

Lecture 10: Money and interest rates

ECON-C3100 Intermediate Macroeconomics I

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- Money is considerably trickier than it looks!
- For economists, an asset which is readily accepted in exchange by others (exact definition later)
- The control of the supply of money is exerted by the monetary authority, the central bank
- Money is a central theme in macroeconomics - so why haven't we discussed it earlier?
- The principle of monetary neutrality: In the long run, the supply of money does not matter for the real economy (long run economic growth, standards of living, employment, unemployment)
- Also in this lecture: what is money, who creates it, how it does so, and, for what purpose

Money and the neutrality principle

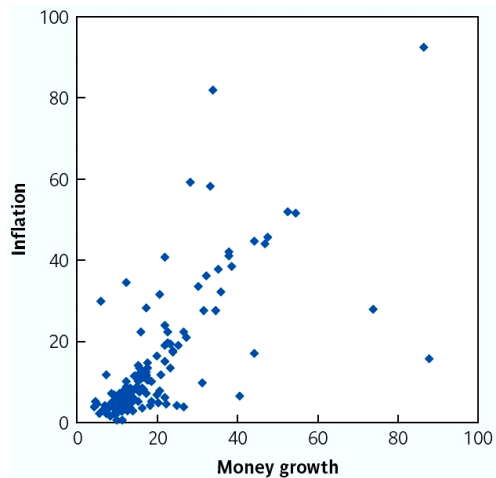
- A fundamental principle of economics is that money ultimately only affects the price level, leaving the real side of the economy untouched
- Think of money as a numbering system that allows us to express prices of all the goods and services we buy and sell in common terms
- The exchange rate is a way of converting this numbering into a different measurement unit

⇒ Prices and the nominal exchange rate should grow at the same rate as money - at least in the long run

This common-sense idea is called the **monetary neutrality principle**

Money growth and inflation

Countries with fast money growth have had high inflation rates - with some exceptions



- Money is held by households and firms to carry out transactions
- As a first approximation, assume that people hold money as a proportion k of their income (we will refine the analysis later)
- For a country as whole, the total demand for money, denoted M , is simply proportional to the nominal GDP PY (the Cambridge equation)

$$M = kPY \quad (1)$$

- Since the purchasing power of money is inversely proportional to the price level (what happens if prices double overnight?), it can be written as the ratio M/P

- M/P is also called the real value of money, and measures the purchasing power of the money stock
- Rearranging equation 1

$$\frac{M}{P} = kY$$

- *Real* money demand is equal to the share k of *real* GDP

- What happens if the central bank doubles the stock of money overnight and distributes the new banknotes to everyone?
- Faster money growth will ultimately only lead to higher inflation
- More formally: If the nominal money stock M doubles, the left hand side of $M/P = kY$ doubles as well
- According to the monetary neutrality principle, in the long run, real GDP, Y , is unaffected
- This means that P has to perform the balancing act, and money and prices remain proportional to each other

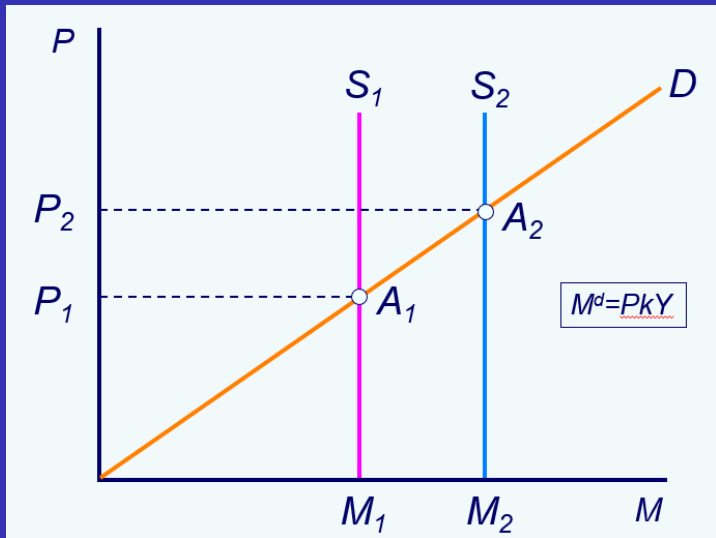
- Formally, the monetary neutrality principle means that inflation π , the growth rate of the price level, is equal to the growth rate of the money stock

$$\pi = \frac{\Delta M}{M}$$

- The equation

$$\frac{M}{P} = kY$$

can be interpreted as a money market equilibrium condition: the demand for money by households and firms (LHS) must equal the supply of money by the central bank.(RHS)



Money, prices and output

- The view that nominal variables do not affect real variables in the long run is also called the dichotomy principle, and implies that long-run growth is independent of the evolution of money
- But growth does affect real money demand, because more transactions require more money
- Using approximate growth rates on equation $M/P = kY$, reveals that the growth rate of money demand is equal to the sum of GDP growth and inflation

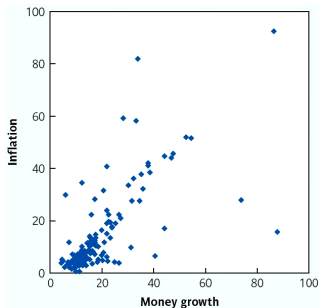
$$\frac{\Delta M}{M} = \pi + \frac{\Delta Y}{Y}$$

- If the central bank determines the money supply and if GDP growth is driven by other, non-monetary factors, the above relationship explains inflation

$$\pi = \frac{\Delta M}{M} - \frac{\Delta Y}{Y}$$

Money, prices and output

- The two equations on the previous slide can be interpreted as follows:
- Money demand is driven by GDP growth, but if the central bank increases money supply faster than what GDP grows, this creates inflation



- Different growth rates in different countries partly explain deviations from a linear relationship between money growth and inflation
- But we also need to understand why k is not necessarily constant

Inflation and money growth in the long run: A rule of thumb

- Assume that the monetary neutrality principle holds, and that inflation is simply the difference between money growth and GDP growth
- Assume also that GDP grows at an annual rate of 3 %. This means that the real demand for money (kY) also grows by 3 % per year
- If the central bank increases money supply by that same 3%, the average inflation rate is 0 %

Nominal money supply (%)	Inflation rate (%)
0	-3
3	0
8	5
50	47
103	100

What is money?

David Hume: *"Money is not, properly speaking, one of the subjects of commerce; but only the instrument which men have agreed upon to facilitate the exchange of one commodity for another. It is none of the wheels of trade: It is the oil which renders the motion of the wheels more smooth and easy"*

- In addition to this convenience function, money represents wealth, it is widely accepted, it can be readily exchanged for goods and services, and it is a yardstick for the value of goods and services
- Nineteenth century definition: money has four attributes or functions: 1) means of payment, 2) unit of account, 3) store of value, and 4) standard of deferred payment
- Is this still and accurate definition for what we use today and what we will use as money in the future?

Technical definitions of money

- Commodity monies (gold, silver)
- Paper money backed by commodity money became the dominant form of money by the end of the 19th century

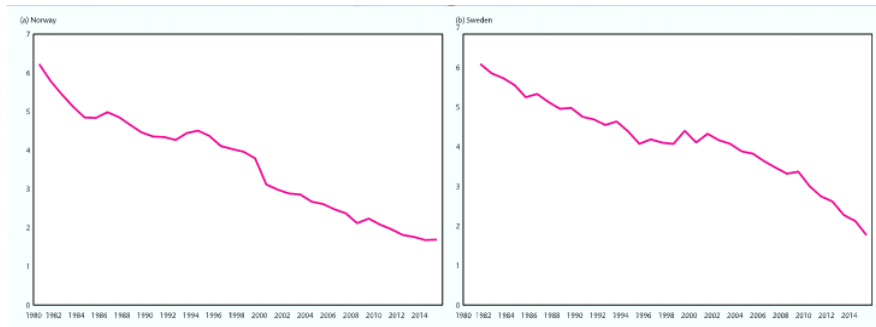
"You cannot ride the claim to a horse, but you can pay with a claim to money" (Schumpeter, 1996)

- For the first time, money became the liability of the issuer
- Fiat money - not backed by any precious metal - is legal tender simply because the government decrees it to be
- Paper cash and metal coins - currency - can be used to buy anything without caring about lack of intrinsic value
- Bank accounts which can be converted at banks for cash, IOU's

To understand the nature of money is to understand that it is accepted by others as a means of payment

The role of currency is decreasing

Currency in circulation in Norway and Sweden



Technical definitions of money

- Instead of currency, to pay for the goods and services or assets that people buy, they increasingly move funds electronically
- This means that they transfer ownership of parts of their bank accounts to others
- Bank accounts are banks' liabilities
- Most of what macroeconomists consider to be money is in fact bookkeeping entries in bank ledgers.

Money in four countries and euro area, 2015

		Currency	M0	M1	M2	M3
United Kingdom	(£ bn)	67.4	373.3	1464.3	2130.6	2401.3
	% of GDP	3.6	20.0	78.5	114.3	128.8
Euro Area	(€ bn)	1110.8	1930.8	6630.8	10234.5	10836.8
	% of GDP	10.7	18.6	63.7	98.3	104.1
United States	(\$ bn)	1380.8	3611.4	3147.0	12401.5	
	% of GDP	7.7	20.1	17.5	69.1	
Poland	(zł bn)	163.0	215.0	692.1	1145.7	1155.4
	% of GDP	9.1	12.0	38.7	64.0	64.6
Sweden	(SEK bn)	73.5	144.4	2289.4	2728.9	2788.7
	% of GDP	1.8	3.5	55.1	65.7	67.1

Note: US stopped publishing M3 statistics after 2006.

Definitions of money

- $M1 = \text{currency in circulation} + \text{sight deposit accounts at banks}$
- $M2 = M1 + \text{time/savings deposits at banks with unrestricted access}$
- $M3 = M2 + \text{larger, fixed term deposits} + \text{accounts at non-bank institutions}$
- Definitions of monetary aggregates differ across the world depending e.g. on retail banking practices. Definitions are also developed along with the technological development in banking

The money makers: central and commercial bankers

$$M = \text{currency in circulation} + \text{bank deposits}$$

- While currency is produced by the monetary authorities - the central bank and/or the Treasury - the bigger part, bank deposits, is created by commercial banks
- Money is actually created by the private sector!
- Can banks create money without limits? No
 - They do it only if it is profitable, and more importantly
 - they do it under the control and supervision of the central bank

Central banks

- The central bank controls money and credit conditions. It is the bankers' bank.
- Just as households and firms keep money at the bank to execute their daily transactions, banks maintain deposit account balances at the central bank
- Central banks generally do not take deposits from households and firms, but often serve as the bank for the national and local governments
- Central banks create two sorts of money: 1) currency, and 2) bank reserves, the funds held by commercial banks at the central bank
- The sum of currency and bank reserves is known as the **monetary base, M0**
- M0 is not much larger than the amount of currency in circulation, implying that the reserves of the commercial banks are small
- Yet, the supply of bank reserves is the tool through which central banks can control money creation by commercial banks

Commercial banks

- Banks take funds from depositing customers and lend to others who want to borrow. They also advise customers on wealth management, provide insurance, and may trade financial assets on their own account
- Most importantly though, banks are custodians of the **payment system**: they create most of the means of payment and enable households, firms, and governments to transact with each other
- When you deposit money in your bank, you may assume that the money is there waiting for you. Most likely, it is lent to some other customer
- For the bank, your deposit is a liability of immediate or short maturity
- Banks make, in turn, loans which are of long maturity, i.e. paid back over months or even years
- Taking on short term liabilities and using them to acquire long term assets is called **maturity transformation**

Balance sheet of a typical commercial bank

UniCredit Bank (consolidated), December 31 2015, EUR millions

Assets	Liabilities
Foreign assets	Currency in circulation
Loans to commercial banks	Deposits by commercial banks
Securities	Deposits by government
	Net worth

Assets		Liabilities	
Demand deposits at ECB and cash	10303	Liabilities to central bank*	28412
Financial assets held for trading	90997	Deposits from customers	449790
Loans and receivables with customers	473998	Deposits from other banks	111373
Loans and receivables with banks	80073	Other liabilities	220771
Other assets	285135	Net worth	50087
Total assets	860433	Total liabilities plus net worth	860433

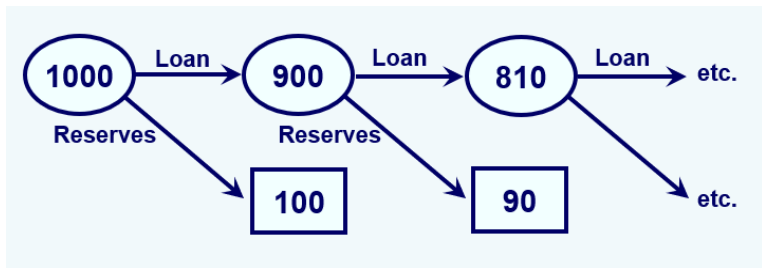
Balance sheet of a typical commercial bank

- Observations
 - Banks' assets (what the bank owns) are mostly loans to their customers (mortgages, corporate loans)
 - Banks are very indebted, their primary liability (what the bank owes) is the deposits of their customers
- Maturity transformation is the primary business model of banks. They borrow short and lend long, and so provide an important **liquidity service** to lenders.
- Maturity transformation can be risky. If the bank's customers suddenly want to withdraw the money they have deposited, this can in a worse case scenario lead to a bank run
- Given the riskiness, why is the economic system willing to trust bank deposits as its money?
 - It is in banks' own interest to act responsibly
 - Banks are tightly regulated and supervised

The money creation process

The money multiplier

An initial deposit triggers a succession of loans, paid in the form of deposits. When the bank keeps 10% of any deposit as reserves, each new loan is 90% of the previous one



The money creation process

The money multiplier

- The money multiplier process explains two fundamental features of modern fiat money systems
 - Money is created by private commercial banks as they make loans to customers who want to borrow
 - Central banks can still control the size of the money stock if they want to
- Money is backed by trust in the banks.
- Money will be trusted ultimately as long as the assets in the banks' balance sheets are known to have adequate value

The central bank controls the money creation by commercial banks

- Recall, the supply of bank reserves is the tool through which central banks can control money creation by commercial banks
- Instead of holding all their reserves in cash, the commercial banks deposit these amounts with the central bank
- Bank reserves = cash held in bank vaults + bank deposits held at the central bank
- The proportion of deposits set aside in the form of bank reserves is called the **reserve ratio**
- In many countries the reserve ratio is imposed by the central bank

Reserve Ratio Requirements, Selected Countries

Country	Deposits subject to reserve requirements	Mandatory reserve ratio requirement
Australia	None	
Canada	None	
Denmark	None	
China	Deposits at large financial institutions	18.5%
Czech Republic	Deposits with maturity up to 2 years	2.0%
Euro area	Deposits with maturity up to 2 years	1.0%
Hungary	All deposits	2.0%
New Zealand	None	
Poland	All deposits except funds from repurchase agreements	3.5%
Sweden	None	
Switzerland	Deposits with maturity up to 3 months	2.5%
United Kingdom	None	
United States	Transaction accounts in excess of \$15.2m but less than \$110.2m	3.0%
	Transaction accounts in excess of \$110.2m	10.0%

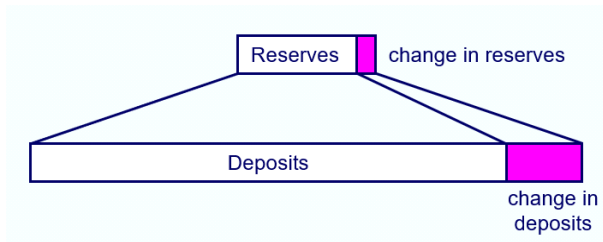
- The act of borrowing money from the bank can give rise to money creation even without an initial deposit
- In that case, the bank credits the borrowers account by the amount of the loan, and raises the amount of reserves it wants or has to raise, e.g. 10% of the amount of the loan
- To be profitable, banks have an incentive to lend as much as they can while holding as few reserves as they must
- The reserve ratio implies that reserves must be at least a fraction of deposits

$$\text{reserves} \geq rr \times \text{deposits}$$

The reserves - money stock link

Reserves are a share of deposits, or in reverse: the volume of deposits that banks issue cannot exceed a multiple of existing reserves

$$\text{deposits reserves} \leq \frac{1}{rr} \times \text{reserves}$$



By choosing the volume of reserves, the central bank can control total bank deposits

The money market and its players

- As described earlier, banks may need additional reserves or they can hold excess reserves
- If a bank needs more reserves it can borrow from some other bank holding excess reserves - for a price on the **money market** (interbank market, open market)
- Instead of a physical market place, the money market is a *network of banks* that facilitates buying and selling of reserves (deposits at the central bank)
- If all banks face a growing demand for loans, and collectively need more reserves, then the central bank has to decide whether or not to create these additional reserves
- When the central bank creates new reserves, it makes a loan to commercial banks through the money market and charges an interest rate. When banks lend to each other they also charge interest

- The interest rate charged on the money market is called the
- It is the ultimate cost of financing for commercial banks. In their own lending activities they charge their customers the money market rate plus a premium that represents their riskiness
- The EONIA rate has been replaced by Ester, the euro short term rate (−0.564 on 10th of February 2021)

The demand for money

- In order to satisfy the demand for money, commercial banks create much of what we call money when they grant loans to their customers. As they do so, they need to acquire sufficient reserves to meet their reserve ratio
- Therefore, the demand for money by the private sector translates into the **derived demand** for central bank money M_0
- Recall our earlier definition of the (nominal) demand for money kPY . That proportion of GDP is the inverse of the velocity V of money ($k = 1/V$) - the number of times money is 'spent' on GDP each year on average ($V = PY/M$)
- To assume that k is constant is contradicted by the evidence

The interest rate as the cost of money

- Borrowing money from the bank costs you the interest rate, or if you acquire more money by selling assets, you give up the interest rate you could earn on your assets
- In both cases, the interest rate emerges as the opportunity cost of holding money. This is why the demand for money declines when the interest rate increases
- Money demand is a proportion k of GDP, but this proportion is not constant

$$M^d = k(i) PY$$

The money market

- The derived demand for $M0$ by commercial banks is a fraction of the public demand for M
- If the public wants to hold more money, the derived demand schedule shift to the right from D to D'

