4. Money and Inflation. Monetary Policy

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4.1 Inflation

The inflation rate along with the unemployment rate is one of the best known and most watched economic indicators. Together they form so-called **misery index** - the index of poverty. It means that both a higher rate of unemployment and a increasing inflation create economic and social costs for a country.

In this chapter we focus on the measuring the inflation, sources of inflation and anti-inflationary policies. In detail, we also deal with monetary policy, the macroeconomic stabilization policy that should defend price stability.

4.1.1 Measuring inflation

Inflation is a rise in the general price level of goods and services in an economy over a period of time. When the general price level rises, each unit of currency buys fewer goods and services. Consequently, inflation also reflects an erosion in the purchasing power of money – a loss of real value in the internal medium of exchange and unit of account in the economy.

A key measure of price inflation is **the inflation rate** - the annualized percentage change in a general price index (normally the Consumer Price Index) over time. Presented inflation rate (more precisely average inflation rate) characterizes the percentage change of average price level of latest twelve months against the average price level of previous twelve months. These so called moving averages are calculated from consumer price indices with fixed base (e.g. December 2005=100). The ratio expresses development trend in average price level with removed seasonal influence.

Table 1 Inflation in CR

2010/ month	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
CPI (y/y, %)	0,9	0,8	0,7	0,6	0,6	0,6	0,8	0,9	1,1	1,2	1,4	1,5

Year	99	00	01	02	03	04	05	06	07	08	09	10
Inflation Rate	2,1	3,9	4,7	1,8	0,1	2,8	1,9	2,5	2,8	6,3	1,0	1,5

2005 = 100	1	2	3	4	5	6	7	8	9	10	11	12
2010	114,3	114,3	114,6	115,0	115,1	115,1	115,5	115,2	114,9	114,7	114,9	115,5

Note: 'y/y' annual change.

Source: CZSO, 2011.

The Consumer Price Index provides a broad measure of the cost of living. Trends in consumer prices are measured on consumer basket based on a sample of goods and services paid for by population. Price representatives include such products and services which account for an important share in population's expenditure and cover the entire sphere of consumption. For example, in the case of the Czech consumer basket, their total number is about 730. They are step by step aggregated into 12 main parts of consumer basket by means of a weighted arithmetic average of individual price indices. Weights for the consumer baskets are based on the structure of household expenditures as established by family budget statistics in 2008, which were rectified by national accounts statistics. In other words, The CPI measures prices of a selection of goods and services purchased by a 'typical consumer'.

Consumer price indices are derived from the Laspeyres formula. The price base is December 2005 or 2005 average. The consumer price index comparing any two periods can be derived from them. To measure overall inflation, the price change of a large 'basket' of representative goods and services is measured. This is the purpose of a price index, which is the combined price of a 'basket' of many goods and services. The combined price is the sum of the weighted average prices of items in the 'basket'. A weighted price change is calculated by multiplying the unit price change of an item to the stable weights of items in the consumer basket. Weighted pricing is a necessary means to measuring the impact of individual unit price changes on the economy's overall inflation. Those weighted average prices are combined to calculate the overall price. To better relate price changes over time, indexes typically

choose a 'base year' price and assign it a value of 100. Index prices in subsequent years are then expressed in relation to the base year price.

Table 2 Consumer Basket – CR in 1995 and 2005 vs. Germany

	Consumer Basket	A. CR - stable weights 1999	B. CR - stable weights 2005	C. Germany stable weights 2005	A.-B. Gap (bp)	B.-C. Gap (bp)
		1000,0	1000,0	1000,0		
01.	Food and non-alcoholic beverages	197,6	162,6	104,0	-34,9	58,6
02.	Alcoholic beverages, tobacco	79,2	81,7	39,0	2,5	42,7
03.	Clothing and footwear	56,9	52,4	49,0	-4,5	3,4
04.	Housing, water, energy, fuel	236,4	248,3	308,0	11,9	-59,7
05.	Furnishings, households equipment and maintenance	67,9	58,1	56,0	-9,9	2,1
06.	Health	14,3	17,9	40,0	3,5	-22,1
07.	Transport	101,4	114,1	132,0	12,7	-17,9
08.	Post and telecommunication	22,5	38,7	31,0	16,2	7,7
09.	Recreation and culture	95,5	98,7	116,0	3,1	-17,3
10.	Education	4,5	6,2	7,0	1,7	-0,8
11.	Restaurants and hotels	74,2	58,4	44,0	-15,8	14,4
12.	Miscellaneous goods and services	49,5	63,0	74,0	13,5	-11,0

Source: CZSO, 2011.

Table 3 Calculation of CPI

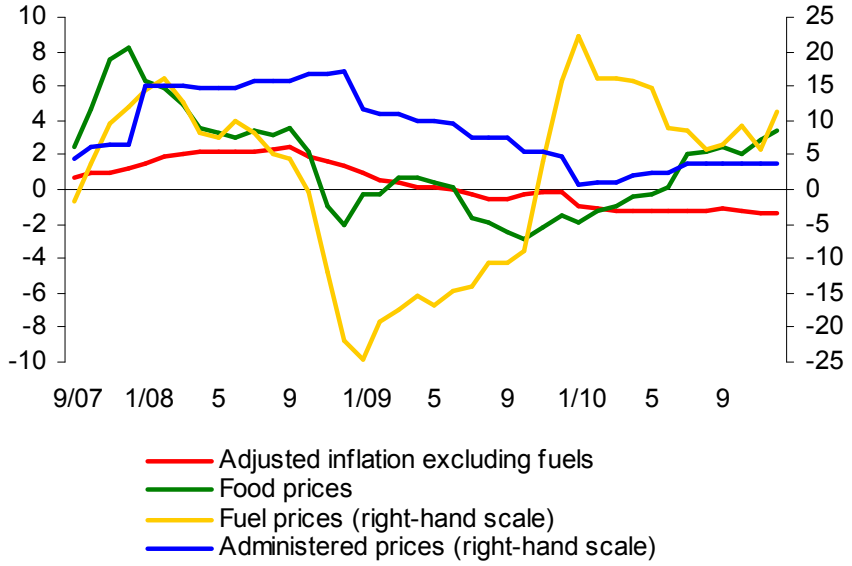
	Consumer Basket	CR- stable weights 2005 (%)	Price change (y/y %)	Inflation (y/y in %)
		A	B	C = A * B / 100
01.	Food and non-alcoholic beverages	16,3	5,0	0,81
02.	Alcoholic beverages, tobacco	8,2	1,0	0,08
03.	Clothing and footwear	5,2	-2,0	-0,10
04.	Housing, water, energy, fuel	24,8	7,0	1,74
05.	Furnishings, households equipment and maintenance	5,8	-1,5	-0,09
06.	Health	1,8	2,0	0,04
07.	Transport	11,4	1,0	0,11
08.	Post and telecommunication	3,9	0,0	0,00
09.	Recreation and culture	9,9	1,5	0,15
10.	Education	0,6	2,0	0,01
11.	Restaurants and hotels	5,8	0,5	0,03
12.	Miscellaneous goods and services	6,3	0,6	0,04
SUM (01.+…+12.)		100,0	-	**2,8**

Source: CZSO, 2011.

Other widely used price indices for calculating price inflation include the following:

- **GDP deflator** is a measure of the price of all the goods and services included in GDP. It is defined as its nominal GDP divided by its real GDP.
- **Producer price indices** (PPIs) which measures average changes in prices received by domestic producers for their output. This differs from the CPI in that price subsidization, profits, and taxes may cause the amount received by the producer to differ from what the consumer paid. There is also typically a delay between an increase in the PPI and any eventual increase in the CPI. Producer price index measures the pressure being put on producers by the costs of their raw materials. This could be 'passed on' to consumers, or it could be absorbed by profits, or offset by increasing productivity. In India and the United States, an earlier version of the PPI was called the Wholesale Price Index.
- **Commodity price indices** - measure the price of a selection of commodities. In the present commodity price indices are weighted by the relative importance of the components to the economy.
- **Core price indices**: because food and oil prices can change quickly due to changes in supply and demand conditions in the food and oil markets, it can be difficult to detect the long run trend in price levels when those prices are included. Therefore most statistical agencies also report a measure of 'core inflation', which removes the most volatile components (such as food and oil) from a broad price index like the CPI. Because core inflation is less affected by short run supply and demand conditions in specific markets, central banks rely on it to better measure the inflationary impact of current monetary policy.

Graph 1 Inflation components



Note: annual percentage changes

Adopted from CNB, Inflation report. Jan 2011.

Case Study: India – measuring of inflation

See: http://labourbureau.nic.in/Special%20Art%20CPI%20IW%20NS%202006.pdf and http://labourbureau.nic.in/indnum.htm.

4.1.2 Inflation types

deflation – a fall in the general price level; negative inflation rate

disinflation – a decrease in the rate of inflation

stagflation – a combination of inflation, slow economic growth and high unemployment;

reflation – an attempt to raise the general level of prices to counteract deflationary pressures;

hyperinflation - is inflation that is very high or 'out of control'; an out-of-control inflationary spiral; the annual inflation reaches two-digit values; examples: Germany in 1923, Argentina 1975-1991,…

4.1.3 Nominal versus real value

An important use of inflation (the CPI) is to adjust nominal quantities – at their current values – for the effects of inflation. Real quantity is measured in physical terms. To convert a nominal quantity into a real quantity, we must divide the nominal quantity by a price index for the period. This operation is called **deflating** a nominal quantity and it express the purchasing power of the quantity.

Indexing is the practice of increasing a nominal quantity each period by an amount equal to the percentage increase in a specified price index. Indexing prevents the purchasing power of the nominal quantity from being eroded by inflation. For example, nominal minimum wage are used to be periodically raised to keep the real value from eroding. Or rent and wage contracts tend to include an inflation clause.

4.1.4 Real vs nominal interest rates

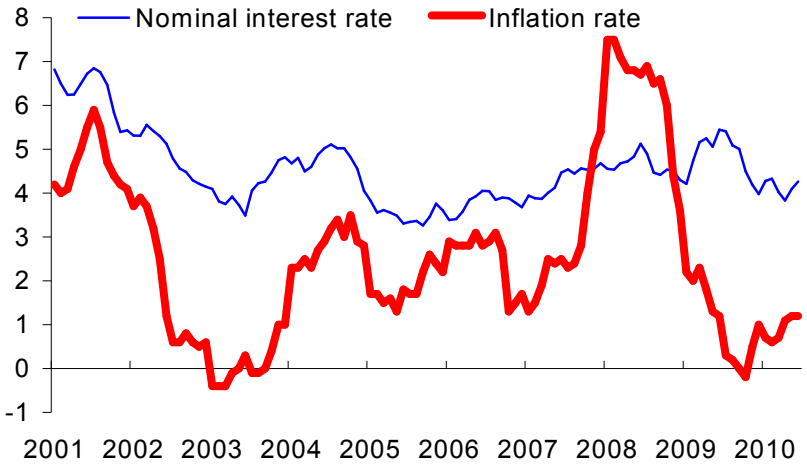
Irving Fisher came with the observation that interest rates tend to be high when inflation is high and low when inflation is low (see below graph). Why? When inflation is high, borrowers and lenders anticipate that it will be high in the near future. We would expect lenders to raise their nominal interest rates so that their real rate of return will be unaffected. Borrowers are willing to pay higher nominal interest rate, because they understand that the loan will be repaid in currency of reduced real value. So in real terms, their cost of borrowing is unaffected by an equal increase in the nominal rate and the inflation rate.

Real interest rate is the annual percentage increase in the purchasing power of a financial asset. The real interest rate on any asset equals the nominal interest rate on that asset minus the inflation rate:

$$r = i - \pi, \tag{4.1}$$

where *r* is the real interest rate, *i* the nominal interest rate and π the inflation rate.

Graph 2 Inflation versus nominal interest rates



Source: CNB, ARAD.

Note: Nominal interest rates: 10y Czech government bond yield.

If we incorporate expectations into the equation, then we obtain an equation called the **Fisher equation**:

$$i = r^e + \pi^e, \qquad (4.2)$$

In long-run, the expected real interest rate is equal to equilibrium real interest rate (r^*), so we could write the Fisher equation in the following form:

$$i = r^* + \pi^e. \qquad (4.3)$$

The Fisher Effect is an evidence that in the long-run, purely monetary developments will have no effect on that country's relative prices.

4.1.5 Cost and benefits of inflation

Inflations' effects on an economy are various and can be simultaneously positive and negative.

Cost of inflation

Shoe-Leather cost: a higher inflation rate leads to a higher nominal interest rates, so the opportunity cost of holding money are higher as well. So people decrease their cash held but have to make more trips to the bank.

Tax distortions: the nominal incomes are taxed, so if because of higher inflation the nominal incomes increase, the tax increases as well, while the real value of income goes down and finally the real incomes after tax are even lower. It is especially valid in the system of progressive taxation, when higher inflation pushed the tax-payers into higher tax brackets as their nominal income increased over time.

Money illusion: people appear to make systematic mistakes in assessing nominal versus real changes.

Inflation variability: higher inflation is typically associated with more variable inflation. This makes financial assets riskier and less attractive for investment into them, which might discourage savings.

Noise in the price system - occurs when general inflation makes it difficult for market participants to interpret the information conveyed by prices. If inflation is high, one might have problem to distinguish between a price increase as a result of higher demand or and price increase as a result of the general inflation.

Unexpected redistribution of wealth – when unexpected inflation redistribute wealth from one group to another. In general, unexpectedly high inflation rates help borrowers at the expanse of lenders.

Interference with long-term planning - people might find it difficult to forecast prices over long periods.

The benefits of inflation

Seignorage – is equal to the revenues from money creation, when the government issues bonds and are bought by the central bank. The revenues from money creation allow the government to borrow less from public or to lower taxes.

The option of negative real interest rates – an economy with a low average inflation rate may find itself unable to use monetary policy to return output to the natural level of output. If the country has a very low inflation rate and nominal interest rates and it is hit by an adverse shock to spending, the room for monetary policy to help avoid a decline in output by cutting interest rates would be clearly limited. Moreover, higher inflation erodes the real value of production cost e.g. nominal wages, which might help restoring the balance between labour demand and supply.
Money illusion – many people would accept the real wage cut more easily than cut in nominal wages. The presence of inflation allows for downward real-wage adjustments more easily than when there is no inflation.

While the high inflation rates reduce the economic efficiency and growth, the stable low but positive and predictable inflation might help an economy. Nowadays, the economists are just worried about deflation as are about hyperinflation, or even more.

A **deflationary spiral** is a situation where decreases in price lead to lower production, which in turn shifts wages and demand down; as a result, prices go down in the 2nd round. Since reductions in general price level are called deflation, a deflationary spiral is when reductions in price lead to a vicious circle, where a problem exacerbates its own cause. The Great Depression was regarded by some as a deflationary spiral.

Having regard to the existing costs and benefits of inflation, the **optimal inflation rate** is estimated between 2 and 4%.

4.1.6 Sources of inflation

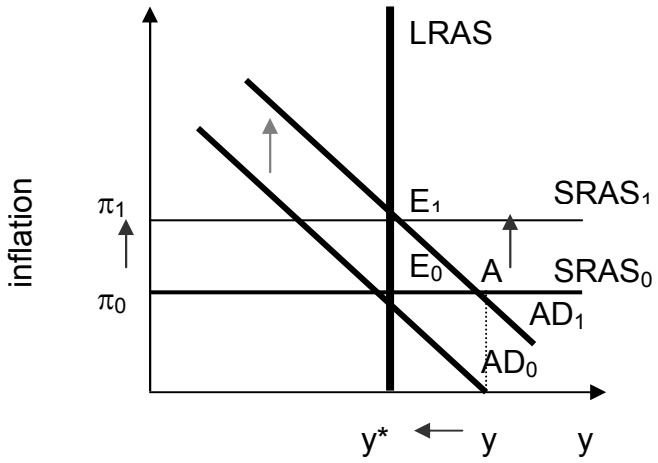
Excessive aggregate spending

a) excessive agregate demand or excessive aggegate demand growth, which leads to the so-called **demand-pull inflation**.

Imagine a situation where the government decides to support the aggregate demand by higher social benefits. Higher population transfers increase household

consumption by cTR. Higher consumption will increase AD curve, which will move northeast to AD_1.The economy reaches new, short-run economic balance at point A (the intersection of AD_1 and the original SRAS ($SRAS_0$)). The actual output and planned total expenditure has risen above potential output, creating expansionary gap. Because inflation is inertial and does not change in the short run, the immediate effect of the increase in government transfers is only an increase in output. However, inflation will not remain the same indefinitely. The excessive aggregate expenditure pushes up (relative) prices, so inflation and inflation expectations will gradually begin to increase. The SRAS line moves to the north, to the point E_1 - the intersection of AD_1 and LRAS. Inflation and thus the SRAS line must move up enough to eliminate the positive output gap, to restore the long-term economic equilibrium. The impact of higher social benefits on output was only temporary. In the long run, actual output has returned to the level of potential output, but at a higher rate of inflation (π_1).

Graph 3 Demand-pull inflation - expansionary gap



b) **inflation shock** – sudden growth of producer prices because of increasing costs (higher wages or higher prices of materials, energy and services or changes in technology) provoking the so-called **cost-push inflation**. The source of inflation may also be **the aggregate supply shock** (supply-shock Inflation), which is either an inflation shock or shock affecting the potential product.

The inflation shock is a sudden change in the inflation rate due to sharp changes in energy prices or food production materials, minerals, etc., unrelated to the output gap. When such an inflation shock occurs, relative prices must change. The source of the inflation shock may be 'just' increase in inflation expectations. Inflation shock can be negative – so called adverse inflation shock – because it causes a sudden rise in inflation - see the oil shock in 1973 and 1979 and price liberalization in Czechoslovakia in 1991. An inflation shock that reduce inflation, is called favorable inflation shock (see drop in oil prices in 1986).
If the inflation shock is only temporary, it has no lasting impact on inflation expectations and affects only SRAS line. Conversely, if it is a permanent inflation shock, inflation expectations will have to adjust to a new situation, and both SRAS and LRAS line will move.

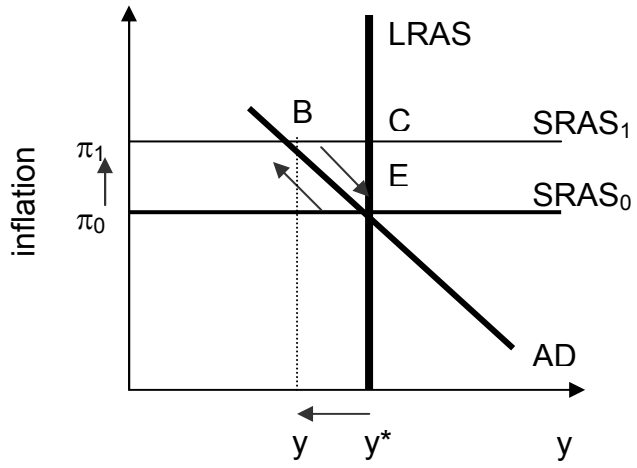
Negative inflation shock that hit an economy directly increases inflation, so SRAS line shifts rapidly upward to $SRAS_1$. A new short-run equilibrium is established at point B, where $SRAS_1$ intersect the AD curve. Because of adverse inflation shock, the inflation rate rises to π_1 and output falls below potential. The shock creates the worst possible scenario: higher inflation and recessionary gap. The combination of higher inflation and recession is called **stagflation**.

An adverse (temporary) inflation shock creates the dilemma for policymakers. If they have decided keep the macroeconomic policies stable (we speak about neutral fiscal or monetary policy), they rely on the self-correction of the economy. Because of the recessionary gap, inflation would begin to drift downward, until finally the recessionary gap is eliminated. Inflation would stop declining only when long-run equilibrium is restored, at point E at the original inflation rate and actual output at the potential. In this case, the central bank doesn't change inflation target and tries to prevent inflation from becoming permanently higher. 'Doing-nothing" or neutral policy approach would put the economy through a protracted recession. But policymakers might opt to eliminate the recessionary gap more quickly, since they may consider the period of recession too long and costly and may choose to hit either by increasing government spending and easing of

monetary policy (by raising inflation target). This means that economic policy accommodates the inflation shock and we call it the **accommodating economic policy**. Both of these measures will lead the AD shift to right into the new equilibrium at point C. At this point, potential output and full employment is reached but at permanently higher inflation rate. The initial increase in inflation leads to a change in inflationary expectations. Consequently, the higher inflation rate will be sustained.

The speed with which the SRAS line shifts back down following an adverse inflation shock depends partly on public's expectation of how the central bank will act. It they believe that the central bank will maintain its original target inflation rate, their inflation expectations will not change even if the inflation rate rises temporarily. The people's inflation expectations are **anchored**. Than the SRAS line will shift back down more rapidly and output will return to potential more quickly.

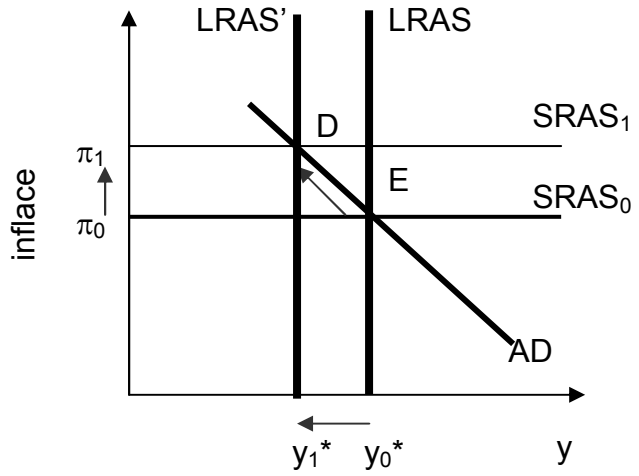
Graph 4 Adverse Inflation Shock



An adverse shock to potential output – it is a permanent supply shock such as the exhaustion of local gold deposits or rapid and prolong increase in input prices. It shifts the LRAS line leftwards. The shock to potential output permanently reduces the productive capacity – its potential and full employment. At the same time, the inflation

rate moves permanently up – the SRAS line shifts upwards and the new long-term equilibrium is found at lower output level but higher inflation rate, The fall in output and rise in inflation and inflation expectations is permanent.

Graph 5 Adverse shock to potential output



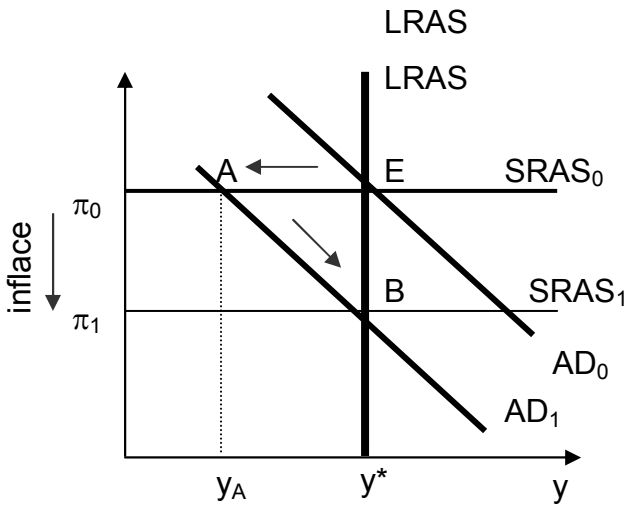
4.1.7 Disinflation policy - reducing high inflation

There three methods of disinflation:

A) **cold turkey method**: a rapid and significant reduction in AD (either by raising interest rates or by reducing government expenditure). The result is the shift of AD curve leftward followed by a rapid decline in inflation rate accompanied by a deep decline in output and employment First of all, the economy moves to point A. Once economic agents adapt to new low level of aggregate expenditure, the economy will stabilize in the new long run equilibrium at point B. Nevertheless, the recession is deep but very likely short. Faster the inflation expectations move down, shorter recession will be. If the inflation expectations were almost rational, than the recession would be very short.

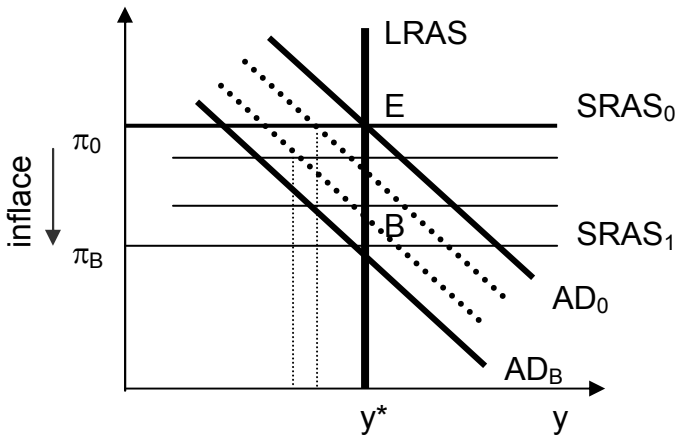
The credibility of the disinflation policy matters as well - if the economic agents believe in the plan to reduce inflation, they swiftly adjust their inflation expectations and consequently, the adjustment path will be short and less costly.

Graph 6 Disinflation – cold turkey method



B) **gradualism**: slow and gradual reduction in aggregate demand. The AD is shifted step by step down simultiously with the inflation rate. The actual output and employment declines along the AD. Since the reduction of AD is only gradual, the recession is likely shallow but prolonged.

To compare the cost of both methods we use so-called **sacrifice ratio** for disinflation: the ratio of cumulative loss in output to the fall in inflation rate.



C) **Income policy**: this policy tries to eliminate the adverse affects of inflation shock on an economy. It tries to provoke or support positive supply shocks. Income policy

tries to affect market prices or in an extreme case, to control incomes and prices in the economy.

4.2 Money & money market

Self-study: Frank: Ch 23, Blanchard: Ch 4 & 25.
Demand for money, money creation, money multiplier, money supply

Money

A medium of exchange
A unit of account
A store of value and standard of deferred payment

Fiat money: non-commodity money

Money creation and money multiplier

To make it easier, we assume that economic agents hold only checkable deposits and banks keep only legal reserve requirements (shortly reserves), which require them to hold reserves in some proportion to checkable deposits ('reserve ratio').

We could demonstrate the money creation on consolidated balance sheet of central bank, banks and nonbanking sector (incl. government, private sector and households). The balance sheet of the central bank: the assets of the central bank are the bonds it holds. The liabilities of the central bank are the money it has issued and reserves of banks. The banks, as financial intermediaries, receive funds from government, private sector and households (see deposits as banks' liability), and use these funds to buy bonds or stocks, or to make loans to other households / private companies / government. The banks have to keep some of funds received from nonbanking sector as reserves, and use the rest to make loans and purchase bonds. So, their key liabilities are checkable deposits and their assets consist of reserves, loans and holding bonds.

Graph 7 Balance Sheets of Central Bank, Banks and Nonbank Sector

Central Bank (CB)

Assets	*Liabilities*
Bonds	Currency
	Reserves of banks

Nonbanking Sector

Assets	*Liabilities*
Currency	Debt
Checkable deposits	Net Worth

Banks

Assets	*Liabilities*
Cash and reserves at CB	Liabilities to CB
Loans	Deposits
Bonds	Net Worth

Now, we assume that one commercial bank sells to the central bank $100 worth of bond or the central bank buys $100 worth of bond. The central bank has now plus $100 in reserves and plus $100 in assets – bonds. The balance sheet of the central bank increases by $100.

Graph 8 Central bank buys bond

Central Bank

Assets		*Liabilities*	
Bonds	+100	Reserves	+100

Nonbanking Sector

Assets	*Liabilities*
Currency	Debt
Checkable deposits	Net Worth

Banks

Assets		*Liabilities*
Reserves	+100	Liabilities to CB
Debt		Deposits
Bonds	-100	Net Worth

The commercial bank decides to issue loans of $100 to nonbanking sector. The nonbanking sector has now new debt of $100 and deposits the liquidity in checking account in the bank (we assume, nobody wants to hold any currency.)

Graph 9 Issue of loan

Central Bank

Assets		*Liabilities*	
Bonds	+100	Reserves	+100

Nonbanking Sector

Assets	*Liabilities*
Currency	Debt +100
Checkable deposits +100	Net Worth

Banks

Assets		*Liabilities*
Reserves	-100	Liabilities to CB
Debt	+100	Deposits
Bonds		Net Worth

The bank has to keep some reserves at the central bank, e.g. 2% of checkable deposits (or $2). With the rest ($98) it issue new debt to private sector. The new debt is deposited bank in the bank. The bank has to increase the reserves at the central bank by 2% of additional increase in deposits (0.8 multiply by $98), or $1.96. The rest (96.04) is used for new debt. And so on….

Graph 10 Multiplication

Banks

Assets	*Liabilities*
Reserves +2	Liabilities to CB
Loans +98	Deposits +100
Bonds	Net Worth

Nonbanking Sector

Assets	*Liabilities*
Currency	Debt +100
Checkable deposits +100	Net Worth

Banks

Assets	*Liabilities*
Reserves +1,96	Liabilities to CB
Loans +96,04	Deposits +98
Bonds	Net Worth

Nonbanking Sector

Assets	*Liabilities*
Currency	Debt +98
Checkable deposits +98	Net Worth

The final increase in deposits is a sum of

$$\Delta R + (\Delta R - r \bullet \Delta R) + (\Delta R - r \bullet \Delta R) - r \bullet (\Delta R - r \bullet \Delta R) + \ldots . \qquad (4.4)$$

where ΔR is an increase in reserves at the central bank and r reserve ratio.

The series is a geometric series and its sum is equal to

$$\Delta D = \frac{\Delta R}{r}, \qquad (4.5)$$

where D are deposits.

If the money are not hold in currency, **money multiplier** is equal to:

$$\frac{M1}{M0} = \frac{D}{R} = \frac{1}{r} \qquad (4.6)$$

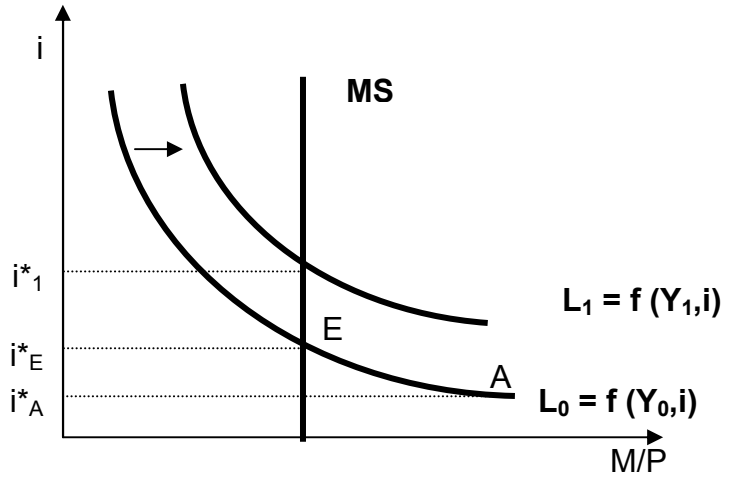
Keynesian demand for money – theory of liquidity preference

Liquidity preference in macroeconomic theory refers to the demand for money, considered as liquidity. The concept was first developed by John Maynard Keynes to explain determination of the interest rate by the supply and demand for money. The demand for money as an asset was theorized to depend on the interest foregone by not holding bonds. According to Keynes, demand for liquidity is determined by three motives:

1. the transactions motive: people prefer to have liquidity to assure basic transactions, for their income is not constantly available. The amount of liquidity demanded is determined by the level of income: the higher the income, the more money demanded for carrying out increased spending.
2. the precautionary motive: people prefer to have liquidity in the case of unexpected problems that need unusual costs. The amount of money demanded for this purpose increases as income increases.
3. the speculative motive: people retain liquidity to speculate that bond prices will fall. When the interest rate decreases people demand more money to hold until the interest rate increases, which would drive down the price of an existing bond to keep its yield in line with the interest rate. Thus, the lower the interest rate, the more money demanded (and vice versa).

The liquidity-preference relation can be represented graphically as a schedule of the money demanded at each different interest rate. The supply of money together with the liquidity-preference curve in theory interact to determine the interest rate at which the quantity of money demanded equals the quantity of money supplied.

Graph 11 Money market equilibrium in short-run



Friedman's theory of demand for money; Friedman argued that the demand for money could be described as depending on a couple of economic variables. Thus, where the money supply expanded, people would not simply wish to hold the extra money in idle money balances; i.e., if they were in equilibrium before the increase, they were already holding money balances to suit their requirements, and thus after the increase they would have money balances surplus to their requirements. These excess money balances would therefore be spent and hence aggregate demand would rise.

Friedman argues that the demand for nominal liquid balances by economic agents depends on: permanent income and wealth (Y^P and W), the opportunity cost of holding wealth in liquid form (or bond yields i_B and equity yields i_E), the purchasing power of money (or price level P), expected changes in the value of money arising from future price level movements (π); the physical to human capital ratio (h), and tastes & preferences (u). Formally expressed:

$$MD = f(W, i_B, i_E, P, \pi, h, u). \qquad (4.4)$$
$$+ \quad - \quad - \quad + \quad - \quad + \quad \pm$$

Alternative theory – Cambridge cash-balance theory

The **Cambridge equation** formally represents the Cambridge cash-balance theory, an alternative approach to the classical quantity theory of money. Both quantity theories, Cambridge and classical, attempt to express a relationship among the amount of goods produced, the price level, amounts of money, and how money moves. The Cambridge equation focuses on money demand instead of money supply. The theories also differ in explaining the movement of money: In the classical version, associated with Irving Fisher, money moves at a fixed rate and serves only as a medium of exchange while in the Cambridge approach money acts as a store of value and its movement depends on the desirability of holding cash.

Economists associated with Cambridge University, including Alfred Marshall, A.C. Pigou, and John Maynard Keynes (before he developed his own, eponymous school of thought) contributed to a quantity theory of money that paid more attention to money demand than the supply-oriented classical version. The Cambridge economists argued that a certain portion of the money supply will not be used for transactions; instead, it will be held for the convenience and security of having cash on hand. This portion of cash is commonly represented as k, a portion of nominal income (the product of real income times the price level, *P.Y*). The Cambridge economists also thought wealth would play a role, but wealth is often omitted from the equation for simplicity. The Cambridge equation is thus:

$$M^D = k.P.Y \tag{4.5}$$

Assuming that the economy is at equilibrium ($M^D = M^S$), Y is exogenous, and *k* is fixed in the short run, the Cambridge equation is equivalent to the equation of exchange with velocity equal to the inverse of k:

$$M/k = P.\ Y \tag{4.6}$$

4.3 Monetary policy

Monetary policy is the macroeconomic stabilization policy conducted by the central bank or another monetary authority. The central bank controls the money supply, or targeting interest rate(s) for the purpose of promoting **price stability**.

Internal price stability: stable and low inflation rate
External price stability: stable currency exchange rate

Functions of a central bank may include:

- implementing monetary policy
- controlling the nation's entire money supply (issuing coins and notes)
- the Government's banker and the bankers' bank (‘lender of last resort’)
- managing the country's foreign exchange and gold reserves and the Government's stock register
- regulating and supervising the banking industry
- setting the official interest rate – used to manage both inflation and the country's exchange rate – and ensuring that this rate takes effect via a variety of policy mechanisms

Independence of central banks

Over the past decade, there has been a trend towards increasing the independence of central banks as a way of improving long-term economic performance. However, while a large volume of economic research has been done to define the relationship between central bank independence and economic performance, the results are ambiguous.

Advocates of central bank independence argue that a central bank which is too susceptible to political direction or pressure may encourage economic cycles (‘boom and bust’), as politicians may be tempted to boost economic activity in advance of an election, to the detriment of the long-term health of the economy and the country. In this context, independence is usually defined as the central bank's operational and management independence from the government.

The literature on central bank independence has defined a number of types of independence.

Legal independence: the independence of the central bank is enshrined in law. This type of independence is limited in a democratic state; in almost all cases the central bank is accountable at some level to government officials, either through a government minister or directly to a legislature. Even defining degrees of legal independence has proven to be a challenge since legislation typically provides only a framework within which the government and the central bank work out their relationship.

Goal independence: The central bank has the right to set its own policy goals, whether inflation targeting, control of the money supply, or maintaining a fixed exchange rate. While this type of independence is more common, many central banks prefer to announce their policy goals in partnership with government. This increases the transparency of the policy setting process and thereby increases the credibility of the goals chosen by providing assurance that they will not be changed without notice. In addition, the setting of common goals by the central bank and the government helps to avoid situations where monetary and fiscal policy are in conflict; a policy combination that is clearly sub-optimal.

Operational independence: The central bank has the independence to determine the best way of achieving its policy goals, including the types of instruments used and the timing of their use. This is the most common form of central bank independence.

Management independence: The central bank has the authority to run its own operations (appointing staff, setting budgets, etc.) without excessive involvement of the government. The other forms of independence are not possible unless the central bank has a significant degree of management independence. One of the most common statistical indicators used in the literature as a proxy for central bank independence is the 'turn-over-rate' of central bank governors. If a government is in the habit of appointing and replacing the governor frequently, it clearly has the capacity to micro-manage the central bank through its choice of governors.

4.3.1 Policy instruments

The main monetary policy instruments available to central banks are open market operations including foreign exchange market interventions, reserve requirements, interest rate policy, re-lending and re-discount (including using the term repurchase market), and credit policy.

Open market operations – through open market operations, a central bank influences the money supply in an economy directly. Each time it buys securities, exchanging money for the security, it raises the money supply. Conversely, selling of securities lowers the money supply. Buying of securities thus amounts to printing new money. In practice, the central bank buys or sells the given assets (typically government bonds). The counterparty is a commercial bank that need a short-term loan (or money / liquidity) from a central bank or would like to deposit its free reserves at the central bank. The short-term loans are guaranteed by a collateral securities (government bonds). Because these loans are short-term, commercial banks continuously need to payback and borrow again – rolling over the loan, if there is s systematic lack of liquidity in the banking system. This dependence allows the central bank to influence money market conditions: it can step up lending to increase liquidity. Or it can absorb the liquidity excess by selling bills or by not renewing maturing loans.

The main open market operations are:

- temporary lending of money for collateral securities (‘Reverse Operations’ or ‘repurchase operations’, otherwise known as the ‘repo’ market). These operations are carried out on a regular basis, where fixed maturity loans (of 1 week and 1 month for the ECB or 2 week for the Czech National Bank) are auctioned off.
- Buying or selling securities (‘direct operations’) on ad-hoc basis.
- Foreign exchange operations such as forex swaps.

Box 1 Open market operations of the European Central Bank

The ECB conducts four types of open-market operations:

- main refinancing operations – weekly auctions for loans of 2W maturities; commercial banks submit bids and the ECB chooses how much to allocate at which interest rate. This the main source of liquidity provision to the market.
- Longer-term refinancing operations, which are monthly auctions for loans of one-month maturity.
- Fine-tuning and structural operations, which are occasionally conducted to deal with special circumstances.
- Standing facilities, which set a ceiling and a floor for the short-term (overnight) interest rate. These operations are undertaken by individual commercial banks to either deposits funds at the marginal deposit rate (the floor) or borrow from the ECB at the marginal lending rate (ceiling). These facilities are used daily at the commercial banks' initiative.

These operations take the form of a **reverse transaction** or repurchase agreement ('repo' for short), loans of limited duration. The ECB publicly announced the rate at which it will conduct its next main refinancing operations as well as the floor and ceiling rates. The key short-term market rate of the ECB is named EONIA (euro overnight index average) moves within the tunnel set by the lending and deposit rates. EONIA closely follows the ECB's main rate – the refinancing rate.

Box 2 Main instrument of the Czech National Bank monetary policy

Open market operations are used for steering interest rates in the economy. Open market operations are mostly executed in the form of repo operations. With regard to their aim and regularity, the CNB's open market operations can be divided into the following categories:

The main monetary policy instrument takes the form of repo tenders. The CNB accepts surplus liquidity from banks and in return transfers eligible securities to them as collateral. The two parties agree to reverse the transaction at a future point in time, when the CNB as borrower repays the principal of the loan plus interest and the creditor bank returns the collateral to the CNB. The basic duration of these operations is 14 days; the **two-week repo rate (2W repo rate)** is therefore considered to be of key importance in terms of monetary policy. Repos with shorter maturities are executed from time to time depending on the forecasts of banking sector liquidity. Owing to the systemic liquidity surplus in the Czech banking sector, 2W repo tenders are currently used exclusively for absorbing liquidity.

The CNB conducts variable rate tenders, which means that the declared repo rate serves as the maximum limit rate at which banks' bids can be satisfied in the tender. The bids are ranked using the American auction procedure, i.e. those with the lowest interest rate are satisfied as having priority and those with successively higher rates are accepted until the total predicted liquidity surplus for the day is exhausted. If the volume ordered by the banks exceeds the predicted surplus, the CNB either completely refuses the bids at the highest rate or reduces them pro rata. Repo tenders are usually announced three times a week. Banks may submit their orders - i.e. the amounts of money and the interest rates at which they want to enter into transactions with the CNB.

The supplementary monetary instrument is **the three-month repo tender**. Here, the CNB accepts liquidity for a three-month period. The three-month repo tender again uses the American auction procedure (see the two-week repo tender). In these operations, the CNB does not intend to send signals to the market and therefore the three-month repo rate used for this tender is not the CNB's rate but the money market rate in effect at the time of calling the tender. At present this instrument is not used. The last three-month tender was called in January 2001.

Fine-tuning instruments (foreign exchange operations and securities operations) are used ad hoc, mainly to smooth the effects on interest rates caused by unexpected liquidity fluctuations in the market. These instruments are rarely used.

BOX 2 – continues

Automatic facilities

Automatic facilities are used for providing and depositing liquidity overnight. As, from the banks' point of view, these represent standing facilities for depositing or borrowing money, the interest rates applied to them form the corridor for short-term money market rates (as well as for the two-week repo rate).

- the deposit facility is a non-collateralised standing facility which banks may use to make overnight deposits of surplus liquidity with the CNB. The deposits are remunerated at the discount rate, which generally provides a floor for short-term interest rates on the money market.

- the marginal lending facility is a standing facility which banks that have a general repo agreement with the CNB may use to obtain overnight liquidity from the CNB in the form of repos. The interest rate applied to this facility is the Lombard rate. Owing to a persistent liquidity surplus, banks make minimal use of this facility. The Lombard rate provides a ceiling for short-term interest rates on the money market. The CNB may at any time, for extraordinary monetary-policy reasons, temporarily limit or completely suspend the provision of Lombard loans.

Extraordinary facilities - in autumn 2008, the CNB introduced extraordinary liquidity-providing repo operations with two-week and three-month maturities aimed at fostering the functioning of the government bond market. From January 2011, only the liquidity-providing repo operation with two-week maturity remains in place.

Minimum reserves - every bank, building society and foreign bank branch in the Czech is required to hold a pre-specified volume of liquid funds - known as minimum reserves - on its account with the CNB. The reserve requirement is 2% of the base used for calculating the minimum reserves. Effective from 12 July 2001, the reserve base is the volume of bank's deposits from non-banks with maturity up to 2 years. Each bank is required to maintain over a maintenance period an average end-of-day balance on its minimum reserves accounts equal to or greater than the reserve requirement set for the given maintenance period. Since 12 July 2001, the funds on this account have been remunerated at the CNB two-week repo rate up to the pre-specified volume of minimum reserves. The reserve requirement is currently of little significance as a monetary policy instrument, but the money held on these accounts fulfils another important role: it serves as a cushion for the smooth functioning of the interbank payment system.

Source: adopted from Czech National Bank, http://www.cnb.cz/en/monetary_policy/instruments/index.html. March 2011.

Foreign exchange market interventions - open market operations can also influence the foreign exchange market and thus the exchange rate. The central banks that adopted some kind of fixed exchange rate regime or 'managed float' are time to time forced to use its foreign exchange reserves (usually in the form of government bonds or foreign currencies) to keep the exchange rate in pre-determined target or band. For instance, if the central bank wishes to prevent a currency's depreciation, it buys back its own currency on the foreign exchange market, and pays for it by drawing on its stock of foreign assets (foreign reserves). As a result, foreign reserves of the central bank decline, and the money base is reduced since the domestic currency bought back on the foreign exchange market is effectively withdrawn from circulation. And through multiplier effect, money supply decline as well. Similarly, to prevent appreciation, the central bank sell its own currency and acquires foreign assets; the monetary base increases, and so do the money supply.

Box 3 Intervention and Sterilization

Exchange and open market interventions both affect the liabilities and assets of the central bank. The only difference lies in which asset class changes: in the case of open market intervention, there are domestic assets such as repurchase agreements or bonds; in the case of exchange market intervention, there are foreign reserves. The similarity highlights the possibility of a conflict between monetary control and exchange rate control. So, the monetary policy autonomy is lost when the central bank has to intervene on the foreign exchange market to fix the exchange rate.

However, the central bank can offset, or **sterilize**, the impact of its foreign exchange intervention on the money supply by intervening on the open market with a transaction of the same volume, but with the opposite effect on money market liquidity. For instance, to support the currency, the central bank has to sell its foreign exchange reserves buys the equivalent amount of its own currency. As a result, central bank's assets decline, monetary base shrinks by the same amount. BUT if the central bank simultaneously purchase the same worth of securities on the open market from commercial banks, it injects the same amount of money base into the market. The end effect of proceed sterilization is a reshuffling of the asset side of the central bank's balance sheet – an increase in domestic asset holdings matched by a reduction of foreign reserves. The monetary base has not changed.

Source: adopted from Burda (2001).

Interest rates - nowadays many central banks are used to set interest rate - so called target rate - to influence the market rates. The mechanism to move the market towards the so-called the target rate (Federal Fed Funds Rate in the USA o 2W repo rate in the Czech Republic) is generally to lend money or borrow money, until the targeted market rate is sufficiently close to the target. Central banks may do so by lending money to and borrowing money from (taking deposits from) a limited number of qualified banks, or by purchasing and selling bonds. Central banks are used to set the target rate, and a tolerance band. Qualified banks borrow from each other within this band, but never above or below, because the central bank will always lend to them at the top of the band, and take deposits at the bottom of the band. It is also notable that the target rates are generally short-term rates. The actual rate that borrowers and lenders receive on the market will depend on (perceived) credit risk, maturity and other factors. For example, a central bank might set a target rate for overnight lending of 4.5%, but rates for (equivalent risk) five-year bonds might be 5%, 4.75%, or, in cases of inverted yield curves, even below the short-term rate. Many central banks have one primary 'headline' rate that is quoted as the 'central bank rate' or 'key rate'. In practice, they will have other tools and rates that are used, but only one that is rigorously targeted and enforced.

A typical central bank has several interest rates or monetary policy tools it can set to influence markets. In the case of European Central Bank (ECB) there are:

* Marginal lending rate (as of Feb 2011 1.75% in the Eurozone) – a fixed rate for institutions to borrow money from the central bank. (In the USA this is called the discount rate).
* Main refinancing rate (1.00% in the Eurozone) – the publicly visible interest rate the central bank announces. It is also known as minimum bid rate and serves as a bidding floor for refinancing loans. (In the USA this is called the federal funds rate).
* Deposit rate (0.25% in the Eurozone) – the rate parties receive for deposits at the central bank.

These rates directly affect the rates in the money market, the market for short term loans.

Reserve requirements - in practice, many banks are required to hold a percentage of their deposits as reserves. Such legal reserve requirements were introduced in the nineteenth century to reduce the risk of banks overextending themselves and suffering from bank runs, as this could lead to knock-on effects on other banks. So the commercial banks are required to hold a certain percentage of their assets in the form of cash reserves. The central bank might decide to limit money supply growth by rising the required reserve ratio. The commercial banks have to limit its lending activity and deposit more cash on the central bank's balance. Because the demanding move in the required reserve ratio that would curb the excessive money supply growth might need to be extensive, and thus costly for the commercial banks, nowadays reserve ratio are normally change only in small increments, and then only in emergency situations. One of the last central banks that uses reserve ratio as a operational monetary policy instrument is the People's Bank of China that retains (and uses) more powers over reserves because the yuan that it manages is a non-convertible currency.

Other instruments: **Capital requirements** - all banks are required to hold a certain percentage of their assets as capital, a rate which may be established by the central bank or the banking supervisor. For international banks, including the 55 member central banks of the Bank for International Settlements, the threshold is 8% (see the Basel Capital Accords) of risk-adjusted assets, whereby certain assets (such as government bonds) are considered to have lower risk and are either partially or fully excluded from total assets for the purposes of calculating capital adequacy. Partly due to concerns about asset inflation and repurchase agreements, capital requirements may be considered more effective than deposit/reserve requirements in preventing indefinite lending: when at the threshold, a bank cannot extend another loan without acquiring further capital on its balance sheet.

Exchange requirements - to influence the money supply, some central banks may require that some or all foreign exchange receipts (generally from exports) be exchanged for the local currency. The rate that is used to purchase local currency may be market-based or arbitrarily set by the bank. This tool is generally used in countries with non-convertible currencies or partially-convertible currencies. The recipient of the local currency may be allowed to freely dispose of the funds, required

to hold the funds with the central bank for some period of time, or allowed to use the funds subject to certain restrictions. In other cases, the ability to hold or use the foreign exchange may be otherwise limited. In this method, money supply is increased by the central bank when it purchases the foreign currency by issuing (selling) the local currency. The central bank may subsequently reduce the money supply by various means, including selling bonds or foreign exchange interventions.

Margin requirements and other tools - in some countries, central banks may have other tools that work indirectly to limit lending practices and otherwise restrict or regulate capital markets. For example, a central bank may regulate margin lending, whereby individuals or companies may borrow against pledged securities. The margin requirement establishes a minimum ratio of the value of the securities to the amount borrowed.

Central banks might have requirements for the quality of assets that may be held by financial institutions; these requirements may act as a limit on the amount of risk and leverage created by the financial system. These requirements may be direct, such as requiring certain assets to bear certain minimum credit ratings, or indirect, by the central bank lending to counterparties only when security of a certain quality is pledged as collateral.

Self-study: BLANCHARD, O. – ARICCIA, G. D. – MAURO, P. (2010): *Rethinking Macroeconomic Policy*. IMF. SPN/10/03. February 12, 2010.

4.4 Monetary Policy Regimes

Exchange rate anchor

The monetary authority stands ready to buy or sell foreign exchange at given quoted rates to maintain the exchange rate at its preannounced level or range; the exchange rate serves as the **nominal anchor** or intermediate target of monetary policy. This type of regime covers exchange rate regimes with no separate legal tender: currency board arrangements; fixed pegs with and without bands; and crawling pegs with and without bands. Under this arrangement, a central bank maintaining a fixed exchange rate by either buying or selling its own currency on the foreign exchange market against its foreign reserves. If the exchange rate tends to weaken, the central bank buys its own currency in the market using its reserves. This places greater demand on the market and pushes up the price of the currency. As a result, the supply of money in domestic economy declines. If the exchange rate tends to strengthen, the central bank sells its own currency, thus increasing its foreign reserves. The domestic supply of money increases.

A central bank has to invest many resources in getting the foreign reserves to pile up in order to defend the pegged exchange rate. Moreover a central bank, when having a fixed rather than floating exchange rate, cannot use monetary policy with a free hand. For instance, by using reflationary tools to set the economy rolling (by injecting more money in the market), the central bank risks running into a trade deficit. This might occur as the purchasing power of a common household increases along with inflation as a result of higher money supply and thus nominal interest rates. Imports get relatively cheaper and at the same time the pressure on currency to weaken occurs and the central bank has to intervene – buying the domestic currency on the market. Finally, supply of money goes back down and nominal interest rates up. The impact of the easing monetary policy measure is only temporal.

Advantages of fixed exchange rate regime:

- 'to **import (low) inflation**' - inflation is matched to the value of another single currency or to a basket of other currencies.

- to help emerging economies to gradually build up a credible monetary policy and establish a credible central bank
- to reduces uncertainty about the exchange rate (some uncertainty still remains in relation to possible revaluation of the exchange rate)

Disadvantages:

- if the exchange rate is fixed, the possible restoration of an external balance has to be done by other means (not by exchange rate adjustment), which may cause an economic recession; the standard tools of monetary policy (especially interest rates) are out of the game, or must be subordinate to a single goal: exchange rate stability. The ability of economies to respond to an external shock is lower than that of free-floating exchange rate and the shock can lead even to currency crisis.
- Divorce the exchange rate from domestic monetary conditions may result in speculative attacks (see currency crisis in South East Asia, Russia, Brazil in the late 1990s)
- Hand in hand with the rapid expansion of capital markets, it is becoming increasingly difficult to maintain a stable exchange rate; a central bank in the fight against international capital flows can't stand for long.
- Abandonment of fixed exchange rate is associated with large economic cost, including loss of credibility of a central bank.

Some countries allow some flexibility in the exchange rate target either in the form of a band of fluctuation (see Czech Republic since February 1996 till May 1997), or by letting the exchange rate depreciate along a pre-specified trend (so-called crawling peg; see e.g. Hungary since 1995 till 2000). Other have completely linked their currency to another one, operating a currency board (Argentina till 2002, Estonia till 2010, Hong-Kong, Bulgaria). The most extreme form of exchange rate targeting is the complete adoption of a foreign currency, which completely eliminates domestic monetary policy. It is called dollarization (see Ecuador, Panama, Liechtenstein to Swiss franc) or euroization when the euro becomes the national currency (e.g. Kosovo, Montenegro)

Monetary aggregate anchor – monetary targeting

The central bank uses its instruments to achieve a target growth rate for a monetary aggregate, such as reserve money, M1, or M2. In other words, it targets the rate of money growth explicitly. The targeted aggregate becomes the nominal anchor or intermediate target of monetary policy. This regime is closely linked with the monetarist school of economics and its key proponent Milton Friedman. M. Friedman was best known for reviving interest in the money supply as a determinant of the nominal value of output, that is, the **quantity theory of money**. The quantity theory emphasizes the following relationship of the nominal value of expenditures (the price level P time real output Y) and to the quantity of money M multiplied by velocity of the money:

$$M \cdot V = P \cdot Y . \tag{4.7}$$

Velocity of money was taken to be the ratio of net national product in current prices to the money stock. Or the 'V' is the transactions velocity of money - the average frequency across all transactions with which a unit of money is spent. This reflects availability of financial institutions, economic variables, and choices made as to how fast people turn over their money.

According to the quantity theory of money, the short-run effect of a change in the money supply is primarily on output but that the longer-run effect is primarily on the price level.

So in line with this, there is a close and stable association between price inflation and the money supply, mainly that price inflation should be regulated with monetary deflation (reduction of money supply) and price deflation with monetary inflation (increase in money supply). So, the causation running from money to prices.

To sum up, the theory above is based on the following hypotheses:

1. The source of inflation is fundamentally derived from the money supply growth.
2. The supply of money is exogenous (set by the central bank)
3. The demand for money, as reflected in its velocity, is a stable function of nominal income, interest rates, and other factors.

4. The mechanism for injecting money into the economy is not that important in the long run.

5. The real interest rate is determined by non-monetary factors: (productivity of capital, time preference).

An application of the quantity-theory approach aimed at removing monetary policy as a source of macroeconomic instability was to target a constant, low growth rate of the money supply. Still, practical identification of the relevant money supply, including measurement, was always somewhat controversial and difficult. As financial intermediation grew in complexity and sophistication in the 1980s and 1990s, it became more so. As a result, some central banks, including the U.S. Federal Reserve, which had targeted the money supply, reverted to targeting interest rates. But monetary aggregates remain a leading economic indicator. With some evidence that the linkages between money and economic activity are robust even at relatively short-run frequencies. While mainstream economists agree that the quantity theory holds true in the long run, there is moreover still disagreement about its applicability in the short run. Critics of the theory argue that money velocity is not stable and, in the short-run, prices are sticky, so the direct relationship between money supply and price level does not hold. Others criticize the focus of the quantity theory on the supply of money without adequately explaining the demand for money. They say the theory fails to explain the mechanism of variations in the value of money. And finally, the monetary targeting is not very transparent regime for the general public.

In the short period when the economy can move off potential, monetary policy can be actively used to address short term imbalances. In times of recession and too low inflation, the central bank increases the money supply and nominal interest rates go down. Lower interest rates encourage aggregate demand and consequently output increases. Employment and the economy will gradually return to the natural level and the potential. With higher product inflation increases. In the long run, the result of above described the **expansionary monetary policy** affects only inflation (increase inflation). By contrast, if inflation goes up and output stays above potential, the central bank reduces money supply, nominal interest rates go up and aggregate demand and output decrease. In this case, the central bank adopts the **restrictive monetary policy**.

Box 4 The ECB´s definition of euro area monetary aggregates

Based on conceptual considerations and empirical studies, and in line with international practice, the Eurosystem has defined a narrow (M1), an 'intermediate' (M2) and a broad aggregate (M3). These aggregates differ with respect to the degree of moneyness of the assets included. The Table below shows the definitions of the euro area monetary aggregates using the definition of liabilities issued by the MFI sector (see Table 1) as well as by entities belonging to the central government sector (Post Offices, Treasuries) of the euro area. As noted above, these aggregates include only positions of residents of the euro area which are held with MFIs located in the euro area. Holdings by euro area residents of liquid assets denominated in foreign currency can be close substitutes for euro-denominated assets. Therefore, the monetary aggregates include such assets if they are held with MFIs located in the euro area.

Narrow money (**M1**) includes currency, i.e. banknotes and coins, as well as balances that can immediately be converted into currency or used for cashless payments, i.e. overnight deposits.
'Intermediate' money (**M2**) comprises narrow money (M1) and, in addition, deposits with maturities of up to 2 years and deposits redeemable at notice of up to 3 months.
Broad money (**M3**) comprises M2 and marketable instruments issued by the MFI sector. Certain money market instruments, in particular money market fund (MMF) shares/units and money market paper, and repurchase agreements are included in this aggregate. A high degree of liquidity and price certainty make these instruments close substitutes for deposits. As a result of their inclusion, M3 is less affected by substitution between various liquid asset categories than narrower definitions of money, and is more stable.

Liabilities	M1	M2	M3
Currency in circulation	X	X	X
Overnight deposits	X	X	X
Deposits with agreed maturity up to 2 years		X	X
Deposits redeemable at notice up to 3 months		X	X
Repurchase agreements			X
Money market fund (MMF) shares/units and money market paper			X
Debt securities up to 2 years			X

Source: Adopted from CNB, http://www.cnb.cz/en/statistics/money_and_banking_stat/mbs_harmonisation/mbs_harmonisation_aggregates.html. March 2011.

Monetary targeting has become very popular in the 70th of the last century. That time, the monetarism was on the top of the popularity. The principal protagonist was Milton Friedman. Monetary targeting can be credited for the successful disinflation of the 1980s. Unfortunately, the link between money growth and inflation has become less predictable, much as the link between money base and wider monetary aggregates has become clouded. Widespread financial deregulation in the mid-1980s first, information technology on banking and financial markets in the 1990s next, have resulted in instability in the public's demand for money. As a result, control of the money base M0 does not deliver a precise handle on the wider aggregates. One answer has been to target inflation directly. In late 1980s, the inflation targeting was initially implemented by the Bank of New Zealand. In the late 1990s, the new regime of monetary policy - inflation targeting has become very popular. At present, the monetary targeting is applied by only less-developed economies such as Argentina, Iran, Cambodia and China (together with pegged exchange rate).

Inflation targeting framework

Inflation targeting involves the public announcement of medium-term numerical targets for inflation with an institutional commitment by the monetary authority to achieve these targets. Additional key features include increased communication with the public and the markets about the plans and objectives of monetary policymakers and increased accountability of the central bank for attaining its inflation objectives. Monetary policy decisions are guided by the deviation of forecasts of future inflation from the announced target, with the inflation forecast acting (implicitly or explicitly) as the intermediate target of monetary policy.

In the inflation targeting regime the central bank adjusts its key interest rate depending on the deviation of the predicted inflation from the inflation target and of actual output from potential. This relationship between inflation and inflation's target plus output gap is known as an interest rate rule or a so-called **Taylor rule**:

$$i_t = \pi_f + r^* + \alpha\,(\pi_f - \pi^t) + \beta\,(y_f - y^*), \qquad (4.8)$$

where i_t is the target short-term nominal interest rate (e.g. 2W repo rate or the federal funds rate in the US), π_f is the forecasted rate of inflation, π^t is the desired rate of

inflation, r^* is the assumed equilibrium real interest rate, y_f forecasted real GDP growth rate, and y^* potential growth rate; α and β are coefficients that describe the weight of inflation and output gap, given by the central bank's preferences. Given the fact that the aggregate demand is affected by real interest rates, the coefficient $\alpha > 1$, since the central bank must raise nominal interest rates by more than inflation.

The rule 'recommends' a relatively high interest rate (a **tight monetary policy**) when inflation is above its target or when output is above potential, in order to reduce inflationary pressure. It recommends a relatively low interest rate (**easy monetary policy**) in the opposite situation, to stimulate output and inflation. Sometimes monetary policy goals may conflict, as in the case of stagflation, when inflation is above its target while output is below full employment level (or potential). In such a situation, a Taylor rule specifies the relative weights (α and β) given to reducing inflation versus increasing output.

The rule is intended to foster price stability and full employment systematically by reducing uncertainty and by increasing the credibility of future actions by the central bank. It may also avoid the inefficiencies of time inconsistency from the exercise of discretionary policy.

Box 5 Discretionary policy and time inconsistency

Discretionary policy describes macroeconomic policy based on the ad hoc judgment of policymakers as opposed to policy set by predetermined rules. For instance, a central banker could make decisions on interest rates on a case by case basis instead of allowing a set rule, such as the Taylor rule, determine interest rates. 'Discretionary policies' refer to actions taken in response to changes in the economy, they use subjective judgment to treat each situation in unique manner. In practice, most policy changes are discretionary in nature. Policy makers use auto stabilizers to adjust the aggregate demand.

Time inconsistency, or dynamic inconsistency, describes a situation where a decision-maker's preferences change over time in such a way that what is preferred at one point in time is inconsistent with what is preferred at another point in time. It is often easiest to think about preferences over time in this context by thinking of decision-makers as being made up of many different 'selves', with each self representing the decision-maker at a different point in time. The inconsistency will occur when somehow the preferences of some of the selves are not aligned with each other.

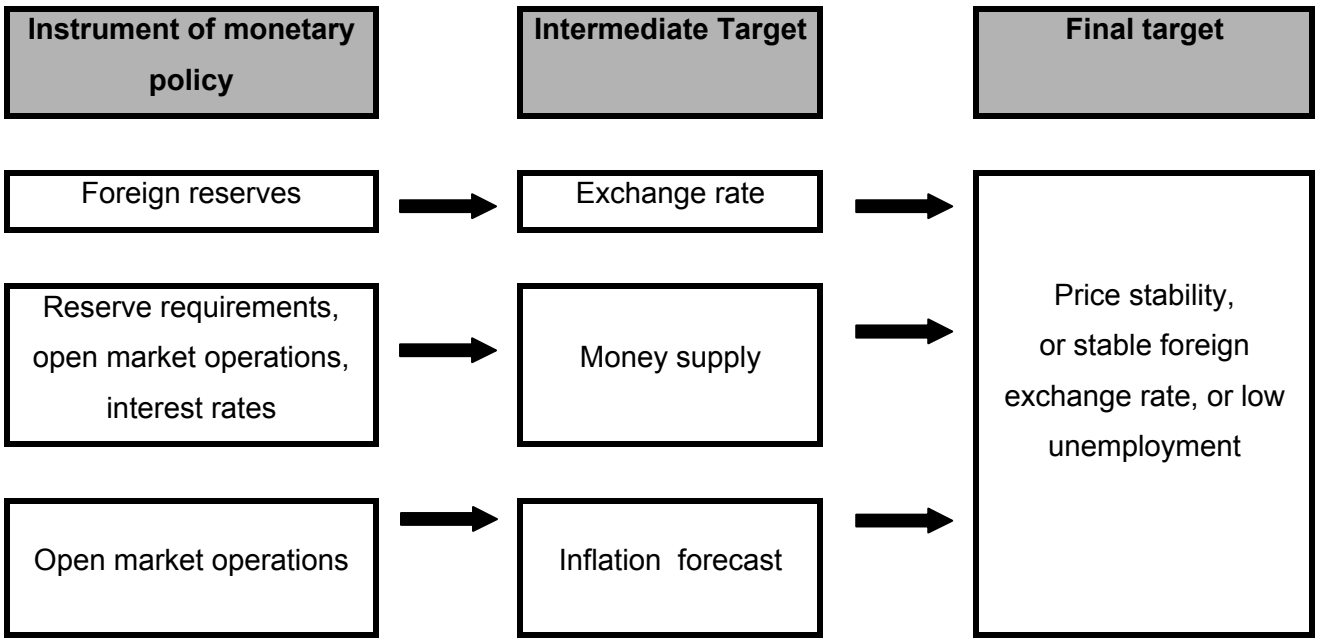
Inflation targeting has been adopted e.g. in Canada, UK, Chile, Israel, Mexico, Czech Republic, Poland, Hungary, and Sweden.

More detail: self study: Svensson (1998) and Mishkin (2000).

Other popular regimes:

foreign exchange reserves targeting, or a combination of the previous regimes such as money supply targeting and fixed exchange rate with a fluctuation band (see China) or monetary and inflation targeting (see ECB).

Graph 12 Monetary policy scheme



4.5 Monetary Policy Transmission Channels

Monetary policy transmission channels describe the way through which the monetary policy by using its policy instruments affects the economy aiming to achieve its target.

Conventional Monetary Policy Transmission Mechanism are as follows:

The interest rate channel, suggests that monetary policy makers use their leverage over short-term interest rates (e.g. federal funds rate) to influence the cost of capital, and subsequently, purchases of durable goods and firm investment. Because prices are assumed to be sticky in the short-run, short-term interest rate changes affect the real interest rate. Changes in the real interest rate are what influence firm investment and household spending decisions on durable goods. These changes in investment and durable good purchases affect the level of aggregate demand and final production.

Lower real interest rates encourage spending sensitive to real interest rates (especially investment and consumption), aggregate demand increases and production rises. Inflation also increases.

$$i\downarrow (\pi_f < \pi^t) \Rightarrow \text{private expenditure} \uparrow \Rightarrow AD\uparrow \Rightarrow Y\uparrow + \pi\uparrow$$

The credit channel affects the economy by altering the amount of credit firms and/or households have access to in equilibrium. Factors that reduce the availability of credit reduce agents' spending and investment, which leads to a reduction in output. The credit channel view posits that monetary policy adjustments that affect the short-term interest rate are amplified by endogenous changes in the external finance premium. The external finance premium is a wedge reflecting the difference in the cost of capital internally available to firms (i.e. retaining earnings) versus firms' cost of raising capital externally via equity and debt markets. External financing is generally more expensive than internal financing. Contractionary monetary policy is thought to increase the size of the external finance premium, and subsequently, through the credit channel, reduce credit availability in the economy. The main difference

between the interest rate channel and the credit channel of monetary policy transmission is the mechanism through which spending and investment decisions are changed due to monetary policy changes. Alternatively, the credit channel of monetary policy transmission is viewed as an indirect amplification mechanism that works in tandem with the interest rate channel.

The credit channel, can occur through two conduits: the balance sheet channel and the bank lending channel. The balance sheet channel refers to the notion that changes in interest rates affect borrowers' balance sheets and income statements. The bank lending channel refers to the idea that changes in monetary policy may affect the supply of loans dispersed by depository institutions. The bank lending channel theorizes that changes in monetary policy will shift the supply of intermediated credit, especially credit extended through commercial banks. Monetary policy actions may affect the supply of loanable funds available to banks, and consequently the total amount of loans they can make. Banks serve to overcome informational problems in credit markets by acting as a screening agent for determining credit-worthiness. Thus many agents are dependent on banks to access credit markets. If the supply of loanable funds banks possess is affected for some reason, then so too should be the borrowers who are dependent on banks' funds for business operations. Firms reliant on bank credit may either be shut off from credit temporarily or incur additional search costs to find a different avenue through which to obtain credit. This will increase the external finance premium, consequently, reducing real economic activity.

Lower real interest rates reduce the interest cost of debt and increase demand of companies on loans. So, investment and consumption increase and finally aggregate demand and production go up. Inflation also increases. The importance of this channel in a given economy depends on the economic dependence on bank loans. The more indebted economy, more sensitive to changes in real interest rates.

$$i\downarrow (\pi_f < \pi^t) \Rightarrow \text{credit issue} \uparrow \Rightarrow AD\uparrow \Rightarrow Y\uparrow + \pi\uparrow$$

The exchange rate channel is one of the intermediate policy variables through which monetary policy is transmitted to the larger economy through its impact on the

value of domestic currency, domestic inflation (the pass-through effect), and economic output. Changes in the exchange rate might induce changes in the relative prices of goods and services, and the level of spending by individuals and firms, especially if significant levels of their wealth are held in foreign currencies. An appreciation in the value of the exchange rate makes imported goods and services relatively cheap, while depreciation makes exports cheaper to foreign buyers, thereby inducing higher competition in export markets at home. On the other hand, with depreciation, imports become more expensive and so less competitive against goods produced by domestic producers. Changes in the exchange rate therefore, have implications for individual spending and investment behavior of firms, all of which can affect aggregate demand, economic growth, price stability and full employment.

$$i\downarrow (\pi_f < \pi^t) \Rightarrow E\uparrow \Rightarrow NX\uparrow \Rightarrow Y\uparrow + \pi\uparrow$$

For example, a decline in interest rates (i) in a situation where inflation is predicted below the inflation target ($\pi_f < \pi^t$) leads to an exchange rate depreciation ($\uparrow$E). A weaker exchange rate will promote exports and reduce imports, both of which contribute to the improvement in net export (NX$\uparrow$). Higher net exports increases aggregate demand, consequently output and inflation. Inflation is boosted also by an increase in import prices due to the weakening exchange rate.

Equity Price Channels

There are two channels involving equity prices that are important to the monetary transmission mechanism: these involve 'Tobin's q theory of investment' and wealth effects on consumption. Tobin's q theory provides a mechanism by means of which monetary policy affects the economy through its effects on the valuation of equities. Tobin defines q as the market value of firms divided by the replacement cost of capital. If *q* is high, the market price of firms is high relative to the replacement cost of capital, and new plant and equipment capital is cheap relative to the market value of business firms. Companies can then issue equity and get a high price for it relative to the cost of the plant and equipment they are buying. Thus investment spending will rise because firms can buy a lot of new investment goods with only a small issue of equity. On the other hand, when q is low, firms will not purchase new investment goods because the market value of firms is low relative to the cost of capital. If

companies want to acquire capital when q is low, they buy another firm cheaply and acquire old capital instead. Investment spending will then be low.

But how might monetary policy affect equity prices? In a monetarist story, when the money supply rises, the public finds it has more money than it wants and so tries to reduce the holdings of money by increasing their spending. One place the public can spend more is in the stock market, increasing the demand for equities and consequently raising their prices. Or according to the Keynesians, the fall in interest rates stemming from expansionary monetary policy making bonds less attractive relative to equities, thereby causing the price of equities to rise. Combining these views with the fact that higher equity prices will lead to a higher *q* and thus higher investment spending (I↑) leads to the following transmission mechanism of monetary policy:

$$M\uparrow \Rightarrow \text{equity prices} \uparrow \Rightarrow q\uparrow \Rightarrow I\uparrow \Rightarrow Y\uparrow$$

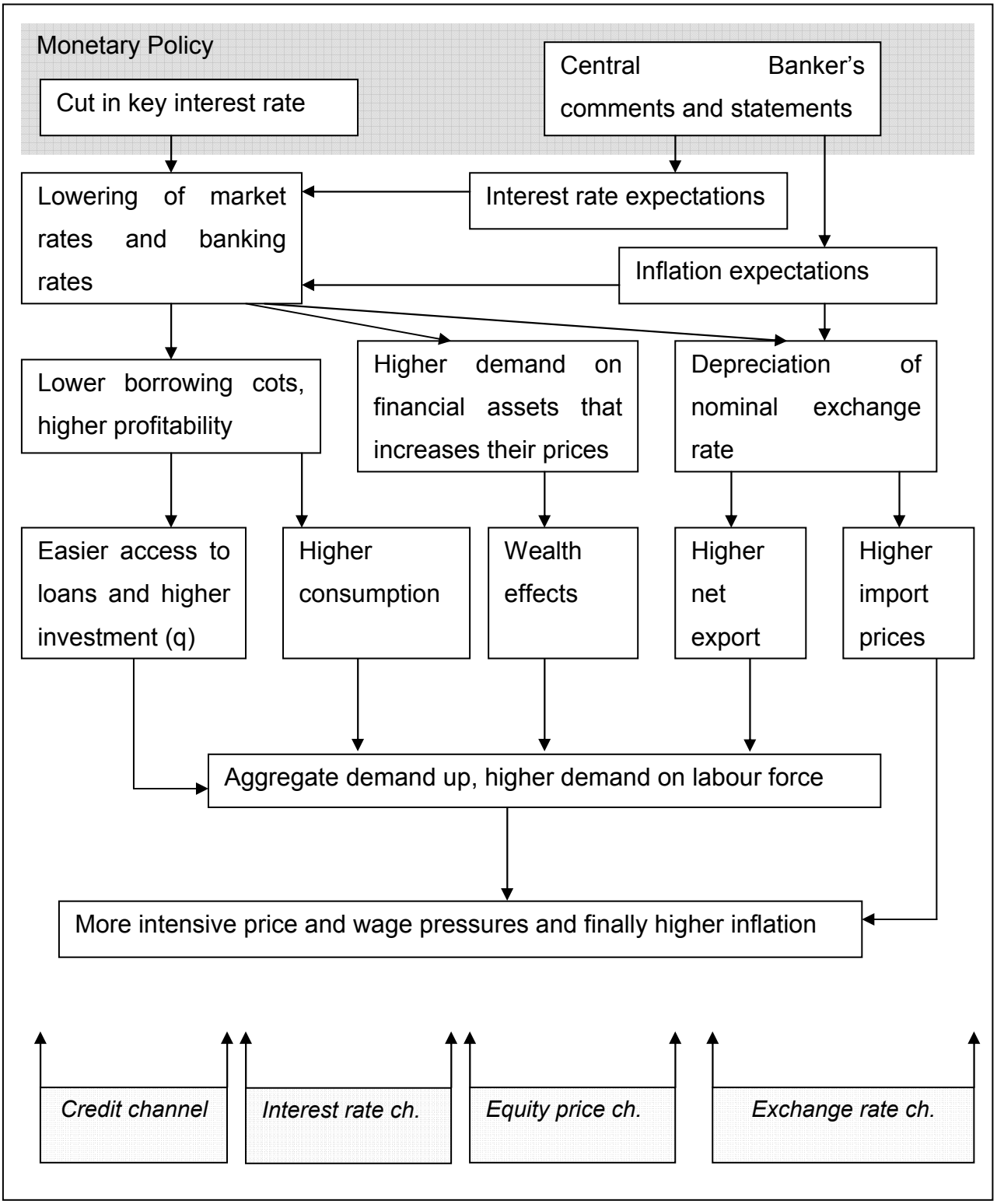
Wealth effects: an alternative channel for monetary transmission through equity prices occurs through wealth effects on consumption. This channel has been strongly advocated by Franco Modigliani. The wealth of consumers is made up of both human capital, real capital and financial wealth. A major component of financial wealth is common stocks. When stock prices rise, the value of financial wealth increases, thus increasing the lifetime resources of consumers, and consumption should rise. Since we have already seen that expansionary monetary policy can lead to a rise in stock prices, we then have another monetary transmission mechanism: housing and land price channels. Both of the wealth and Tobin's q channels described above allow for a quite general definition of equity. The Tobin's q framework applies straightforwardly to the housing market, where housing is equity. An increase in house prices, which raises their prices relative to replacement cost, leads to a rise in Tobin's q for housing, thereby stimulating its production. Similarly, housing and land prices are an extremely important component of wealth and so rises in these prices increase wealth, thereby raising consumption. Monetary expansion, which raises land and housing prices through the mechanisms described above, thus leads to a rise in aggregate demand. Therefore, the monetary transmission mechanism also operates through the land and housing price channels.

The decline in real interest rates reduces the demand for cash and increases the demand for other financial assets such as securities and bonds. As a result, increase the price of assets (bonds, equities, etc.). Asset-holders feel richer (the so-called wealth effect) and increase their consumption. Finally, the increase in aggregate demand, output and inflation.

$i\downarrow (\pi_f < \pi^t) \Rightarrow$ equity prices $\uparrow \Rightarrow q\uparrow \Rightarrow I\uparrow \Rightarrow AD\uparrow \Rightarrow Y\uparrow + \pi\uparrow$

$\Rightarrow$ households' wealth $\uparrow \Rightarrow C\uparrow \Rightarrow AD\uparrow \Rightarrow Y\uparrow + \pi\uparrow$

Graph 13 Monetary Policy Scheme



4.6 Pitfalls of monetary policy

Liquidity Trap

Liquidity trap is called an extreme situation, when nominal interest rates are near zero and the central bank left little room for its further reductions. Inflation is very low and economic agents do not expect any inflation increase. They prefer holding cash. Therefore, this situation called liquidity trap. The central bank has no chance with the standard tools (interest rates) to support the economy because low nominal interest rates (close to zero) combined with stable low inflation expectations preventing a decline in real interest rates that might support economy. Monetary policy will then lose influence on aggregate demand and can not lead the economy out of recession. In the 1990s, Japan was in the liquidity trap and dealt with it by a significant fiscal expansion and released large amounts of money into the economy.

Insensitivity of expenditure to changes in interest rates

If aggregate demand is not sensitive to changes in interest rates, the central bank would loss the effective tool - interest rates - to influence the economy. On the contrary, the fiscal expansion would be very effective, because no crowding-out effect of the fiscal expansion occurs. Close to this situation might find 'young' economies with underdeveloped financial sector, where the share of loans granted to households and firms is negligible.

Time lags

The monetary policy affects the economy with some time delay. The central bank must firstly recognize that the economic situation calls for intervention (cognitive lag). Then the decision makers choose appropriate measures. While the central bank decisions (for example a change in interest rates) can be applied immediately, the impact of decisions could be seen with a long time delay, since economic variables respond with time lags and the transmission channels do not always work without any defect. It might happen that, due to the long action lag, the monetary policy begin to work at the time when the state of the economy would be quite different.

For example, the Czech National Bank assumes that its policy measures will impact the economy in horizon of 12-18 months.

4.7 The position of the monetary policy

The **Monetary Conditions Index** (MCI) is an index number calculated from a linear combination of a real interest rate and an real exchange rate. The MCI begins with a simple model of the determinants of aggregate demand in an open economy, which include variables such as the real exchange rate as well as the real interest rate. Moreover, monetary policy is assumed to have a significant effect on these variables, especially in the short run. Hence a linear combination of these variables can measure the effect of monetary policy on aggregate demand. Since the MCI is a function of the real exchange rate, the MCI is influenced by events such as terms of trade shocks, and changes in business and consumer confidence, which do not necessarily affect interest rates.

The MCI may also serve as a day-to-day operating target for the conduct of monetary policy, especially in small open economies. Central banks compute MCIs, with the Bank of Canada being the first to do so, beginning in the early 1990s.

Let aggregate demand take the following simple form:

$$y = a_0 + a_1 r + a_2 q + v, \tag{4.9}$$

where y denotes aggregate demand (logged), r … real interest rate (measured in percents); q … real exchange rate (defined as the foreign currency price of a unit of domestic currency). A rise in *q* means that the domestic currency appreciates (*q* is the natural log of an index number that is set to 1 in the base period); v … stochastic error term assumed to capture all other influences on aggregate demand; a_1 and a_2 are the respective real interest rate and real exchange rate elasticities of aggregate demand. Empirically, we expect both a_1 and a_2 to be negative, and $0 \leq a_1/a_2 \leq 1$.

Only changes in the MCI, and not its numerical value, are meaningful, as is always the case with index numbers. Changes in the MCI reflect changes in monetary

conditions between two points in time. A rise (fall) in the MCI means that monetary conditions have tightened (eased).

Because the MCI begins with a linear combination, infinitely many distinct pairs of real interest rates *r* and real exchange rates *q* yield the same value of the MCI. Hence *r* and *q* can move a great deal, with little or no effect on the value of the MCI. Nevertheless, the differing value of *r* and *q* consistent with a given value of MCI may have widely differing implications for real output and the inflation rate, especially if the time lags in the transmission of monetary policy are material. Since a_1 and a_2 are expected to have the same sign, *r* and *q* may move in opposite directions with little or no change in the MCI. Hence the MCI that changes little after an announced change in monetary policy is evidence that financial markets view the policy change as lacking credibility.

The real interest rate and real exchange rate require a measure of the price level, often calculated only quarterly and never more often than monthly. Hence calculating the MCI more often than monthly would not be meaningful. In practice, the MCI is calculated using the nominal exchange rate and a nominal short run interest rate, for which data are readily available. This nominal variant of the MCI is very easy to compute in real time, even minute by minute, and assuming low and stable inflation, is not inconsistent with the underlying model of aggregate demand.

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4.8 Exercises

1. In 2000, the monthly expenditure per household made in average CZK 6500,-. In 2006 it was CZK 7900,-. Calculate, how much the prices of consumer goods and services changed if there was no change in the structure of expenditures (or if the structure of the consumption basket remained the same). Calculate the average annual inflation rate in the period of 2000 and 2006.

2. Consider a simple basket and based on data below in the table and calculate the consumer price index.

Consumer Basket	Constant weights in 1999 (%)	Price change (y/y %)	CPI (y/y %)
Food and beverages	25,0	10,0	
Consumer goods	40,0	-2,0	
Living	24,0	10,0	
Services	11,0	2,0	
Total	100,0	-	

3. In a company, trade unions had negotiated a collective 3-year agreement including an annual nominal wage growth of 5%. Assume that inflation reached 2%, than 4%, and the last year of the agreement 6%. Was this agreement favorable for employees? How do the real wages change?

4. Depict the impact of a permanent oil shock in AS-AD model on an economy.

5. How would most likely react a central bank when the economic stagflation occurs? Assume that the central bank operates under a) fixed exchange rate regime, b) monetary targeting and c) inflation targeting. The main target of the central bank is to ensure price stability.

6. Suppose that a central bank increases the money supply growth by 2 percentage points. Velocity of money is estimated about 5. Calculate the change in the growth rate of nominal gross domestic product.

7. The central bank forecasts now that the future rate of inflation exceeds the inflation target by 1 percentage point, and output will reach 102% potential in horizon of 12-18 months. Calculate the target short-term nominal interest rate (i), if you know that the equilibrium (or long-term) nominal rate is 4% and the weight of the inflation gap is 1.5 and the weight of output gap of 0.5.