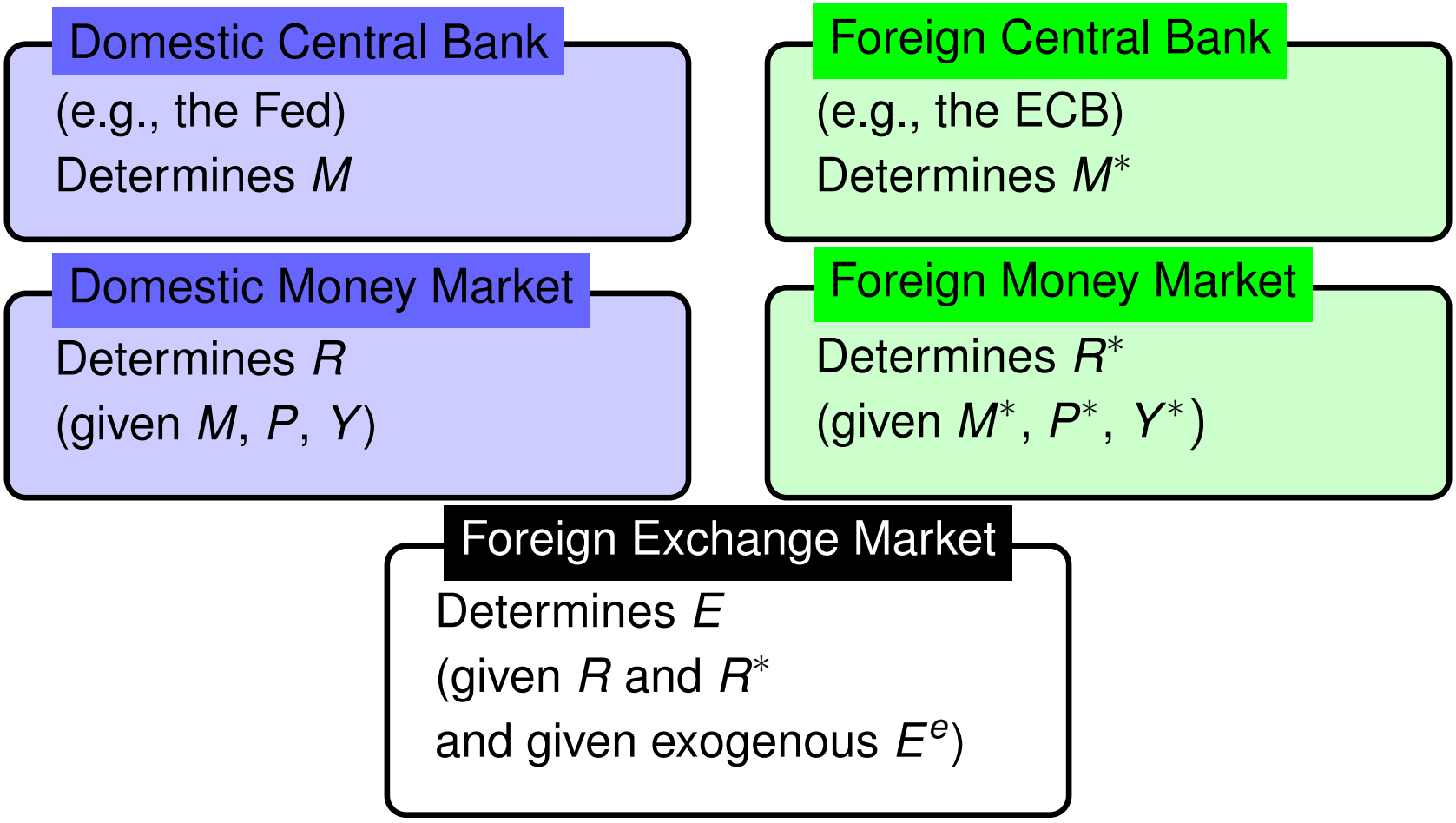
Transmission Mechanism



The [Kuttner.Mosser-2002-EconPolRev] characterization of the monetary policy transmission mechanism.

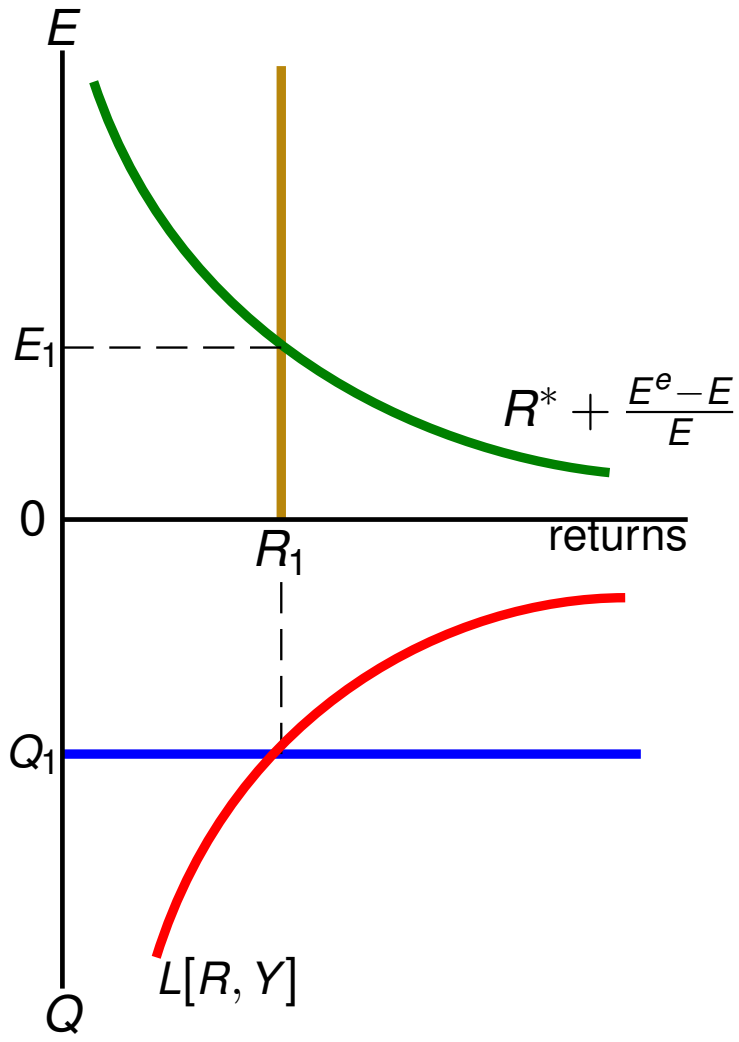
Simplified Transmission Mechanism

Short-Run Money Market/Exchange Rate Linkages:



Note: compare KOMIF Fig 4-7 (KOM 15-7)

Simultaneous Equilibrium (Money Market and FX Market)



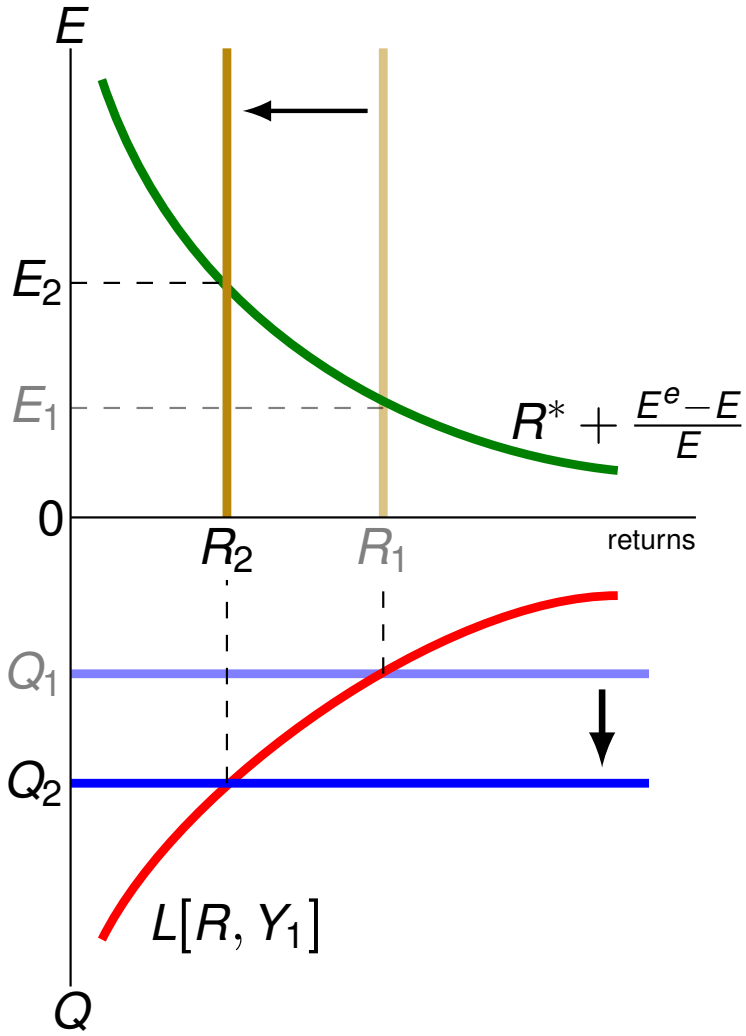
Note: compare KOMIF Fig 4-6 (KOM 15-6)

Increase in the Domestic Money Supply ($\downarrow$ 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

Intial 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:

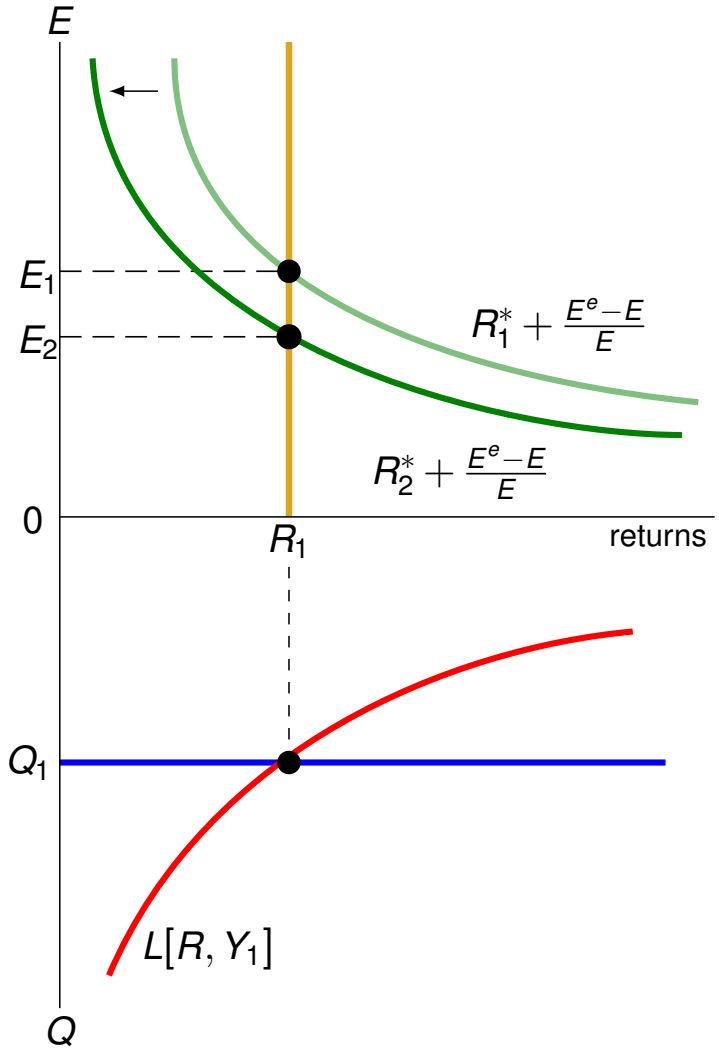
- $R = R^*$
- $E^e = E_1$
- $E = E_2 > E^e$ (negative expected future depreciation)
- $Q = Q_2$ (with $M = M_2$ and $P = P_1$)

Increase in the Foreign Money Supply ($\downarrow$ 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 (↓R*)



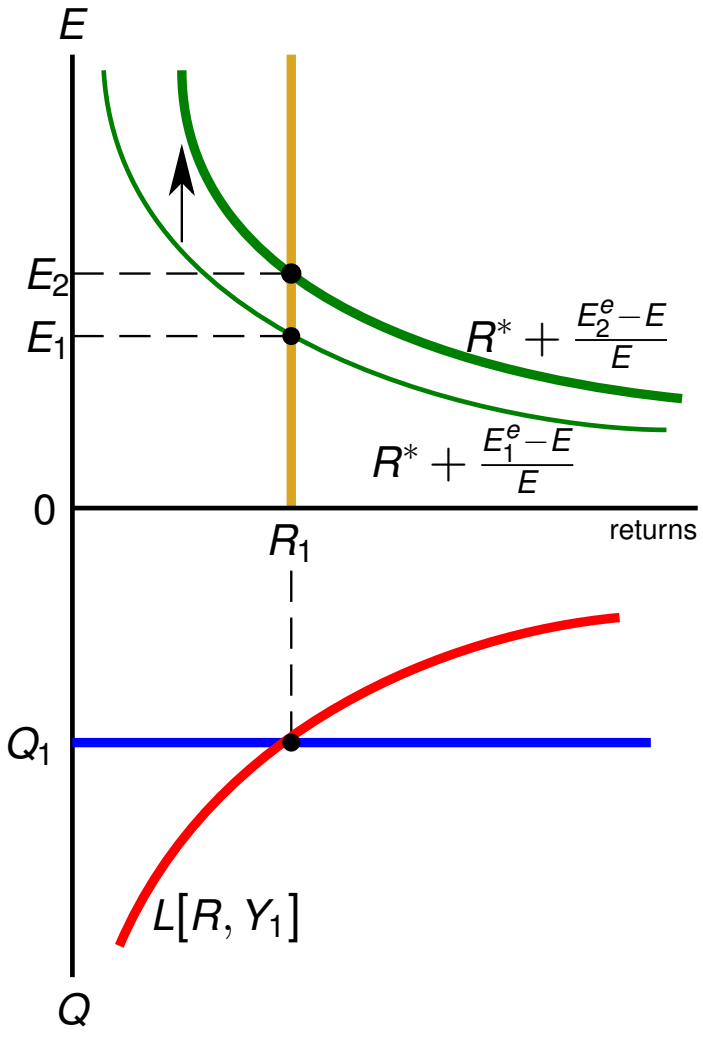
Note: compare KOMIF Fig 4-9 (KOM Fig 15-9)

Increase in the Expected Future Spot Rate

1. $\uparrow E^e \rightarrow \uparrow$ expected depreciation, increasing the expected rate of return on euro 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. There is no change in monetary policy.

Impact Effect of ↑ Ee



Short Run vs. Long Run

What is the long run? Long enough for a change in the money supply to produce its full effect on the economy.

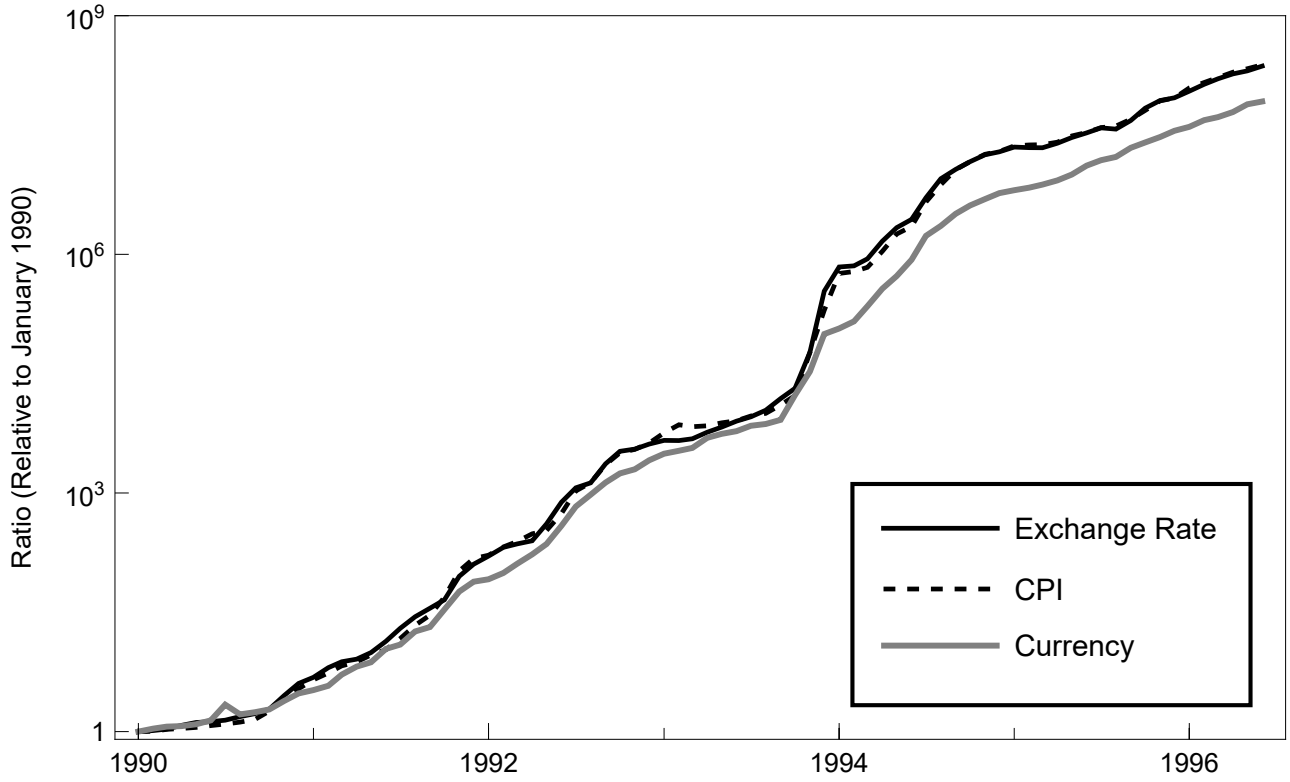
Long-run neutrality of money: In the long run, a change in M produces a proportional change in all nominal stock variables (e.g., P, E, etc)

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

Long Run and Short Run

Up to now, have 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 (cont.)

Long-run prediction for ↑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 ↑P

Long Run (cont.)

Equilibrium condition: M/P = L[R,Y]

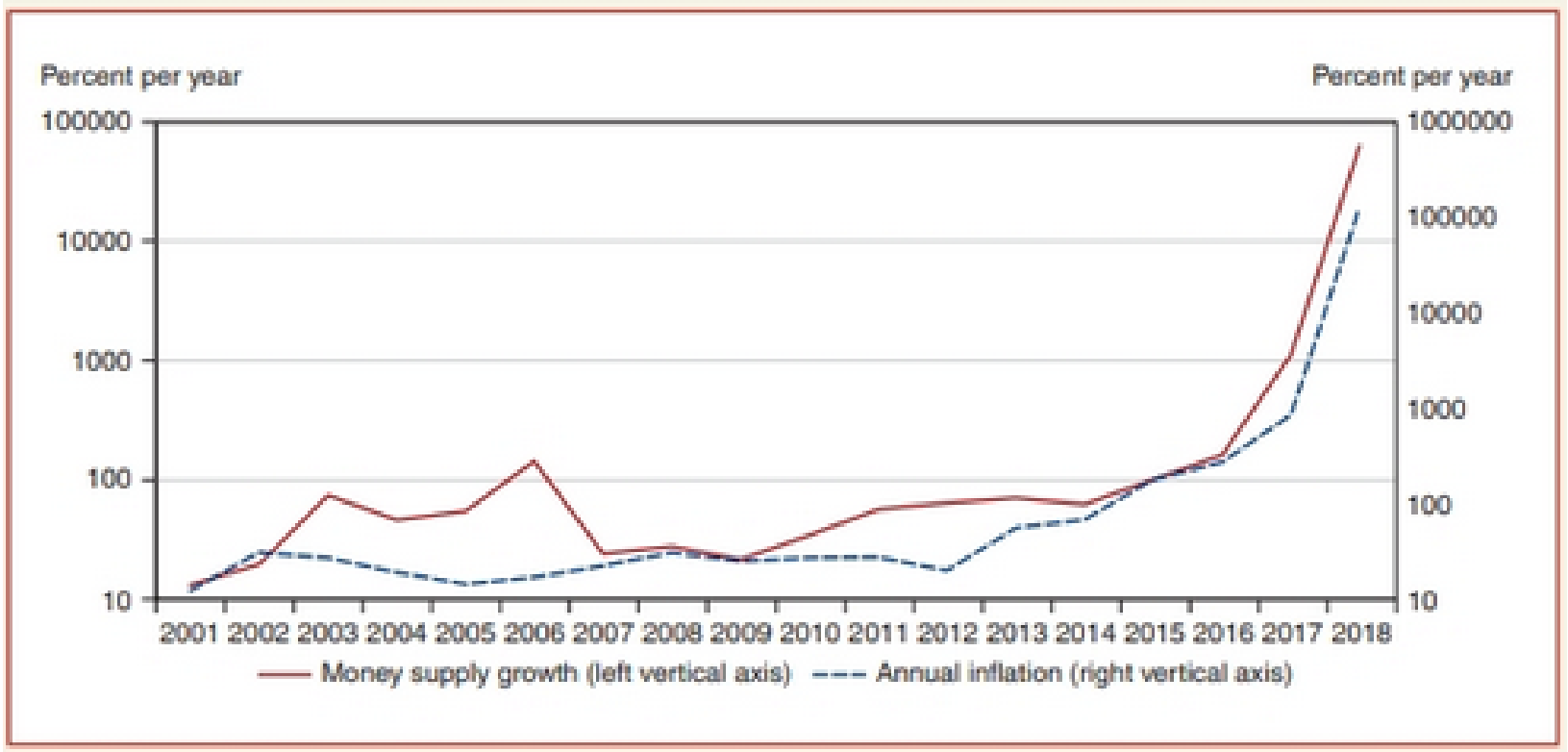
- now predicts that P adjusts proportionally when M changes.

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

$$M/P = L[R, Y]$$
$$P = M/L[R, Y]$$
$$\Delta P/P = \Delta M/M - \Delta L/L$$

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

The VZ Hyperinflation



Inflation in Turkey

https://fred.stlouisfed.org/graph/?g=10arw

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.

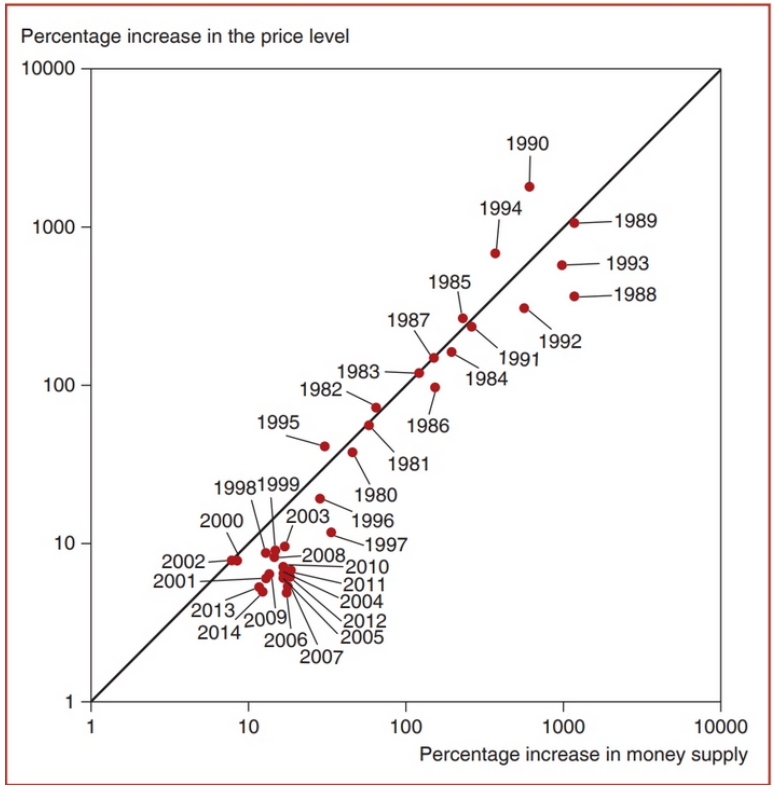
Money and Prices in the Long Run (cont.)

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

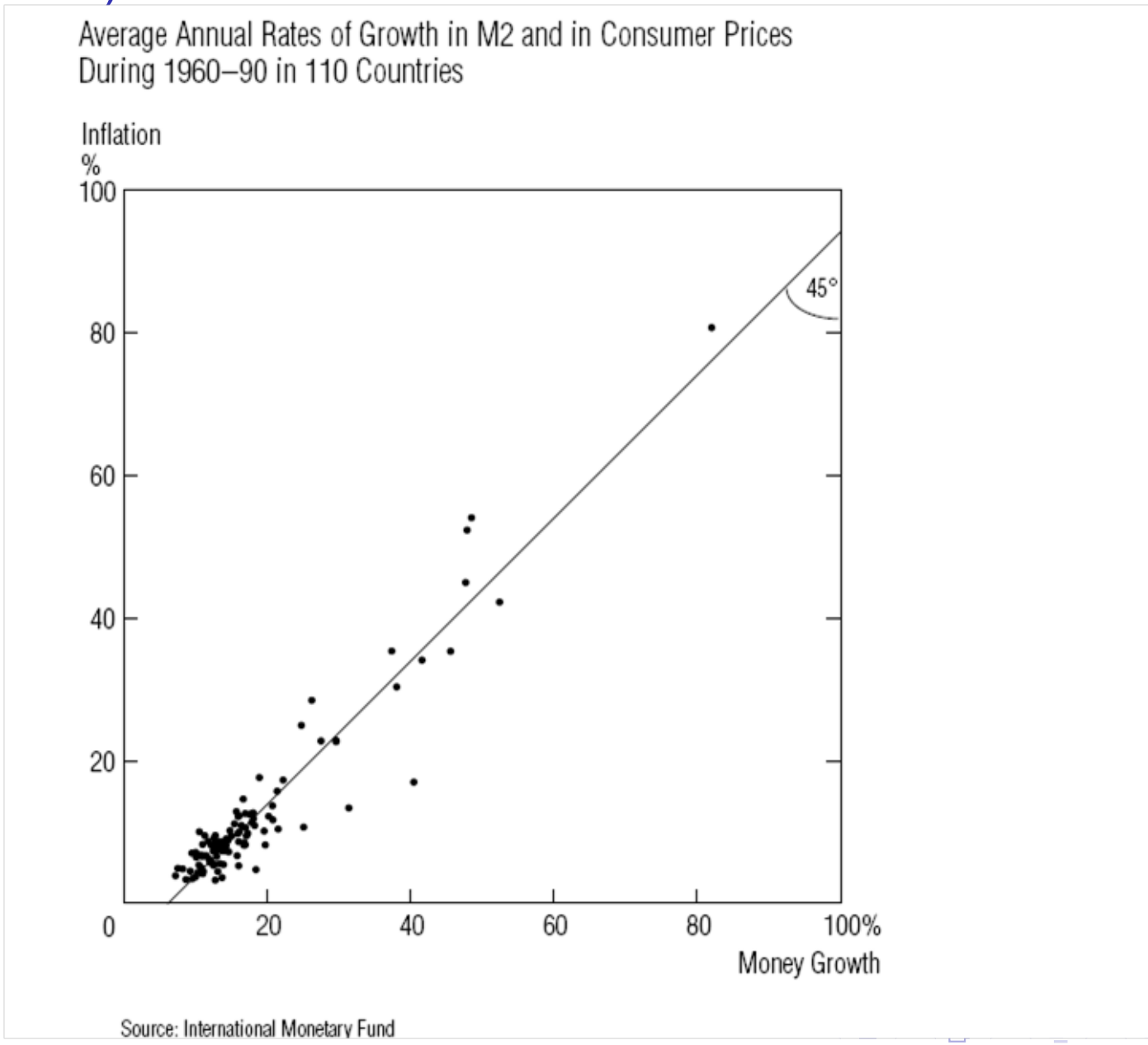
Western Hemisphere Developing Countries, by Year, 1987–2007



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)



Short-Run Effects of a Permanent Increase in the U.S. Money Supply

Combine two previous experiments:

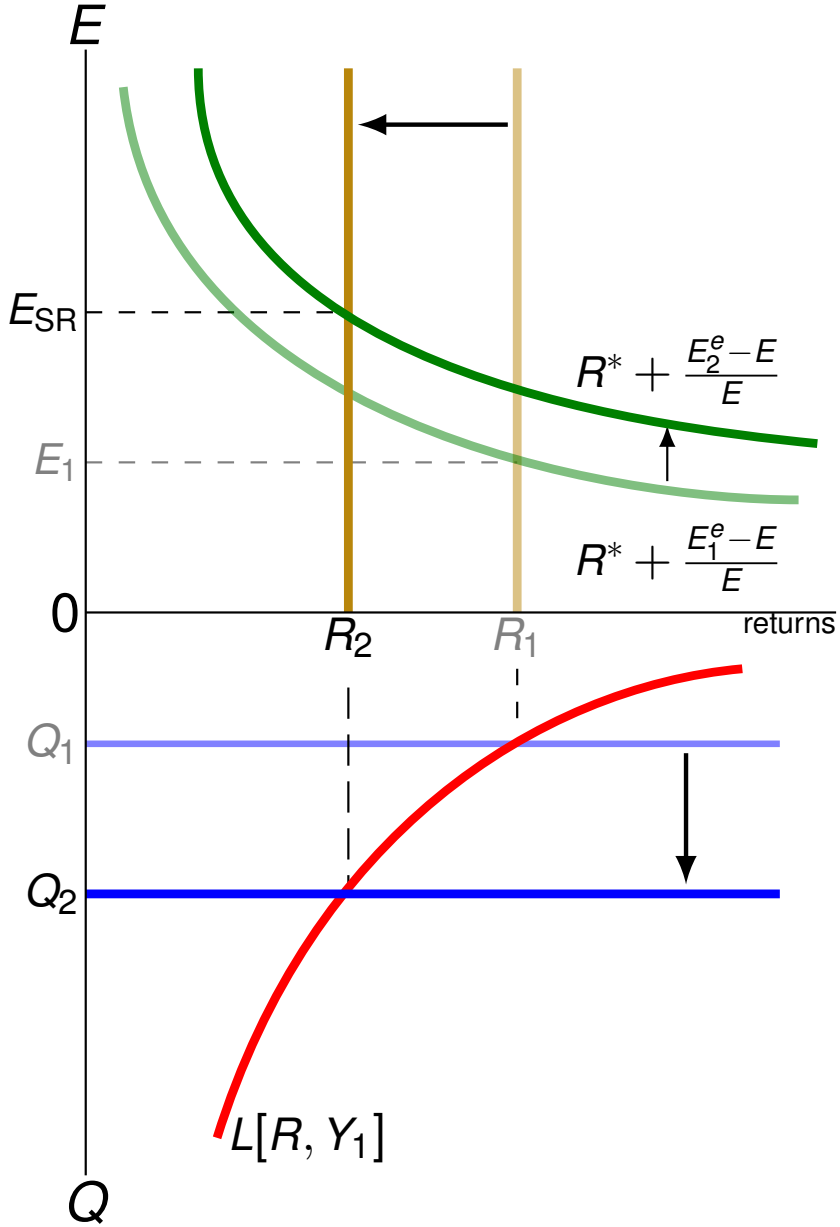
↑ **M (given E^e):** drives down R, producing a depreciation.

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

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

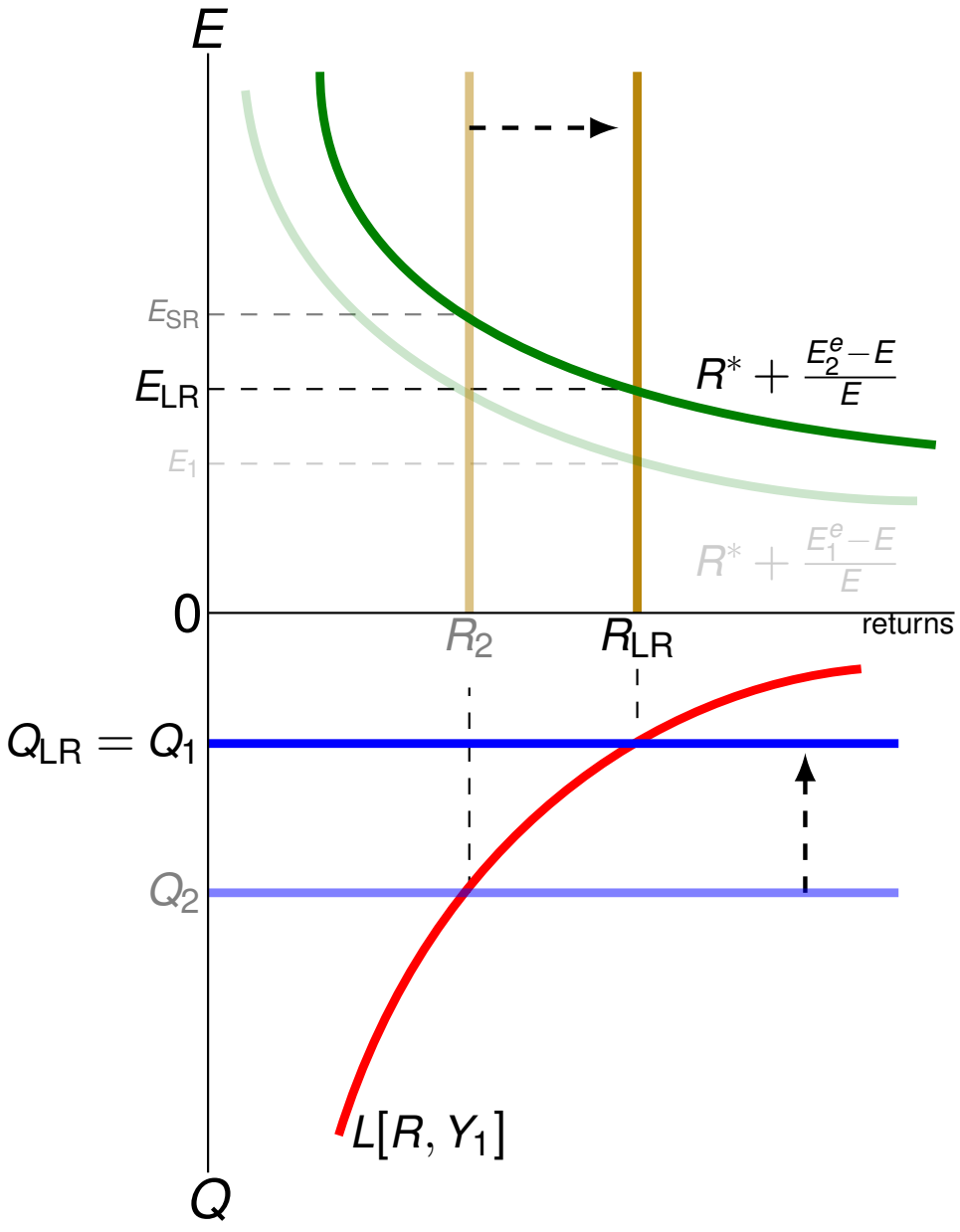
Note: Y remains exogenously fixed.

Short-Run Effects of a Permanent Increase in M



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

Long-Run Effects of a Permanent Increase in M



Overshooting

Permanent $\uparrow$M: $\rightarrow$ a proportional $\uparrow$E in LR

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

Permanent $\downarrow$M: $\rightarrow$ a proportional $\downarrow$E in LR

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

Rudiger Dornbusch (1942–2002)

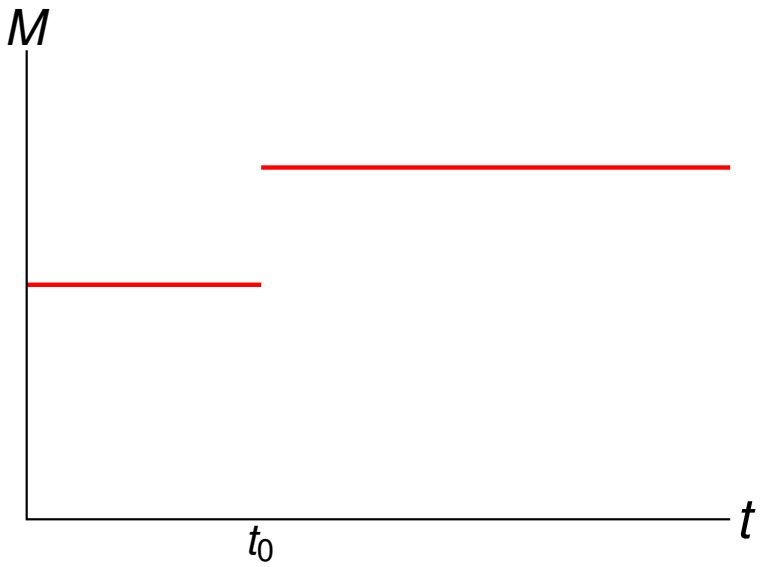
1971 Chicago PhD

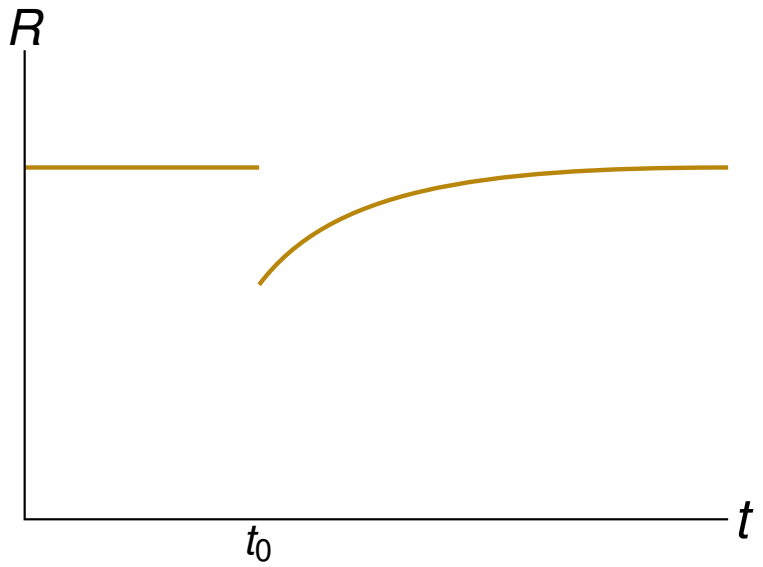
1975–2002 MIT's econ dpt

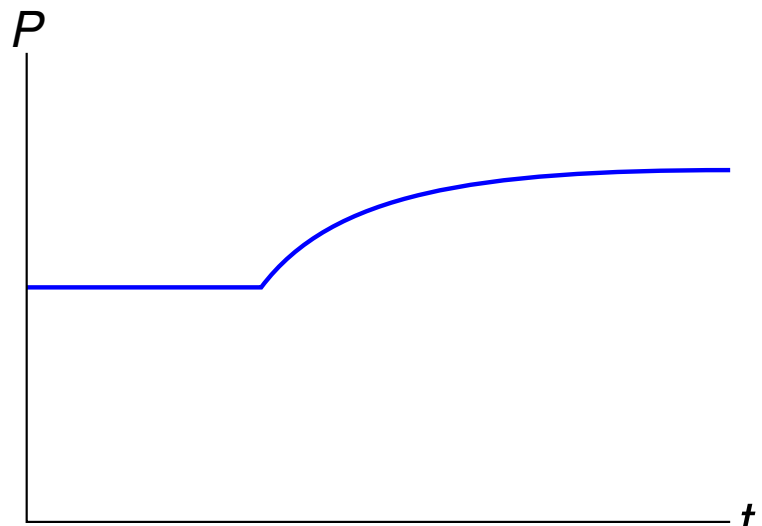
1976 "Expectations and Exchange Rate Dynamics" (JPE)

1999 prediction: "This expansion will run forever." (re the 1991–2001 expansion)

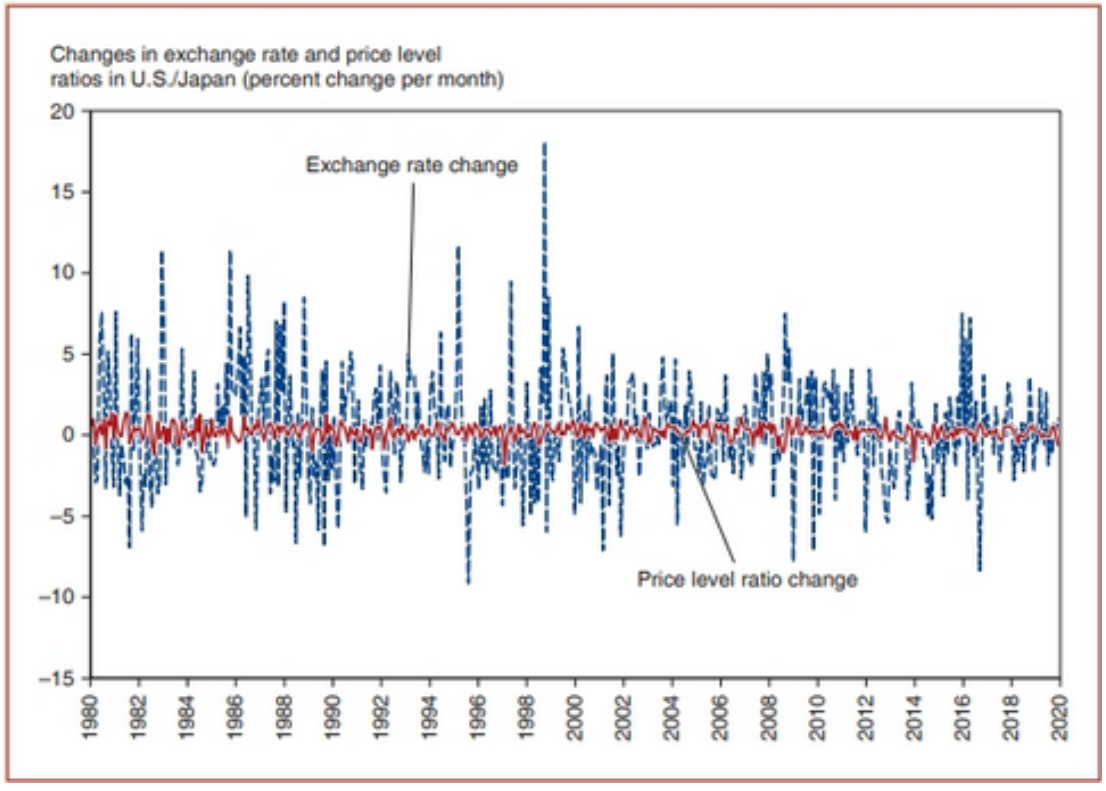
Permanent Increase in M: Changes Over Time







Month-to-Month Variability of the Dollar/Yen Exchange Rate and of the U.S./Japan Price Level Ratio



Compare: KOMIF Fig 4-12 (KOM 15-12)

Price levels are less volatile because they change slowly.

Exchange rates are volatile. They are influenced by interest rates and expectations, which may change rapidl

Summary: Exchange Rate Overshooting

The exchange rate *overshoots* when its SR response to a change is greater than its LR response.

- This asset-markets-only 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

Appendix: Some More Policy Makers

Haruhiko Kuroda (31st Governor, Bank of Japan)

MPhil in Economics, Oxford
1971

President, Asian Dev. Bank
Feb 2005 - March 2013

Governor, Bank of Japan
March 2013 - March 2023

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 2008 - 2013

Bank of Japan

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

Reorganized 1998 Bank of Japan Act of 1997

principles: independence and transparency

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

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 2013-2020 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

Mario Draghi, 3rd President of the ECB

1976 PhD in Economics, MIT

1981 - 1991 Professor, University of Florence

1984 - 1990 World Bank, Executive Director

1991 - 2001 Italian Treasury, Director General

2002 - 2005 Goldman Sachs, Vice-President and Managing Director

2011 - 2019 ECB, President (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)