Money, Interest Rates, and Exchange Rates

International Finance

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2024

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This lecture

1. Introduction
2. Money Supply
3. Money demand
4. Money market equilibrium
5. The Money Supply and the Exchange Rate in the Short Run
6. Money, the Price Level, and the Exchange Rate in the Long Run
7. Inflation and Exchange Rate Dynamics
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Introduction

Introduction

- Factors that affect a country's money supply or demand are among the most powerful determinants of its currency's exchange rate against foreign currencies.
- This chapter combines the foreign-exchange market with the money market to determine the exchange rate in the short run.
- It analyzes the long-term effects of monetary changes on output prices and expected future exchange rates.

Introduction: goals

- At the end of this class you should know what is money and what variables affect its demand and supply.
- You should understand why the price of money is the nominal interest rate.
- You will be acquainted with some of the tools and mechanisms through which monetary policy is conducted. You will be expected to know how the conventional instruments work.
- The main goal of this lecture is to connect the equilibrium in the money market with the exchange rate.

Introduction: what is money?

- What does it mean to have a lot of money?
- The value of our wealth is stored in different assets, a subset of such assets is money.
- Liquidity: speed at which an asset can be purchased or sold without causing a drastic change in its price.
- **Money**: assets that are widely used and accepted as payment and therefore readily to make transactions.
- Functions of money:
  - Medium of exchange
  - Unit of account
  - Store of value

Introduction: from barter to fiat money

- Barter is inefficient: double coincidence of wants.
- Money facilitates trade of goods and services: e.g., allows people to trade their labor for money, then use the money to buy goods and services in separate transactions.
- A commodity has intrinsic value. Accept it in a transaction seems somehow natural.
- But commodities can be bulky and inconvenient.
- A certificate or claim to the ownership of the commodity would help.
- If no one consume the commodity, and use the certificates mostly for transactions, the intrinsic value becomes irrelevant.
- Fiat money has no intrinsic value, but is worth to hold because we all use it.

Example

Figure 1: Canadian bank note, 1817

Example

Figure 2: US 100 dollar bill, 1882

Example

Figure 3: Canadian dollar, 1935

Introduction: money and banking

- History of money and banking are tightly intertwined.
- The banking business is to borrow and lend.
- Banks wrote claims which where paid on demand —paper money.
- Some of the deposits are lent by the bank to the public.
- What would happen if some borrowers do not pay back? How about the majority not paying back?
- What would happen if too many notes are printed and all of them arrive at the bank the same time?

Introduction: money and banking

"Trust grows at the speed of a coconut tree, and falls at the speed of a coconut"

- Money and banking requires a build up of trust/reputation.
- The value of a bank note would fade away in the case of bankruptcy.
- The rules of the banking system were born to minimize these problems.
- Nonetheless, even with good rules and good practices, there's still room for failure. (Financial crises in the U.S. vs U.K in the XIX century)
- Central bank: the bank of the banks and the lender of last resort.

Introduction: measuring money

Although in most countries there is a monopoly on the supply of currency, there are other assets —usually supplied by the banking system— that fall in our definition of money. (do you have *money* in your checking account?)

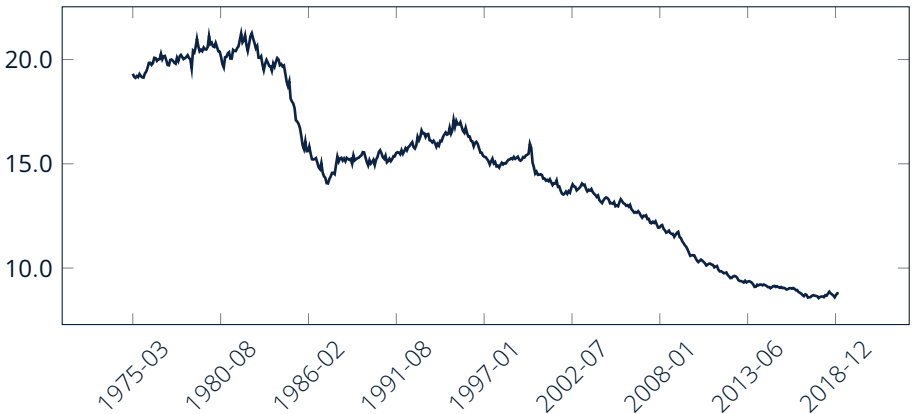
- Distinguishing what is money from what is not is sometimes difficult. (financial innovation and technology)
- There is no single best measure of the money stock.
- Most central banks of the world keep track of M1 and M2.

Introduction: measuring money

Bank of Canada (link):

- M1+ (gross): Currency outside banks plus all chequable deposits held at chartered banks, trust and mortgage loan companies, credit unions and caisses populaires.
- M1++ (gross): M1+ (gross) plus all non-chequable deposits (other than fixed-term deposits) held at chartered banks, $\cdots$; less interbank deposits; plus continuity adjustments.
- M2 (gross): Currency outside banks plus bank personal deposits, bank non-personal demand and notice deposits; less interbank deposits; plus continuity adjustments.
- M3 (gross): M2 (gross) plus bank non-personal term deposits and foreign-currency deposits of residents; less interbank deposits; plus continuity adjustments.

Figure 4: Currency outside banks as % of M1+



Source: Bank of Canada, Selected monetary aggregates and their components

Money Supply

Money Supply

- We know that the central bank holds the monopoly of issuing currency.
- Define the monetary base as the total amount of dollars held by the public (C), plus the dollars held by banks as reserves (R). $B = C + R$
- For the purpose of this class consider money to be currency in circulation (C) plus deposits (D). (M1+)
- Assume banks have to hold a minimum proportion ν_d of their deposits as reserves. Would they hold more?
- Assume households like to hold a proportion ν_c of their money as currency.
- Note that B, ν_d, and ν_c are exogenous variables. Both B and ν_d are decided by the central bank.

Money Supply

- The supply of money is:

$$M^s = C + D$$

- The monetary base is :

$$B = C + R$$

- We would like to express the money supply as a function of the exogenous variables
- Note that $\frac{M^s}{B} = \frac{C/D+1}{C/D+R/D}$
- Substituting the definition of currency and reserves to deposit ratios, and rearranging we get

$$M^s = \underbrace{\frac{1+\nu_c}{\nu_c+\nu_d}}_{\text{multiplier}} \times B \tag{1}$$

Money multiplier

In a fractional-reserve banking system, the supply of money corresponds to the monetary base multiplied by a factor (greater than one) that increases as less currency the household wants to hold, and the less reserves banks are required to have. This factor is called the money multiplier.

Example

Money multiplier

- Assume the central bank prints $ 100, and makes it available to the public.
- People don't like to keep cash in the pockets so they make a deposit in the bank. $\nu_c = 0$
- The bank lend $80 and keep as reserves $20. $\nu_d = 0.2$
- The $80 borrowed by the public is used to make transactions. The counterpart in the transaction makes a deposit of $80.
- The bank lends $64 and keeps as reserves $16 ...

Money multiplier (cont)

- At the end of the cycle, the amount of currency in circulation is 0 and deposits are:

$$D = 100 \times \left[1 + (1 - 0.2) + (1 - 0.2)^2 + \cdots\right] = 100 \times \frac{1}{0.2}$$

- Therefore, the money supply in this economy is

$$M^s = C + D = 0 + 500$$

- The money multiplier is 5

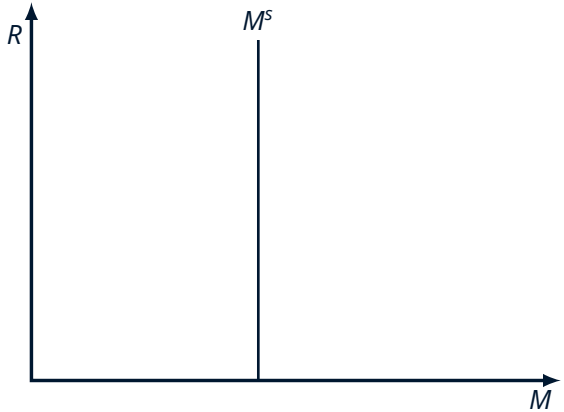
Money Supply and monetary policy

- Let's say that the central bank would like to increase the quantity of money supplied in the economy.
- How can this be done? helicopter drop!?
- Some of the typical instruments:
  - **Open market operations**: purchases and sales of government bonds. (to banks, not directly from the government!)
  - **Discount window rate**: banks interact with the central bank to meet reserve requirements or in case of emergencies.
  - **Reserves requirements**: impose on banks a minimum reserve–deposit ratio
- Unconventional instruments: quantitative easing.

Money Supply

- We will assume the supply of money given exogenously by the monetary authority

Figure 5: Money Supply



Money demand

Money demand: why do we use money?

- **Portfolio theories**: people hold many different assets, including money, bonds, stocks, houses, and consumer durable goods.
- **Transaction theories**: money is necessary to make transactions.
- Combining both imply that holding money and non-monetary assets requires to balance:
  - Expected Return
  - Risk
  - Liquidity
  - Time to maturity
- We will see a simple model where holding money is costly but necessary for transactions.

Money demand: Baumol-Tobin

- Assume households want to spend Y smoothly during the period. To keep things simple assume prices don't change.
- Transactions are made using cash only. (money = cash)
- Each withdrawal of money costs f (e.g., fees)
- Alternative assets have a return of R (e.g., savings account or bonds)
- The household has to decide how many times it will withdraw money (N).

Money demand: Baumol-Tobin

- If the household withdraws once ($N = 1$) the average cash holding is $Y/2$ (Y at the beginning and 0 at the end)
- If the household withdraws N times the average cash holding is $Y/(2N)$
- The total cost is the sum of the transaction fees plus the foregone interest:

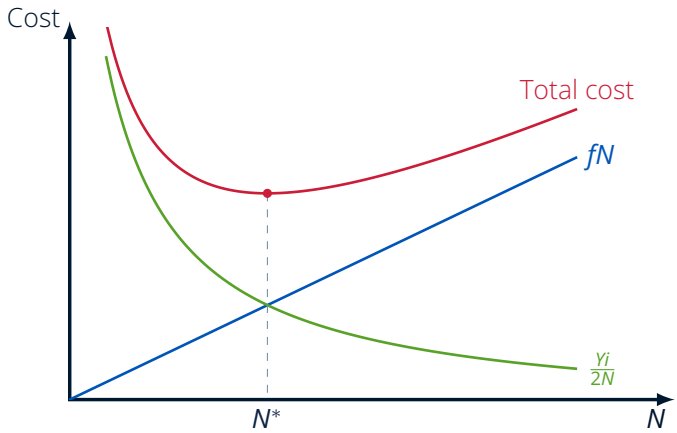
$$\text{Total Cost} = N \times f + \frac{Y}{2N} \times R$$

- The first order condition of the previous equation with respect to N implies

$$N^* = \sqrt{\frac{YR}{2f}}$$

Money demand: Baumol-Tobin

Figure 6: Cost of withdraw



Money demand: Baumol-Tobin

- With the optimal number of trips we can compute the money demand (average cash holding)

$$M^d = \sqrt{\frac{Yf}{2R}} \tag{2}$$

- This demand has two properties that are supported by the data
  1. The elasticity with respect income is positive.
  2. The elasticity with respect interest rates is negative.
- Note that the elasticities for income and interest rates are $1/2$ and $-1/2$, respectively. This is a strong prediction that empiric studies do not ratify.
- One hypothesis is that the parameters in the demand function are volatile. (This is very relevant at the time of choosing a monetary policy instrument: interest rates vs quantity of money)

Money demand: a generalization

The model we just saw can give you an idea on how the money demand works. For the rest of the course we will continue with a general version of it, maintaining some of the properties and including prices.

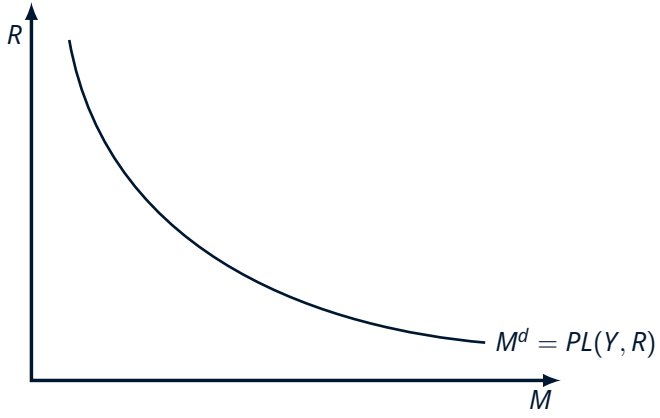
$$M^d = P \times L(Y, R) \tag{3}$$

where

- M^d is the aggregate nominal money demand.
- P is the price level.
- Y is real income/output.
- R is the nominal interest rate.
- L is the demand for real money balances (Liquidity)
  - $\frac{\partial L}{\partial i} < 0$
  - $\frac{\partial L}{\partial Y} > 0$ with elasticity less than 1.

Money demand

Figure 7: Money Demand



Money market equilibrium

Money market equilibrium

- Equilibrium in the money market is reached when money supply equalizes money demand.

$$M^s = P \times L(Y, R)$$

- Recall that money and non-monetary assets (e.g., bonds) are related through the foregone interest when choosing money.
- The higher the price of a bond, the lower its yield.

Bond prices and yields

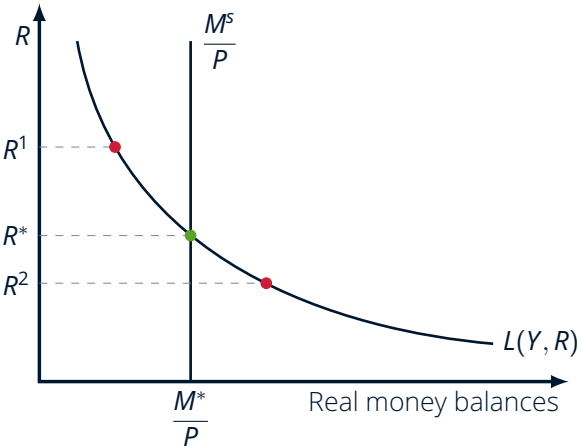
The return of a bond that costs \$100 and will pay \$110 at maturity is $\frac{110}{100} - 1 = 10\%$. If the price of the same bond jumps to \$104.7, its return fall to $\approx \%5\%$

Money market equilibrium

- How does the money market clears?
- Assume there is an excess of supply of money.
  - When there is too much money, the private sector's demand for non-monetary assets increase.
  - Higher demand for non-monetary assets implies higher price if the supply remains unchanged.
  - An increase in the price of the non-monetary asset implies a fall in the return/interest rate.
  - Lower return/interest rates increase the quantity of money demanded.
  - The excess supply gap closes.
- The exercise with excess demand in similar

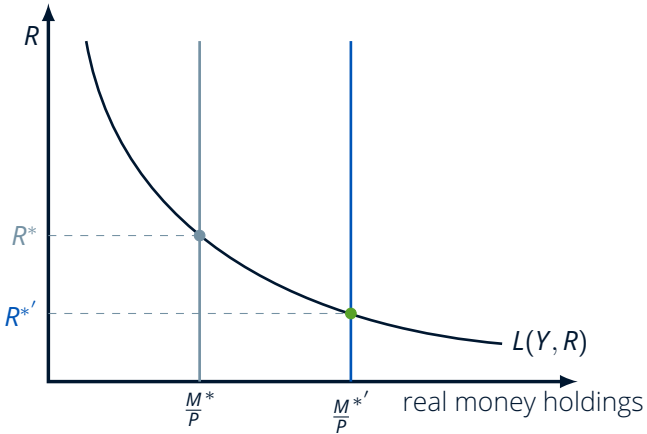
Money market equilibrium: interest rate and real money holdings

Figure 8: Determination of the Equilibrium Interest Rate



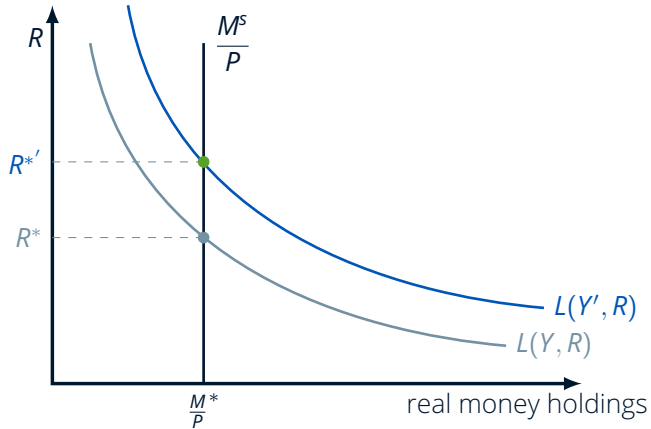
An increase (fall) in the money supply lowers (raises) the interest rate, given the price level and output.

Figure 9: Effect of an Increase in the Money Supply on the Interest Rate



An increase (fall) in real output raises (lowers) the interest rate, given the price level and the money supply.

Figure 10: Effect on the Interest Rate of a Rise in Real Income



The Money Supply and the Exchange Rate in the Short Run

All price rigidities fade away in the long run, and output depends on inputs and technology

Short run analysis

The price level and the real output are given (fixed).

Long run analysis

The price level is perfectly flexible and always adjust to preserve full employment.

The local money market determines the local interest rate, which in turn affects the exchange rate that maintains the interest parity.

Figure 11: Simultaneous Equilibrium in the Local Money Market and the Foreign-Exchange Market

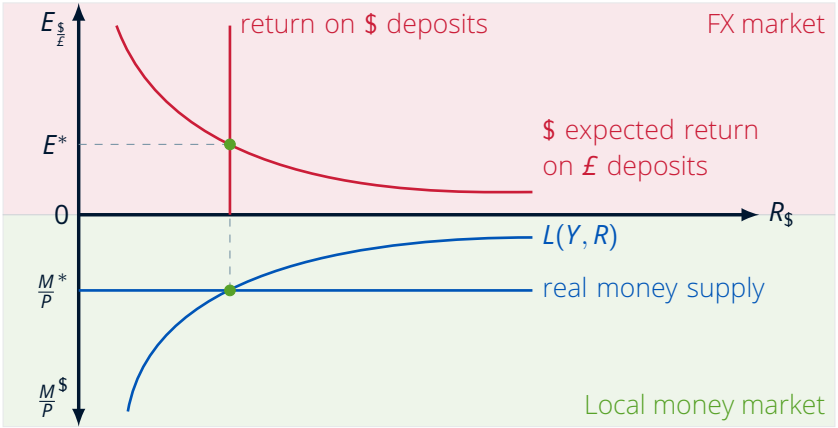
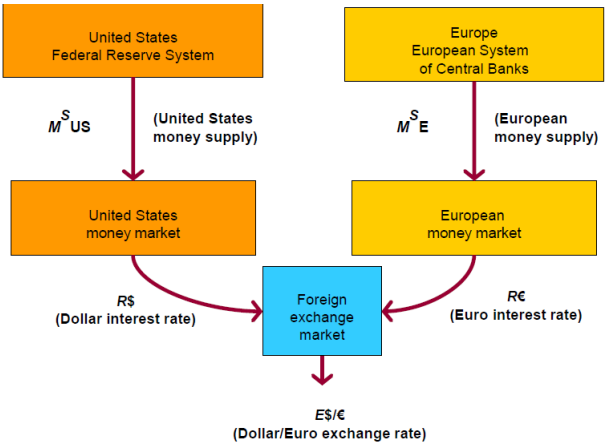
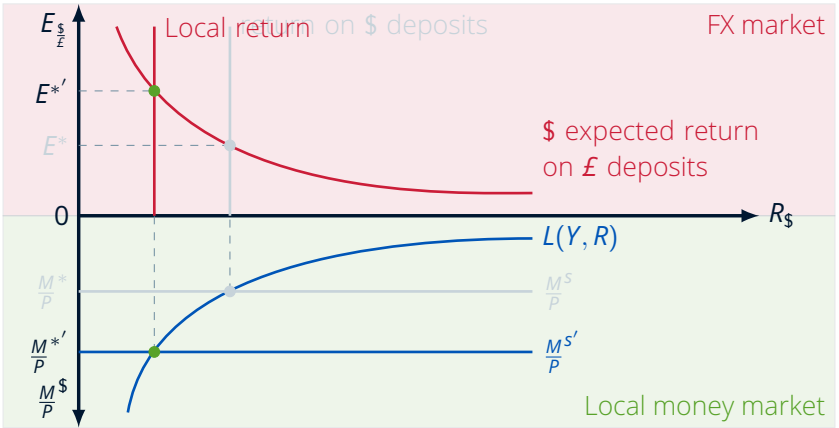


Figure 12: Money-Market/Exchange Rate Linkages



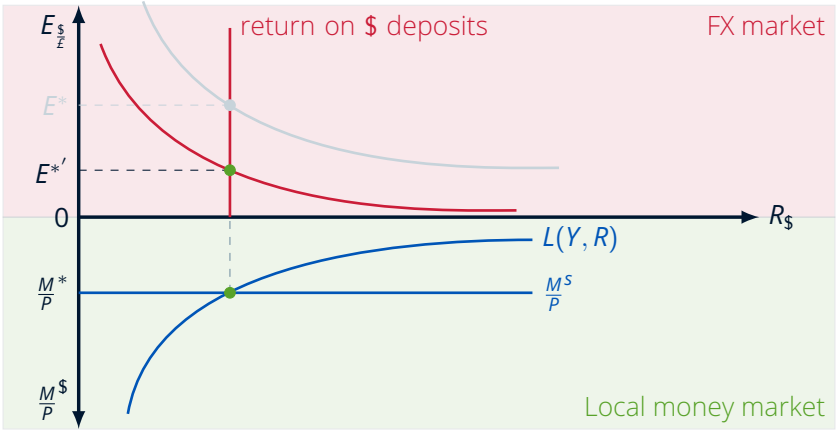
An increase (decrease) in a country's money supply causes its currency to depreciate (appreciate) in the foreign exchange market

Figure 13: Effect on Exchange Rate of an Increase in the Local Money Supply



- Europe's Money Supply and the Dollar/Euro Exchange Rate
  - An increase in Europe's money supply causes a depreciation of the euro (i.e., appreciation of the dollar).
  - A reduction in Europe's money supply causes an appreciation of the euro (i.e., a depreciation of the dollar).
  - The change in the European money supply does not disturb the U.S. money market equilibrium.

Figure 14: Effect of an Increase in the Foreign Money Supply on the Exchange Rate



Money, the Price Level, and the Exchange Rate in the Long Run

- **Long-run equilibrium**: Prices are perfectly flexible and always adjusted immediately to preserve full employment.

- The money market equilibrium can be rearranged to give the long-run equilibrium price level:

$$P = \frac{M^s}{L(R, Y)} \tag{4}$$

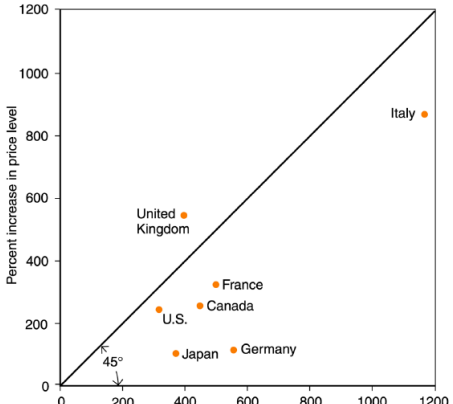
- An increase in a country's money supply causes a proportional increase in its price level.

Money, the Price Level, and the Exchange Rate in the Long Run

- A change in the supply of money has no effect on the long-run values of the interest rate or real output
- A permanent increase in the money supply causes a proportional increase in the price level's long-run value
- This prediction is based on the money market equilibrium condition: $M^s/P = L$ or $P = M^s/L$
- This condition implies that $\Delta P/P = \Delta M^s/M^s - \Delta L/L$
- The inflation rate equals the monetary growth rate less the growth rate for money demand

In a cross-section of countries, long-term changes in money supplies and price levels show a clear positive correlation

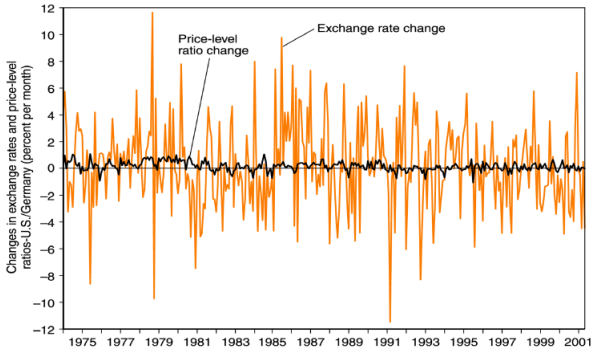
Figure 15: Monetary Growth and Price-Level Change in the Seven Main Industrial Countries, 1973-1997



A permanent increase (decrease) in a country's money supply causes a proportional long-run depreciation (appreciation) of its currency against foreign currencies.

Short-Run Price Rigidity versus Long-Run Price Flexibility

Figure 16: Month-to-Month Variability of the Dollar/DM Exchange Rate and of the U.S./German Price-Level Ratio, 1974-2001



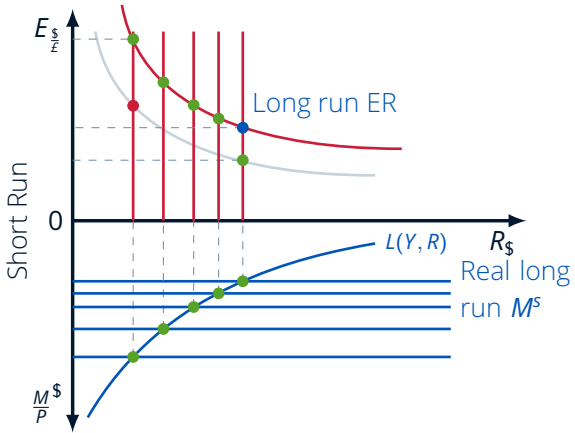
Inflation and Exchange Rate Dynamics

Inflation and Exchange Rate Dynamics

- A change in the money supply creates demand and cost pressures that lead to future increases in the price level from three main sources:
  - Excess demand for output and labor
  - Inflationary expectations
  - Raw materials prices
- **Permanent Money Supply Changes and the Exchange Rate** How does the dollar/euro exchange rate adjust to a permanent increase in the U.S. money supply?

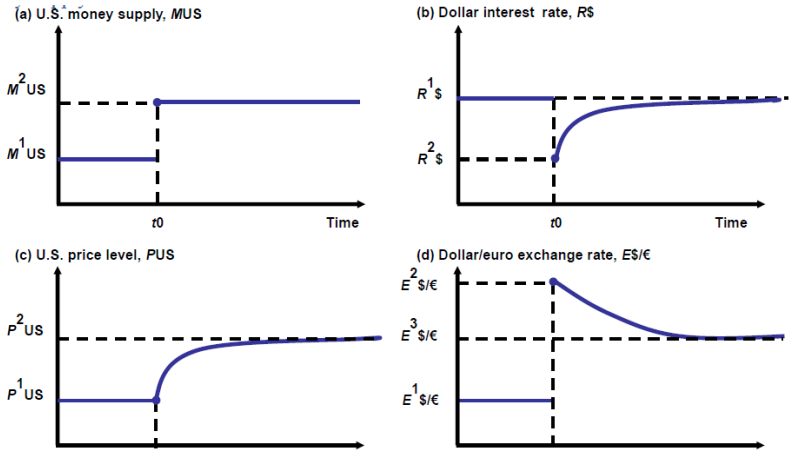
A permanent increase in money supply makes the Exchange Rate to overshoot

Figure 17: Effects of an Increase in the U.S.Money Supply



- The increase in money reduces the interest rate in the short run.
- If premanenet, in the long run the dollar should depreciate. Current expectations change.
- Prices start adjusting until we converge to the long run.

Figure 18: Time Paths of U.S. Economic Variables After a Permanent Increase in the U.S. Money Supply



Exchange Rate Overshooting

- The exchange rate is said to overshoot when its immediate response to a disturbance is greater than its long-run response.
- It helps explain why exchange rates move so sharply form day to day.
- It is a direct result of sluggish short-run price level adjustment and the interest parity condition.

Main takeaway

Main takeaway

- Money is held because of its liquidity.
- Aggregate real money demand depends negatively on the opportunity cost of holding money and positively on the volume of transactions in the economy.
- The money market is in equilibrium when the real money supply equals aggregate real money demand.
- By lowering the domestic interest rate, an increase in the money supply causes the domestic currency to depreciate in the foreign exchange market.
- Permanent changes in the money supply push the long-run equilibrium price level proportionally in the same direction.
- These changes do not influence the long-run values of output, the interest rate, or any relative prices.
- An increase in the money supply can cause the exchange rate to overshoot its long-run level in the short run.