Money and Exchange Rates

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[1]I wish to acknowledge Battista Severgnini for providing last year's slides to me. His generosity saved me much time, and these slides are partially based on his. Any errors are of course my own.

Last time

- Chapter 13:
  - National income accounts
  - National saving, investment, and the current account
- Chapter 14:
  - Exchange rate
  - The foreign exchange market
  - The demand of currency deposits
  - Interest rate parity
  - Partial equilibrium ex. rates

Plan for Today

- Chapter 15
  - Money
    - What is special about it?
    - How is it measured?
    - What determines how much people want?
  - A Short-run model of the money market
  - Adjustment in the Long-run
    - Why exchange rates are so volatile
- Chapter 16
  - The law of one price
  - Purchasing Power Parity
  - Relative vs. Absolute PPP

But first a review

National income accounting

- Focus on *Gross National Product* or GNP
- Definition from textbook:
  - The value of all final goods and services produced by the country's factors of production and sold on the market in a given time period
- Let's parse this

Gross National Product

- Definition from textbook:
  - The value of all final goods and services produced by the country's factors of production and sold on the market in a given time period
- The value in common terms – often current national currency

Gross National Product

- Definition from textbook:
  - The valueof all final goods and services produced by the country's factors of production and sold on the market in a given time period
- Only final goods are counted, not intermediates
- Count only the sale of the textbook, not the sale of the paper to the bookmaker
- Final goods can also be "investment" like production machines

Gross National Product

- Definition from textbook:
  - The value of all final goods and services produced by the country's factors of production and sold on the market in a given time period
- The final goods must have been produced using factors of production owned by nationals
  1. Land (resources)
  2. Labor (human capital)
  3. Capital (machines, buildings, etc)
- Production does not have to take place within the country

Gross National Product

- Definition from textbook:
  - The value of all final goods and services produced by the country's factors of production and sold on the market in a given time period
- Only count final goods that are sold in the relevant year
- Do not count sale of used textbooks!
- Sale of previously manufactured stuff is just exchange, not production
- Caution: Inventories are counted as a firm selling to itself

Gross National Product (GNP)

- Often separate GNP by ultimate use of production

$$GNP = C + I + G + CA$$

where

- C is consumption
- I is investment
- G is government purchases
- CA is current account balance (exports minus imports)
- Let's talk about these categories

National Saving

- Define national savings as:

$$S = Y - C - G$$

- GNP identity:

$$Y = C + I + G + CA$$

- Combine the two:

$$\implies S - CA = I$$

- Investment can be financed by:
  1. Putting off consumption (pay today)
  2. Borrowing from abroad (pay tomorrow)
  3. Current account sometimes called *net foreign investment*

National Saving: Private vs government

$$S = Y - C - G$$

$$S = (Y - C - T) + (T - G)$$

$$S = S^p + S^g$$

National Saving: Private vs government

- Combining our two definitions of saving:

$$S = I + CA = S^p + S^g$$

$$S^p = I + CA - S^g$$

$$S^p = I + CA + (G - T)$$

- Private saving is used for:
  1. Investment at home
  2. Investment abroad
  3. Purchasing government debt

Balance of Payments Accounts

- Two types of transactions:
  1. Credit if a foreigner pays a native
  2. Debit if a native pays a foreigner
- A *Financial Asset* holds wealth: stocks, bonds, debt, etc
- current account + financial account + capital account = 0
  1. **current account**: tracks flows of goods and services (imports and exports)
  2. **financial account**: tracks flows of financial assets (financial capital)
  3. **capital account**: flows of special categories of assets: typically intangible assets like debt forgiveness, copyrights and trademarks.

Chapter 14: Exchange Rates and the Foreign Exchange Market: An Asset Approach

Exchange Rates

- *Direct*: The price of the foreign currency in terms of DKK (e.g., 7.45 DKK per Euro): $E_{DKK/EURO}$
- *Indirect* : The price of DKK in terms of the foreign currency (e.g., 0.13 Euro per 1 DKK)

Exchange rate regimes:

- *flexible*: Exchange rate is determined freely by the market
- *fixed*: Exchange rate is politically determined and market is manipulated

The Foreign Exchange Market

Main actor:

- **Commercial banks and other depository institutions**
  - Suppose I want to buy some books from Amazon UK
  - Nordea charges me in DKK, and then pays Amazon in GBP
- Interbank trading is lions share of foreign currency trading
- *Wholesale* rates in the Financial Times: only trades of 5 million dkk and up
- *Retail* rates available to you and I are much worse

The Foreign Exchange Market

Other actors:

1. **Non-financial businesses** directly buy foreign currency transactions to pay foreign employees or suppliers
2. **Non-bank financial institutions** may trade foreign currency for investment clients
3. **Central banks** conduct official international reserves trades (small)

Ways to trading currency

- **Spot rate**: exchange rates for currency exchange "on the spot", or when trading is executed immediately.
- **Forward rate**: promise to buy or sell in the future

Other methods:

1. **Foreign exchange swap** sell currency on the spot and promise to buy it back in the future
2. **Futures contract** Promise to deliver currency in the future
3. **Options contracts** Option to buy or sell currency for a fixed rate in the future

The Demand for Currency

- Most important determinant of demand: belief about future value
  1. Expected rate of return
  2. Expected future exchange rate
- Rate of return definitions:
  - **Rate of return:** the % change in value that an asset offers during a time period
  - **Real rate of return:** inflation-adjusted rate of return
  - if inflation=0 $\Rightarrow$ rate of return=real rate of return

Some other considerations

- In addition to expected return, investors care about:
  1. *risk*: Uncertainty about future real returns
  2. *liquidity*: Ease of selling currency?
- For now, we will ignore these considerations
- Assume certain knowledge of future, and liquid market

Comparing assets

Example: Should we invest in a Danish bond or a Euro bond?

- Return of 1 DKK in DK bonds in DKK
  $\Rightarrow R_{DKK,t}$
- Return of 1 DKK in Euro bonds in DKK:
  $\Rightarrow \left(\frac{E^e_{DKK/EURO,t+1}}{E_{DKK/EURO,t}} \right) (1 + R_{EURO,t}) - 1$

A convenient approximation

- Return of 1 DKK in Euro bonds in DKK:
$$\left(\frac{E^e_{DKK/EURO,t+1}}{E_{DKK/EURO,t}}\right)(1+R_{EURO,t})-1$$
- Some algebra: $R_{EURO,t}+\frac{E^e_{DKK/EURO,t+1}-E_{DKK/EURO,t}}{E_{DKK/EURO,t}}+$
$$R_{EURO,t}\frac{E^e_{DKK/EURO,t+1}-E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$
- Final term is usually small
- Return of 1 DKK in Euro bonds in DKK is approximately
$$R_{EURO,t}+\frac{E^e_{DKK/EURO,t+1}-E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$
- Euro interest rate plus the rate of depreciation of the Kroner against the Euro

Using our approximation

- Approximation $R_{EURO,t} + \dfrac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$
- Buy the DKK bond if:

$$R_{DKK,t} - R_{EURO,t} - \frac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}} > 0$$

Interest rate parity

- In equilibrium, all assets should give the same expected return
- Why?
- Using our approximation:

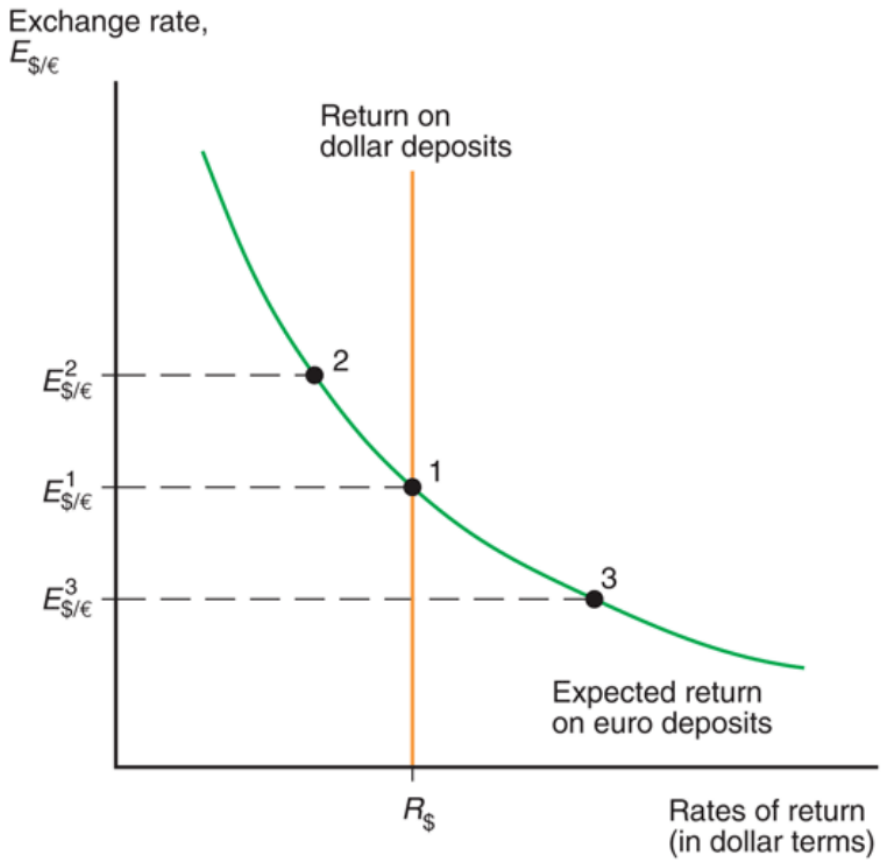
$$R_{DKK,t} = R_{EURO,t} + \frac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$

Effect of current exchange rates on return

- All else equal (including future exchange rate)
  - Current depreciation of *DKK* lowers the *DKK* return on Euro bonds
  - Appreciation of *DKK* raises the *DKK* return on Euro bonds
- Intuitive, because depreciation means one can buy less Euros today!

Equilibrium exchange rate

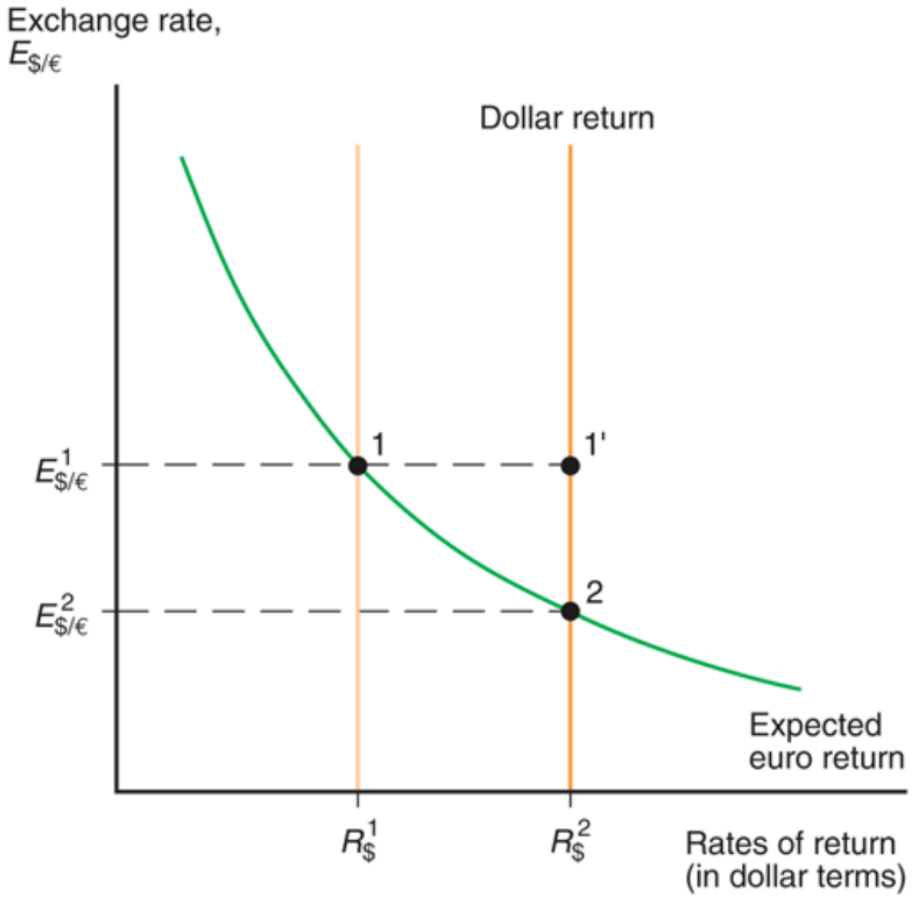
$$R_{DKK,t} = R_{EURO,t} + \frac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$



Changing interest rates and exchange rate

$$R_{DKK,t} = R_{EURO,t} + \frac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$

- Rise in interest rate results in current currency appreciation



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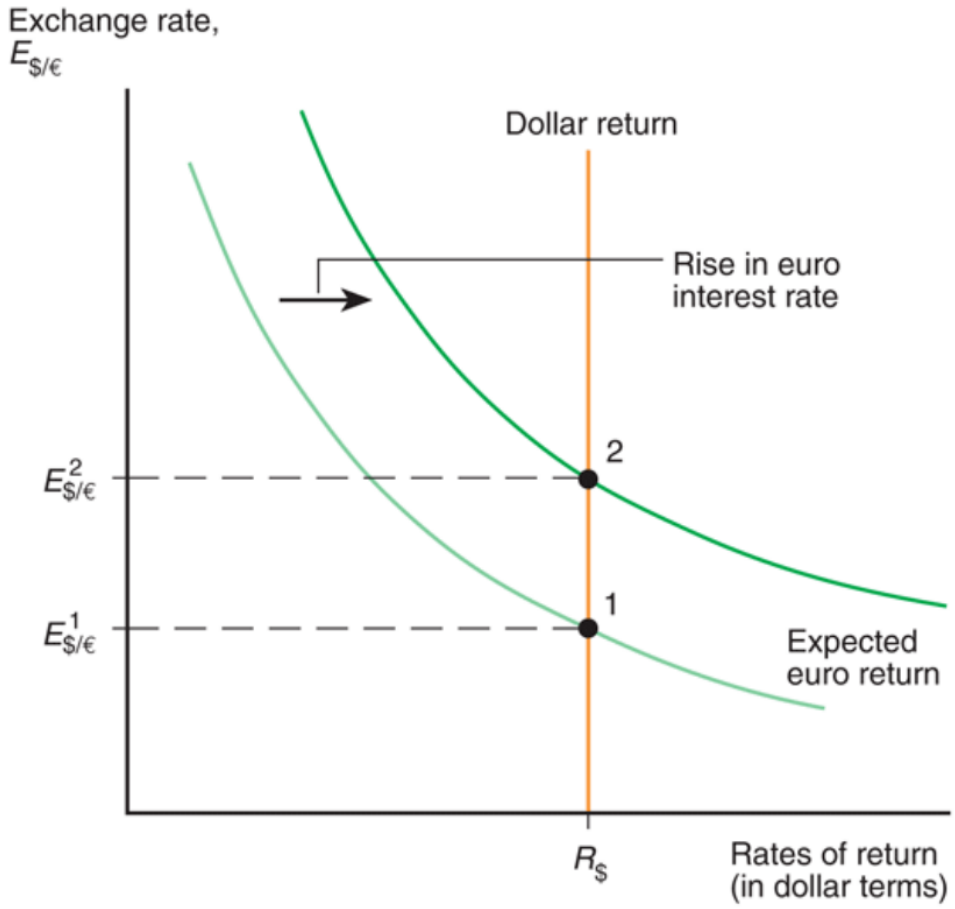
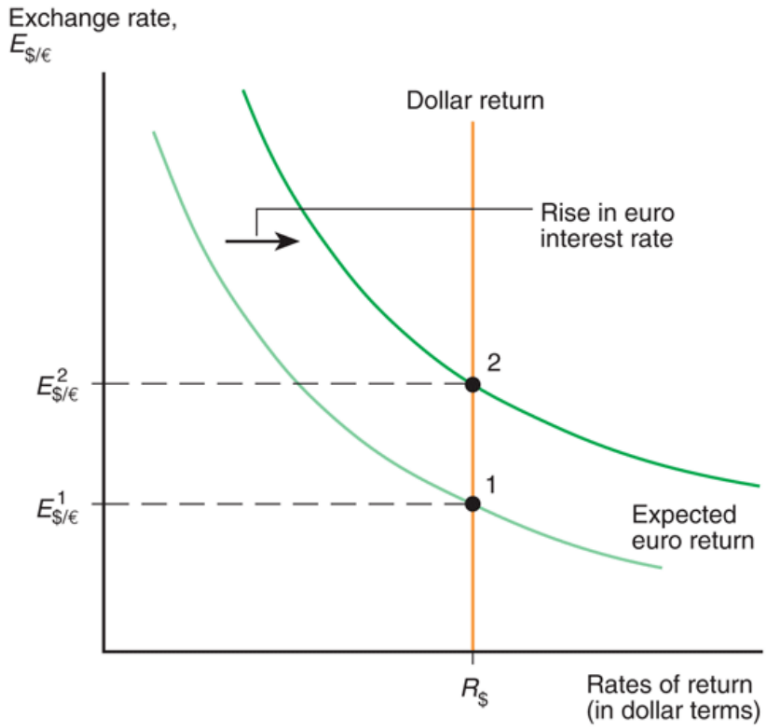


Changing future exchange rate and current exchange rate

$$R_{DKK,t} = R_{EURO,t} + \frac{E^e_{DKK/EURO,t+1} - E_{DKK/EURO,t}}{E_{DKK/EURO,t}}$$

- Rise in future exchange rate results in current currency appreciation



Review

- End review

Chapter 15: Money, Interest Rates, and Exchange Rates

Money

- Why do we need it?
  1. Medium of exchange
  2. Unit of account
  3. Store of value

Money - Medium of exchange

- Mutual cooincidence of wants
  - I want a bottle of water right now
  - 7-Eleven needs economic analysis right now
- Unlikely. . .
- Money helps us:
  - Avoid complicated barter exchanges
  - Automatically get the value of our own production
  - When we buy something, it is as if we had bartered

Money - unit of account

- Comparing values of different things
- Thought experiment
  - Suppose that the prices at the canteen in Solberg Plads were all in bananas
  - Suppose that the prices at the canteen in Porcelaenshavn were all in toothbrushes
  - For ex: Coke costs 10 bananas at SP, and 2 toothbrushes at P
  - Where is it more expensive?
- Money helps us:
  - Quickly compare prices across goods and locations

Money - Store of Value

- Money is an asset
  - If you want, keep in under your mattress!
- It is the most liquid asset, a benchmark

What is money?

- More difficult question than it seems!

Type of money	M0	MB	M1	M2	M3	MZM
Notes and coins in circulation (outside Federal Reserve Banks and the vaults of depository institutions) (currency)	✓[9]	✓	✓	✓	✓	✓
Notes and coins in bank vaults (Vault Cash)		✓				
Federal Reserve Bank credit (required reserves and excess reserves not physically present in banks)		✓				
Traveler's checks of non-bank issuers			✓	✓	✓	✓
Demand deposits			✓	✓	✓	✓
Other checkable deposits (OCDs), which consist primarily of Negotiable Order of Withdrawal (NOW) accounts at depository institutions and credit union share draft accounts.			✓[10]	✓	✓	✓
Savings deposits				✓	✓	✓
Time deposits less than $100,000 and money-market deposit accounts for individuals				✓	✓	
Large time deposits, institutional money market funds, short-term repurchase and other larger liquid assets[11]					✓	
All money market funds						✓

- M1 is the most liquid
- In this book, *money supply* is M1

A difficult quesiton

- Money does three things
  1. Medium of exchange
  2. Unit of account
  3. Store of value
- Why do we use pieces of paper and not gold coins?
- Or at least pieces of paper that could be redeemed for gold
  - What is the advantage we get from paper?
  - Gold has an advantage: independent value...
- Bitcoin...

Money Supply & Demand

- **money supply** controlled by Central Bank
  - Actually process a bit complicated, see Chpt. 18
  - For now just assume M1 chosen by Central Bank
- **money demand** represents the amount of monetary assets that people are willing to hold. This is based on:
  1. Interest rates/expected rates of return
  2. Risk/inflation
  3. Liquidity

Expected return and interest

- M1 pays no interest (to a first approximation)
- If hold cash, lose interest gained by holding illiquid asset
- The higher the interest rate, the higher opportunity cost of holding cash
  - One safe way of earning interest is a risk-free bond
  - Classic example, American T-Bill
  - The higher the return on T-Bill, the less demand for cash

Risk

- Textbook claims risk is not important
- Argument, all financial assets are denoted in currency
- Can't insure against risk
- I'm not sold on this argument: flexible rate bonds, bonds denoted in gold, etc
- OK as a first approximation

Liquidity

- Main use of cash – financing everyday purchases
- More purchases you make, the more cash you need
- Debit card (Dankort) purchases still in M1
- Credit card purchases also involve cash transfers

Individual demand for money

- Decreasing in the interest rate on other assets
- Mostly unrelated to risk
- Increasing in the amount of daily purchases

Aggregate Money Demand

- Sum up all individual demand
- The aggregate demand of real money can be expressed as:

$$\frac{M^d}{=} PL(R, Y)$$

where:

- P is the price level: higher prices, more cash needed
- Y is real national income: more stuff, more purchases
- R is a measure of interest rates on non-monetary assets
- $L(R, Y)$ is the aggregate demand of real monetary assets

Aggregate Demand of Real Money

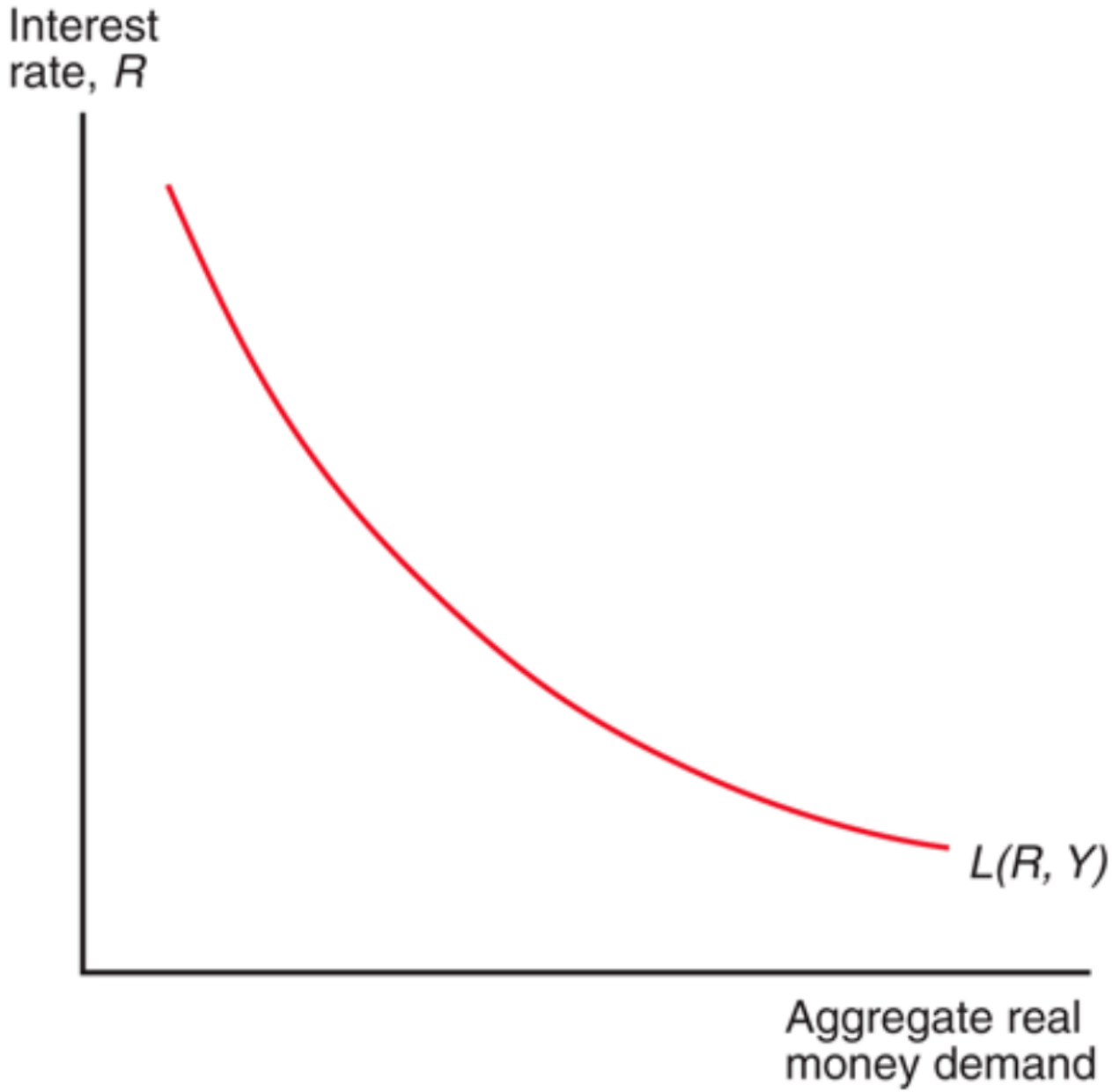
$$\frac{M^d}{P} = L(R, Y)$$

- M^d scales perfectly with P
- If all prices double, need twice as much cash
- Demand for real money

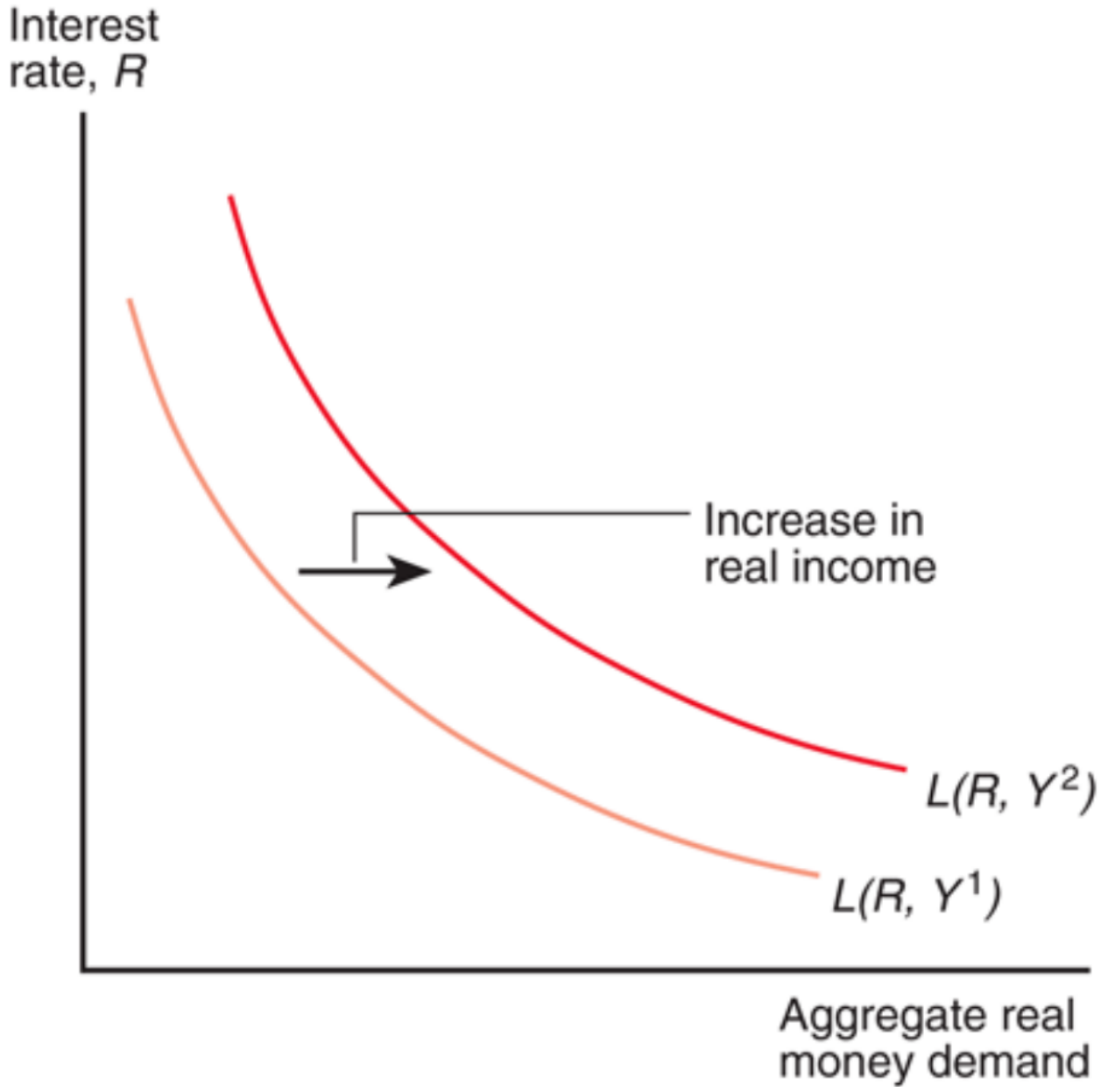
$$\frac{M^d}{P} = L(R, Y)$$

- The L function is demand for holding real value in liquid form

Money demand and interest rate



Shift in National Product



A Short-run Model of the Money Market

- Assume that changes in money supply do not affect:
  1. Price level
  2. GNP level
- Changes do affect interest rate of other assets
- In equilibrium:

$$M^s = M^d$$

- Plug in our formula for money demand, in equilibrium

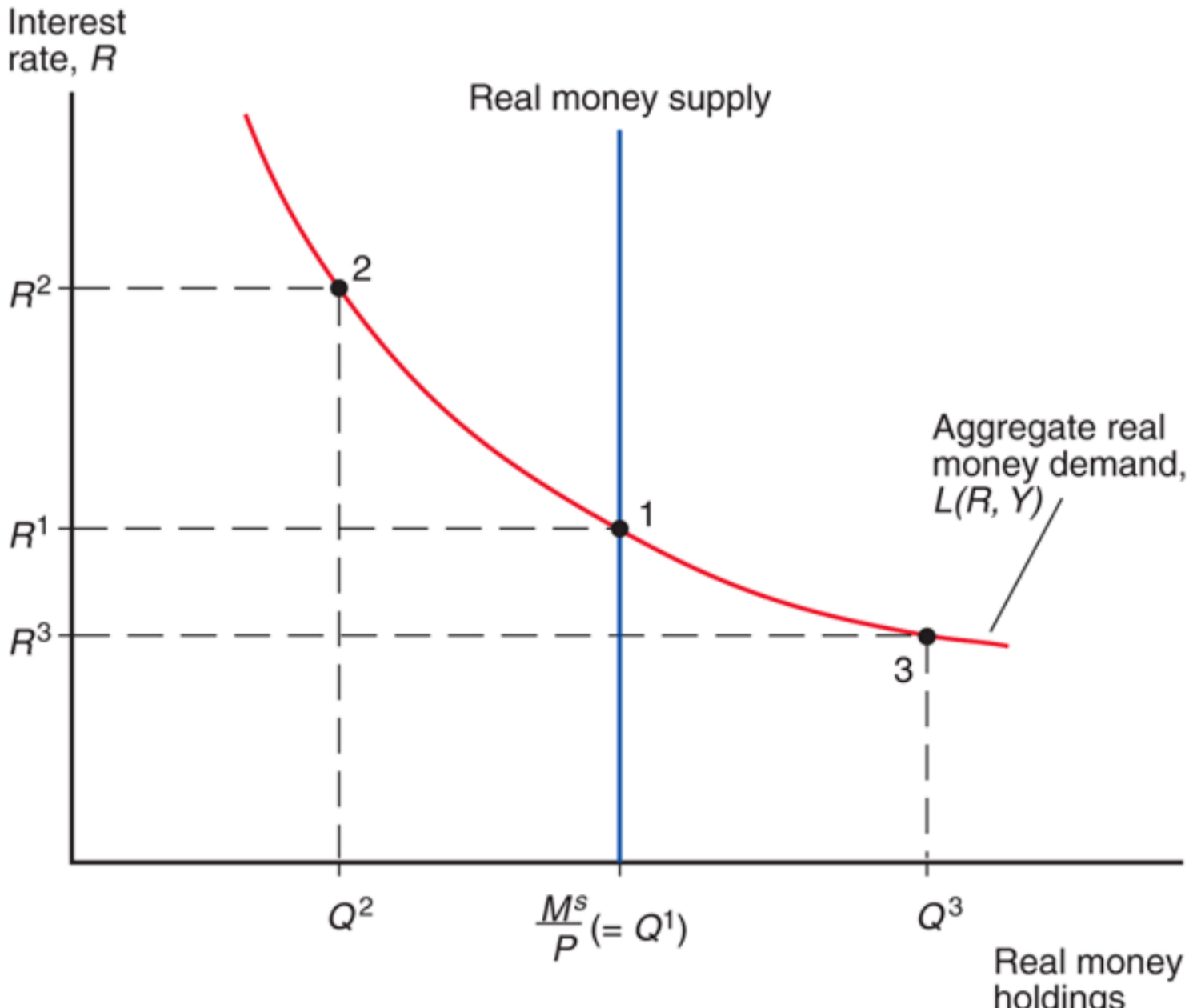
$$\frac{M^s}{P} = L(R, Y)$$

- Real money supply (LHS) equals real money demand (RHS)
- Higher money supply $\Rightarrow$ lower interest rate

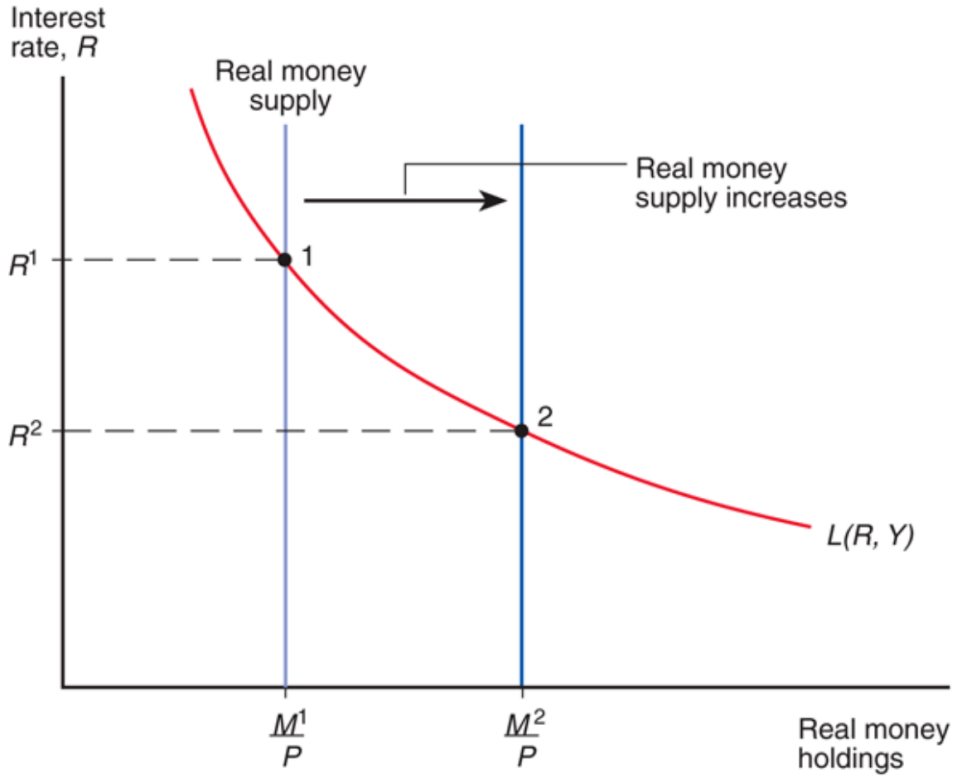
Money supply and interest rate in the short-run

- If more supply than demand for money:
  1. People with money will buy bonds for lower interest rate
  2. As interest rates fall, people more willing to hold money
- If more demand than supply for money:
  1. People will promise more money in the future for money today
  2. As interst rates rise, people less willing to hold money

Determination of the Equilibrium Interest Rate

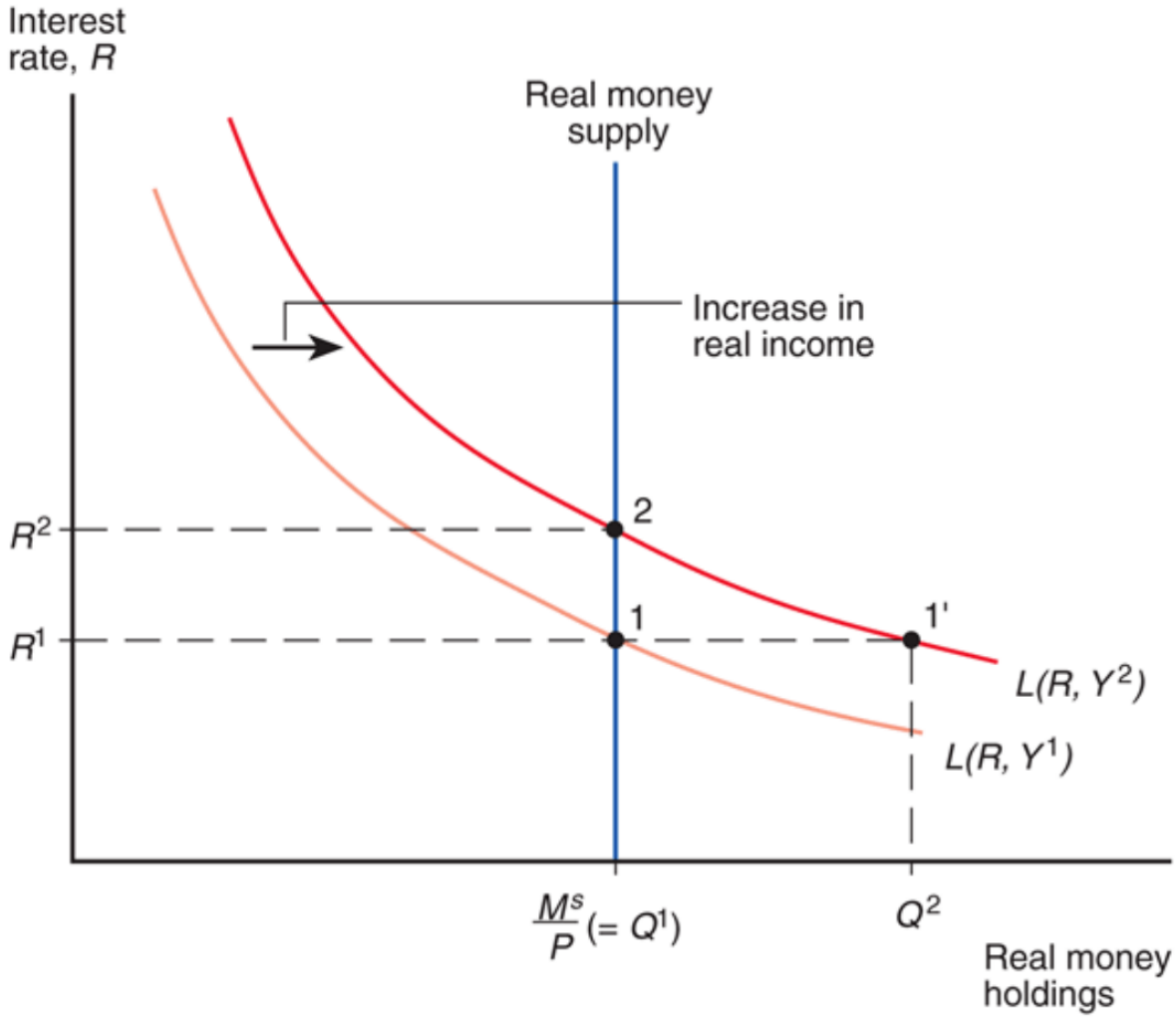


Effect of an Increase in the Money Supply on the Interest Rate



- Short run: Central bank can lower interest rate by increasing money supply
- Short run: Central bank can raise interest rate by decreasing money supply

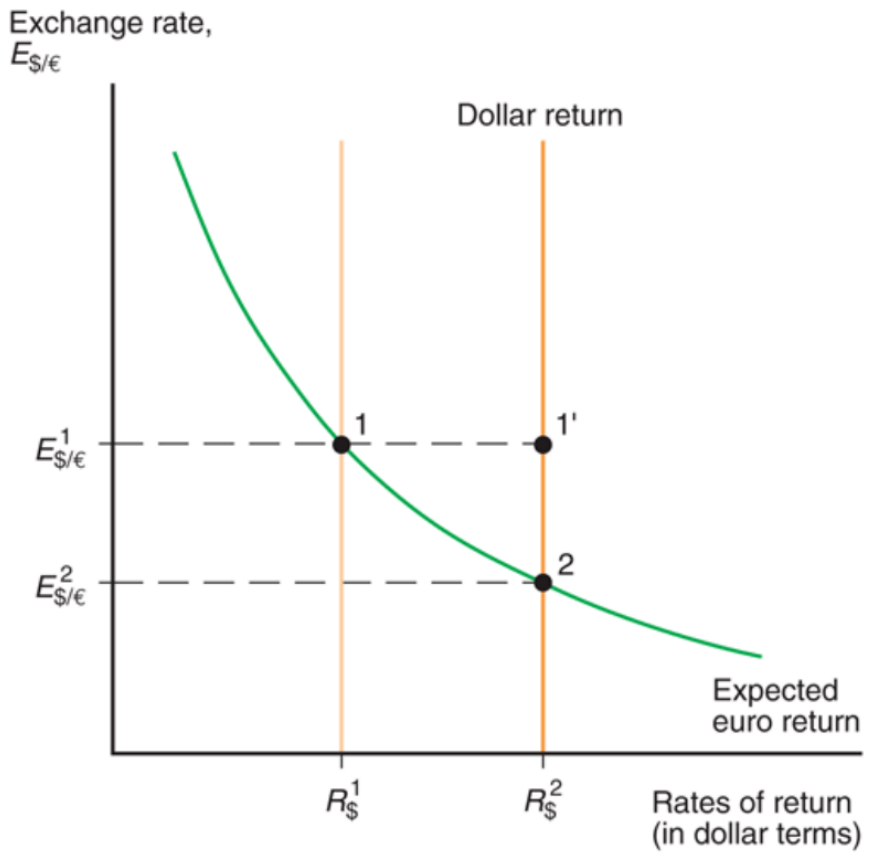
Effect on the Interest Rate of a Rise in Real Income



- Short run: Output growth increases interest rate
- Short run: A fall in output decreases interest rate

Reminder: Interest rate parity condition

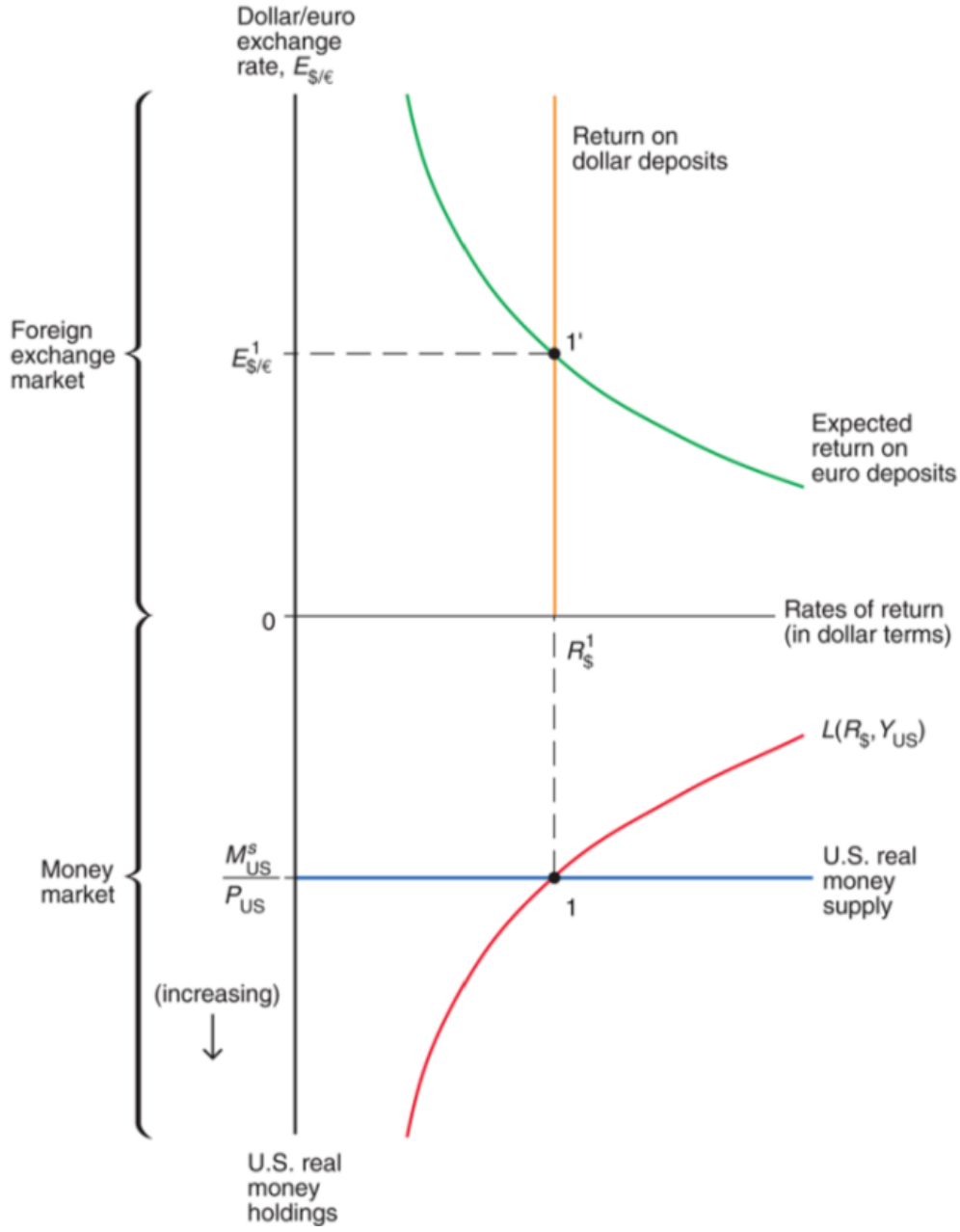
- Assume that the return on Euro bonds is fixed in Euros
- Given dollar interest rate, exchange rate adjusts to satisfy parity



Money supply and exchange rate

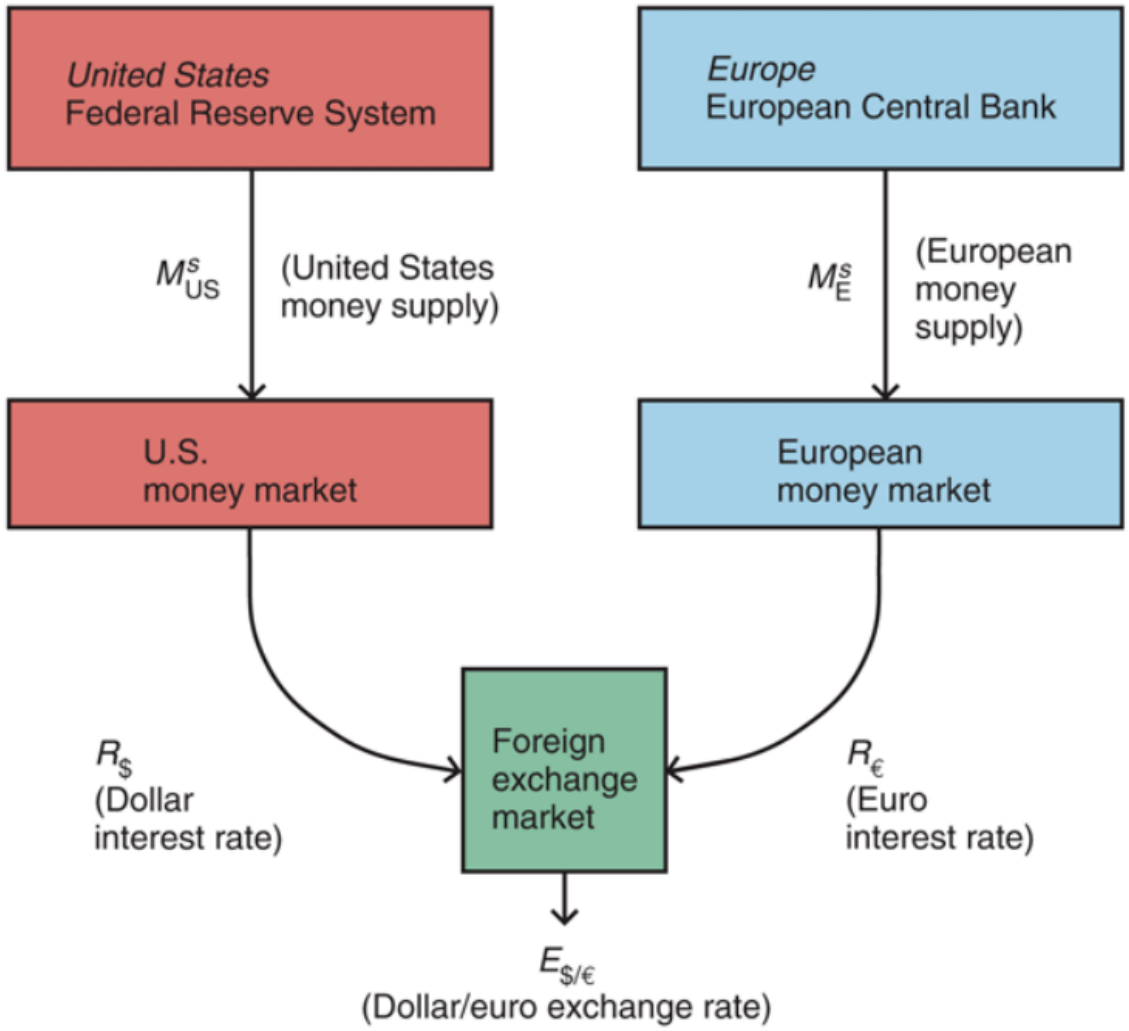
- Suppose Central Bank ups money supply
- Interest rate goes down as people buy bonds
- Dollar depreciates to maintain interest parity

Money supply and exchange rate

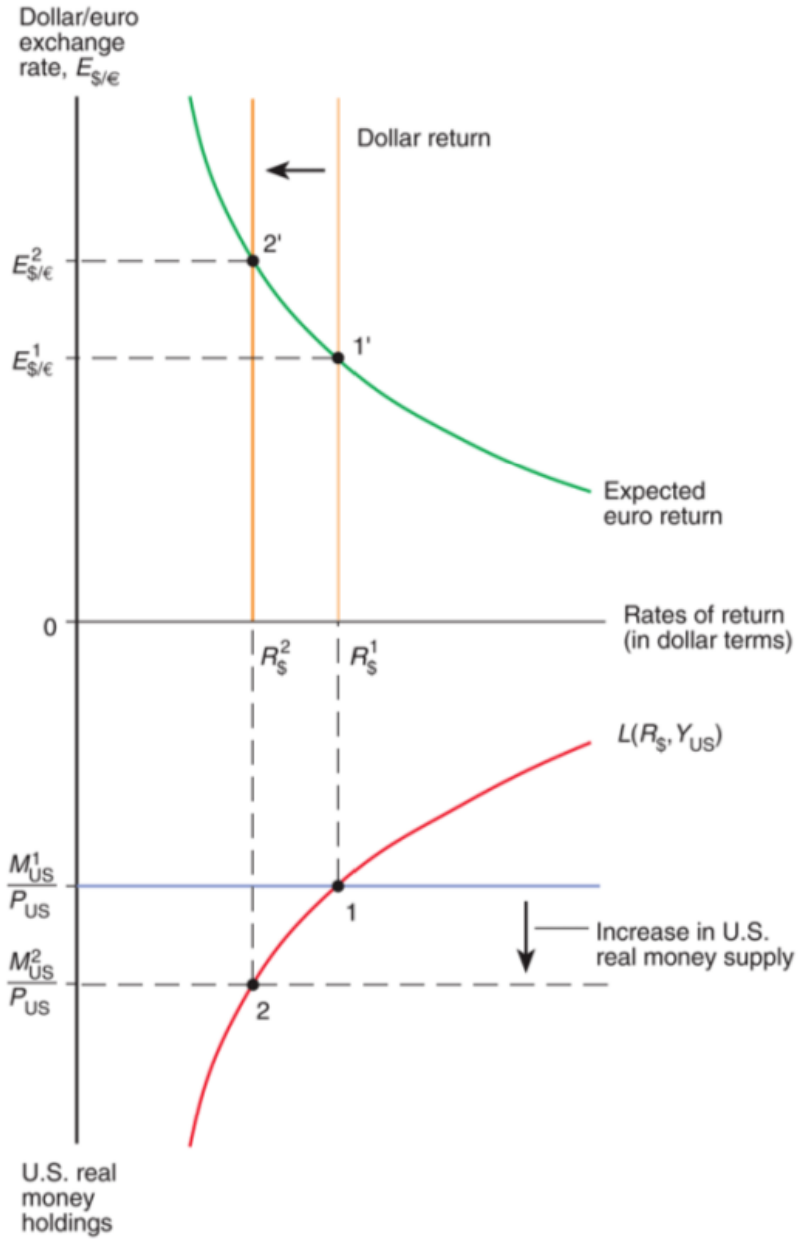


Money Market/Exchange Rate Linkages

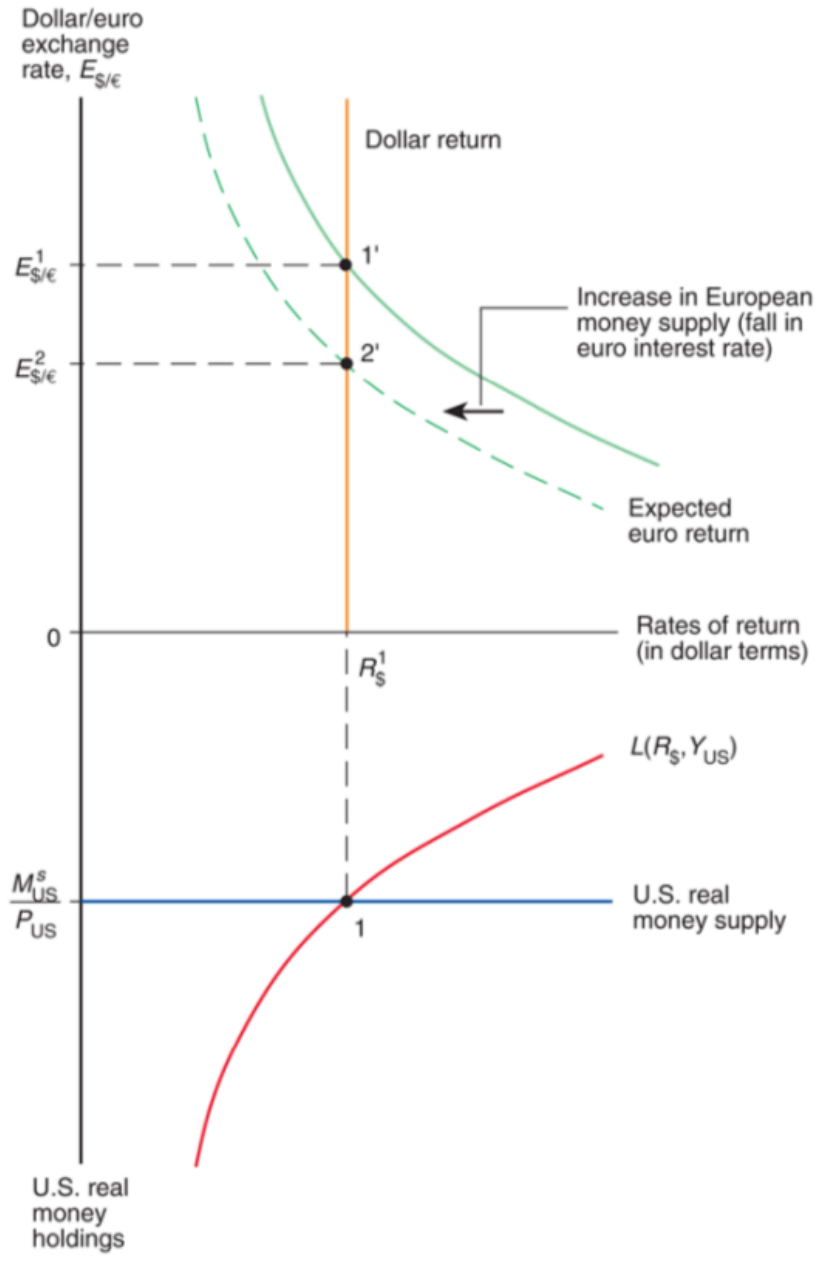
- It is a two central bank game!



Increase in dollar supply



Increase in euro supply



Changes in the Domestic Money Supply

An increase in a country's money supply:

- $R \Downarrow$
- depreciation of the domestic currency

An decrease in a country's money supply:

- $R \Uparrow$
- appreciation of the domestic currency

Changes in the Foreign Money Supply

How would a change in the supply of euros affect the U.S. money market and foreign exchange markets?

- An increase in the supply of euros $\Rightarrow$ depreciation of the euro
  1. $R_{EURO} \Downarrow$
  2. depreciation of the euro
- A decrease in the supply of euros $\Rightarrow$ appreciation of the euro

Long & Short Run

- Affect of more money supply
- **Short run:** Prices are sticky, real money supply rises
- **Long run:** Prices adjust so that real money supply falls to its original level

In the Long Run

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

- $M^s = PL(R, Y)$
- $P = \dfrac{M^s}{L(R, Y)}$

Money supply has no long run effecton output and interest rates

Money supply, output and interest

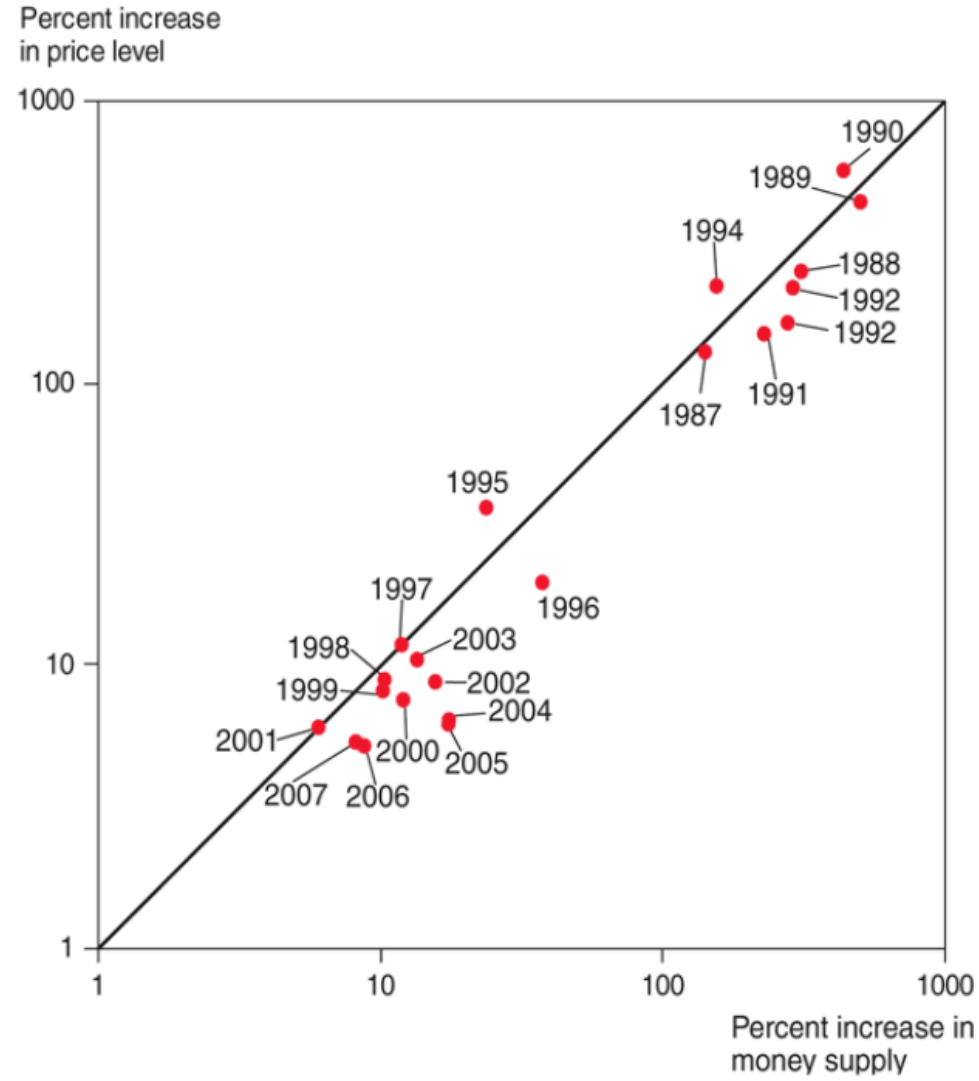
- Money supply has no long run effecton output and interest rates
- Intuition
  - A currency reform: Turkish millionaires
  - 2005, new Turkish lira, divide old lira by one million
  - For a period, both lira could be used
  - Everything in the country lost six zeros
  - No effect on output or interest
- Central Bank actions are similar
- Double the money, halve the prices

Money supply, demand, and inflation

- Long run prices:
- $P = \frac{M^s}{L(R, Y)}$
- $\frac{\Delta P}{P} = \frac{\Delta M^s}{M^s} - \frac{\Delta L}{L}$

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

Average Money Growth and Inflation in Western Hemisphere Developing Countries, by Year, 1987-2007



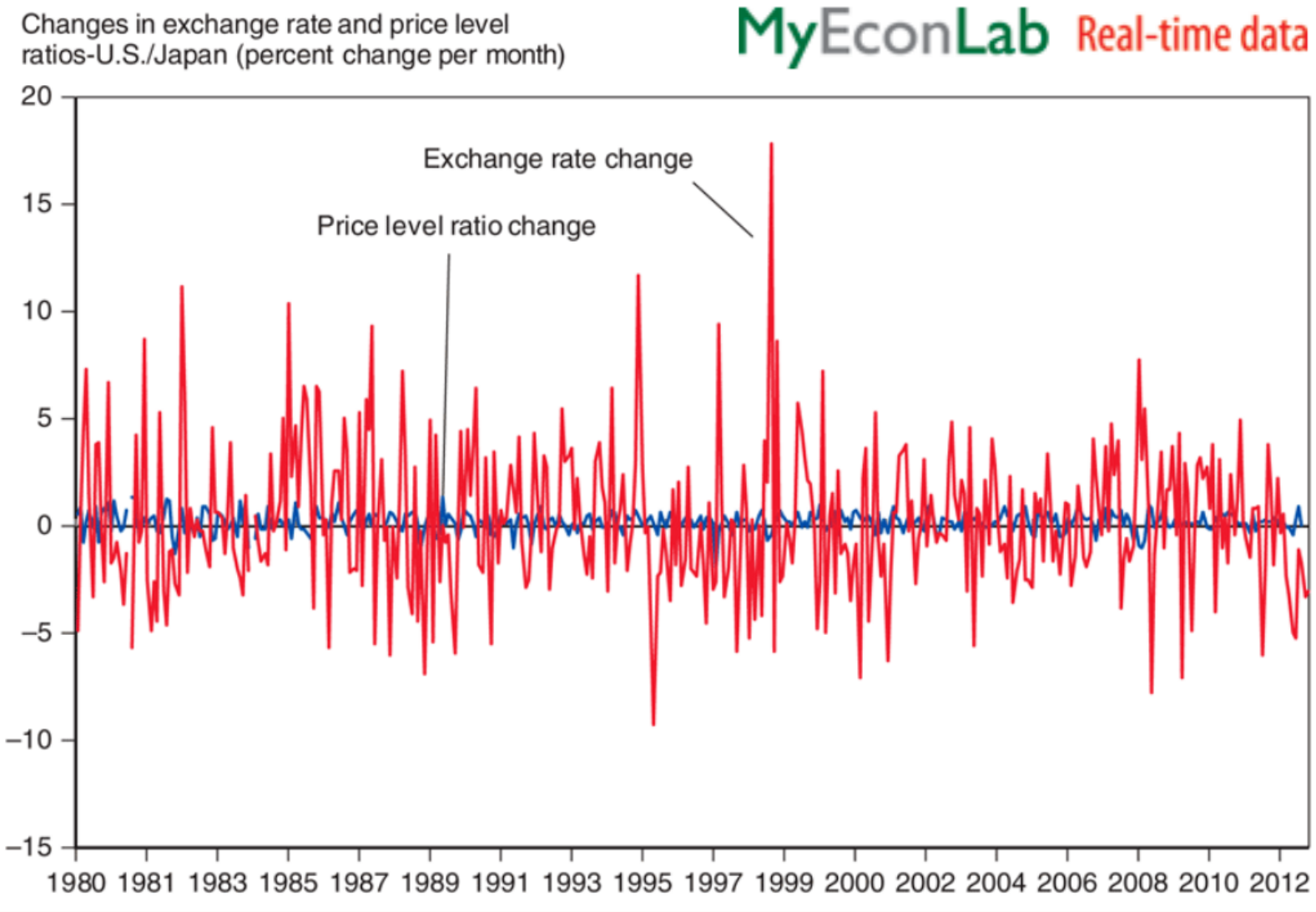
Source: IMF, *World Economic Outlook*, various issues. Regional aggregates are weighted by shares of dollar GDP in total regional dollar GDP.

Short run and Long run

- Money cannot shift prices immediately
  - Long-term contracts
  - Menu costs

Exchange Rates vs Price Level

- In short-run example, we let exchange rates adjust, not prices;
- This assumption seems reasonable for US and Japan



Source: Price levels from International Monetary Fund, *International Financial Statistics*. Exchange rate from Global Financial Data.

Short run and Long run

- Money cannot shift prices immediately
- Over time, however, prices will adjust
  1. Excess demand of goods and services: labor $\Uparrow \Rightarrow$ wage $w \Uparrow$ $P \Uparrow$
  2. Inflationary expectations: $P^e \Uparrow w \Uparrow P \Uparrow$
  3. Raw materials prices: Adjust quickly

Excess demand for factors

- More money but the same prices means people buy more
- To produce more, firms have to buy more inputs
- Old workers are stuck on contract
- New workers can bargain for higher wages
- The increase in input price causes increase in output price

Inflationary expectations

- People know about increse in money supply
- Long run, prices will rise
- Workers bargaining for Long-term contracts will demand higher wages

Raw materials

- The price of raw materials (oil) adjusts quickly
- Output prices eventually need to reflect increase in input cost

Money supply and exchange rates, long-run

- Review:
  - The return to Euro bonds in dollars depends on expected depreciation
  - The more the dollar is expected to depreciate, the higher Euro bond returns
- Permanent money supply increases raise expected depreciation

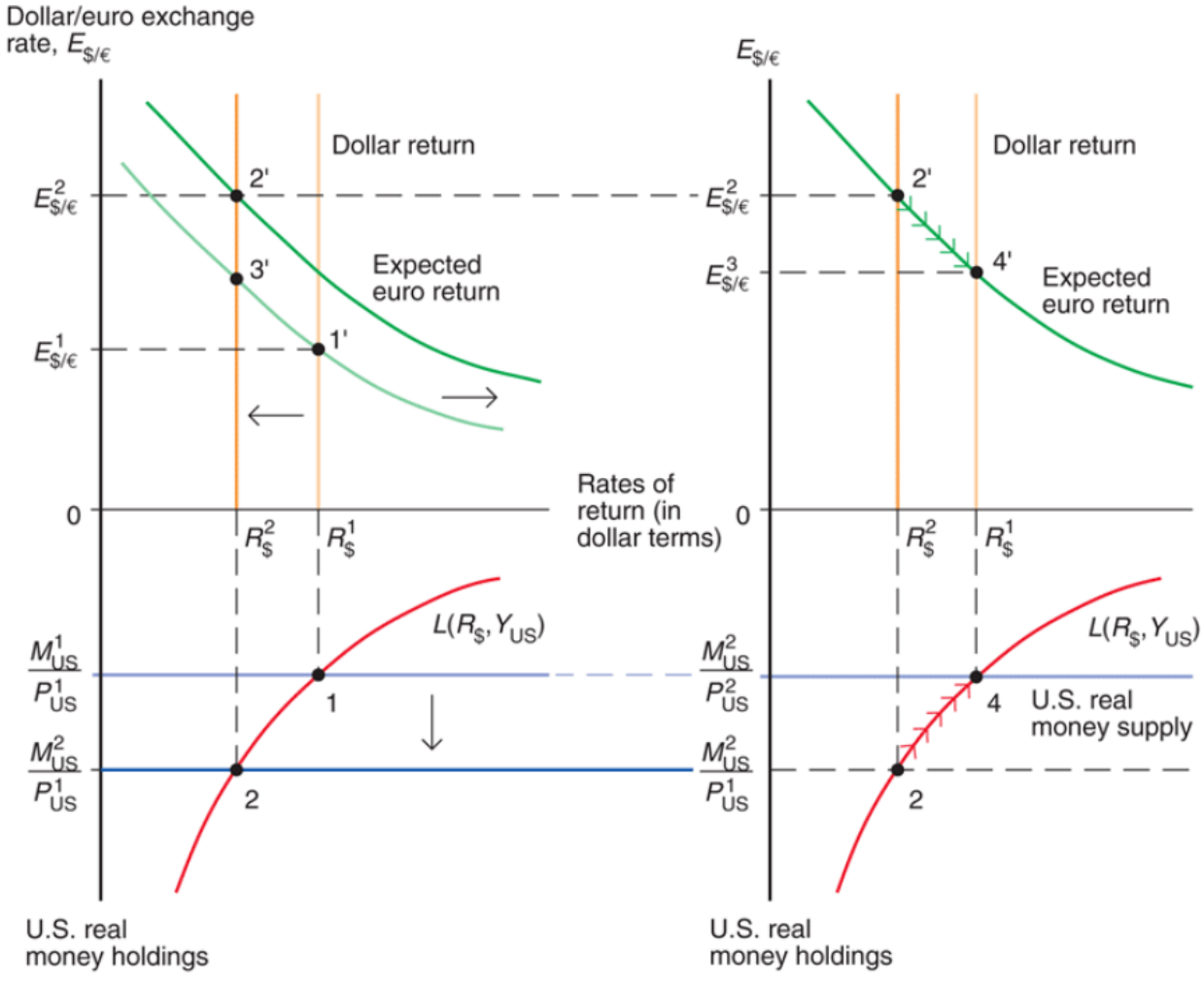
Money supply and exchange rates, long-run

- Review:
  - The return to Euro bonds in dollars depends on expected depreciation
  - The more the dollar is expected to depreciate, the higher Euro bond returns
- Permanent money supply increases raise expected depreciation

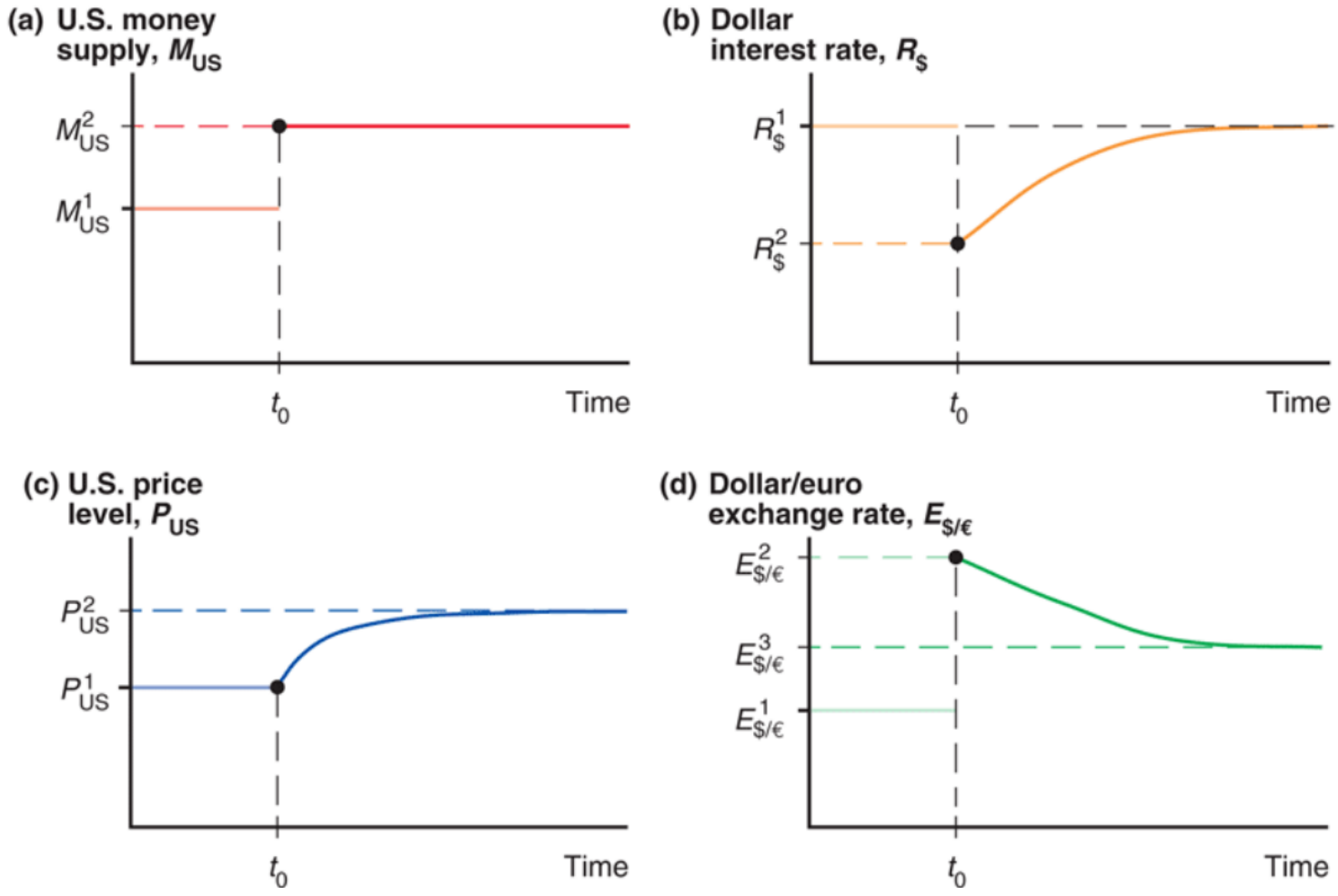
Increase in money supply and exchange rate, long-run

- Initially:
  - Money supply goes up, interest rate falls, depreciation
  - Money supply goes up, expected depreciation, more depreciation
- Then:
  - Prices adjust to long run real money supply level
  - Real money supply falls, interest rate rises, appreciation
  - Exchange rate settles level depreciated relative to initial level
- The double depreciation followed by appreciation: *exchange rate overshoot*

Money, Prices, Exchange Rates, and Expectations



Money, Prices, Exchange Rates, and Expectations



Summary of Chapter 15

- We have seen short run sticky prices which cause short-run real effects
- We have seen that in the long run, money is neutral (no real affect)
- We have seen that expectations about money supply affect current exchange rates
- In Chapter 16, we will study how long-term demand and supply shifts affect exchange rate
- Discussion builds on the linkages studied in Chapter 15

Chapter 16: Price Levels and the Exchange Rate in the Long Run

The Law of One Price (1)

The prices of identical goods sold in different countries must be the same when expressed in terms of the same currency.

- This law applies only in competitive markets free of transport costs and official barriers to trade.
- Example: If the dollar/pound exchange rate is USD 1.50 per pound, a sweater that sells for USD 45 in New York must sell for £30 in London.

The Law of One Price (2)

The dollar price of good i is the same wherever it is sold

$$P^i_{US} = \left(E_{USD/EURO}\right) x \left(P^i_E\right)$$

where:

- P^i_{US} is the dollar price of good i when sold in the U.S.
- P^i_{EURO} is the corresponding euro price in Europe
- $\left(E_{USD/EURO}\right)$ is the dollar/euro exchange rate

Purchasing Power Parity (PPP)(1)

PPP

- is the application of the law of one price across countries for *all* goods and services.
- compares average prices across countries
- predicts a dollar/euro exchange rate of

$$E_{USD/EURO} = \frac{P_{US}}{P_E}$$

where

- P_{US} is the dollar price of a reference commodity basket sold in the United States
- P_E is the euro price of the same basket in Europe

Purchasing Power Parity (PPP)(2)

Rearranging,

$$P_{US} = \left(E_{USD/EURO}\right) x \left(P_E\right)$$

All countries' price levels are equal when measured in terms of the same currency

PPP & Law of One Price

- The law of one price applies to individual commodities; PPP applies to the general price level
- If the law of one price holds true for every commodity $\Rightarrow$ PPP must hold for the same reference baskets across countries
- BUT if PPP holds, this does not mean that law of one price is respected

Purchasing Power Parity (PPP)(3)

1. Absolute PPP: exchange rates equal relative price levels
2. Relative PPP: the percentage change in the exchange rate between two currencies equals the difference between the percentage changes in national price levels.

$$\frac{(E_{USD/EURO,t} - E_{USD/EURO,t})}{E_{USD/EURO,t-1}} = \pi_{US,t} - \pi_{EUROPE,t}$$

where π_t = inflation rate from period $t-1$ to t

Absolute & Relative PPP (1)

If absolute PPP holds $\Rightarrow$ relative PPP holds

	t	$t+1$
Absolute PPP	$P_{US,t-1} = USD100$ $E_{t-1}P_{EURO,t-1} = USD100$	$P_{US,t-1} = USD110$ $E_tP_{EURO,t} = USD110$
$\Rightarrow$		
Relative PPP	$\pi_{US,t} = 10\%$ $\pi_{EUROPE,t} = \frac{(E_t - E_{t-1})}{E_{t-1}}$	

Absolute & Relative PPP (2)

Not the other way around!

	t	$t+1$
Relative PPP	$\pi_{US,t} = 10\%$ $\pi_{EUROPE,t} = \frac{(E_t - E_{t-1})}{E_{t-1}}$	
NOT TRUE $\Rightarrow$		
Absolute PPP	$P_{US,t-1} = USD200$ $E_{t-1}P_{EURO,t-1} = USD100$	$P_{US,t-1} = USD220$ $E_tP_{EURO,t} = USD110$

- Next time we will continue our discussion of Chapter 16

A Long-Run Exchange Rate Model Based on PPP

- Monetary approach to the exchange rate
- A theory of how exchange rates and monetary factors interact in the long run.
- The fundamental equation of the monetary approach
- Price levels can be expressed in terms of domestic money demand and supplies.

1. In the United States:

$$P_{US} = \frac{M^s_{US}}{L(R_{USD}, Y_{US})}$$

2. In Europe:

$$P_{EUROPE} = \frac{M^s_{EURO}}{L(R_{EURO}, Y_{EUROPE})}$$

PPP and Money Market

$$E = \frac{P_{US}}{P_{EURO}} = \frac{\frac{M^s_{US}}{L(R_{USD}, Y_{US})}}{\frac{M^s_{EURO}}{L(R_{EURO}, Y_{EUROPE})}}$$

Specific Predictions:

1. Money supplies: if M^s_{US} (M^s_{EU}) $\Uparrow\Rightarrow$ long-run depreciation (appreciation) of the dollar against the euro
2. interest rates: if R_{USD} (R_{EU}) $\Uparrow\Rightarrow$ causes a depreciation (appreciation) of the dollar against the euro
3. Output levels: a rise if Y_{US} (Y_{EUROPE}) $\Uparrow\Rightarrow$ causes an appreciation (depreciation) of the dollar against the euro.

The Fisher Effect (1)

- A more reasonable description of monetary policy is constantly growing money supply
- Money supply grows at a constant growth rate results in ongoing inflation at the same rate

The Fisher Effect (2)

$$E = \frac{P_{US}}{P_{EURO}} = \frac{\frac{M^s_{US}}{L(R_{USD}, Y_{US})}}{\frac{M^s_{EURO}}{L(R_{EURO}, Y_{EUROPE})}}$$

Given M^s_{EURO} and P_{EURO} constant, if M^s_{US} grows by π, P_{US} grows by π

$$\Rightarrow$$

E depreciated by π each period

$$\frac{E_t - E_{t-1}}{E_t} = \pi_t - \pi_{t-1}$$

Monetary policies in the US and Euroland determine the development in the exchange rate

The Fisher Effect (3)

Given Uncovered Interest Rate Parity,

$$R_{USD,t} = R_{EURO,t} + \left(\frac{E^e_{EURO,USD,t+1} - E_{EURO,USD,t}}{E_{EURO,USD,t}} \right)$$

and relative PPP

$$\frac{(E_{USD/EURO,t} - E_{USD/EURO,t})}{E_{USD/EURO,t-1}} = \pi_{US,t} - \pi_{EUROPE,t}$$

$$\Rightarrow$$

Real interest rates are equal

$$\Rightarrow$$

$$R_{USD} - R_{EURO} = \pi^e_{US} - \pi^e_{EUROPE}$$

or

$$R_{USD} - \pi^e_{US} = R_{EURO} - \pi^e_{EUROPE}$$

The Fisher Effect (4)

Given Uncovered Interest Rate Parity,

$$R_{USD,t} = R_{EURO,t} + \left(\frac{E^e_{EURO,USD,t+1} - E_{EURO,USD,t}}{E_{EURO,USD,t}} \right)$$

and relative PPP

$$\frac{(E_{USD/EURO,t} - E_{USD/EURO,t})}{E_{USD/EURO,t-1}} = \pi_{US,t} - \pi_{EUROPE,t}$$

$$\Rightarrow$$

Real interest rates are equal

$$\Rightarrow$$

$$R_{USD} - R_{EURO} = \pi^e_{US} - \pi^e_{EUROPE}$$

or

$$R_{USD} - \pi^e_{US} = R_{EURO} - \pi^e_{EUROPE}$$

The Fisher Effect (5)

- A rise (fall) in a country's expected inflation rate will eventually cause an equal rise (fall) in the interest rate that deposits of its currency offer.
- In the long run, purely monetary developments should have no real effects.
- expected growth in money supply affects the interest rate through inflation.

Overall trade review