

5 Money and inflation

5.1 Motivation

Main focus: **inflation = the percentage change in overall level of prices**¹

- **mechanism:** inflation - level of prices - rate of exchange of money for G & S
- ass.: prices are fully flexible (long run)

Overview:

1. Money: definition + typology
2. Money supply and money demand
3. Causes of inflation
4. Costs of inflation - expected and unexpected
5. Hyperinflation

5.2 Money - what is it ?

Wide definition = stock of assets that can be readily used for transactions
(value + liquidity + exchange)

5.2.1 Functions of money:

1. **store of value:** in time, imperfect (inflation)
2. **unit of account:** terms in which prices are quoted - measurement of value)
3. **medium of exchange:** acceptable for purchase
 - liquidity - how fast you can convert money to G & S
 - barter \Leftrightarrow double coincidence of needs

¹For an overview of rates of inflation over the world, see linked map.

5.2.2 Types of money:

- Historical evolution: barter -> commodity money -> fiat money ²
- **commodity money:** has intrinsic value (valuable on its own)
 - goods that are highly durable, accessible in limited amount (not few, not too much), small and easy to transport, widely valued and accepted
 - gold, silver, salt (African tribes, 15th century)
 - funny examples: cigarettes (POW camps), stones fei (island Yap), wampum
- **fiat money:** with no intrinsic value - matter of general acceptance as means of payment
 - first fiat money - probably China

5.3 Money supply = amount of money

- commodity money - quantity of given commodity, fiat money - # of printed banknotes, coins + other liquid assets
- Agent of government = **central bank** (in Czech republic = CNB)
- direct + indirect tools to regulate

Measure = **Monetary aggregates** (Czech National Bank data, by 31.1.2009):

	Definition	Amount (CZK millions)
C	currency in circulation	362 815.6
M1	C + overnight deposits	1 665 559.1
M2	M1 + deposits with maturity < 2 years + deposits redeemable up to 3 months	2 645 565.6
M3	M2 + repurchase agreements + money market fund shares + debt securities (up to 2 years)	2 713 673.8

- C and M1 - store of value + medium of exchange
- M2 and M3 - only store of value

Role of banks in determination of money supply:

- Banks use deposits made by customers to make loans (mortgages, etc.)
- **Reserves:** deposits that banks have received but did not lend out, goal = availability in case when depositors want to make withdrawal

²For more info on the origins of money, I recommend <http://szabo.best.vwh.net/shell.html>

- Example: let us assume reserve-deposit ratio (rr) = 20%

Assets		Liabilities	
Reserves	200	Deposits	1 000
Loans	800		

- Borrower can post it in another bank => resources for further loans
- **Banks can "create money"** = create assets (loans) that are part of money supply => $M = 1000 + 800$; however, they do not create wealth
- Total money supply = $\frac{1}{rr} \times \text{initial}M$

MODEL:

- **reserve-deposit** ratio (rr) - determined by banks + regulating laws (min. level)
- **currency-deposit** ratio (cr) - HH's preferences over their money holdings

$$\begin{aligned}
 B(\text{monetary base}) &= C(\text{currency}) + R(\text{reserves}) \\
 M(\text{money supply}) &= C(\text{currency}) + D(\text{deposits}) \\
 \frac{M}{B} &= \frac{C + D}{C + R} = \frac{\frac{C}{D} + 1}{\frac{C}{D} + \frac{R}{D}} = \frac{1 + cr}{cr + rr} \\
 M &= \frac{1 + cr}{cr + rr} \times B
 \end{aligned}$$

- $\nearrow B \Rightarrow \nearrow M$; $\nearrow rr \Rightarrow \searrow M$; $\nearrow cr \Rightarrow \searrow M$

Instruments of monetary policy: indirect

- **open-market operations:** purchases & sales of government bonds
 - buys bonds => increase in M; sells bonds => decrease in M
- **reserve requirements:** minimum reserve-deposit ratio
 - affects creation of new money through banks (through rr)
- **discount rate:** charged on loans by CB for banks - in case they have too low reserves to meet reserve requirements - affects monetary base
- mostly used - open-market operations
- However, CB cannot fully control money supply - cr is affected by preferences and expectations, banks can hold excessive reserves

5.4 Money demand

5.4.1 Macro view - Quantity theory of money

Quantity equation: identity relating amount of money in the economy with the number of transactions / income

$$M \times V = P \times T$$

where M - money supply, V - transaction velocity of money, P - price level, T - # of transactions

$$M \times V = P \times Y$$

where M - money supply, V - income velocity of money, P - price level, Y - real GDP

Money demand function:

- M - nominal value of money, $\frac{M}{P}$ - real money balances = how much can one buy

$$\left(\frac{M}{P}\right)^D = kY$$

- we can rewrite it to the form of quantity equation

$$\frac{M}{P} = kY \quad \rightarrow \quad \frac{M}{k} = PY \quad \rightarrow \quad V = \frac{1}{k}$$

- ↗ k → ↘ V (k is small => holdings of money are small => velocity is high)
- **assumption:** velocity V is constant => $M\bar{V} = PY$
- How is price level determined: V is constant and Y is determined by real variables => changes in P depends on changes in M primarily

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

5.4.2 Role of interest rates and expectations

Two types of interest rates:

- **nominal** interest rate i : what bank pays, not adjusted for inflation
- **real** interest rate r : adjusted for inflation, real return to investment

Relationship = **Fisher equation**

$$i = r + \pi$$

- as r is determined on market for loanable funds ($I = S$), then nominal int. rate accommodates for inflation => increase in π equals increase in i = **Fisher effect**

Role of expectations - two real interest rates:

- **ex ante** real interest rate = $i - \pi^e$, where π^e is inflation rate expected at the time when people buy bond/take out loan
- **ex post** real interest rate = $i - \pi$, where π is inflation rate realized at the time of selling the bond/repayment of loan

How this translates into **money demand**?

- nominal interest rate = opportunity cost of holding money $\Rightarrow \left(\frac{M}{P}\right)^D = L(Y, i)$
- relevant is expected inflation rate $\pi^e \Rightarrow \left(\frac{M}{P}\right)^D = L(Y, r + \pi^e)$
- **price level** does not only depend on **current money supply** BUT also on **money supply expected** in the future (through π^e)

5.4.3 Micro view - Transaction and portfolio theories of money demand

Transaction theory of money demand

- emphasize the "medium of exchange" function of money
- based on the tradeoff between need for liquidity and the possibility of interest income
- example = Baumol-Tobin model (in details at exercise session)
- in agent based modelling - Cash-in-advance models (agent can only carry out transactions equal or less than their money holdings); Money in the utility functions models

Portfolio theory of money demand

- emphasize the "store of value" function of money, thus relevant for M2 and M3 aggregates
- simple portfolio theory - money demand function

$$\left(\frac{M}{P}\right)^D = L(r_s, r_b, \pi^e, W)$$

where r_s, r_b are expected real returns on stock and bond, respectively; π^e is expected inflation rate and W is real wealth

5.5 General causes of inflation

Demand-pull inflation

- consumers demand (and are able to spend for) more output than economy is producing
- causes: accumulated savings, easy access to credit, increase in money supply

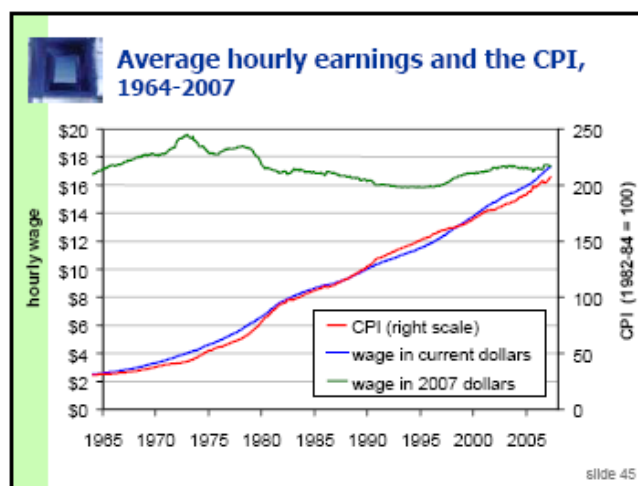
Cost-push inflation

- increase in production costs - typical example = oil crisis
- increase in labor productivity and wages

5.6 Costs of inflation

Question = Why is inflation bad?

- Common opinion: Inflation reduces real wages !
- BUT - In the long run, real wage is determined by labor supply and labor demand, that is derived from marg. product of labor (not by price or inflation rate)



- change in price level = change in units of measurement
- Why, then, is inflation such a social problem?

5.6.1 Costs of inflation - micro level

- **Price effect:** based on differentiated increase in relative prices;
How much a person suffers from inflation depends on what happens to prices of G&S that he actually purchases.
- **Income effect:** based on changing values of income flows;
People whose nominal income rise more slowly than the rate of inflation end up with less real income
- **Wealth effect:** based on changing value of stock of wealth;
If interest rate is smaller than rate of inflation => real value of savings is reduced
all lead to REDISTRIBUTION

5.6.2 Costs of expected inflation

1. shoeleather costs

- costs related to reducing money balances held, to avoid the inflation tax
- $\nearrow \pi \Rightarrow \nearrow i \Rightarrow \searrow \frac{M}{P}$ (opportunity costs of holding money are high)
- same monthly spending + lower average money holding = more frequent trips to bank (time, fixed fees, etc.)

2. menu costs

- costs of changing prices for firms - new menus, new catalogues, repricing

3. exogenous variation in relative prices

- firms change their prices at different times => relative price distortions
- microeconomic inefficiencies in allocation of resources

4. unfair tax treatment

- some taxes are not adjusted for inflation - e.g. capital gains tax

5. general inconvenience

- hard to compare nominal values from different time periods => hard to do financial planning; social tension - people feel that they are being cheated

5.6.3 Costs of unexpected inflation

1. **Arbitrary redistribution of wealth:** when contracts are based on expected inflation π^e and π turns out different, e.g. debts (debtor vs. lenders:
 - if $\pi > \pi^e \Rightarrow$ debtor is better off than lender (lender gets lower real interest rate)
 - if $\pi < \pi^e \Rightarrow$ debtor is worse off than lender (debtor has to pay higher interest rate)

due to risk aversion,

2. **Higher uncertainty** - economic decisions become more difficult - mainly long term (e.g. investment into education)
people are risk averse - they are worse off
3. **Speculation** - if you expect price to rise, it is profitable to buy goods and services now and resell later; if this is carried too far - only already produced goods are traded - contraction in supply

5.6.4 Benefits :-) of inflation

- positive effect on labor market - as nominal wages are rarely cut, without inflation real wages would be above the equilibrium level implied by lower demand
- "taxation" of underground economy

5.7 Hyperinflation

Definition: if $\pi > 50\%$ in a month (i.e. 100x increase in prices over a year)

- money loses function of a store of value \Rightarrow affects other functions (mainly as medium of exchange)
- all costs become huuuuuuuge
- return back to barter, commodity money or use of foreign currency

Highest monthly inflation rates in history:

Country	Month of highest π	highest π (monthly)	daily π	time needed for prices to double
Hungary	July 1946	$1.30 \times 10^{16} \%$	195 %	15.6 hours
Zimbabwe	Nov 2008	79 600 000 000 %	98 %	24.7 hours
Yugoslavia	Jan 1994	313 000 000 %	64.6 %	1.4 days
Germany	Oct 1923	29 500 %	20.9 %	3.7 days
Greece	Nov 1994	11 300 %	17.1 %	4.5 days
China	May 1949	4 210 %	13.4 %	5.6 days

Cause: excessive money printing by government

- government needs to cover its expenditures (**seignorage**), and it cannot raise taxes or get the financing by issuing bonds (bad credit risk)
- **self-enforcing**: more money is printed => lower value of tax revenue => need for further printing
- reinforced by speculative behavior of people => contraction in supply => further inflationary pressures

End: strict and painful **fiscal reform** - both expenditure and revenue (taxes) side

5.8 Classical Dichotomy

- **real variables** = variables measured in physical units (e.g. real GDP, real wage)
- **nominal variables** = variables expressed in terms of money (e.g. nominal wage, nominal interest rate)

Classical dichotomy: theoretical separation of real and nominal variables in the classical model, which implies that nominal variables do not affect real variables

Neutrality of money: changes in the money supply do not affect real variables

- both approximately true in the long run