Monetary policy and the inflation process prior to EMU membership

The Czech and Hungarian experience

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Notation

$E_t(\bullet)$	expectations given information up to period t
$\hat{\bullet}$	growth rate
$\bullet^d$	domestic variable
$\bullet^f$	foreign variable
Δ	first difference operator
A	total factor productivity
B	base money
C	cash
c	ratio of cash to money supply
CPI	consumer price index
cpi	consumer price index in logs
D	deposits
d	aggregate demand in logs
E	nominal exchange rate in levels
e	nominal exchange rate in logs
er	real exchange rate in logs
i	interest rate
i^{eq}	equilibrium (neutral) nominal interest rate
K	capital stock
L	labour
l	long-term interest rate
M^S	money supply
m^s	money supply in logs
MC	marginal costs
mc	og of marginal costs
mm	money multiplier
NT	non-tradable sector
P	price level
Q	labour productivity
q	labour productivity in logs
R	reserves
r	real interest rate

r^{eq}	equilibrium real interest rate
rr	required reserves
T	tradable sector
tr	log of costs of tradable inputs
ULC	unit labour costs
u	unemployment rate
u^{eq}	equilibrium unemployment rate (NAIRU)
v	velocity of money
W	wage
w	log of nominal wage
w^{RT}	real wage targeted by employees in logs
w^{T}	wage targeted by employees in logs
X	index of a price included in the CPI
x	log of individual price index included in the CPI
Y	level of real output
y	log of real output
Y^{POT}	potential output
y^{POT}	log of potential output

$\varepsilon_{x,p}$	elasticity of demand to price changes
μ	isk premium
π	inflation rate
π^{eq}	catching-up related equilibrium inflation rate
π^{T}	inflation target
υ	mark-up
φ	premium for differences in equilibrium real interest rates and equilibrium inflation rates
χ	liquidity premium
ψ	disturbance term capturing the effect of supply shocks

$\alpha, \beta, \delta, \theta, \kappa, \lambda, \omega, a, b, c, z$	parameters

Abbreviations

ATS	Austrian Schilling
BIS	Bank for International Settlements
CIP	Covered Interest Parity
CHF	Swiss Franc
CNB	Ceska Narodni Banka (Czech National Bank)
COICOP	Classification of individual consumption by purpose
CPI	Consumer Price Index
CZK	Czech Koruna
DEM	German Mark
ECB	European Central Bank
ECM	Error-correction mechanism
EHT	Expectations hypothesis of the term structure of interest rates
EMU	Economic and Monetary Union
ERM-II	Exchange rate mechanism II
EU	European Union
EUR	Euro
FDI	Foreign Direct Investment
GBP	British Pound
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
HICP	Harmonised Index of Consumer Prices
HP filter	Hodrick-Prescott filter
HUF	Hungarian forint
IFS	International Financial Statistics of the IMF
IMF	International Monetary Fund
IS curve	Investment-savings balance curve
LOP	Law of one price
MM	Money market
MNB	Magyar Nemzeti Bank (Hungarian National Bank)
NAIRU	Non-accelerating inflation rate of unemployment
NKPC	New Keynesian Phillips curve
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary least squares
PP	Percentage point

PPP	Purchasing Power Parity
VAR	Vector Autoregressive Model
VAT	Value added tax
VECM	Vector Error-Correction Model
UIP	Uncovered Interest Parity
US	United States
USD	United States Dollar

1. Introduction and overview of the study

During the past twenty years, the former communist countries in central Europe have experienced massive and rapid change. The transition process initiated in the late 1980s allowed them to emerge as market economies and, in 2004, to become members of the European Union. They have outperformed the more developed EU countries in terms of real growth since the mid-1990s and have started to catch up in living standards. Rapid change occurred also in the financial and monetary area: the countries have established financial sectors, their goods and financial markets have become increasingly internationally integrated, and inflation declined to single-digit levels. Two former transition countries, Slovenia and Slovakia, already have introduced the euro.

Yet, the former transition countries remain emerging market economies in terms of both their income level and the functioning and development of institutions. Their main economic interest remains to facilitate a steady process of convergence in income levels with the more developed economies. The income convergence process requires, among others, institutional development and vigorous investment into human as well as fixed capital. In particular the latter, however, entails numerous challenges for macroeconomic stability including low and stable inflation.

First, all investment projects are surrounded by uncertainty. Vivid, but prudent investment decisions are needed to raise the supply capacity on a lasting basis. Overly optimistic expectations about the speed of convergence may lead to demand growing well above capacity and ultimately to overheating and inflationary pressures. In addition, the catching-up growth process entails financial development and financial deepening as the investments are financed at least in part by bank credit. That carries the risk that banks may start to extend loans too easily and fail to sufficiently monitor the borrowers. Credit booms can emerge, where the ability of the financial sector to assess the viability of investment projects may be impaired due to the "financial accelerator" (Bernanke et al., 1999a). If the investments turn out less profitable then expected, financial stability might be endangered.

Second, most of the (former) transition countries have opened up to foreign capital early in the transition process. Restrictions on capital transactions are also precluded by EU membership. So far, openness to capital flows has brought huge benefits as it has led to capital inflows that facilitated investment and easier access to higher technologies as well as managerial skills. At the same time, however, it has created risks. The level of foreign debt has to remain sustainable. If the country cannot generate sufficient income to service

the debt, sharp changes in the demand level and in the real exchange rate might become unavoidable. Such unsustainable debt can emerge if the capital inflows facilitate a lending boom in residential construction, for consumption purposes or in sectors with low growth potential. Large current account deficits also create vulnerability to sudden swings in capital flows, exchange rate volatility and currency speculation. That has been demonstrated again during the recent financial crisis. Swings in capital flows can be triggered by unsustainable imbalances on the part of the emerging market economy, but they can also stem from shocks to the international capital market or to risk sensitivity. A sudden stop in capital inflows, irrespective of its origin, can necessitate a sudden adjustment in the demand level and the nominal exchange rate, with adverse consequences for price stability.

Third, the process of real convergence is related to price level convergence, which may be reflected in real appreciation of the currency. If the exchange rate is fixed, this will imply an inflation differential to the more developed economies. While it is an equilibrium phenomenon and need not indicate deteriorating competitiveness, the higher inflation rate may become ingrained in the inflation expectations. In such circumstances, a decline in the underlying pace of equilibrium real appreciation will not only harm competitiveness, but may also endanger macroeconomic stability. Inflationary pressures can also emerge from adjustments of regulated prices, supply shocks such as a surge in the price of oil, strong demand growth (overheating) and wage pressures stemming e.g. from overly optimistic growth expectations. Furthermore, some countries have not yet succeeded to reduce inflation to levels close to that of the euro area due to ingrained moderate inflation expectations.

Fourth, owing to the rapid changes and limited knowledge of the functioning of these economies, the efficiency of economic policies including monetary policy may be impaired. The institutions are also weaker than in the more developed countries. As a result, because of the numerous inflationary pressures, the higher susceptibility to shocks and the developing institutions, preserving low inflation is subject to specific challenges in the new member states of the European Union. At the same time, the integration into international financial markets impacts on the monetary strategy and the instruments available to the central bank. With liberalised capital flows, the domestic interest rate may be strongly dependent on the international interest rate. It is likely to be below the interest rate that would equilibrate domestic supply and demand, which is evidenced by the prevailing current account deficits. Admittedly, this does not rule out the sustainability of catching-up growth. However, the imbalances between demand and supply might become excessively large and require correction.

Joining of the European Union has eased some challenges as institutional uncertainty was reduced. Other challenges, however, have risen. As members of the European Union, the new member states are required to strive for euro adoption. Currently the countries have a derogation regarding the introduction of the common currency,[1] but they are nevertheless required to strive to meet the preconditions of euro adoption. These include the Maastricht nominal convergence criteria, which stipulate that

- the average inflation rate in the previous twelve months, measured by the Harmonised Index of Consumer Prices (HICP), does not exceed by more than 1.5 percentage points the average inflation rate of the three best-performing EU member states.
- the average of market interest rates on long-term government bonds does not exceed by more than 2 percentage points the average of the three best-performing Member States in terms of inflation.
- the general government deficit in the year before assessment does not exceed 3 % of GDP. Furthermore, the government debt does not exceed 60 % of GDP.
- for two years prior to assessment, the national currency has to participate in the exchange rate mechanism ERM-II. During that period, the currency may not be unilaterally devalued and it should fluctuate in a rather narrow band around the central parity.

A substantial body of literature exists on whether or not the new member states can meet these criteria and whether this is sensible (e.g. Buiter/Grafe, 2002; Buiter, 2004; de Grauwe/Schnabl, 2005; Filacek et al., 2006). The main doubts arise as to the ability of the new member states to simultaneously meet the inflation and the exchange rate criteria. The price level convergence process alone would imply a sizeable equilibrium inflation differential towards the euro area if the nominal exchange rate is to be kept stable. However, in spite of the widespread doubts about the ability of the catching-up economies to qualify by meeting the Maastricht criteria during the evaluation phase, a number of them have managed to do so. This applies not only to the recent cases of Slovenia and Slovakia, but also to the early entrants Spain, Portugal and Greece.

Nevertheless, the catching-up growth process certainly impairs maintaining low inflation *after* euro adoption. Indeed, the main economic goal of the nominal convergence criteria is "to ensure that only those Member States having economic conditions that are conducive to the maintenance of price stability and the coherence of the euro area can participate in it" (ECB, 2008a:7). By meeting the convergence criteria the countries are expected to maintain price stability on a *lasting* basis. The countries have to commit to price stability as the main objective of monetary policy and to adhere to the macroeconomic stability culture that is

[1] Except for the two countries mentioned above that already have adopted the euro.

the basis of EMU (European Commission, 2006:19). Substantial heterogeneity would also complicate monetary policy. Specifically, with sizeable inflation disparity, monetary policy might react to an average that is not representative of any country. Furthermore, the real interest rate channel may reinforce divergence in inflation and business cycles within a monetary union because the country with the highest inflation rate faces the lowest real interest rate.

In itself, meeting the convergence criteria during the run-up phase does not ensure that the countries will retain similar (and low) inflation rates within the euro area. For one thing, the price level convergence process in countries in the catching-up growth process will manifest itself in inflation differentials towards the more developed economies. For another, the interest rate setting of the ECB is oriented at the euro area average, which is dominated by the large and developed economies such as Germany and France. Because of the catching-up growth process, the "equilibrium real interest rate" of the former transition economies exceeds the rate prevailing in the euro area as a whole. Thus, the adoption of the common currency will most likely entail a loosening of monetary conditions. This is exacerbated by the fact that the inflation differential due to the price level convergence process alone implies that real interest rates are lower than in the more developed economies of the euro area. Activity may be boosted, but most probably inflation also.

Inflation differentials in a monetary union are not always harmful. For example, inflation differentials occur if a member state is subject to an asymmetric shock[2], i.e. a rapid deterioration in the demand or supply conditions, which necessitates a depreciation of the real exchange rate. With a common currency, the adjustment mechanisms of independent interest rate policy or a change in the nominal exchange rate are not available. Such shift in the real exchange rate towards the other countries of the euro area is possible only through lower inflation rates. As a consequence, temporary differences in the inflation rates between countries participating in a monetary union cannot be avoided. Nevertheless, not all inflation differentials need to originate from the *adjustment* to a shock. An inflation rate above the average level in the monetary union may well be the consequence of the already mentioned real interest rate shock after euro adoption. It may also stem from an asymmetric demand or supply shock or overheating, circumstances to which emerging markets are particularly prone. Inflation differentials might then indicate an adjustment *need*, i.e. a need for real exchange rate depreciation through a period of lower inflation and lower unit labour costs growth than in the other euro area member states. The adjustment of the real exchange rate can be brought about only through the adjustment of prices and wages. If these are sticky, for instance because of ingrained higher inflation expectations or backward looking

[2] Or symmetric shocks that affect the individual member states of the monetary union asymmetrically.

inflation expectations, inflation differentials can become persistent, compounding the adjustment need. The adjustment process can then entail a period of weak growth and higher unemployment. It can be further impeded by the already mentioned reaction of real interest rates, i.e. the fact that real interest rates are the lowest in the country with the highest inflation rate. While that may help sustain the growth momentum, it hinders adjustment to the shock. Indeed, the need to adjust to shocks without an independent monetary policy is a major risk of participation in a monetary union. This is also stressed in theories of optimum currency areas, which have traditionally been used to gauge the costs and benefits of participation in a monetary union.[3]

The experience of Spain and Portugal during the past ten years has demonstrated the benefits and risks associated with euro area membership for countries in the catching-up growth process (cf. European Commission, 2008). Spain in particular recorded a rather long period of above-average growth, which allowed it to catch up in income levels with the more developed EU countries. One reason for the stronger activity was the pronounced decline in real interest rates during the nominal convergence process. This was the result of, first, a decline in nominal interest rates. In the run-up to EMU, policy rates had to be kept relatively high to achieve disinflation. The adoption of the common currency and an interest rate determined primarily by the large and more developed economies hence implied a strong decline in the policy rate. Second, inflation accelerated after euro adoption owing to the price level convergence process and a boost to bank lending and domestic demand. During the period of buoyant growth, not only was inflation markedly above the euro area average, but external imbalances and external debt were on the rise also. In part this was justified by the catching-up growth process, but it also resulted from deteriorating competitiveness. The lower risks within the monetary union make financing of external imbalances easier and hence reduce adjustment pressures. Still, the external deficit and debt cannot grow forever. At some point they have to stabilise, which may compel a correction of the demand level and most probably also of the real exchange rate.[4] The duration and severity of the adjustment process, but also the magnitude of the imbalances depend, among others, on the wage-price dynamics. The adjustment process will be smoother if wages and prices react flexibly to deteriorating demand. By contrast, sluggish adjustment mechanisms can stall the catching-up growth process, as the Portuguese experience shows.

It is very likely that the new member states will face similar challenges as Spain or Portugal once they have entered the euro area. It is very likely that

[3] An overview of the theories of optimum currency areas can be found in Baldwin/Wyplosz (2004) or deGrauwe (2007).
[4] In Spain, that process has been underway since early 2008.

1) inflation will rise above the euro area average after euro adoption. That will be the consequence of the price convergence process but probably also of the boost to activity.
2) they will face a decline in the real interest rate or a loosening of monetary conditions. The magnitude of the decline depends on the inflation differential on the one hand, but on the monetary policy pursued in the run up to EMU on the other. The higher policy rates have to be kept to achieve inflation levels as required in the Maastricht Treaty, the more pronounced will be the decline in real interest rates.

The consequences thereof for macroeconomic stability and the smoothness of the catching-up growth process depend among others on the flexibility, with which wages and prices adjust to changes in demand, and on inflation expectations. The more inflation expectations are affected by the higher inflation rate, the higher the potential adjustment need after the boom phase.

The present investigation deals with the inflation process and inflation convergence with the euro area in two future EMU member states, the Czech Republic and Hungary. It studies the link between inflation and monetary policy on the one hand, and the impact of inflation determinants such as the price level convergence process, euro area inflation and wage growth on the other. We will deal, first, with their monetary policy and the numerous factors that shaped it, i.e. the transition, the integration into international financial markets, disinflation from moderate inflation levels, the catching-up growth process and the nominal convergence process. Second, we investigate the interest rate setting of the central bank and its pass-through within the economy. While this is to some extent related to the interest rate convergence criterion, it is not the main focus of the study. Instead, we concentrate primarily on the effectiveness of monetary policy in managing inflation. We investigate whether the current policies are conducive to fulfilling the Maastricht criteria. We also investigate whether or not the adoption of the euro will imply a loosening of monetary conditions. Third, the investigation turns to the inflation process and the determinants of inflation convergence. We are interested in the underlying dynamics related to the catching-up growth process (price level convergence) on the one hand, and the importance of foreign prices or the wage-price dynamics on the other. That allows us to hypothesise about the extent to which inflation may rise again after euro adoption and about the efficiency of adjustment through wages and prices.

The choice of the two countries is motivated by the fact that the Czech Republic and Hungary have similar size, with 10 million inhabitants each. Both countries are small open economies; the ratio of exports to GDP stands at approximately 80 %. GDP per capita is well below that of the euro area: in 2007 per capita GDP in PPP terms amounted to 74 % for the Czech Republic and to 58 % for Hungary. Both countries have currently no

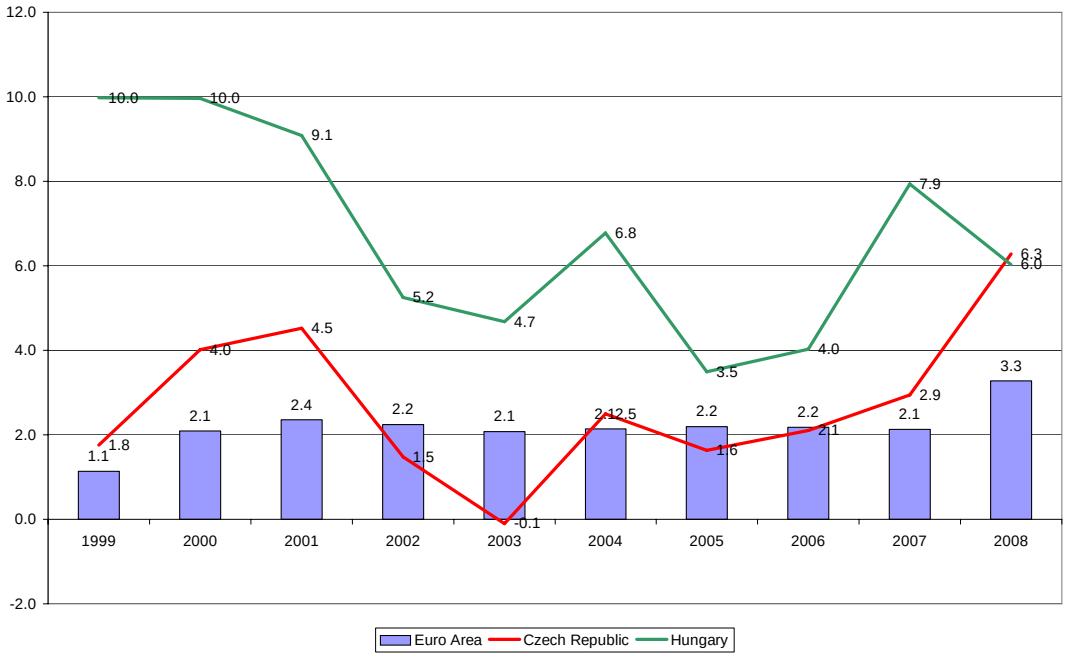
specified target date for euro adoption and they are not participating in ERM-II.[5] Their central banks conduct monetary policy within the framework of inflation targeting. However, the countries differ substantially as regards their level of nominal convergence with the euro area. While Hungary has recorded inflation rates perceptibly above the euro area level during the past few years, the Czech Republic broadly met the inflation criterion during 2002-2007 (cf. Graph 1.1, p. 25). Only with the worldwide surge in food and energy prices in 2007 and 2008, also Czech inflation climbed to 6.3 % in 2008 and thus well above the convergence criterion. The Czech long-term interest rates rose also in 2008, but remained close to the euro area's level, while the already sizeable differential between Hungary's long-term yields and its euro area counterpart widened further (Graph 1.2, p. 25). The policy rate of the Czech central bank has stayed below that of the ECB in 2006-2008 (Graph 1.3, p. 26). Hence we will also investigate why the Czech and Hungarian performance has differed.

The investigation is structured as follows. The second chapter reviews the main interest rate setting theories. Because interest rates are nowadays the main policy instrument of central banks, it includes an overview of central bank strategies and interest rate rules. The third chapter deals with the determinants of inflation and disinflation. It presents the quantity theory, purchasing power parity and the Phillips curve as the most important theoretical concepts relating to inflation. The importance of inflation expectations for maintaining low inflation, but also for phases of moderate inflation is stressed. In addition, we study preconditions and costs of disinflation. The fourth chapter then reviews the specifics of monetary policy and of the inflation process in the (former) transition economies. It shows how monetary policy and strategy has been shaped by the challenges of transition, financial sector development, the integration into international capital markets, catching-up growth and price level convergence, and EU entry. Chapters 5 and 6 are devoted to the country studies of monetary policy, interest rate determination and the inflation process in the Czech Republic and Hungary. After an overview of the objectives and strategies of their central banks and an analytical description of the factors that have shaped monetary policy, we show results of econometric tests of the central banks' interest rate reaction functions. We then turn to the inflation process. After a detailed analysis of the trends in headline inflation and its components, we present the results of econometric tests of the inflation determinants. In particular, we tested the importance of the nominal exchange rate, euro area inflation, and wage dynamics for the price trends.

[5] In particular in Hungary, the recent financial turmoil has led to a more focused discussion about the suitable target entry date.

Graph 1.1:

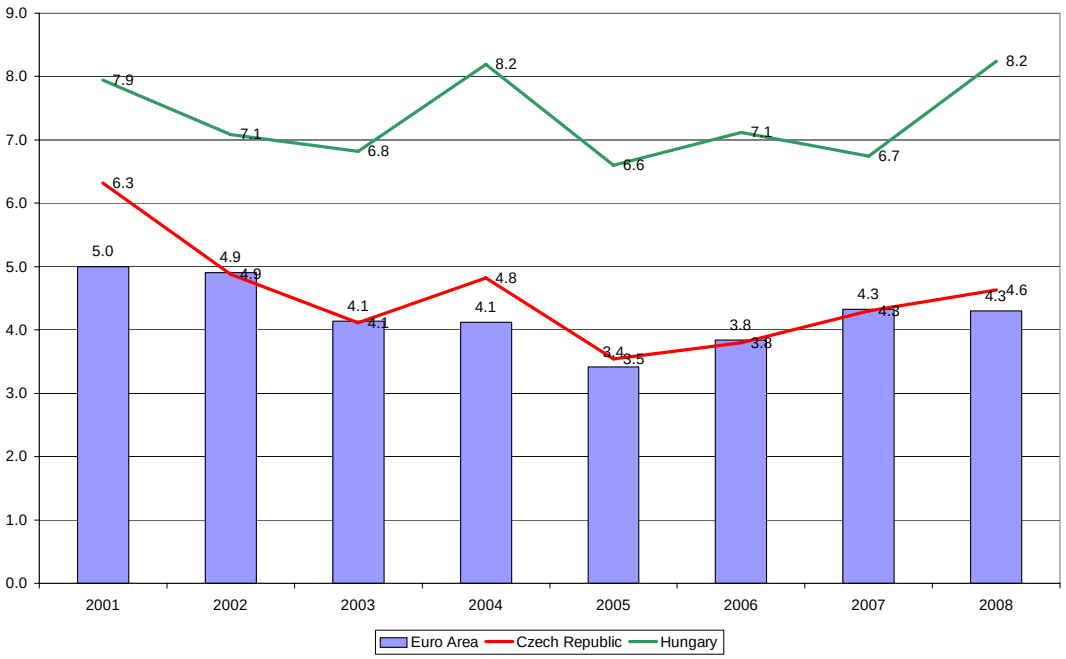
Annual average inflation rates in the euro area, Czech Republic and Hungary, 1999-2008



Source: Eurostat.

Graph 1.2:

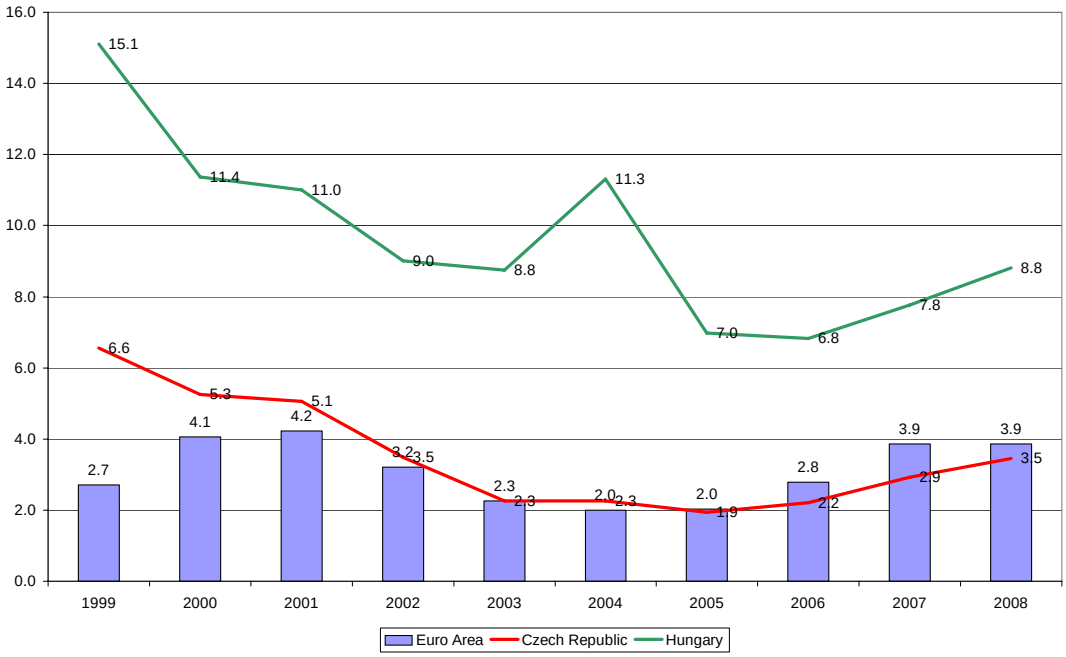
Long term interest rates (Maastricht criterion) in the euro area, Czech Republic and Hungary, 2001-2008



Source: Eurostat.

Graph 1.3:

Central bank main policy rates in the euro area, Czech Republic and Hungary, 1999-2008



Source: Eurostat.

To briefly summarise the results of the empirical chapters, for the Czech Republic it turns out that the low levels of inflation and of policy interest rates have crucially hinged on the trend nominal appreciation of the currency. This appreciation has been the result of sizeable direct investments but also of expectations of further nominal appreciation. On the one hand, the trend nominal appreciation has dampened inflation through steadily declining prices of industrial goods. On the other hand, the central bank used interest rate policies to reduce appreciation pressures. It is therefore that interest rates were kept below the level of the ECB in some periods. With a continuing nominal currency appreciation the Czech Republic may be able to meet the Maastricht criterion on inflation. By contrast, with a stable or even depreciating nominal exchange rate, inflation may well climb above the euro area's level. Furthermore, the strong contribution of the nominal appreciation to both low inflation and low interest rates implies that monetary conditions for the Czech economy would ease markedly in the euro area. The policy interest rate has often been below that suggested by the Taylor rule, which has been counteracted by the effect of the appreciating nominal exchange rate. As regards inflation, its dynamics are characterised by a strong adjustment in relative prices. Whereas industrial goods prices have declined in nominal terms, prices of regulated items and market services have exerted strong upward pressure

on inflation. That kept inflation positive despite the sizeable nominal appreciation and led to a pronounced real appreciation of the currency. To some extent this can be regarded an equilibrium phenomenon. However, real appreciation is found also for industrial goods prices since the nominal appreciation has been passed through to industrial goods prices only to some extent. If these trends are to continue, inflation in the Czech economy would rise perceptibly with a stabilisation of the exchange rate and after euro adoption.

Similarly as in the Czech Republic, the Hungarian inflation process has been marked by a substantial adjustment in relative prices. In particular, the relative price of services to industrial goods prices has risen markedly. Yet, the inflation differential can be related to the catching-up growth process only to some extent. The higher inflation dynamics, and hence the marked inflation differential towards the euro area, has also been the consequence of wage pressures and of inflation expectations that have not yet declined to levels compatible with the Maastricht inflation criterion on a lasting basis. Furthermore, Hungarian inflation dynamics have not benefited from a trend nominal appreciation of the exchange rate. Instead, after having been tightly managed until 2001, the nominal exchange rate fluctuated, rather pronouncedly, within a 30 % fluctuation band between 2001 and 2008. One reason for the slow progress in disinflation and higher inflation expectations might be an insufficient credibility of disinflation policies. The Hungarian central bank has long tried to minimise the output costs of disinflation and put rather strong emphasis on external competitiveness and the real exchange rate. A phase of high real interest rates to break ingrained inflation expectations, similar to the disinflation episode in the late 1990s in the Czech Republic, has so far been avoided. Furthermore, in the inflation targeting regime that was in place between 2001 and 2008, the central bank pursued two targets. In addition to the inflation target it also fixed the exchange rate. That created policy challenges and contributed to target breaches in quite a few years. Admittedly, inflation impulses have stemmed also from the international environment (energy and food prices) and from fiscal policy. Nevertheless, all of these factors have nurtured the rather high inflation expectations of the public.

As a result, the higher Hungarian policy rates are to some extent determined by the higher inflation rate. At the same time, Hungary has experienced constant fiscal strains and a strong election-related expenditure cycle. Generous expenditure programmes and large fiscal deficits in election years were followed by fierce adjustment measures. That has not only affected growth and inflation, but also created an unstable policy environment and shaped the risk attached to Hungary by the financial markets. Owing to the permanent fiscal strains, a high foreign debt, current account deficits and a central bank insufficiently dedicated to disinflation policies, Hungary has been susceptible to shocks from the

international capital markets. On numerous occasions, the Hungarian currency has been the target of currency speculation. Because of the exchange rate target, in such periods the central bank had to focus on stabilising the exchange rate and fending off the adverse consequences of unstable financial flows. Thus, the swings in fiscal policy have also been a source of unstable monetary policy. Moreover, interest rates have reflected significant risk premia.

The econometric evidence suggests that the Hungarian central bank did adhere to its own goals as it reacted to the exchange rate and the inflation rate. However, short-term factors seem to have dominated the rate setting. Furthermore, even the rather high nominal interest rates did not imply real interest rates sufficiently high to bring about lasting disinflation. The econometric tests of the inflation process show that wage pressures have substantially contributed to the inflation differential towards the euro area. As a result, for a lasting decline in inflation to levels close of the euro area and compatible with the Maastricht inflation criterion, a further decline in the inflation rate expected by economic agents is necessary. That could be promoted by the more transparent monetary policy framework that has been in place since the floating of the currency in early 2008. On the other hand, however, the fact that the policy rate has also served to stabilise the nominal exchange rate or capital flows after shocks from fiscal policy implies that as long as the shock potential of Hungarian fiscal policy does not decline, monetary policy can hardly become more stable and focused. As long as fiscal policy will not be put on a sustainable path, also monetary policy and its credibility will suffer. At the same time, the ingrained inflation expectations at a level inconsistent with price stability raise the costs of participation in monetary union. Even if Hungary were able to qualify for euro adoption soon, as long as wage setters do not align their inflation expectations with those prevailing in the euro area, in all likelihood, any negative inflation shock would be followed by a time-consuming and costly adjustment process.

2. Theories of interest rate determination

2.1 Uncovered interest parity, inflation expectations and the term structure of interest rates

2.1.1 Uncovered interest rate parity

Three main approaches to interest rate determination exist in the literature. In this first section, we consider the link between interest rates of different economies in integrated financial markets. If investors are risk neutral, they will demand the same yield for identical financial products. As long as financial assets with identical risk and maturity carry different interest, investors will demand the asset with the higher yield and hence drive the price up and the interest rate down. Therefore, in integrated financial markets, interest rate convergence is considered the equilibrium condition. However, the experience with liberalised capital flows and increasing financial market integration through the reduction of barriers to cross-border financial transactions shows that interest rates have not necessarily converged (cf. e.g. Pigott, 1993). One reason for the continuing divergence in interest rates is the existence of different currencies and flexible exchange rates. Only when the assets are denominated in the same currency, investors can engage in risk-free arbitrage. With fixed exchange rates, the risk associated with the exchange rate may appear small, but it can remain as to the viability of the regime or the fixed parity. If the exchange rate is fluctuating, *yields* convergence means that the nominal interest rates will differ to the extent that the exchange rate is expected to change. The equilibrium condition is called uncovered interest parity (UIP). It can be approximated by[6]

$$i_t = i_t^f + E_t(\Delta e_{t+1}) . \qquad (1)$$

Empirical evidence of UIP is weak for countries with fluctuating exchange rates (cf. Taylor, 1995; Meredith and Chinn, 2004; Isard, 2006). This stands in contrast not only to the popularity of UIP in theoretical models but also to covered interest parity (CIP), from which UIP is derived. Covered interest parity states that yields that are hedged through forward exchange rate contracts have to equalise. However, covered interest parity is established through the forward exchange rate, whereas uncovered interest parity will hold only if the future exchange rate is correctly forecast. That does not seem to be empirically verified (Cuthbertson/Nitzsche, 2004:583). In addition, UIP can be violated also because of differences in the liquidity of financial markets or different taxes on the financial product.

[6] i_t denotes the domestic interest rate for one period ahead, i_t^f the foreign interest rate for the same period and $E_t(\Delta e_{t+1})$ the change of the nominal exchange rate expected in period t for the next period. Except for interest rates, lower case letters denote variables in logs.

UIP is therefore sometimes extended by a term that captures the risk associated with the exchange rate:[7]

$$i_t = i_t^f + E_t(\Delta e_{t+1}) + \mu_t . \quad (2)$$

Further premia can be added such as liquidity premia (i.e. how easily the assets can be traded) or country premia. These premia drive a wedge between the nominal interest rates of different countries. They can moreover vary over time. Therefore, although a link between the interest rates of different countries may exist, this link need not be as straightforward as suggested by UIP.

Empirically, interest rate convergence or co-movement is more often found in countries with fixed exchange rates (cf. Frankel et al., 2004; Pigott, 1993). Indeed, flexible exchange rate regimes are explicitly viewed as having the advantage of independent interest rate setting of the domestic monetary authority. It can set the interest rate with a view to domestic conditions or isolate the economy from an external shock. Still, free capital flows, a stable exchange rate and monetary policy (i.e. the interest rate) geared towards domestic conditions pose an "impossible trilemma" (cf. for a recent analysis: Obstfeld et al., 2005). As a result, if nominal interest rates are deliberately set independently from the rates in other countries, the exchange rate may adjust in line with yield convergence suggested by UIP. Owing to the reasons mentioned above, nominal yield equalisation need not be complete despite the general tendency to convergence.

2.1.2 Fisher equation

A second approach to interest rate determination is based on a decomposition of the nominal interest rate into the real interest rate and expected inflation as in the Fisher relation (Fisher, 1930):[8]

$$i_t = r_t + E_t(\pi_{t+1}) . \quad (3)$$

According to this theory, economic agents wish to be compensated for expected losses in purchasing power and base their investment decisions on real yields. If this theory is applied to integrated financial markets, equilibrium requires the real yields to equalise between the domestic and foreign economies:

$$r_t \overset{!}{=} r_t^f \quad (4)$$

[7] μ_t stands for the risk premium.
[8] i_t denotes the interest rate in t for one period ahead, r_t the real interest rate (given the expectations for inflation) and $E_t(\pi_{t+1})$ the expectations of the inflation rate one period ahead.

or

$$i_t - E_t(\pi_{t+1}) \overset{!}{=} i_t^f - E_t(\pi_{t+1}^f). \quad (5)$$

Only if we additionally assume that the nominal exchange rate is driven by purchasing power parity (PPP), i.e.

$$\Delta e_t = \pi_t - \pi_t^f, \quad (6)$$

uncovered interest parity holds in nominal and real terms:

$$r_t + E_t(\pi_{t+1}) = r_t^f + E_t(\pi_{t+1}^f) + E_t(\Delta e_{t+1}). \quad (7)$$

The *nominal interest rates* may still differ because of an expected inflation differential and hence an expected change in the nominal exchange rate. Convergence of nominal interest rates will occur only with the same real rate, a stable exchange rate, a similar inflation outlook and without any interest rate premia.

However, the inflation differential can be an equilibrium phenomenon, e.g. due to the process of real and nominal convergence during catching-up growth.[9] The nominal exchange rate can then remain stable despite the inflation differential, violating PPP. As a result, interest rates of catching-up countries might exceed the rates in the more developed countries. Furthermore, the interest rate differential can also reflect differences in equilibrium real rates.[10] In terms of the equation based on UIP, the equilibrium appreciation could be captured by a premium term suggesting that the higher growth also implies higher risk:

$$i_t = i_t^f + E_t(\Delta e_{t+1}) + \mu_t + \varphi_t, \quad (8)$$

with

$$\varphi_t = r_t^{eq-diff} + \pi_t^{eq-diff}, \quad (9)$$

i.e. capturing the differences in equilibrium real interest rates ($r_t^{eq\text{-}diff}$) and in the equilibrium inflation rate ($\pi_t^{eq\text{-}diff}$). In contrast to the UIP theory, which suggests that financial markets will induce convergence in the nominal rates, this theory maintains that nominal interest rates will differ so long as the expected inflation rates (including any potential equilibrium deviation) differ. The requirement of interest rate convergence in the Maastricht criteria was based on such reasoning. It was not motivated primarily by the interest in financial

[9] This will be investigated in more detail in Chapters 3 and 4.

[10] Equilibrium real interest rates (or "natural" /"neutral" real interest rates) are determined in the market for savings and depend on the supply and demand thereof. An early definition of the natural interest rate was given by Wicksell (1936). Currently, the equilibrium real interest rate is seen to reflect "economic growth that is consistent with potential output without pressure being put on prices" (Deutsche Bundesbank, 2001:36), yielding a demand level consistent with potential output growth at stable prices (cf. also Williams, 2003). Countries in the catching-up growth process are expected to exhibit higher equilibrium real interest rates due to the higher growth potential on the one hand and a smaller pool of savings on the other.

market integration or nominal exchange rate stabilisation.[11] Instead, the convergence of long-term interest rates should prove that the longer term inflation expectations are similar (i.e. that nominal convergence is lasting), so that the potential costs of common monetary policy arising from different trends in the inflation rate are minimised. The Maastricht interest rate criterion is consequently defined in terms of the rates of the three countries with the lowest *inflation*.

2.1.3 Expectations hypothesis of the term structure

The two theories examined so far focus on the interest rates and the market for a *particular instrument*, i.e. the link between particular interest rates in different economies. By contrast, the third interest rate theory, the expectations hypothesis of the term structure, states that the interest rates of financial instruments with similar risk but different maturities are linked (cf. e.g. Cuthbertson/Nitzsche, 2004:494). Assuming an opportunity to arbitrage over time, the expectations hypothesis (EHT) suggests that the long-term interest rates l are related to the sequence of current and expected future short-term interest rates i:

$$(1+l_{t,n}) = \sqrt[n]{(1+i_t)\cdot(1+E_t(i_{t+1}))\cdots(1+E_t(i_{t+n-1}))}\,, \tag{10}$$

with $l_{t,n}$ being the n-period long-term rate at time t, and i_{t+j} , $j=0,1\ldots n-1$ being the short-term rates at time $t+j$. With small interest rates this can be approximated by taking logs because for these $ln(1+x) \approx x$. Hence

$$l_{t,n} = \frac{1}{n}(i_t + \sum_{j=1}^{n-1} E_t(i_{t+j}))\,. \tag{11}$$

That can be rearranged to (cf. Wolters/Hassler, 1998:143)

$$l_{t,n} = i_t + \sum_{j=1}^{n-1} \frac{n-j}{n} E_t(\Delta i_{t+j})\,. \tag{12}$$

According to this theory, long-term interest rates of different countries will converge only if the *sequence* of expected short-term rates over the horizon in question has converged. Therefore, even if markets expect the same inflation rate in the future (e.g. in two to three years) and form their expectations of future rates accordingly, long-term interest rates will differ to the extent that the expected short-term rates in the early years differ. The short-term rates are to a large extent determined by central bank rate setting (see next section). Depending on the exchange rate regime and capital account convertibility, the rate setting of small countries can depend on the international interest rate, but it could also be guided by domestic considerations. An important implication of the expectations hypothesis of the

[11] Although nominal exchange rate stabilisation is implicit in the requirement of converged interest rates, it constitutes an own convergence criterion.

term structure is that long-term interest rates will converge when countries form a monetary union because then by definition the current and future short rates are the same.

The yield curve, i.e. the string of interest rates of the same risk but different maturities at a given point in time, depends on a number of factors (cf. e.g. Bank of England, 1999). According to equation (12), the long and the short-term rates differ by the expected sequence of changes in the short-term rate. Over the longer horizon, this series of differences can be regarded as fluctuating around a fix expected value. In the medium term, however, the cumulated differences in the short rates can be either positive or negative, indicating a trend of rising or declining interest rates. The link between short-term and long-term interest rates may therefore depend on the assumed effects of a particular short-term rate for the future development of the economy. If an increase in the short-term rates is supposed to lead to lower inflation and hence lower future short-term rates, this may imply a downward sloping yield curve.[12] By contrast, with a short-term rate hike considered insufficient by the financial market for reducing inflation rates, the long-term rates may rise instead, leading to an upward sloping yield curve. In addition, according to the liquidity preference theory, longer-term interest rates include a liquidity premium, $\chi_{t,n}$:

$$l_{t,n} = \frac{1}{n}(i_t + \sum_{j=1}^{n-1} E_t(i_{t+j})) + \chi_{t,n}\,. \qquad (13)$$

As a result, in general, the longer rates will exceed the short rates, giving rise to a "typical" yield curve. By contrast, if short rates are expected to decline in the future, the yield curve is inverted, i.e. downward sloping. Whether or not the expectations theory holds in practice can be studied with tests of the pass-through, i.e. of a statistically significant link between short-term and long-term rates (e.g. in Wolters/Hassler, 1998). According to recent research, in economies with deep and open financial markets such as the United States and the euro area, the link between the long rates (government bond yields) and the short rates (money market rates) may have become rather weak though not non-existent (Idier et al., 2007). That is explained by stronger international interest rate convergence.[13]

[12] "The impact on longer-term interest rates can go either way. This is because long-term interest rates are influenced by an average of current and expected future short-term rates, so the outcome depends upon the direction and extent of the impact of the official rate change on expectations of the future path of interest rates." (Bank of England, 1999:4).

[13] Other factors that could have played a role is the save haven function of US government bonds and the accumulation of large savings by emerging economies invested in the U.S.

2.2 Central bank interest rates

2.2.1 Monetary transmission mechanisms

In the preceding section, it was suggested that the short-term rates are strongly influenced by the central banks' rate setting. This is because currently most central banks use interest rates as their main policy instrument. By adjusting the policy rates they aim to achieve macroeconomic objectives. In principle, the objectives of central banks can be manifold, and also have been manifold in the history of central banks (cf. Capie, 1995). They can include price stability, full employment or output growth close to potential growth, but also financial stability (as lenders of last resort), external balance (competitiveness or solvency of the economy), a peg to another currency or some commodity, and government financing (cf. Bofinger et al., 1996).

Nowadays price stability is seen as the objective with the highest priority (Mishkin, 2000). It can be accompanied by the goal of stabilising output and employment over the business cycle[14], which however rests on price stability at least in the medium to long term (cf. e.g. Bruno/Easterly, 1998). Interest rate setting of central banks is hence geared towards price stability or an inflation target. Yet, price stability does not follow directly from central bank interest rate setting, i.e. of the interest rate for base money.[15] The central bank is directly involved only with the commercial banks operating in the money market. These transmit the central bank policies through the financial market to the real economy. Thus, with its instruments, the central bank can affect demand and price setting only indirectly.[16] This indirect influence is exerted through various transmission channels or mechanisms and can imply that changes in the interest rate can be felt in output or inflation with "long and variable lags". The main monetary transmission channels are (cf. e.g. Bank of England, 1999; Mishkin, 2001):

- *Interest rate channel*. The interest rate for base money influences other interest rates in the financial market (due to the term structure or through the banks' profit maximisation, cf. e.g. de Bondt, 2005). These interest rates in turn affect spending and savings of households on the one hand and investment of firms financed through external funds on the other hand. Demand of households and firms relative to the

[14] Some central banks, such as the Federal Reserve in the US, have a dual mandate of low inflation and maximum sustainable employment.
[15] Alternatively, also base money could be the main instrument of monetary policy. The interest rate is used as the main instrument due to the high priority attached to interest rate stability. Additional instruments of central banks are standing facilities or required reserves.
[16] Some prices, such as prices of commodities, cannot be affected by the central bank at all.

supply of the economy bears on inflation either directly through the goods market or indirectly through the labour market and wage pressures.

- *Lending channel*. The lending channel of monetary transmission (Bernanke/Gertler, 1995) suggests that – given imperfect information and frictions in the financial market – a change in the interest rate may change standards of creditworthiness and therefore the supply of bank loans. The effect of a change in the interest rate is thereby amplified.

- *Asset price channel*. Interest rates of the central bank affect asset prices through the discounting factor. If loans are secured on assets, a change in the asset prices following a change in the interest rate will impact on the availability of loans.

- *Exchange rate channel*. Assuming flexible exchange rates and free capital flows, interest rates are related to the exchange rate. For instance, in line with UIP, higher interest rates will lead – with unchanged expectations about the future exchange rate – to exchange rate appreciation. In a second step, this influences competitiveness and the demand of domestic and foreign goods. At the same time, a change in the exchange rate will directly affect the general price level through prices of imported goods and as a cost-push factor through intermediate goods.

- *Expectations channel.* Interest rate setting of the central banks (in addition to the general strategy of the central bank) will have a bearing on the public's expectations about the future development of inflation and output, which can leave its mark on price and wage setting.

- *Money supply*. Based on the quantity theory, also money supply transmits monetary policy impulses. If higher money supply means higher real balances ("excess supply of money"), this can lead to inflation. This transmission channel is particularly pronounced in countries where the central bank directly allocates credit to e.g. the government or state-owned enterprises. In general, higher money supply is associated with lower short-term interest rates; the money supply and the interest rate channel are then connected.

2.2.2 Central bank strategies

Interest rate setting of a central bank is made against the background of the final objective and the transmission mechanisms assumed to predominate in the given economy. Central bank rate setting can be discretionary, as it was the case in some decades of the 20th century (cf. e.g. King, 1999). However, central banks can also follow an explicitly defined monetary policy strategy that relies on the transmission mechanism assessed as the most

powerful. It can consist of a specified procedure and can include rules for central bank actions, which make central bank actions more transparent and predictable.[17]

2.2.2.1 Monetary targeting

Until recently, central banks' strategies often included a so-called intermediate target, i.e. a target value defined for a variable that can be controlled more rapidly by the instrument of the central bank than the final objective, and which has a clear link to the final objective of price stability.[18] If such a variable exists, movements in the intermediate target can signal a potential deviation from the targeted final objective in advance, which enables the central bank to swiftly react. One intermediate target used by some central banks until the 1990s was money supply, where an inflation objective is – based on the quantity theory and given a forecast of real GDP growth – translated into a target for nominal GDP growth.[19] However, with the liberalisation of financial markets as well as the shift to indirect monetary policy implementation, the link between the instruments, money supply and inflation became less stable or reliable (cf. Estrella and Mishkin, 1997; the debate on this issue is documented in ECB, 2008b).

2.2.2.2 Nominal exchange rate targeting

Another intermediate target, used mainly by central banks of small open economies, has been a fixed exchange rate. When fixing the exchange rate, a central bank makes a commitment to sell and buy domestic currency without limits at the set exchange rate. The main instrument could therefore be intervention in the foreign exchange market, which subsequently affects money supply and the interest rate in the money market. However, central banks often use the interest rate as the main instrument instead. Because of arbitrage considerations, the nominal exchange rate adjusts to the level of domestic and foreign interest rates. As a result, the central bank will set the interest rate in line with the foreign interest rate and the risk or other premia associated with the domestic currency. A strategy of a fixed exchange rate will be conducive to maintaining low inflation if the country is characterised by high openness to foreign trade and if the currency is pegged to a low-inflation currency. Domestic inflation will then be influenced by stable import prices. In addition, the commitment to a fixed exchange rate can anchor inflation expectations. Yet, the viability and credibility of this regime hinges critically on the central bank's ability to

[17] The issue of how transparent a central bank should be and whether it should follow rules or decide discretely is broadly discussed (for an overview on the issue of rules versus discretion see e.g. Dwyer, 1993).
[18] For a broad description of the strategies based on intermediate targets see e.g. Bofinger et al. (1996).
[19] Within this strategy, the interest rate setting of the central bank should bring about the targeted magnitude of base money and money supply. However, interest rate setting need not be the main instrument of the central bank in this strategy.

secure sufficient reserves of foreign currency. In particular, persistent current account deficits, which could arise if the country loses competitiveness through higher inflation, put strains on the reserves. If the central bank runs out of foreign currency, a change in the exchange rate or the exchange rate regime altogether will become unavoidable. All in all, a fixed exchange rate regime can guide inflation due to the import prices on the one hand, and competitiveness, credibility and sustainability considerations on the other, but its viability depends on whether or not major imbalances in the current and financial accounts can be avoided.

Similarly to the intermediate target of the money supply, fixing the nominal exchange rate has become less widespread. The reasons are, first, that if prices and wages are sticky, a fixed exchange rate can imply adjustment costs in terms of lost output and employment in the event of an economic shock that shifts the equilibrium real exchange rate. Second, the need to adjust interest rates in line with the anchor currency's central bank can imply high restrictions for the domestic economy. If a shock affects the anchor country, the domestic economy will have to cope with this shock also, although it may have been unaffected in the first instance. Also, the central bank cannot adjust the interest rates in reaction to domestic shocks. These two restrictions can undermine the support for and the credibility of the peg. To preserve the credibility of the fixed exchange rate, the central bank has to show strong commitment through accepting also the adverse consequences of a fixed exchange rate. Otherwise, financial markets could – in particular with liberalised capital flows – challenge the fixed rate through speculation. As a consequence, with liberalised capital flows, it has become more difficult to sustain a fixed exchange rate (Obstfeld/Rogoff, 1995).

A particular problem of this strategy is related to emerging economies with shallow financial markets and weakly developed institutions (cf. Mishkin, 2007). These may choose a fixed exchange rate as a means to increase the credibility of the central bank and of disinflation policies. Fixing the nominal exchange rate is the most transparent signal of the central bank's commitment to achieve and maintain low inflation. However, inflation rates may still deviate quite substantially from that in the anchor country. This raises the issue of whether or not it can be maintained also in a case when inflation declines only slowly, competitiveness deteriorates and current account deficits start to persist or widen. It can invite currency speculation if capital flows are liberalised. Likewise, capital flows may come to a halt because of shocks to the international financial system, compelling a sudden adjustment of the domestic demand level. In recent years, that has turned out damaging for a number of small countries with underdeveloped markets (Calvo/Reinhart, 2000). A second problem arises from the fact that a fixed exchange rate may appear firmer than what

is actually the case. Domestic firms and agents may prefer to take up loans in foreign currency assuming that the exchange rate risk is small. If the exchange rate then has to be adjusted because of diminishing competitiveness or a growing current account deficit (or because the regime collapses), the debt denominated in foreign currency increases, which depresses domestic activity.

To raise the independence of a central bank with a fixed exchange rate, target zones (Krugman, 1991) can be defined, where the currency is allowed to fluctuate around a central parity in bands that can be as wide as 15 % on each side of the central parity. However, on the one hand these systems may not be able to stabilise expectations as a hard-pegged nominal exchange rate can. On the other hand, they suffer from similar problems in defending the band when the currency hits the band edge (Obstfeld/Rogoff, 1995).

2.2.2.3 Direct inflation targeting

Due to the increasing difficulties encountered when using the strategies based on intermediate targets, many central banks recently switched to the strategy of direct inflation targeting (cf. e.g. Bernanke et al., 1999b). In this strategy, achieving low inflation is the main objective or overriding goal of the central bank. The central bank makes – through explicitly defining a numerical inflation target – a commitment to systematically meet this inflation rate. The central bank does not define an intermediate target, but uses all information available that could signal future price trends or inflationary pressures. The main central bank instrument is the interest rate for liquidity-providing or liquidity-absorbing operations in the money market.

In practice, inflation targeting includes the following steps. The central bank monitors the economy and analyses numerous financial and real indicators that help predict inflation trends. The central bank produces inflation forecasts and compares these forecasts with the targeted inflation rate. The projected inflation then can be viewed as an intermediate target (Svensson, 1997). In the event of deviation, the central bank adjusts its policy instrument in order to achieve the announced inflation target. The interest rate is hence adjusted in response to deviations of the projected inflation from the targeted rate. An increase in the forecasted inflation rate above the targeted rate will lead to monetary tightening. That will weaken demand and subsequently reduce inflationary pressures. Tightening of monetary conditions will also come about through an appreciation of the nominal exchange rate. At the same time, through the inflation target and the commitment of the central bank to meet the target, the inflation targeting regime tries to influence expectations. Provided the credibility of the central bank as regards its ability to meet the target is strong enough,

economic agents will adjust their expectations and set wages and prices guided by the inflation target.

Successful inflation targeting has a number of preconditions (cf. e.g. Debelle, 1997). First, the central bank has to be able to concentrate only on inflation. In particular, it must be independent of the government so that there is no direct financing of budget deficits. Likewise, there should be no other objectives that are equally or more important than attaining low inflation. Second, the central bank has to be capable of producing a reliable inflation forecast as the central bank's rate setting is guided by the deviations of the forecasted inflation from the targeted rate. Third, the central bank needs knowledge of the functioning of the economy and transmission mechanism of monetary policy, and in particular, the reaction of inflation and output to changes in the interest rate. The adjustment in the interest rate should have the intended effects on inflation. Fourth, the strategy depends crucially on the reputation and the credibility of the central bank as regards its ability to achieve the targeted value of inflation. A lack of credibility would make monetary management more complicated because the agents will not adjust their expectations of inflation to the targeted inflation by the central bank – the inflation target would not serve as the benchmark for price setting. Given the fact that the transmission from the central bank's instrument to inflation is surrounded by uncertainty, transparency as well as a clear communication strategy is of eminent importance. Specifically, if a target is missed, a convincing communication to the public of the causes and consequences thereof is needed if the reputation of the central bank is not to be damaged.

Because a central bank cannot affect with its instruments all prices,[20] and because of a positive likelihood of unforeseen shocks, the inflation targeting regime can include escape clauses. These explicitly state under which circumstances the target could be missed. In some cases, the central bank can choose not to target headline inflation, but an inflation measure that includes prices that are more easily affected by the central bank. For instance, instead of headline CPI the central bank could target a measure of "core" inflation that excludes the prices of unprocessed food and energy. The target can be specified as a range instead of a point target. And finally, inflation targeting explicitly takes possible lags in the policy transmission into account as the inflation target is typically defined over a medium-term horizon of one to two years. As regards additional targets such as a fixed exchange rate, in principle they do not hinder successful inflation targeting. Still, to ensure the credibility of the inflation target, in the event of conflict, the inflation target has to be given priority.

[20] In particular prices of commodities and foodstuffs are hardly affected by monetary policy.

2.3 Monetary policy reaction functions

2.3.1 Closed economy reaction function

Recent macroeconomic models in the New Keynesian tradition include a monetary policy reaction function based on interest rate setting. This interest rate rule is added to standard supply and demand equations (cf. e.g. Romer, 2001; Carlin/Soskice, 2006). The aggregate relations of the New Keynesian models resemble the traditional equations for aggregate supply and demand, and can be derived from microfounded models (cf. e.g. Gali/Gertler, 1999; Goodfriend/King, 1997). The model presented here is based on Svensson (1997). The central assumption about the inflation process is summarised in the Phillips curve:[21]

$$\pi_{t+1} = \pi^{e}_{t+1} + \alpha_1 (Y_t - Y_t^{POT}) + \varepsilon_{t+1} . \qquad (14)$$

Inflation π depends on expected inflation, π^e, the lagged output gap, $Y\text{-}Y^{POT}$, and possibly on an exogenous shock. According to equation (14), inflation expectations of wage and price setters play a crucial role for price trends. With actual output equalling potential output and absent unexpected shocks, a targeted inflation outcome can be achieved if the economic agents set wages and prices in line with the inflation target. It is therefore that the central banks try to influence inflation expectations through the definition of a target.

However, inflation expectations need not be influenced primarily by the inflation target. For instance, in the model of Svensson inflation expectations are assumed to be backward looking:

$$\pi^{e}_{t+1} = \pi_{t-1} . \qquad (15)$$

In such a case, the inflation rate will change with an exogenous shock or a change in the output gap. Specifically, if inflation exceeds the level targeted by the central bank, a decline in the inflation rate in the next period requires either a positive inflation shock or a negative output gap. Inflation and the output gap are linked primarily through the labour market. If output is below potential output, that typically implies underutilised labour (Okun's law) and hence downward pressures on wage growth and lower cost-push on prices. Also weak demand can reduce price pressures. The relation between inflation and the output gap reflects the 'sacrifice ratio', i.e. the costs of reducing inflation in terms of lost output and employment, abstracting from a shift in the other determinants. It depends on, first, the production function (link between output and employment), second, the wage setting relation (the link between wages and unemployment) and, third, the price setting relation (the link between wages and prices). As a result, if inflation expectations cannot be easily modified, e.g. due to stubborn backward looking behaviour, a reduction in inflation can be

[21] The Phillips curve will be studied in more detail in Section 3.3.2.

achieved only with a higher output gap. The magnitude of the output costs depends on the sacrifice ratio.

The second equation of the model is the IS curve. Aggregate demand (the IS curve) relative to potential output, i.e. the output gap, depends on the lagged output gap, the previous period's real interest rate and exogenous shocks:

$$Y_{t+1} - Y_{t+1}^{POT} = \beta_1 (Y_t - Y_t^{POT}) - \beta_2 (i_t - \pi_t) + \eta_{t+1} . \quad (16)$$

Specifically, an increase in the real interest rate has a negative effect on the output gap. The influence of the central bank enters through the interest rate, i_t, as it is assumed that the interest rate in the IS curve is determined by the central bank, for instance through a stable and predictable interest rate pass-through.

The third equation is the central bank's reaction function, or the central bank's interest rule. It is derived from the objectives of the central bank. In line with Svensson (1997), the objective is to choose a sequence of current and future policy rates that minimises the expected future deviations of inflation from the targeted inflation rate. The current period loss function is given by:

$$L = 0.5 \cdot (\pi_t - \pi_t^T)^2 . \quad (17)$$

From the three equations shown here, Svensson derives an optimal central bank reaction function, i.e. an interest rate rule that depends on the output gap and deviations of the current inflation rate from the inflation target. The reaction function is 'optimal' as it stabilises output and inflation – given the microfoundations of the model – in an optimal way. The rule can be summarised in the following implicit function:

$$i_t = f(\pi_t, \pi_t - \pi_t^T, Y_t - Y_t^{POT}) . \quad (18)$$

The parameters of the interest rate rule depend on the microfoundations of the model and in particular on the sensitivity of inflation to the output gap (the 'sacrifice ratio') and the sensitivity of the output gap to the interest rate (the IS curve). Note that the rule incorporates the contemporaneous inflation rate. It can nevertheless approximate the policy rule of a central bank pursuing inflation forecast targeting. The inclusion of the contemporaneous inflation rate results from the fact that current inflation is predetermined by past inflation and output.

Because an optimal interest rate rule is the result of an optimisation problem, it shows the best response of the central bank given a particular model of the economy. It depends crucially on the assumed microfoundations. Therefore, the exact form of an interest rate rule and its implications for inflation and output dynamics have become subject to intensive

research. In addition to "optimal rules", some researchers have defined "simple rules". These are based on ad hoc considerations and are guided by the interest in transparency and robustness, i.e. they should show desirable outcomes (i.e. low inflation and low output volatility) in a number of theoretical models (cf. Kuttner, 2004; Taylor, 1999; Orphanides, 2007).

The most widely known "simple" monetary policy rule is the Taylor rule (Taylor, 1993). The original specification of the rule is:

$$i_t = \pi_t + r_t^{eq} + 0.5 \cdot (\pi_t - \pi_t^T) + 0.5 \cdot (Y_t - Y_t^{POT}), \quad (19)$$

with equal weights in the reaction to output and inflation deviations (0.5). Taylor used ad hoc parameters in his rule and set both the targeted inflation rate and the equilibrium real rate at 2 %. For the stability of the system, i.e. in order for inflation to converge to the targeted value after a shock, parameter restrictions must hold. The "Taylor principle" requires that after deviations of the current inflation rate from the targeted rate (e.g. after a shock), the real interest rate has to rise. Hence, the parameter in front of the inflation rate must exceed 1. In the above equation this easily holds as it can be rearranged to:

$$i_t = r_t^{eq} + 1.5 \cdot \pi_t - 0.5 \cdot \pi_t^T + 0.5 \cdot (Y_t - Y_t^{POT}). \quad (20)$$

It is important for our research to note that within this system of equations, a parameter of above 1, i.e. a real interest rate hike following an inflation shock, does – eventually – lead to lower inflation. However, the time period until inflation declines depends on the microfoundations and the preferences of the central bank. With a weak reaction of the price setters to the output gap, the disinflation process can be slow. At the same time, in the real world the process can be counteracted by the occurrence of new shocks.

The Taylor rule has become a benchmark for reaction functions in closed economies even if central banks in practice never set the interest rate based on two indicators only.[22] In particular when assessing the central bank's behaviour in retrospect, these simple rules seem to capture the essential elements of central bank rate setting (cf. evidence for the Federal Reserve System in Taylor, 1993, and Clarida et al., 2000; for the Bank of England Nelson, 2001).

2.3.2 Open economy reaction functions

Whereas the Taylor (1993) rule has become a benchmark for central bank reaction functions in closed economies, no such rule has yet been accepted for open economies. In small, open economies, both prices and demand are influenced to a substantial degree by

[22] Moreover, this specification of the rule assumes real time knowledge of the included data on the part of the central bank, which is not given (Orphanides, 2003 and 2007).

the nominal and real exchange rates. A central bank could therefore also systematically react to the exchange rate. Moreover, many central banks of small economies seem to be cautious towards an outright floating exchange rate and seem to react to movements in it at least to some extent (Calvo/Reinhart, 2002). Numerous specifications of an open economy Phillips curve were proposed (e.g. Svensson, 2000; Ball, 1998; Gali/Monacelli, 2005; Batini et al., 2005). It can include the nominal or real exchange rate, the terms of trade or the import prices in domestic currency. Consequently, also the "optimal" policy rule for small open economies can be specified with reference to various measures of external competitiveness (e.g. Svensson, 2000; Ball, 1998; Batini et al., 2003). Ball (1998) maintains that in an open economy the central bank's instrument should be a "monetary condition index", i.e. a weighted sum of the interest rate and the exchange rate. Taylor (2001) argues that because the nominal exchange rate reacts to the interest rate (the policy instrument) anyway, there is no need to react to it independently.

Within an open economy macromodel that contains an IS demand curve (with a real exchange rate), a backward-looking accelerationist Phillips curve (which includes changes in the real exchange rate), a number of possible exchange rate models and central bank reaction functions, Wollmershäuser (2006) investigates whether the macroeconomic performance of an open economy differs with a policy rule that excludes ("closed economy rule") or includes the exchange rate, either nominal or real ("open economy rule"). In addition to the numerous policy rules, he considers a range of exchange rate models (UIP, UIP with high uncertainty due to risk premium shocks, a link between the real exchange rate and the real interest rate or a real interest rate differential). This variety of models is tested because of the high uncertainty that surrounds the true determinants of exchange rate development. One result of Wollmershäuser is that the inclusion of the exchange rate can improve macroeconomic performance if uncertainty about the true exchange rate determinants or the true model is high. Another result is that if UIP is driving the nominal exchange rate, then the closed economy policy rule is efficient and should be followed. If there is uncertainty about the true drivers of the exchange rate, the economy can be better off with an open economy rule, i.e. where the central bank reacts to the exchange rate. Among the investigated central bank interest rate rules, the rule that includes current inflation, the output gap and the level of the real exchange rate (and its lag) performs best. As a result, if UIP holds, an interest rate rule that includes domestic variables such as inflation and the output gap can be used as a benchmark reaction function also for open economies. By contrast, if the exchange rate model is not known or surrounded by high uncertainty, the inclusion of the exchange rate in the reaction function is indicated. Note that the foreign interest rate as such is never part of the "optimal" reaction functions because it is the nominal (or real) exchange rate that affects inflation and activity.

3. Theories of inflation and disinflation

3.1 Quantity theory

Inflation is a sustained process of a rising price level, where the rates of change are markedly above zero (Frisch, 1983; Pohl, 1981; Bernholz, 2003). A natural starting point for investigating inflation is the quantity equation (Fisher equation of exchange): [23]

$$P_t \cdot Y_t = v_t \cdot M_t^S \,. \tag{21}$$

According to this equation, the average price level of the economy is given by the level of money supply, the real income[24] within a particular period in time and the velocity of money. Given income and velocity, any increase in the price level necessitates an increase in money supply. Log differencing of the quantity equation and assuming constant velocity ($\Delta v_t=0$) leads to[25]

$$\Delta p_t = \Delta m_t^S - \Delta y_t \,. \tag{22}$$

Inflation occurs if the growth rate of money supply exceeds that of real income. Based on this equation, the quantity theory states that the main source of inflation is excessive money supply. That, however, hinges critically on the assumption of an exogenous money supply, i.e. that money supply, controlled by the central bank, is the forcing variable. Furthermore, real GDP and money velocity have to be determined independently from money supply.

Although an increase in the price level generally cannot occur without an increase in money supply, the quantity equation and its restatement in terms of inflation can be regarded a theory of the causes of inflation only to a limited extent. The main objection to it is related to the control of money supply by the central bank. First, money supply is not determined by one institution only, but jointly by the central bank, the banking system and the public. The central bank can control directly only the monetary base (B), i.e. reserves of the banks (R) and currency in circulation (C):

$$B = C+R. \tag{23}$$

Money supply is defined as a broader measure of money and includes the sum of currency in circulation, C, and deposits held at commercial banks (D):

$$M^S = C + D. \tag{24}$$

Owing to the deposit expansion potential of the commercial banks, deposits are a multiple of the reserves held by commercial banks (a detailed description of it e.g. in Handa, 2000, or Bofinger et al., 1996). With compulsory reserve requirements (*rr* being the required

[23] P denotes the price level, Y real income, v money velocity and M^S money supply.
[24] Or, more precisely, the real transactions. These are assumed to be related to income.
[25] Lower case letters denote logarithms; the difference in logs of variables yields a continuous growth rate.

reserve ratio), the maximum deposit expansion of the commercial banks is *mm = 1/rr*, called the money multiplier.[26] As long as the multiplier is stable or predictable, this mechanism would allow control of the money supply by the central bank. However, some money is held by the public in terms of currency and hence is not subject to deposit expansion processes. In addition, demand for deposits (and reciprocally for cash) can depend on the interest rate. Thus, the ratio of currency to deposits can change over time and this can make the link between the monetary base and money supply less stable. The money supply is thus less easily controlled than assumed in the quantity theory. In addition, the money creation process of the commercial banks is not as mechanical as suggested by the money multiplier theory. Banks decide about credit expansion and hence deposit creation also based on the interest rate as the price of refinancing on the one hand and income from lending on the other, which is not considered in the money multiplier theory. Another strand of models relates the money supply process to the interest rates of the central bank and to the interest rate charged by the commercial banks. Money creation then depends on the differential between the lending rates of commercial banks, their refinancing costs and the costs and probability of clients' defaults (cf. e.g. Bofinger et al., 1996:521-533).

Second, with the advancements in financial products and financial deepening observed since the 1980s, the types of deposits and of financial instruments have increased markedly. This has made the definition of money and monetary aggregates more complicated. A number of monetary aggregates can be defined depending on the liquidity of the considered deposit types.[27] It may not be obvious which aggregate is the most suited for the application of the quantity theory. Moreover, money is demanded also for numerous financial operations, e.g. in the asset markets, which implies that some money included in the money supply aggregates is not used for real transactions affecting the price level. This in particular has led to the observation that the link between money and inflation has become weaker in recent years (ECB, 2008b; Greiber/Setzer, 2007). It has also contributed to the less frequent application of monetary targeting by central banks. Nevertheless, a close link between base money, money supply and inflation will exist if the central bank extends loans to e.g. the government or state-owned enterprises. Indeed, all major inflations started

[26] "Maximum deposit expansion" applies to a situation where the monetary base is used only for creating deposits and not to hold cash. In a case with reserve requirements and cash holdings of the public (with the ratio of cash to money supply of *c*), the multiplier becomes

$$mm = \frac{1}{c + rr(1-c)}.$$

[27] Every central bank has an own definition of the relevant monetary aggregates. For instance, the ECB defines "narrow money (M1)" to include currency and overnight deposits. "Intermediate money (M2)" includes in addition to M1 also deposits with a maturity of up to two years and deposits redeemable at a period of notice of up to three months. "Broad money (M3)" contains furthermore certain marketable instruments of the banking system.

or were accompanied by direct crediting of the government by the central bank (cf. Bernholz, 2003).

Third, also the monetary base need not be fully under the control of the central bank. The monetary base is created through

- loans to the government
- foreign exchange intervention and
- loans to the commercial banks.

For the central bank to have full control of the monetary base and changes therein, it has to be able to control all these items. Specifically, for a central bank that operates a fixed exchange rate with liberalised capital flows, the control of the money supply (and base money) is limited. It is subject to the requirements of keeping the exchange rate at the targeted level and hence by the demand and supply in the foreign exchange market. Although central banks can apply sterilisation and thus retain some control of the monetary base, this cannot be pursued over a longer term. This holds in particular for economies that face steady and large capital inflows (cf. e.g. IMF, 1997).

In addition, also central banks with full independence of the government and no obligation to intervene in the foreign exchange market may not fully control base money. The fact that central banks currently set the interest rate for base money implies that the supplied volume depends on what the banking system demands at the particular interest rate. Through setting the policy interest rate, the central bank intends to bring about a particular level of demand in the economy and lets the public and the financial markets determine the necessary money supply and – through the demanded currency and reserves of the commercial banks – the monetary base (cf. Handa, 2000:234).

Finally, a central bank may choose to accommodate the liquidity needs of the public given an ongoing inflation process because of output considerations. In terms of the model in Chapter 2.3, if, in order not to threaten output and employment, the real interest rate is not raised after an increase in inflation, this will imply higher demand for money and – given the automatic accommodation to it at the set interest rate – higher money supply.

To summarise, inflation necessitates money growth. However, because of numerous factors (e.g. financial innovation and the growth in operations in the asset markets), the link between money growth and inflation has weakened. In addition, some monetary policy strategies such as a fixed exchange rate strategy make focusing on money supply impossible, while the use of the interest rate as the main policy instrument has led to the current practice that base money and the money supply are at least to some extent

endogenous. In such circumstances, money supply cannot be viewed as the principal source of inflation.

3.2 Purchasing Power Parity

In particular in small open economies, where imports and exports can account for a substantial share in GDP, prices are influenced by the foreign price level and foreign inflation. This is first owing to the direct effect of imported goods' prices on the price level and second due to the competitive pressures arising from international competition. Similarly as in the case of interest rates, the international link between prices is suggested by the "law of one price" (LOP). It states that in the absence of natural or regulatory barriers, arbitrage forces prices of identical goods to converge, i.e. the price P is the same expressed in common currency:

$$P^d = P^f \cdot E \,. \tag{25}$$

The nominal exchange rate E is defined as units of domestic currency for one unit of foreign currency. Purchasing power parity (PPP) is the aggregate expression of the law of one price. Converted in the same currency, composite price measures are equal:

$$\sum_j \beta_j P_j^d = E \cdot \sum_i \alpha_i P_i^f \,. \tag{26}$$

α_i and β_i denote the weight of the individual prices in the composite price measure. Because the law of one price is defined over individual prices for identical goods, for PPP to hold in absolute terms, the goods included in the domestic and foreign price measures and their respective weights have to be the same and LOP has to be verified for all individual goods. Even in such a case, however, inflation in the domestic small economy will correspond to inflation in the foreign economy adjusted for exchange rate changes[28] only for small rates of change and in approximation:[29]

$$\sum_j \beta_j \hat{P}_j^d = E \cdot \sum_i \alpha_i \hat{P}_i^f + \hat{E} \cdot \sum_i \alpha_i P_i^f \,. \tag{27}$$

In reality, the link between foreign and domestic prices suggested by PPP need not hold very strictly. First, the LOP assumes that prices in the integrated international market are set within perfectly competitive markets and that they therefore equalise. However, with differentiated products and hence segmented markets, firms will set prices with a mark-up over costs.[30] Thus, they have some scope in their price adjustment. The mark-up can fluctuate and prices need not be immediately adjusted. Specifically, the pass-through to

[28] The exchange rate is assumed to be flexible.
[29] '^' denotes growth rate.
[30] For mark-up pricing see also next section.

domestic currency prices may depend on the local competitive pressures and local demand conditions ("pricing to market", Krugman, 1986) and therefore also on the ability of firms to roll over higher costs (e.g. due to a nominal appreciation) into prices. The price adjustment may also depend on the exchange rate regime. If a change in the exchange rate is viewed as temporary, e.g. when exchange rates are freely fluctuating, price setters may hesitate to immediately adjust their prices to exchange rate changes. The adjustment process may be stretched owing to staggered price adjustment, when not all firms can quickly re-optimise the price (Devereux/Yetman, 2009). Furthermore, with the monetary policy regime of inflation targeting and floating exchange rates, the credible inflation target and the anchoring of inflation at low levels may also contribute to a lower pass-through of exchange rate changes to prices. In addition, a low inflation environment may in itself reduce the pass-through because of a lower "perceived persistence of cost changes" (Taylor, 2000). Nevertheless, although also tradable goods' prices can deviate from the LOP even for a longer period of time, this may imply a loss of competitiveness and declining demand addressed to the economy with the higher price level and a build-up of trade deficits. At some point, that might require correction, e.g. through a relative decline in the prices, which may come about through a decline in the mark-up.

Second, not all goods are actually traded or even tradable. Transportation costs may make the trading of some products impossible or too costly; this applies particularly to services. Some products are therefore non-tradable. The Balassa-Samuelson model (Balassa, 1964; Samuelson, 1964) is a supply-side theory of differences in price levels between two economies owing to non-tradables. Numerous derivations of this effect exist. The derivation presented here follows Égert et al. (2003) in that the Balassa-Samuelson effect is presented as a relation between the price levels of tradables and non-tradables.[31] An economy is divided into a sector producing internationally traded (T) goods and a sector with non-traded (NT) goods. The latter will comprise mainly labour intensive services that are immediately consumed. In terms of Cobb-Douglas production functions: [32]

$$Y_T = A_T \cdot L_T^b \cdot K_T^{1-b} \tag{28}$$

$$Y_{NT} = A_{NT} \cdot L_{NT}^c \cdot K_{NT}^{1-c} . \tag{29}$$

In line with the above mentioned assumption of a higher labour elasticity of services, $c > b$.

[31] Other authors such as Sarno/Taylor (2001) derive the Balassa-Samuelson effect for the (difference in) inflation rates. Such a model is the basis of "mechanical" applications of the effect (cf. Sinn/Reutter 2000), where the "equilibrium" inflation differential and inflation rate are calculated from the observed rates of productivity growth.

[32] Y denotes output, A total factor productivity, L labour, K capital, T and NT the tradable and non-tradables goods sectors, respectively, and b and c the labour elasticity in the two sectors.

The relative price of non-tradables is then determined by the first-order conditions for profit maximisation: [33]

$$A_T \cdot (1-b) \cdot \left(\frac{1}{K_T / L_T} \right)^b = \frac{i}{P_T} \tag{30}$$

$$A_T \cdot b \cdot \left(\frac{K_T}{L_T} \right)^{(1-b)} = \frac{W}{P_T} \tag{31}$$

$$A_{NT} \cdot (1-c) \cdot \left(\frac{1}{K_{NT} / L_{NT}} \right)^c = \frac{i}{P_{NT}} \tag{32}$$

$$A_{NT} \cdot c \cdot \left(\frac{K_{NT}}{L_{NT}} \right)^{(1-c)} = \frac{W}{P_{NT}} . \tag{33}$$

Given that the capital stocks in both sectors, interest rates and prices in the traded goods sector are assumed exogenous, the system of four equations explains four unknown variables, namely W, L_T, L_{NT} and P_{NT}. Equation (30) determines the capital labour ratio (and labour demand) in the traded goods sector, and equation (31) the nominal wage in the industrial sector. Because of the assumption of wage equalisation in the economy, the nominal wage set in the traded goods sector also holds in the non-traded goods sector. As a result, the non-traded goods sector adjusts the price of non-tradables and the labour input. In the model, this is determined jointly in equations (32) and (33).

Because of the assumption of perfect competition, prices equal marginal costs. With the Cobb-Douglas technology used in the model above, equation (31) can be re-arranged to

$$P_T = \frac{W}{b \cdot \left(Y_T / L_T \right)} \tag{34}$$

or

$$P_T = \frac{1}{b} \cdot ULC_T .^{34} \tag{35}$$

The same applies to the non-tradables. For the tradables, causality runs from the exogenously given prices to wages set in the domestic economy and hence unit labour costs. For non-tradables, unit labour costs are determined through the productivity level in non-tradables and wages set in the tradables sector; the firms adjust the prices. Assuming that productivity growth is higher in tradables than in non-tradables, wage growth in the non-tradable sector will exceed its productivity growth; prices therefore grow accordingly.

[33] W denotes wages, i interest rates and P prices.
[34] ULC stands for unit labour costs.

Because of the wage equalisation, the relative price of non-tradables can be expressed as a function of the price of tradables and the productivity ratio:

$$P_{NT} = P_T \cdot \frac{b}{c} \frac{(Y_T / L_T)}{(Y_{NT} / L_{NT})}. \tag{36}$$

The entire price index, composed of tradables with weight $1-\beta^{NT}$ and non-tradables with weight β^{NT},

$$P = P_T^{(1-\beta_{NT})} \cdot P_{NT}^{\beta_{NT}} \tag{37}$$

becomes

$$P = P_T \cdot \left[\frac{b}{c} \frac{(Y_T / L_T)}{(Y_{NT} / L_{NT})} \right]^{\beta_{NT}}. \tag{38}$$

The overall price level will deviate from the price level of tradables by the ratio of labour productivity between the tradable and non-tradable sector adjusted by the weight of the non-tradables. Specifically, if it is assumed that productivity in non-tradables is similar across countries, whereas the difference in economic development stems from productivity in tradables (industrial goods), countries with higher productivity in tradables will have higher price levels. Dynamically, however, countries with higher productivity growth in the tradables sector, e.g. countries in the catching-up growth process, will have higher inflation rates. The Balassa-Samuelson model is thus used to explain both the lower price levels in countries at a lower stage of development, and the higher inflation rates during the process of real convergence.

If PPP holds for tradables

$$P_T^d = P_T^f \cdot E, \tag{39}$$

the domestic price level, now expressed in logs, becomes:

$$p^d = p_T^f + e + \beta_{NT} \cdot \ln \left[\frac{b}{c} \frac{Y_T / L_T}{Y_{NT} / L_{NT}} \right]. \tag{40}$$

As a result, the link to the price level in the foreign economy still exists, but an equalisation can be expected only for tradables.

Third, the local distribution sector can affect price setting through local cost components such as wages and rents of the distribution sector. This will imply that also the prices of traded goods do not equalise despite strong competitive pressures (Corsetti/Dedola, 2003). Crucini et al. (2005:726) suggest a model where the production of retail goods uses a combination of non-traded and traded inputs. Assuming perfect competition, Cobb-Douglas

production technology and constant returns to scale, the output price of good *i* can be viewed as a combination of the prices of the tradable and non-tradable inputs:

$$p_i = \lambda_i w + (1-\lambda_i) tr_i \,, \tag{41}$$

with *w* denoting the logs of non-tradable (wage) costs, *tr* the costs of tradables, and λ the elasticity of non-tradables in the production function. The weights of the tradable and non-tradable inputs vary among the goods. As a result, prices will not equalise as long as the local cost components and their importance in the production process differ.

Fourth, the PPP theory links prices in levels. Owing to measurement issues, it may not be directly applicable to *inflation* rates. Inflation as calculated by the statistical offices refers to a representative basket of goods, the prices of which are reported as price indexes. These reflect price trends relative to some base period. In contrast to the aggregate price level shown in equation (26), the composite price index is calculated as:

$$CPI_t = \prod_{i=1}^{n} X_{i,t}^{\omega_i} \,. \tag{42}$$

All items *i* enter with their price index X_i relative to a base period and with their respective weight ω_i. Log differencing yields a formula for the inflation rate

$$\Delta cpi_t = \sum_{i=1}^{n} \omega_i \Delta x_{i,t} \,, \tag{43}$$

which can be restated in growth rates

$$\pi_t = \sum_{i=1}^{n} \omega_i \cdot \pi_{i,t} \,, \tag{44}$$

where Δcpi_t and π_t stand for the inflation rate in period *t,* and $\Delta x_{i,t}$ and $\pi_{i,t}$ denote the inflation rate of item *i.* The price index series therefore reflects "weighted and cumulated inflation rates", intended to measure *changes* in purchasing power relative to a base period. The absolute price is unknown and hence absolute PPP or the direct link between the absolute prices cannot be verified. Comparison of index series allows merely to investigate "relative PPP". Relative PPP holds if price changes (i.e. inflation rates) in one country are matched by according changes in another country or in the nominal exchange rate, no matter what the difference in absolute terms was in the previous period:

$$\pi_t^d = \pi_t^f + \Delta e_t \,, \tag{45}$$

with $\pi_t{}^d$ denoting the domestic inflation rate in period *t*, $\pi_t{}^f$ the foreign inflation rate and Δe_t the change in the nominal exchange rate during that period.

If relative PPP holds, the real exchange rate is constant:

$$\Delta er_t = 0 \tag{46}$$

or

$$\sum_i \omega_i \cdot \pi_{i,t} = \sum_j \kappa_j \cdot \pi_{j,t} + \Delta e_t \,.^{35} \tag{47}$$

Hence a constant real exchange rate will prevail not only when prices are equalised, but also in periods of a stable deviation of prices. By contrast, a trending real exchange rate and inflation differentials may materialise during a price equalisation process if the absolute prices differed in the base period.

Fifth, also the composition of the indexes matters. The goods included in the consumer baskets used for calculating the price indexes of different countries may differ. The consumer price index is calculated with reference to a basket of goods and services that is representative of a given economy. As a result, PPP may be applicable only to some goods included in the basket. The overall measure of prices and inflation can hence deviate from those in other countries owing to the different composition of the indexes. This might be the case even if the law of one price held for individual goods (cf. also Bayoumi/MacDonald, 1999).

All in all, these five qualifications imply that the "pass-through" from foreign to domestic (aggregate) price measures need not be complete. It depends on the similarity of goods included in the consumer basket, the competitive pressures within the economy, the share of traded and non-traded goods or cost components and the exchange rate regime.

3.3 Supply side models of inflation

3.3.1 Mark-up pricing

The third approach to inflation starts from the price setting of firms and the functioning of the product and labour markets. According to microeconomic reasoning, in equilibrium firms offer the amount of goods for which marginal revenue, i.e. the price of the goods, equals marginal costs. Prices are therefore related to costs. In the benchmark case of perfect competition, however, the development of costs is not a source of inflation, i.e. a sustained increase in the price level, because firms are price takers. Prices are determined by the supply and demand conditions in the entire market, and therefore the price of the good will change if the conditions in the entire market change. In addition, prices adjust smoothly. General and sustained inflation cannot occur even if relative prices of goods adjust to changing demand and supply conditions.

By contrast, in the case of imperfect or monopolistic competition (e.g. in markets with differentiated products), firms enjoy some market power and can choose the price at least to

[35] ω_i denotes the weight of good i in the domestic basket, and κ_j the weight of good j in the foreign basket.

some extent. Costs are then an important determinant of prices and price trends. Because of the declining demand curve, marginal revenue, i.e. the price of a good, depends on the produced amount. To maximise profits, a firm will choose a volume of production where the price (marginal revenue) exceeds marginal costs: [36]

$$P_{IC} = \frac{1}{1 - \frac{1}{\left|\varepsilon_{x,p}\right|}} \cdot MC \,. \tag{48}$$

The formula can be restated as

$$P_{IC} = (1 + \upsilon) \cdot MC \,, \qquad \upsilon = \frac{\frac{1}{\varepsilon_{x,p}}}{1 - \frac{1}{\varepsilon_{x,p}}} \tag{49}$$

where υ stands for the mark-up. The mark-up is positive and will be the higher, the lower the elasticity. With mark-up pricing, costs are a crucial determinant of price setting. The mark-up is an equilibrium phenomenon, which can change when the elasticity of demand changes. However, pricing with a mark-up formula can also be seen as a general way to describe price setting (Pohl, 1981:92). Prices can be set as a mark-up on unit average costs to ensure a "natural profit". Such mark-ups can vary with the business cycle or with (temporary) changes in costs, e.g. due to changes in the exchange rate. The main source of economy-wide (macroeconomic) costs is wages and the costs of imported goods including commodities.

Inflation based on cost-push factors occurs if costs rise on a sustained basis and prices are accordingly adjusted.[37] Formula (49) can be further modified to:

$$P_{IC} = (1 + \upsilon) \cdot \frac{W}{Q} \,, \tag{50}$$

with Q denoting marginal productivity. Provided the mark-up is constant, this leads to the following link in growth rates:

$$\pi_t = \Delta w_t - \Delta q_t \,. \tag{51}$$

An increase of wages above the growth of productivity will raise prices. In a broader setting, also imported goods, commodities or taxes can generate cost-push inflation.

3.3.2 Phillips curve

The Phillips curve nowadays stands for a link between inflation and a measure of capacity utilisation. Originally, it was a theory of the relation between labour costs and the

[36] P_{IC} denotes the optimal price in markets with incomplete competition, MC marginal costs and $\varepsilon_{x,p}$ the elasticity of demand to changes in the price.
[37] In addition, that requires an accommodating central bank.

unemployment rate. Phillips (1958) showed an empirical regularity between the growth of money wages and unemployment for the United Kingdom during the time period of 1861-1957. Unemployment was found to have been negatively related to the growth rate of money wages. This was theoretically explained by the functioning of the labour market (Lipsey, 1960). If demand for labour exceeds supply at a given wage, the bargaining power of wage earners strengthens and money wages will rise along higher employment. Hence, in addition to a "trend or targeted growth rate of wages", wage growth depends negatively on the unemployment rate (cf. Frisch, 1983):

$$\Delta w_t = \Delta w_t^T + f(u_t)\text{, for instance} \tag{52}$$

$$\Delta w_t = \Delta w_t^T + z \cdot u_t^{-1}. \tag{53}$$

The log difference of wages approximates their growth rate; the unemployment rate u is a ratio and $z > 0$. The link to price setting is made with mark-up pricing. Wage growth will raise prices if it is not accompanied by according productivity growth. Inflation is given by[38]

$$\pi_t = \Delta w_t - \Delta q_t + \Delta \upsilon_t. \tag{54}$$

As a result, excess demand in the labour market will be connected with higher inflation:

$$\pi_t = \Delta w_t^T + z \cdot u_t^{-1} - \Delta q_t + \Delta \upsilon_t. \tag{55}$$

As long as the targeted growth rate of wages equals productivity growth and the mark-up remains constant, the inflation rate will depend only on the unemployment rate and hence the overall level of demand relative to potential output. In the 1960s the link between unemployment and inflation was interpreted as a trade-off between inflation and unemployment – a causal link from higher inflation (generated by an "activist" central bank) to lower unemployment. This however has proven incorrect in the subsequent years when many countries experienced stagflation, i.e. inflation alongside economic stagnation.[39]

One reason why this trade-off did not work over a longer time period is that it requires permanent money illusion on the part of the wage earners: due to the "unexpected" inflation, real wages turn out lower than anticipated. However, unless there is permanent money illusion, wage setters will adjust inflation expectations. The link between nominal wages and unemployment was therefore augmented by the expected inflation rate (Friedman, 1968). Wage growth then becomes: [40]

[38] w denotes the nominal wage, q productivity and υ the mark-up introduced on previous page.
[39] This does not rule out the possibility that the labour market situation affects the bargaining power of employees and hence wage growth and inflation, i.e. a causal link from unemployment to inflation (Schreiber/Wolters, 2007).
[40] w_t^{RT} denotes the targeted real wage and $E_t(\pi_{t+1})$ inflation expectations.

$$\Delta w_t = \Delta w_t^{RT} + E_t(\pi_{t+1}) + f(u_t)\,. \tag{56}$$

Inflation is consequently also a function of expected inflation and the unemployment rate:

$$\pi_t = \Delta w_t^{RT} + E_t(\pi_{t+1}) + f(u_t) - \Delta q_t + \Delta \upsilon_t\,. \tag{57}$$

In the original formulation of the expectations augmented Phillips curve, inflation expectations were considered to be formed in adaptive manner, i.e. $E_{t-1}(\pi_t) = \pi_{t-1}$. Thus, also the augmented Phillips curve relationship could be associated with the idea of a trade-off between inflation and unemployment. However, this holds only in the short run. In the long run, when inflation expectations have adjusted to the higher inflation rate, the Phillips curve is vertical, i.e. unemployment is independent of the inflation rate. Instead, it depends on the supply and demand conditions in the labour market and the real wage.

A central concept developed in relation to the Phillips curve is the "natural rate" of unemployment or "non-accelerating inflation rate of unemployment" (NAIRU). Owing to a number of reasons, the labour market equilibrium can be associated with a positive unemployment rate. Early explanations of this are search or wait unemployment, more recent theories in the New Keynesian framework stress imperfections in the labour market due to insider-outsider effects, hysteresis, price and wage stickiness etc. (cf. e.g. Cahuc and Zylberberg, 2004). Because the NAIRU or natural rate is an equilibrium phenomenon, demand policies or a change in the inflation rate cannot lead to a permanent decline of unemployment below the equilibrium rate. Another formulation of the expectations-augmented Phillips curve with simple adaptive expectations is therefore

$$\pi_t = \Delta w_t^{RT} + \pi_{t-1} + f(u_t - u_t^{eq}) - \Delta q_t + \Delta \upsilon_t\,. \tag{58}$$

The Phillips curve often includes an output gap measure instead of the unemployment rate or unemployment gap. This is based on production function considerations, where lower labour input leads to lower output. In addition, Okun's law states that the deviation of employment from its natural level has a stable effect on the deviation of output from its potential. As a result, the inflation augmented Phillips curve suggests that inflation will change if

- inflation expectations deviate from the inflation rate in the previous period,
- the deviation of the unemployment rate from its natural level changes (an unemployment rate rising above the equilibrium unemployment rate indicates downward pressure on wages and prices),
- the deviation between the targeted real wage rate and productivity growth changes, or
- the mark-up changes.

Subsequent research emphasised that expectations need not necessarily be backward looking but might be "rational" in the sense that expectations are formed in line with the assumed underlying model (Muth, 1961). Agents with rational expectations "try to avoid systematic errors" and will adjust inflation expectations in the event of expansionist monetary policy. In such a case, there is not even a short-term trade-off between unemployment and inflation because agents do not suffer from money illusion. With rational expectations, only unexpected events (shocks) lead to a non-vertical Phillips curve in the short run (Lucas, 1972). However, contrary to the labour market model stated above, the new classical macroeconomics school, which introduced the rational expectations, generally assumes that there are no frictions in the labour and goods markets.

Recently, the Phillips curve interpreted as a link between the level of demand and inflation in the short-run has gained in importance again in connection with the development of microfoundations of sluggish adjustment in the labour and product markets (summarised e.g. in Goodfriend/King, 1997). In the product market, this sluggish price adjustment could be due to menu costs or preset prices. In the labour market, wages are agreed on for a certain period and there is no instantaneous adjustment to changes in productivity or demand (i.e. to current marginal costs). The sluggish adjustment gives rise to a short-run link between inflation and economic activity reflected in the New Keynesian Phillips curve (NKPC, e.g. Clarida et al., 1999; Gali/Gertler, 1999).

The NKPC is derived assuming that only a fraction of firms can instantly adjust prices to the optimal level, which is given by marginal costs. The other firms' prices are fixed. Therefore, expectations of the future development of costs are crucial. Because prices are fixed for some periods ahead, when setting the new price, the firms take into account the expected changes in marginal costs. The NKPC is (Gali/Gertler, 1999:200):

$$\pi_t = \lambda \cdot mc_t + \beta \cdot E_t(\pi_{t+1}) \,. \tag{59}$$

The parameter in front of the deviation of marginal costs from its steady state value (*mc)* λ is positive and increases with the number of firms adjusting prices in the current period, i.e. with the frequency of price adjustments. β is a subjective discount factor. Hence, if firms know that they fix prices for some time ahead, they will try to anticipate the future development of costs and will set the price at a level that makes up for the future growth of marginal costs. Thus, in the New Keynesian Phillips curve, inflation expectations are forward looking, i.e. they depend only on the current and expected state of the economy. The inclusion of expectations of future inflation, and only these, underlines the importance of a credible inflation target of a central bank for the inflation process.

Empirical work on the NKPC has not always supported the idea that expectations are (only) forward looking (Rudd/Whelan, 2005). As a result, a hybrid specification was introduced

by Gali/Gertler (1999), which includes, in addition to current marginal costs, both the lagged and expected future inflation rate. Lastly, it was also stated that owing to the better anchoring of inflation expectations with inflation targeting, the link between inflation and cyclical movements reflected in the output gap or unemployment may have declined ("flattening of the Phillips curve", e.g. Laxton/N'Diaye, 2002; Roberts, 2006).[41]

Summing up, the Phillips curve relates inflation to inflation expectations and labour market conditions or some other measure of aggregate economic activity. Resting on the assumption of frictions in the labour and product markets such as preset prices and wages or wage setting depending on the conditions in the labour market and the bargaining power of employees, a weaker business cycle will be associated with lower inflation pressures and vice versa. As regards inflation expectations, two kinds of expectations are modelled: adaptive (backward looking) and rational (in line with the underlying model). As a result, central bank policies can affect the inflation outcome also through a credible inflation target.

3.4 Moderate inflation and disinflation strategies

While staggered adjustment to changing costs can explain inflation persistence, it cannot explain the persistence of moderate inflation, i.e. inflation at low double-digit levels, for some years. Moderate inflation has its roots in backward looking expectations and an accommodating monetary policy. Put in terms of the Taylor rule, sustained moderate inflation occurs if the central bank does not raise real interest rates sufficiently in reaction to an inflation shock to reduce demand and hence inflationary pressures.

Dornbusch and Fischer (1993) see two major causes of sustained moderate inflation: the fiscal motive and the perceived or real costs of disinflation. The fiscal motive arises if a country is unable to collect sufficient taxes or other government revenue on a standard basis and hence has to take recourse to direct central bank credit. The argument of "inflation (being) too costly to stop" is related to the implications of backward looking inflation expectations for employment and output during a disinflation process. Dornbusch and Fischer base their analysis on a model of an open economy with strong backward looking expectations. The model includes the following relations:[42]

a) cost based pricing: $\pi_t = a \cdot \Delta w_t + (1-a)\Delta e_t + \psi_t$, (60)

[41] This opinion is contested by Gordon (2008). That article also gives an overview of the Phillips curve debate since the publication of the original article by Phillips in 1958.

[42] The variables denote: π inflation, Δw_t wage growth, Δe_t change in the exchange rate, u_t unemployment rate, Δm_t^S growth of money supply and ψ_t a disturbance term, capturing the effect of supply shocks. Foreign inflation is assumed to be zero.

b) wage-setting relation: $\Delta w_t = \pi_{t-1} - z \cdot u_t$, (61)

c) exchange rate model: $\Delta e_t = b \cdot \pi_t + (1-b)\pi_{t-1}$, (62)

d) an accelerationist Phillips curve resulting from a)-c):

$$\pi_t = \pi_{t-1} + \theta\psi_t - az\theta u_t \text{, with } \theta = \frac{1}{1-b+ab} \quad , \tag{63}$$

e) an aggregate demand equation: $u_t = u_{t-1} - \tau(\Delta m_t^S - \pi_t) - (\Delta e_t - \pi_t)$. (64)

The parameters *a, b, z* and τ are positive, with $a,b < 1$. Dornbusch and Fischer motivate the strong backward looking wage setting by the observation that economies with sustained moderate inflation show some form of indexation, either explicit or implicit (Dornbusch/Fischer, 1993:9).

The rearranged price setting equation (60)

$$\pi_t = \pi_{t-1} + a(\Delta w_t - \pi_{t-1}) + (1-a)(\Delta e_t - \pi_{t-1}) + \psi_t \tag{65}$$

shows that inflation will decline with a wage restraint. Wage restraint requires either a change in the expectations formation, but it may also come about through a decline in economic activity. In the latter case, the responsiveness of wages to changes in the unemployment rate or to the demand level in the economy decides about the costs of the disinflation process (cf. Section 2.3, but also e.g. Cahuc/ Zylberberg, 2004:463). Policy makers may hesitate to incur such costs in particular if the perceived costs of moderate inflation seem relatively contained through economy-wide indexation, and if the restriction necessary to break inflation expectations is very high.

With strong backward looking expectations, disinflation can come about through real appreciation, which helps reduce inflation rates through the effect of import prices. This can lead to a decline in wage inflation if these are adjusted to the declining inflation rates. However, this strategy carries substantial risks. If inflation does not respond in the anticipated manner, real appreciation may turn out excessive, threatening the external stability without yielding the intended result in inflation performance. A devaluation of the nominal exchange rate may become necessary, generating additional inflationary pressures and harming the credibility of central bank policies. With backward looking expectations, disinflation can also occur with a positive supply shock or a stronger than anticipated recession, where, again, the decline in the inflation rate feeds through to wages. However, for a disinflation strategy from relatively high moderate inflation rates the necessary supply shock has to be rather high. For relatively small deviations from low inflation, Orphanides and Wilcox (2002) rationalise the "opportunistic approach to disinflation" where the central bank does not take any "deliberate anti-inflation action". According to this model, the

central bank will wait until such positive shock occurs and will only try to prevent a further increase in the inflation rate.

However, a supply shock might also be negative as in the case of rising oil prices, in particular if commodities are imported. The ensuing increase in inflation will fuel inflation expectations and further raise inflation if expectations are formed in backward looking fashion. At the same time, such a negative supply shock may require an adjustment in the real exchange rate (the domestic currency should permanently depreciate in real terms if the shock is permanent) and ultimately a decline in the real wage of the domestic economy. As a result, with backward looking expectations, a negative supply shock can further stretch the adjustment process and extend the phase of subdued growth needed to reduce inflation rates. That may ultimately imply higher output costs compared with a strategy that aims to break the backward looking expectations quickly. A similar case is an increase of regulated prices, excise taxes or VAT, which in a first step raise consumer prices. Such administrative measures raise prices with the aim to redistribute income either to the government or to the producers of goods with regulated prices. As a result, real wages should grow by less than the sum of productivity growth and inflation. With backward looking inflation expectations, this adjustment will be slow.

The "desirable" speed of disinflation is often related to the perceived costs of the disinflation process. Indeed, with backward looking expectations, a disinflation process will always imply costs in terms of lost output and employment (cf. also Buiter/Grafe, 2001, who test the implications of different expectations on the output costs of disinflation). Instead, according to models with rational or forward looking expectations, a decline in inflation should be possible without substantial output costs because the agents adjust expectations and thus price and wage growth. Preconditions for costless disinflation are therefore a credible central bank and forward looking inflation expectations. However, Ball (1993) shows in a study of disinflation after moderate inflation episodes in OECD countries that disinflation, both fast and slow, has always been associated with output and employment costs. King (1996) argues that most countries in the developed world that disinflated in the 1980s and early 1990s aimed at a slow disinflation process. The rationale behind it was that private agents do not immediately adjust expectations when the central bank announces a change in its regime to a low inflation target. This immediate adjustment could only occur if the central bank were fully credible, which is unlikely after a longer period of moderate inflation. The central bank can use a commitment device such as a fixed exchange rate, but it may also choose to target a slow disinflation process to allow for learning about the monetary regime on the part of the public. A gradual disinflation strategy has also been criticised, however. A cautious disinflation programme could be regarded as

rather unambitious by the public, and may fuel speculations about future reversals of the policy regime. This is particularly likely during episodes of persistently high government budget deficits (Sargent, 1986). In the case of emerging economies that are fully open to capital flows, a persistent inflation differential also puts permanent strains on monetary policy. The inflation differential and the corresponding interest rate differential attract capital inflows, which imply either high sterilisation costs for the central bank, or a nominal appreciation, which may not prove sustainable (cf. IMF, 1999H: 47).

A particular issue is the monetary strategy in a disinflation process. A fixed nominal exchange rate or a crawling peg with pre-announced devaluation rates can be used to stabilise expectations about the future development of the nominal exchange rate. This can be helpful in particular if the central bank lacks credibility as regards other stabilisation tools. Fixing the nominal exchange rate should restrain the government (i.e. no excessive borrowing that makes the peg noncredible and unsustainable) and the wage setters. A crawling peg may be more suited if there is only a small probability that wage and price setters will adjust quickly to very low inflation rates necessary to stabilise the exchange rate. If this strategy is credible, the main factor driving inflation is the expected future development of the exchange rate. With inflation targeting, the most important instrument is the inflation target of the central bank. In addition, disinflation can be promoted through an increase in the real interest rate. This will imply weaker domestic and foreign demand and a dampening effect on prices from nominal currency appreciation. However, the pass-through from foreign prices and the exchange rate may be lower with inflation targeting due to the higher uncertainty surrounding the floating exchange rate and a slower reaction of the economic agents to changes therein.

4. Specific determinants of interest rates and inflation in transition economies

4.1 Overview of the trends shaping financial markets and monetary policy in transition economies

In the models of Chapter 2, we assumed market-based price determination of financial contracts. In addition, the interest rate for open-market operations is the main monetary policy instrument. The central bank reacts, in a systematic manner, to macroeconomic variables such as prices and output. By adjusting its interest rate, it aims to achieve macroeconomic goals, specifically low and stable inflation. In the stylised model in Chapter 2.3 (p. 40), the central bank's interest rate enters the IS curve, i.e. it directly affects overall demand. The stable transmission through the financial system works by assumption. However, in practice the link from the central bank's interest rate to inflation is indirect. The central bank is directly involved only with commercial banks. For monetary policy to be efficient, the commercial banks have to transmit the central bank's policies reliably through the financial system to the economy. The interest rate pass-through depends, inter alia, on the interest rate sensitivity of the financial system and therefore also on its efficiency and stability. As a result, the precondition of successfully pursuing monetary policy through the interest rate is stable or predictable interest rate sensitivity of the financial system (first stage) and of the real economy (second stage of the transmission).

In the transition economies, interest rates as market prices emerged only with the systemic transition from plan to market in the early 1990s. Also monetary policy aiming at low inflation or stabilisation within the business cycle became relevant only during the transition process. Previously goods' prices and the interest rate were set by the planning agency and monetary control was not exerted by means of managing the financial system. The "financial sector" consisted of state-owned banks that were passively performing the transactions planned elsewhere.[43]

The transition process in the early 1990s entailed liberalisation of economic activity, the decentralisation of the decision making and responsibilities, and the establishment of goods, labour and financial markets.[44] Furthermore, the transition required institutional change, including in the legal system and as regards the tasks, responsibilities and procedures of the government. In the financial system, the institutional change comprised the separation of the monobank into commercial banks and the central bank with standard functions.[45] The

[43] Cf. Anderson/Kegels (1998) for a more detailed description of the starting point.
[44] For a detailed description of the transition process cf. Gros/Steinherr (2004).
[45] These functions include determining market interest rates through their control over the monetary base, managing the payments system, managing the foreign exchange reserves, promoting the stability of the

newly created central banks were, however, involved in numerous tasks related to the transition process. These included

- financial sector restructuring (including restructuring and recapitalisation of the banks, introduction of banking supervision and regulation; function of the "institutional leader" in the introduction of a payment system and in setting up the interbank markets for domestic and foreign currency),
- external liberalisation of the currency (introducing convertibility for current and capital account transactions; currency and reserves management; foreign debt servicing), and
- stabilisation of the macroeconomic environment, necessary due to the inherited internal and external imbalances and the liberalisation measures during the transition.

In the mid-1990s the two countries investigated in this study, i.e. the Czech Republic and Hungary, joined the OECD. That marks the end of the period of systemic change, i.e. the change in the basic coordination mechanism and macroeconomic stabilisation. Nevertheless, the economies remained in the process of reform and development, including market development, institutional deepening and economic restructuring. The restructuring of the real and banking sectors (privatisation, hard-budget constraints for firms and banks, redirection of capital to more efficient uses) was mutually dependent and turned out time-consuming. Also the liberalisation of currency transactions proceeded gradually. Finally, whereas stabilisation of inflation rates could be achieved rather early in the 1990s, inflation remained at moderate levels for a number of years and disinflation was yet to be achieved. Therefore, financial system restructuring and stabilisation, external liberalisation and disinflation continued throughout the 1990s, with the central banks remaining heavily involved in that process.

The systemic change laid the basis for catching-up growth and financial development, which began in the mid-1990s. As a result, the countries started to share characteristics with other emerging economies, i.e. economies with relatively low income but substantial growth potential, and with weak but developing institutions. This has implied particular challenges. First, catching-up growth requires large investments into the capital stock comprising machines and equipment, housing and infrastructure. Opening up for foreign capital and liberalising capital flows can support this process as it can increase the amount of savings available. However, the accompanying current account deficits and rising stocks of foreign debt can create vulnerability to swings in capital flows and impact the exchange rate management. Second, the growth process entails financial deepening and development. This may have implications for financial stability, in particular as the financial systems

financial system, by supervising the banks and by serving as the lender of last resort, acting as the government's banker, determining the exchange rate (in full or joint responsibility). (Wagner, 1998:4).

were shallow and weak in the early stages of the transition and development process. Third, catching-up growth can imply a trend real appreciation of the currency. We will deal with these issues in detail further below.

The preparation process and the accession to the European Union in 2004 substantially reduced institutional uncertainty and increased the credibility of the growth and development process. However, EU membership as such has not changed the fact that these countries are in the catching-up growth process and hence face particular challenges as regards macroeconomic stability. Furthermore, with joining the EU the countries are required to adopt the euro and to meet the Maastricht criteria on nominal convergence. In particular, it is deemed challenging to attain simultaneously low inflation and a stable exchange rate. Because the catching-up growth process is accompanied by price level convergence with more developed economies and hence higher structural inflation, some authors have questioned whether a simultaneous meeting of the inflation and exchange rate criterion is possible (Buiter/Grafe, 2002; Buiter, 2004; deGrauwe/Schnabl, 2005).

Moreover, although low inflation and a stable exchange rate are usually considered to be mutually supporting, the simultaneous commitment to both has the potential to make the two goals conflicting (Buiter, 2004). In small open economies, a country cannot liberalise capital flows, fix the exchange rate and set interest rates according to domestic objectives such as low inflation ("impossible trinity"). With a commitment to a fixed exchange rate, reacting to domestic inflationary pressures by an adjustment of the interest rate is possible only to a small extent. The problem is exacerbated for emerging economies such as the former transition economies, which have run marked current account deficits and accumulated substantial foreign debt. Fixing the nominal exchange rate would further raise their vulnerability towards currency speculation. That vulnerability is considerable irrespective of the exchange rate regime because countries indebted in foreign currency can be subject to shocks originating in the international financial system. Hence, a commitment to an exchange rate fixed within a narrow band as it is stipulated by the Maastricht Treaty may be credible only when inflation rates have declined to euro area levels on a sustainable basis and if structural vulnerability is contained. In sum, the challenges for the central banks in the new EU member states have included the obligation to achieve nominal convergence in an environment of potentially vigorous growth, financial deepening and strong links to the international capital markets.

4.2 Integration into international capital markets

The planned economies were closed economies with currencies serving mainly as units of account. At the outset of transition, foreign trade was heavily regulated, currencies were not convertible and overvalued in market terms (Rosati, 1996). The transformation therefore encompassed liberalisation of foreign trade and of the currencies. Yet, it was a gradual process with sequencing and timing being important issues. Liberalisation of foreign trade (i.e. current account transactions) was a building block of the first set of reform measures because fast liberalisation of foreign trade was expected to enhance competition and thus speed up restructuring (Hartwig/Welfens, 1998:411). In addition, the restructuring of the economy could be guided by the comparative advantages of the countries, while imports could help modernise the domestic capital stock (Stippler, 1998:44). Countries that chose fast liberalisation of foreign trade significantly devalued the currency, whereas countries that liberalised more slowly made smaller adjustments in the exchange rate. All in all however, current transactions were liberalised quite quickly and current account convertibility was achieved within a couple of years, namely when the countries joined the OECD. By contrast, the liberalisation of capital flows was gradual and more cautious. A liberalisation of a wide range of capital transactions was considered neither useful nor practicable in the very early stage of the transition as it would have overly restricted monetary policy.[46] In addition, sensible financial investments require that the interest rate signals the profitability of an investment project. That was not given in the early stages of the transition when financial markets only started to operate and the interest rate as a price emerged.

However, after the successful introduction of current account convertibility, it became more difficult to restrict capital account transactions. In addition, capital flows can have important benefits for the economies in the transition and catching-up growth process. These include that the countries can use a larger pool of savings to finance the investment necessary for catching-up growth. Also privatisation could proceed more quickly with access to foreign capital. Furthermore, sales to foreign investors have improved corporate control and technological skills, enhancing structural change. Also financing costs can be reduced if the interest rate is lower in the more developed economies. Moreover, foreign investments into the financial system can improve the functioning of the financial markets and promote the development of the different segments such as the fixed income market (Buiter/Taci, 2003; Ötker-Robe et al., 2007: 7). Capital account liberalisation can also be seen as an instrument to increase the credibility of policies (Gibson et al., 2006).

[46] At the start of the transition, it was highly likely that the liberalisation of capital transactions would lead to substantial capital outflows (Rosati, 1996:165).

Still, capital account liberalisation entails risks**,** in particular for emerging economies with developing financial markets. First, capital flows can be rather volatile, which appears to be more pronounced in emerging market economies (cf. BIS, 2009). That may impact the volatility of the nominal exchange rate and exchange rate policies. Second, the growth *potential* of emerging economies (or economies in the catching-up growth process) is high. Due to low savings and high potential returns, the equilibrium real interest rate substantially exceeds the returns of more developed economies. Liberalisation of capital flows is therefore expected to lead to a surge in capital inflows (Lipschitz et al., 2002), which the receiving country must be able to use in an efficient manner. Experience shows that capital inflows can be of a magnitude that cannot be put only to highly productive uses by the emerging market economies (BIS, 2009). For instance, large capital inflows may be followed by lending booms. If capital inflows end up in consumer loans or government consumption, the capital stock and hence productive capacities may not grow sufficiently for the growth potential to materialise. It may become difficult to service and repay the debt without major adjustments in the demand level and in the nominal exchange rate. Furthermore, if households or firms borrow in foreign currency to exploit the interest rate differential, the risk of currency mismatches may arise if they are not hedged against currency depreciation. Because the developing financial systems are less experienced in the risk-assessment and monitoring of borrowers, capital inflows may put the financial systems of emerging markets to a test as regards their ability to carefully choose and control the investment projects.

Third, a risk arises also from the fact that the capital inflows can go with current account deficits. These may be further fuelled by real currency appreciation, which can be the consequence of nominal currency appreciation or higher inflation, but in both cases it may deteriorate competitiveness. A country running a current account deficit always risks that financing may dry up, requiring a swift reduction of the demand level. A change in investors' sentiments may be the consequence of domestic conditions, but it may also stem from a change in expectations or risk aversion. Countries running current account deficits are more vulnerable towards turmoil in the international financial markets or contagion effects. Nevertheless, domestic sources of vulnerability such as fiscal deficits (i.e. "twin deficits"), weaknesses in the banking system and financing of the current account deficit through short-term capital flows substantially increase the exposure to currency speculation and currency crisis (cf. Kaminsky, 2003; Roubini/Wachtel, 1998).

Finally, capital inflows to emerging countries can have major repercussions for monetary policy. Openness to capital flows reduces the policy options available to central banks as regards the simultaneous setting of the interest rate and the exchange rate. The relative

importance of the several transmission mechanisms may change when the nominal exchange rate is more flexible and volatile. Exchange rate volatility may hence affect the efficiency of central bank policies. At the same time, capital inflows may give rise to structural liquidity, i.e. a situation where the commercial banks are not always restrained in their lending activity by central bank policies (see Sections 4.3 and 4.5).

As regards the process of currency liberalisation, a consensus view has developed during the past years that the benefits will outweigh the risks only if some preconditions are in place (cf. Eichengreen/Mussa, 1998). These are macroeconomic stability, market-based interest rate setting, sound risk management by the market participants, financial discipline in the financial and the corporate sectors, financial system stability, and properly functioning regulation and supervision of the financial sector. In addition, when liberalising capital flows, sequencing may be beneficial. Longer term investments should be liberalised before the short-term flows because the latter are often driven by speculation and the intention to exploit an interest rate differential. They are therefore likely to be more sensitive to changes in the interest rates or the expectations of the future development (Roubini/Wachtel, 1999:26-27). That can lead to sudden reversals of capital, financial stress or the need to rapidly adjust demand and/or the exchange rate.

Concerning the actual sequencing of capital account liberalisation in the transition economies, the countries chose numerous approaches depending on the starting conditions (such as a high inherited foreign debt) and overall transition strategy (cf. Árvai, 2005). In general, the countries liberalised long-term inward investments early on, but differed in the sequencing and speed of the liberalisation of short-term capital flows or outward investments. OECD membership required the countries to specify a timetable of capital account liberalisation, whereas EU entry was conditioned on free capital flows. Some risks associated with the liberalisation of capital flows materialised already in the 1990s as some currencies became the target of currency speculation or even currency crisis. These impacted on the macroeconomic performance and the exchange rate regime and were followed by increased efforts to ensure macroeconomic stability, reduce vulnerability from current account and fiscal deficits and improve the regulatory framework of financial markets.

Generally, capital account liberalisation in the (former) transition economies gave rise to substantial capital inflows, similarly to the experience of other emerging markets and in line with theoretical considerations. However, their sources have changed over time. In the early phase, i.e. in the second half of the 1990s, the capital inflows consisted mainly of FDI and other privatisation revenue, investments into government bonds and gradually also foreign currency loans. With increasing liberalisation of capital flows, portfolio investments

and short-term flows exploiting the interest rate differential gained importance. Furthermore, the privatisation of large banks to foreign owners (see next section) considerably lifted the amount of bank loans. Parent banks were extending loans to their subsidiaries, most often for lending to households and firms in foreign currency.

While the inflows have in general strengthened growth in the former transition economies, they have also implied the risks mentioned above. Current account deficits have been large and even if trade balances improved, that was counteracted by growing income transfers. The financing of the deficits was to some extent covered by long-term flows (FDI) or bank loans, but in some years, short-term flows could dominate. Foreign debt has risen considerably, both for the economies as a whole and for households. Finally, the currencies appreciated in real terms. Recently, the vulnerability of these countries to shocks in the international financial markets and to changes in the perception of their growth performance was demonstrated by the turmoil in the international financial markets (BIS, 2009). The (former) transition countries faced massive capital outflows and encountered difficulties in raising the capital needed to cover the current account deficits.

The capital inflows have affected monetary policy and induced a number of policy responses to reduce the risks. Early policy responses included a more flexible exchange rate regime (widening of fluctuation bands, later also floating of the currency) and sterilised interventions in the foreign exchange market. However, the underdeveloped financial markets and the fact that foreign-owned banks had access to foreign funds counteracted the sterilisation efforts (Ötker-Robe et al., 2007: 13). In addition, interest rates were reduced in response to capital inflows, but this could entail an unwelcome monetary easing. For some privatisation revenue, inflows were converted directly by the central bank, circumventing the foreign exchange market.

In sum, integration into the international capital markets was a gradual process. However, with EU membership at the latest, all restrictions on capital or current transactions were abolished. Owing to the relatively stable institutional environment and fair growth prospects, the countries have faced huge capital inflows since the mid-1990s. While these have supported the catching-up growth process, numerous risks emerged as regards a smooth growth process and stable inflation. The main risks stem from the volatility of the nominal exchange rate, persistent current account deficits and the growing foreign debt. The recent world-wide financial market crisis has demonstrated that some risks, in particular fast currency depreciation and impaired access to fresh capital, can materialise quickly.

4.3 Financial market development

4.3.1 Financial market development during the transition process

The development of the financial market is reflected in the existing market segments (i.e. deposit banks, stock market, fixed income market) and hence the available financial *instruments* and their liquidity. In addition, the extent of market liberalisation, private responsibility and liability, and the degree of competition determines the *interest sensitivity* of the financial system. That is a crucial precondition of interest rate transmission from the central bank to the real economy. In a liberalised, competitive and profit-maximising financial system, the interest rate reflects the risk, liquidity and maturity of the financial contract on the one hand, and refinancing costs on the other. Furthermore, the available financial instruments, the interest rate sensitivity of the financial sector and of the real economy guide the choice of strategy and policy implementation of the central bank. An interest rate based strategy of the central bank depends crucially on the importance of financial intermediation in the financing of investment projects or durable consumption goods. The interest rate channel of monetary policy transmission is the more powerful, the more investments or consumption are financed through bank loans or bonds.

An interest rate based policy requires financial discipline and a sound banking system to ensure the stable transmission of the interest rate through the financial system. Sound banks will carefully choose their projects, monitor the creditors and provide for risk. In such a case, losses, which are always to some extent likely, need not end up in bank failures or distress borrowing of banks. The banks will react to higher refinancing costs at the central bank by raising the interest rates of their loans to firms and households. By contrast, banks with weak loan portfolios are less sensitive to the central bank's interest rate. On the one hand, weak banks will potentially demand liquidity independently on the interest rate. On the other hand, they will not necessarily transmit changes in the interest rate to lending and deposit rates. Lower rates of the central bank could be used to repair the balance sheet. The transmission of interest rates is then less predictable or exploitable by the central bank (Wagner, 1998: 10).[47] The soundness of banks also bears on the lending channel of monetary transmission (i.e. the availability of credit due to lending standards). Weak banks may react to an increase in the interest rate by lowering the credit standards instead of raising them.

[47] Wagner also notices that with a weak banking sector, the central bank may be pressured to supply liquidity to the ailing banks, thus threatening monetary control (Wagner, 1998 :10). Furthermore, a central bank could refrain from a necessary monetary tightening if this could endanger financial stability (Wagner/Iakova, 2001: 14).

Finally, the existing market segments of the financial system will affect the instrument choice of the central bank. Direct instruments (such as credit and interest ceilings, required reserves but also directed credit) do not necessarily attach an important role to the interest rate and do not require money and securities markets for implementation. By contrast, with indirect instruments (discount and Lombard interest rate, interest rate in open-market operations), the interest rate as the price of commercial banks' refinancing is the fundamental tool of central banks. Indirect instruments include standing facilities (which can be implemented without a particular market framework) and open-market operations, i.e. money market operations and operations in the secondary bond market. Preconditions of the latter are the existence of fixed-income markets and money markets that allow commercial banks to manage liquidity without direct recourse to the central bank's means. With dominating money market based instruments, the central bank aims to influence the overall liquidity available in the economy and – in an optimal case – it adds only marginal liquidity to the money market (cf. Laurens, 2005).

In the transition economies, some segments of the financial system such as the bond or stock markets emerged only during the transition process, while the banking system had to be completely transformed. Financial market development proved a protracted process, also because of its interdependence with progress in enterprise restructuring, legal reform and the correction of distorted incentive structures (cf. Bonin/Wachtel, 2002; Caprio, 1995). Large commercial banks were created from the old monobank and inherited loans to the state-owned enterprises. In some countries, the banks were split according to regional lines, in other cases according to branches – but in both cases the banks had undiversified portfolios. Concentration remained high, competition low and banks were overly dependent on regional or sectoral developments (cf. e.g. Szapáry, 2001). In addition, many loans became quickly non-performing.[48] Rolling over of the debt appeared easier than writing the debt off; banks therefore had persisting ties with non-performing firms. Incentive problems occurred also due to the continued directed credits to state-owned enterprises, or easily available refinancing credit to stabilise the banking sector. Moreover, the numerous recapitalisation programmes created moral hazard problems in that unless policies imposed simultaneously hard-budget constraints, banks could speculate for further government bailouts (Wagner/Iakova, 2001:19; Ganev et al., 2002).[49] Hard-budget constraints for banks required hard-budget constraints for enterprises and therefore the development of the

[48] The causes of the non-performing loans were the decline in output at the start of the transition, undercapitalisation of banks, risk assessment complicated also by the transition process. At the same time also weak risk management practices and shortcomings in the regulatory framework and bank supervision (cf. Szapary, 2001: 13).

[49] It should be noted that newly created banks also often failed due to the high risks in the transition process, but also weak supervision and poor management practices.

banking sector critically hinged on the progress in structural and legal reform (Buiter/Taci, 2003).

As a result, non-performing loans, banking crises and banking recapitalisation programmes were frequent in the early years of the transition process (cf. for the banking system restructuring e.g. Anderson/Kegels, 1998; Wagner/Iakova, 2001; Reininger et al., 2001). Only in the second half of the 1990s,[50] the banking systems started to consolidate after numerous failures, recapitalisation programmes and improvements in the supervisory and regulatory framework. In nearly all former transition economies, the majority of banks was sold to foreign investors to improve their management and performance.

4.3.2 Financial market development since the turn of the century

Since the early 2000, the financial systems and in particular the banking systems have experienced rapid development and growth. Four main issues have characterised the financial sectors in the Czech Republic and Hungary since the turn of the century: the dominance of banks in the financial system, the dominance of foreign-owned banks in the banking systems, a rapid growth in financial intermediation and excess liquidity.

First, the financial systems have been dominated by banks. At the same time, concentration has been rather high, although not substantially higher than in the smaller EU-15 member states (ECB, 2005). The fixed income markets and the stock markets have been developing, but their importance in the overall financial intermediation is still relatively small. In addition, the fixed income markets are dominated by government bonds. Second, the banking sector has been dominated by foreign-owned banks.[51] That can complicate monetary policy through the easy access to funds in their mother banks and lower sensitivity to the interest rate setting of the domestic central bank. In addition, while foreign ownership is supposed to be conducive to financial stability as regards managerial skills or the risk of bank failures (as they are being backed by larger foreign banks), the recent financial crisis has highlighted the risks (Fischer, 2008:6). Particular challenges stem from possible contagion effects, i.e. when either the parent bank is "infected", which impacts the domestic subsidiary, or when the problems in the domestic subsidiary threaten the operations of the parent bank. In both cases, the domestic financial market may face turmoil if that particular bank has an important weight in the financial market. Foreign ownership has also implications for banking supervision. So far, the banks within the EU have been supervised based on the home country principle (Bonin et al., 2008). The supervisors of the parent bank's home country are responsible for the consolidated balance sheet, while the

[50] In the Czech Republic, the banks' consolidation process lasted until the early 2000s.
[51] In the Czech Republic, the share of assets of foreign owned banks in total banking assets exceeded 90 % in 2007, for Hungary the corresponding figure was 85 % (RZB Group, 2008:7).

subsidiary is supervised by authorities of the host country. Supervision may turn out weaker for the subsidiaries than for domestically owned banks if the supervisors of the parent bank do not sufficiently take into account that what seems to be a minor part of business for the parent bank may be an important player in the host country. Because of the home country principle, responsibility is not sufficiently clearly defined in the event of a systemic threat (cf. Euroframe, 2006).

Third, the banking sectors have long been structurally liquid. The huge inflows of foreign capital and the accompanying interventions of the central bank during the period of fixed exchange rate regimes[52] meant that the commercial banks held large excess reserves. To absorb liquidity, the central banks employed sterilisation operations. However, owing to the high volume of excess reserves to be sterilised, the central banks have become systematic liquidity absorbers. Excess liquidity has been perpetuated also by the interest payments of the central bank and the gradual reduction of the required reserve ratios. As a result, the banks have held a large stock of central bank securities and had easy access to liquidity.[53] The fact that the banking systems have been structurally liquid had implications for the transmission of monetary policy (Ganley, no year specified). Although it is still possible for the central bank to guide the interest rate in the money market and hence to exploit the interest rate channel, the commercial banks cannot be forced to lend to the central bank instead of firms or households. The general availability of funds thus may reduce the efficiency of central bank operations.

Fourth, the financial sectors and in particular bank lending has grown rapidly since the turn of the century. Owing to the long restructuring process, lending to the private sector was rather cautious in the 1990s (Wyplosz, 2000) and financial intermediation remained low for the whole decade. Also indicators such as credit to GDP or household debt to GDP point to a still rather low degree of financial intermediation (Pawlowski, 2006). Since the early 2000s, however, credits have grown vigorously owing to the stable macroeconomic environment, favourable growth prospects, banks' consolidation and access to foreign resources by commercial banks (cf. Cotarelli et al., 2003; Backé/Zumer, 2005). Lending has been particularly strong for housing and consumption purposes. In addition, in countries with a marked interest rate differential towards the euro area, a substantial part of lending took place in foreign currency (euros or Swiss francs). Yet, lending booms create challenges to financial stability. To avoid weakening of the banks' balance sheets and thus financial instability, the banks have to correctly assess the profitability of the projects, to monitor the borrowers and to provide for risk. If banks finance the lending from loans from

[52] Interventions were also possible with a flexible, but "managed" foreign exchange rate.
[53] The structurally liquid nature of these markets has in some countries changed after the onset of strains in the financial markets in 2008.

parent banks or through wholesale funding, a sudden change in these financial flows may endanger the banks' stability. The challenges to financial stability are amplified by the high share of foreign currency loans in the overall lending. Foreign currency loans increase the vulnerability of households', firms' and bank's balance sheets to changes in the nominal exchange rate. In addition, the lending boom has affected macroeconomic stability. Credits have often been used to finance imports and hence have implied a worsening of the current account. Strong demand growth can also impact domestic price trends. Thus, the lending booms have led to financial stability depending also on exchange rate stability and the absence of major (unexpected) depreciation (cf. Euroframe, 2006). The substantial impact of the exchange rate on banks' and households' balance sheets may also complicate monetary policy – a change in the exchange rate that is beneficial to macroeconomic stability might endanger financial stability (Wagner/Iakova, 2001:23).

All in all, financial deepening during the growth process has fostered the transmission mechanisms through the interest rate and bank lending. At the same time, the structural liquidity of the banking sector, the dominance of foreign ownership and the high share of foreign currency loans may have undermined the efficiency of interest rate transmission. The lending booms that occurred after the turn of the century have created challenges to the financial and macroeconomic stability of the Central European economies.

4.4 Price trends in the transition and catching-up growth process

4.4.1 Price trends during the transition process

The transition and catching-up economies have been subject to specific price trends (cf. e.g. Sahay/Végh, 1995; Gros/Steinherr, 2004:61-66). Some countries inherited high inflation from the planned era, while the systemic transition process has inflation potential on its own. Given the monetary overhang, price liberalisation was a price push factor in itself, but it could also provoke or foster wage-price-spirals and expectations of high inflation. Likewise, liberalisation of foreign trade required an adjustment of the exchange rate in accordance with the low competitiveness of the transition economies. Because of the uncertainty surrounding the proper level of the exchange rate, a large devaluation was considered necessary if foreign trade liberalisation was to proceed rapidly and balance of payments problems were to be avoided. This affected inflation through the imported goods, but it could generate additional inflationary pressures (a devaluation–wage–price spiral) if the wage earners were compensated for the loss in income. The external liberalisation hence implied a conflict between external balance on the one hand and internal stabilisation and disinflation on the other (cf. e.g. Stippler, 1998). Finally, inflation in the initialisation

period was caused by direct lending of the central bank to the state budget and slow progress in structural reforms, i.e. the poor functioning of the goods and financial markets.

Whereas the direct financing of the government by the central bank could be stopped within a few years, inflation from structural deficiencies continued for some time. As a result, although stabilisation was achieved quickly, inflation rates remained at moderate levels for some years. The main sources were:

- insufficient progress in structural reform, in particular the fact that the "soft-budget constraint" for state-owned firms could be reduced only slowly during the process of restructuring.
- wage indexation and strong backward looking expectations fostering wage-price-spirals. Expectations of high inflation could be inherited from the planned economy, but they were also fuelled by the specific price trends of the transition process. The fact that central bank independence was introduced only during the transformation process exacerbated the problem.
- the exchange rate regimes, in particular crawling peg regimes.
- capital inflows related problems in monetary control (a "restrictive" interest rate could attract foreign capital so that overall monetary conditions need not have been tightened).

Stabilisation and disinflation policies were applied, but the disinflation effort depended also on the perceived costs of reducing inflation. With a decided cut to monetary expansion, inflation could be stopped quickly, but probably at high output cost if the reputation of the central bank were low and inflation expectations were not adjusted. In addition, if structural problems are at the root of the ongoing inflation process, inflation will resume at the time the monetary restriction is eased. As monetary policy is not considered the best instrument for rectifying structural problems, governments and central banks may have preferred to accommodate these impulses (cf. Abel et al., 1998). At the same time, reduced pressure for structural reforms can strengthen inflation expectations, which in turn makes disinflation more difficult and costly. Therefore, the transition process implied a period of strong inflationary pressures and the speed of disinflation depended on the progress in structural reform on the one hand, but on the dedication to disinflationary policies and the perceived costs of disinflation on the other hand.

4.4.2 Price trends in the period of catching-up growth

After a successful disinflation to low levels, inflation rates in these countries have been affected – similarly as in the more developed market economies – by business-cycle related inflation dynamics or the adjustment of relative prices after changes in the exchange rate or fluctuations in commodity and food prices. However, two long-term factors have continued

to drive inflation even after successful disinflation: the price adjustments for regulated items and public utilities, and the general trend to price level convergence with the more developed economies during the real convergence process. As regards regulated prices, some socially sensitive prices have been freed only gradually after the general price liberalisation. Although adjustments have been sizeable and frequent, the very low level of some prices at the outset of the transition implies a long adjustment process. In addition, regulation concerns prices of public utilities (cf. Égert, 2007:12-19). While these are often regulated also in more mature economies, the mismatch in the relative prices may have been higher in the former transition economies. In addition, a number of public services requiring networks and capital were of rather poor quality or non-existent during the planned period. Telecommunications, transport (railways, roads) and the transport equipment, energy and water supply have all required upgrading of the capital stock and networks. This has raised the quality of the services, but it has also affected its price.[54] Furthermore, it may have acted upon the price level in the rest of the economy indirectly, if these goods constitute intermediate products or allow the economy to increase the range and quality of other supplied products.

In addition, the real convergence process is accompanied by price level convergence and hence longer term inflation trends. This stems from the Balassa-Samuelson effect of a trend increase in the prices of non-tradables (cf. Section 3.2). This real appreciation will occur through higher inflation rates of non-tradable goods if the exchange rate is fixed and the industrial goods prices are tied to those of the more developed countries. However, with a nominally appreciating currency, the process of price level convergence need not require higher inflation rates on the part of the catching-up economy. The tradables' goods prices may decline in line with the currency appreciation, while the relative price of non-tradables rises. As a result, inflation may be low in spite of the real appreciation. However, other factors also play a role in the price level convergence process. Firstly, the variety and quality of services increases during the process of catching up, most pronouncedly in the financial market, the real estate market and in business services. Although these may affect the average price level of consumer services only to a limited extent, they may impact the price of other goods and services based on their role as intermediate goods. Secondly, the prices of industrial goods and foodstuffs are also significantly lower owing to the non-tradable components of all goods, intermediate products and other inputs for production. Business services have expanded heavily during the process of catching-up and this may also affect the costs and prices of the industrial goods. Cost-push can be expected also from

[54] The adjustment in the regulated prices is also particularly pronounced because in the early years of the transition these prices were intentionally kept low to reduce inflationary pressures. Likewise, the replacement of the capital stock at market prices entails substantial price advances to meet cost recovery levels (Égert, 2007).

services that are intermediate goods and the price of which increases due to the factors mentioned in the previous sections (quality of network and capital, Balassa-Samuelson effect). Another example is rents and costs of renting premises for firms. In many places in the new member states, rents and construction costs are lower so far. With the upgrading of the stock of houses and buildings and higher costs of construction works (higher standards, higher wage costs), the rents of houses and buildings for enterprising purposes will rise. Finally, the goods of domestic producers might have suffered from lower reputation. Firms have had to underprice their goods in the domestic and foreign market. This may vanish with the quality improvements, leading to price growth also in industrial goods (cf. Cihak/Holub, 2003; Égert/Lommatzsch, 2004; Dreger et al., 2007).

To briefly summarise, all transition economies experienced a period of high inflation at the outset of the transition. After the stabilisation, inflation rates could remain at moderate levels owing to structural problems, inertia in the wage setting or overheating of the economy. In addition, because of the catching-up growth process, inflation rates could stay above the rates in the more developed economies also due to the equilibrium real appreciation. The exact amount of this equilibrium real appreciation is a matter of discussion. Estimates of equilibrium real appreciation indicate that depending on the specific productivity trends of the catching-up economy, the trend real appreciation relative to the euro area may amount to 1-3 % p.a. (Barrell et al., 2008; Kiss/Krekó, 2004).

4.5 Central bank strategies and instruments

4.5.1 Fixed exchange rate strategy during the early phase of the transition

During the early transition and stabilisation phase, the central banks had numerous functions and objectives.[55] Also legally they often had dual mandates of securing "domestic and external stability" (cf. e.g. Ganev et al., 2001; Krzak/Schubert, 1997:36). In the initialisation phase of the transition, the authorities applied restrictive monetary, fiscal and income policies. In addition, the central banks used fixed exchange rates as nominal anchors to stabilise the economy. The fixed nominal exchange rate served to improve the credibility of reforms (signalling effect) and to restrain other policy areas. It had also direct effects on inflation through import prices. However, because of the restricted currency convertibility the signalling and committing effects were the most important.

The fixed exchange rate as nominal anchor was retained also after the initial stabilisation phase despite continuing inflation differentials. This was owing to its signalling function,

[55] Such as those mentioned in Section 4.1: stabilising the economy, financing the budget, stabilising and supporting the financial system in its transition, engineering the external liberalisation.

its ease of application and the direct effects for price developments (Coats/Skreb, 2002). This choice was also determined by the fact that the potential alternative anchor, i.e. monetary aggregates, was considered less powerful (MNB, 2002:58). Still, to support disinflationary policies, the central banks set also monetary targets (explicitly or implicitly through credit ceilings).[56] However, with real appreciation and an increasing currency convertibility, the fixed exchange rate regimes could be challenged by a deteriorating trade balance. In order not to threaten the process of foreign trade and currency liberalisation, discretionary exchange rate adjustments could be made to restore competitiveness. This implied the already mentioned trade-off between external liberalisation (trade) and disinflation because any depreciation of the nominal exchange rate could increase inflationary pressures also due to expectations of further depreciation. As an alternative to the discretionary devaluations, a crawling peg exchange rate regime could be adopted, i.e. a system with regular and pre-announced devaluations. It combines a fixed exchange rate with preserving external competitiveness, and could therefore be more credible as regards the disinflation goals of the monetary authority. The pre-announced adjustments can serve as a disinflation tool if the rate of crawl is gradually reduced, and if the rate of crawl is lower than domestic inflation.

The fixed exchange rate strategy (also as a disinflation tool) was challenged, among others, by the gradual liberalisation of capital account transactions and the substantial capital inflows. Given the fixed exchange rate regime, the central banks had to convert the inflows to domestic currency. In order to reduce the impact on domestic money supply, the central banks applied sterilisation on a large scale. This has had a number of consequences, some of which were already discussed in the sections above. First, sterilisation could have an impact on central bank interest rates. While conducive to disinflation, monetary tightening attracted further capital inflows. The central banks also started to incur substantial sterilisation costs. Second, the banking systems became structurally liquid. Although the central bank will still be able to affect the interest rates in the interbank money market, structural liquidity may reduce the efficiency of the central bank's policy because banks always have access to liquidity (cf. Ganley, no year specified). Third, however, sterilisation did not reduce the vulnerability stemming from the capital inflows. Instead, given the shallow and underdeveloped financial markets, weak banks, current account deficits and inflation differentials on the one hand and the low currency risk on the other, the fixed exchange rate increased the vulnerability of the currencies to speculation. As a consequence, the liberalisation of capital flows reduced the viability of fixed exchange rates.

[56] The countries specified money growth targets in addition to the fixed exchange rate.

The exchange rate regimes could be made more flexible through the introduction or widening of bands around the central parity. The absence of a peg with narrow fluctuation bands may reduce the attractiveness for short-term flows exploiting the interest rate differential. In addition, the capital inflows may lead to nominal appreciation, which is conducive to disinflation and a reduction in the interest rate differential. However, flexible exchange rates as such do not reduce capital inflows due to privatisation or direct investments. They also do not reduce the risks related to servicing the external debt or to sudden reversals of capital. Finally, the fact that capital inflows can result in nominal currency appreciation does not reduce the risk of unjustified real appreciation.

4.5.2 Inflation targeting

The transition to more flexible exchange rate regimes implied the risk that the countries would lack a powerful nominal anchor (Jonas/Mishkin, 2003). Monetary targeting did not seem viable, e.g. due to an unstable money demand and the process of financial development. As a result, the central banks adopted inflation targeting. That, however, may also be difficult to apply in emerging economies. To recall, preconditions of inflation targeting are that the central bank focuses on the inflation rate (not on external equilibrium or any other potential objective) and that it is independent of the government (in particular as regards financing of budget deficits). The central bank needs knowledge of the inflation process and its main determinants and is able to produce a reliable inflation forecast. A stable transmission mechanism exists from the central bank's interest rate to inflation as well as knowledge of it on the part of the central bank. This allows the central bank to react, by adjusting the interest rate, to deviations of the forecast inflation rate from the targeted rate. Moreover, the central bank tries to exploit the expectations channel, which requires credibility of the central bank. These preconditions need not be present in emerging economies, which are characterised by a more volatile macroeconomic environment including higher susceptibility to external shocks, weaker institutions and impaired credibility (Fraga et al., 2003). Nevertheless, the experience of emerging market economies in the last decade indicates that inflation targeting can be regarded as a device to achieve macroeconomic stability and preserve inflation rates at relatively low levels (IMF, 2005; Amato and Gerlach, 2002). Still, a potential problem may arise if the inflation targeting regime initially serves as a disinflation strategy. Credibility has to be built within this more fragile macroeconomic framework and less reliable monetary transmission. If non-existent yet, credibility may have to be acquired through a phase of high interest rates, which may undermine support for the central bank strategy.

As regards the countries under consideration, independence of the central banks and a clear commitment to price stability (or disinflation) were established also due to the requirements

for EU entry. However, the definition of the target, the reliability of the inflation forecast as well as knowledge of the transmission mechanism including of the effect of interest rate changes on inflation raised doubts as to the successful applicability of inflation targeting (Jonas/Mishkin, 2003). First, although the sources of inflation and the nature of the inflation process were in principle known, the forecast has been difficult.[57] Due to the relatively low income level, the share of food, energy and other volatile components is higher than in more developed economies. These components can be affected by central bank policies only to some extent, if at all. Also the share of regulated items or their adjustments are higher. Combined these components could make up more than 50 % of the consumer basket, in particular during the 1990s.[58] This has complicated both the inflation forecast and the choice of target, i.e. whether the central bank should target headline CPI or a sub-index excluding the volatile components. In the choice of the appropriate index of price developments, the central bank had to carefully weigh between choosing an index that is widely understood by the public, but less easily targeted and a target that may be easier to achieve, while the public does not accept this as a measure of inflation.

Second, as regards the knowledge of the transmission mechanisms, both the assessment of the most stable and exploitable transmission mechanism and the numerical effect of shifts in the central bank's interest rate on inflation (including its time horizon) were surrounded by large uncertainty. The nominal exchange rate channel has long been considered the most powerful transmission channel in the transition economies owing to the high openness to trade (cf. Wagner/Iakova, 2001; MNB, 2002; Caviglia et al., 2002). In the early years of the transition, the nominal exchange rate channel operated primarily through direct price effects, demand effects (real exchange rate) and through its signalling function. With the growth of foreign currency loans the exchange rate channel operated also through the income effect of changes in the exchange rate on interest payments. It has furthermore affected the balance sheets of the commercial banks. By contrast, the interest rate channel was assessed to function poorly, in particular during the 1990s and at the time when inflation targeting was introduced (late 1990s or early 2000s) (Wagner/Iakova, 2001:29; Ganev et al., 2001). Financial intermediation was low. Consumption of durable goods was financed through personal savings, whereas firms financed investments through retained profits. Only at the turn of the century, lending started to grow vigorously. However, lending occurred to a substantial extent in foreign currency, circumventing the effect of the domestic interest rate on lending. Likewise, corporate investments have often been financed by the foreign owned parent company (cf. Wagner/Iakova, 2001:29; Ihnat/Prochazka,

[57] An illustrative example of these difficulties applied to Czech inflation can be found in IMF (2001C).
[58] The reduction in the shares of food and energy within the representative consumer basket was quite pronounced during the phase of rapid catching-up growth starting in the late 1990s.

2002:79). Finally, the share of loans in the banks' balance sheets has been much lower than in the euro area, whereas the share of government securities was higher.[59] This may have enabled the banks to react to monetary tightening with changes in the stock of securities instead of a change in the lending to long standing business partners (Bednarski/Osinski, 2002). The interest rate transmission by the commercial banks onto lending and deposit rates may have also been weakened by the excess liquidity prevailing in the money markets. However, recent research indicates that the pass-through from central bank rates to the lending and deposit rates may have strengthened during the past few years (Égert et al., 2007), as well as the importance of the interest rate channel for monetary policy (Mohanty/Turner, 2008). All in all, knowledge of the monetary transmission mechanism was rather poor at the time of the inception of inflation targeting, and the transmission mechanisms were also likely to be affected by the monetary policy regime (cf. also Abel/Siklos, 2002: 321).

Third, the central bank could not have reliable models of the exact effect of monetary policy on inflation or output. The short experience with the market economy implied too few observations for reliable econometric testing and model building. In addition, stable relationships between major economic indicators were not even likely owing to the pronounced structural change. As an example, the rapid development of the financial system may have increased the strength of the interest rate channel, but the exact pattern of change was hardly predictable.

Fourth, credibility may have been low at the time of inception of inflation targeting; reputation had to be built through meeting the inflation targets. All aspects mentioned above may complicate reputation building. Particular problems may arise in a disinflation phase. The inflation target (or band) may be missed because of a positive supply shock, i.e. for instance inflation declining due to unexpected food price declines or a major unexpected exchange rate appreciation. The effect for the credibility of monetary policy depends on whether meeting the target is considered more important than the gain in disinflation. An even more substantial problem arises from the insufficient knowledge on the part of the central bank of the policy transmission. As the central bank may prefer to err on the side of undershooting the inflation target, the monetary restriction may be stronger then necessary. Output costs of the disinflation process may turn out higher than envisaged. However, some mechanisms can be applied to reduce the damage for the central bank from failing to meet the target. The central bank can commit itself in advance to meeting only a medium-term target. It can clarify that it will respond only to factors that endanger its target over the

[59] This was also a consequence of the numerous recapitalisation programmes.

medium term or to factors that can be affected by the central bank's instruments (MNB, 2002:62; CNB, 2008a).

In sum, the former transition economies adopted inflation targeting because the fixed exchange rate strategy could not be sustained. However, its applicability in an environment of emerging economies is complicated by the limited ability to correctly forecast inflation and the insufficient knowledge of the (evolving) transmission mechanism. In addition, the nominal exchange rate has retained its prominent role in the monetary policy transmission and may therefore also affect the decisions of the central banks.

4.5.3 Instruments

In the initial phase of the systemic change, central banks applied direct instruments such as credit limits and interest rate ceilings. In addition, they also extended (long-term) refinance loans and centrally allocated credits (de Melo/Denizer, 1997). The introduction of indirect instruments depended crucially on the interest rate sensitivity of the financial system. The state-owned banks with their high share of non-performing loans were likely to borrow at the central bank independently of the interest rate (Coats/Skreb, 2001:8). Therefore, the first market based instruments were credit auctions, where the commercial banks could test the functioning of the market based instruments. Reserve requirements were rather high and their overwhelming importance in the central banks' instruments was retained during the entire 1990s. Nevertheless, discount and Lombard credits were introduced early on.

Market based instruments related to money market interventions developed only after a number of years, when the money markets, foreign exchange markets and secondary markets for government bonds and bills were established and functioned properly. Also the payments system for a swift transfer of funds had to be put in place. Since the mid-1990s, the institutional frameworks were sufficient to move to interest rates as important policy instruments, but high reserve requirements remained in place. Only with the preparation for joining the EU and EMU, i.e. in the early 2000s, the countries aligned their instruments with the ECB, reducing the importance of reserve requirements and putting the main emphasis on open-market operations such as repurchase agreements. However, an important difference has remained that the central banks of the Czech Republic and Hungary have for a number of years been liquidity absorbers. Their main instrument has been a deposit rate instead of the more usual lending rate.

4.6 Summary of the preceding chapters

The present investigation deals with the inflation process and inflation convergence with the euro area in two future EMU member states, the Czech Republic and Hungary. It studies the link between inflation and monetary policy on the one hand, and the impact of inflation determinants such as the price level convergence process, euro area inflation and wage growth on the other.

In the preceding sections, we first dealt with determinants of interest rates. That is relevant because nowadays central banks use interest rates as their main policy instrument. By adjusting the policy rates they aim to achieve macroeconomic objectives such as low and stable inflation. In the monetary strategy of inflation targeting, a central bank explicitly commits itself to meet a numerically defined inflation target on a systematic basis. However, the link between the policy rate and inflation is indirect as monetary policy is transmitted through the financial markets to the real economy. The transmission mechanisms include the interest rate channel (a change in the interest rates modifies the financial conditions in the economy through the real interest rate) and the exchange rate channel (a change in the interest rate affects the exchange rate and hence the relative price of domestic and foreign goods). The exact link from policy rates to the final goal of price stability is surrounded by uncertainty. In addition, in open economies with free financial flows, domestic interest rates are not independent of the international interest rates. In liberalised markets, yields for similar financial instruments tend to converge. As a result, if the exchange rate is kept stable, interest rates tend to converge. Central banks are hence restricted in their policies by the "impossible trinity". With liberalised capital flows, they cannot independently set both the exchange rate and the policy interest rate.

We stressed the specific challenges that central banks in emerging market economies face when pursuing inflation targeting. These specific challenges include a more volatile environment, higher susceptibility to shocks, particular difficulties in forecasting inflation (also because volatile components such as food prices and commodities prices impact more strongly on headline inflation) and limited knowledge of the (evolving) transmission mechanisms.

We further showed that in theoretical models, central bank interest rate setting is often specified as a "Taylor rule", where the central bank reacts to deviations of the inflation rate from its targeted rate and to deviations of output from potential output. For small open economies, the central bank reaction function can also include the nominal exchange rate if uncertainty about the determinants of the exchange rate is high.

In Chapter 3 we presented the main inflation theories, the quantity theory, purchasing power parity, and price setting through mark-up over costs including wages. Furthermore, the Phillips curve links the tightness of the labour market or the cyclical stance with price trends. In times of low unemployment and a tight labour market, wages can grow vigorously, putting pressures on prices. We also turned to sources of moderate inflation, i.e. sustained periods of inflation rates in the range of ten to thirty per cent p.a. Phases of moderate inflation can occur only with ingrained moderate inflation expectations or strong backward-looking inflation expectations, which perpetuate the original shock to inflation. A disinflation to low inflation can be achieved only if inflation expectations decline. In theory that can occur with a shift to more credible low-inflation policies or with "opportunistic" disinflation. However, in practice disinflation has been achieved mainly during phases of low growth and higher unemployment, where economic slack reduced wage and price pressures.

We have also dealt in detail with the specifics of monetary policy in the (former) transition economies and in emerging market economies. Numerous factors complicate the task of achieving low inflation there. Firstly, the catching-up growth process entails risks for macroeconomic stability, e.g. through rapid financial market development and investment cycles. Growth rates and inflation rates can be more volatile. Inflation pressures can emerge if wage growth is driven by overly optimistic growth expectations. In addition, the price level convergence process implies a real appreciation towards the more developed economies, which may come about through higher inflation. While that is an equilibrium phenomenon, the higher inflation rate may become ingrained in the inflation expectations and harm competitiveness and growth. Second, the evolving financial markets impact on the monetary strategy and policy. Financial market deepening changes the interest rate sensitivity of the economy and the transmission mechanisms of monetary policy. In addition, the integration into international capital markets creates policy challenges and restricts policy options of the central bank. Finally, the credibility of the central bank and institutions in general is lower in emerging market economies.

The transition economies have experienced a phase of rather high inflation during the early stage of the systemic change. In general, stabilisation was achieved quickly, but it was followed by a phase of (low) double-digit inflation with ingrained moderate inflation expectations and wage-price spirals. Disinflation policies could include high real interest rates, pre-announced reductions in the rate of crawl of the nominal exchange rate, or inflation targeting with a steady decline in the targeted inflation rate. However, even if disinflation to inflation levels close to those of the euro area could be achieved, the adjustment of regulated prices has continued to exert steady inflationary pressures.

Moreover, inflation differentials vis-à-vis the more developed economies are to be expected owing to the process of price level convergence that accompanies catching-up growth. These specific price trends could make meeting the Maastricht convergence criteria difficult. Primarily, however, it is unlikely that the countries will be able to retain low inflation after euro adoption. That follows not only from the price level convergence process, but also from the loosening of monetary conditions that the introduction of the euro will most probably entail. We have pointed out that the risks of a boom in activity that may ultimately harm competitiveness and growth depends on the monetary restriction necessary to achieve low inflation in the preparation phase. Furthermore, the wage-price dynamics, and specifically whether an inflation shock is perpetuated through subsequent higher wage growth, are of crucial importance.

4.7 Earlier empirical evidence on interest and inflation determinants in the Czech Republic and Hungary

Despite the short time period, numerous empirical investigations of the interest rates in these countries already exist. They are mainly related to the pass-through from the central bank rates into other interest rates in the economy (money market rates, deposit and lending rates and government bond rates; for an overview cf. Égert/MacDonald, 2006). For instance, Sander and Kleimeier (2004) investigate the transmission from central bank rates to the bank's lending and deposit rates. The results indicate that while the size of financial intermediation has not affected the pass-through, the speed of adjustment has been crucially influenced by the inflation rate. In general, the pass-through to money market and bond yields was assessed to be quicker in the transition countries than in more developed countries. Research of Crespo-Cuaresma et al. (2004) and Égert et al. (2007) however points to a slowing down in the pass-through with economic and financial development. Moreno (2008) finds that government bond yields react to the central bank rate in the Czech Republic and Hungary.

By contrast, only a few empirically oriented articles deal with central bank reaction functions in these countries. This is not surprising given the fact that the interest rates as the main policy instrument could be introduced only when financial markets were sufficiently developed and consolidated, i.e. in the late 1990s. Only with the adoption of inflation targeting, the interest rate for open-market operations became the most important instrument. The two countries were included in central bank reaction function tests by Mohanty/Klau (2004), who studied interest rate determinants in emerging countries with a particular focus on the role of the exchange rate. Potential determinants were the annual

rate of inflation, the output gap and the real exchange rate. For the Czech Republic the results indicate that the central bank reacted to inflation and to the output gap. By contrast, the Hungarian central bank is found to have reacted to the exchange rate, but not to the inflation rate.

More recently, Frömmel and Schobert (2006) estimated open economy Taylor rules for a number of new EU member states. Specifically, they tested whether the central bank interest rate setting can be systematically related to inflation, the real or nominal exchange rate and to the output gap. Again, the results indicate that the Hungarian central bank has not reacted to inflation if the entire estimation period is considered (i.e. spanning from the mid-1990s to the mid-2000s). For the inflation targeting period, however, they cannot detect a pronounced reaction to the exchange rate. As regards the results for the Czech Republic, these turned out similar as in Mohanty/Klau (2004) in that both inflation and the output gap are significant determinants, whereas the exchange rate is not.

As regards investigations of the inflation process, a large body of literature exists about the price level convergence process and the size of the equilibrium real appreciation based on the Balassa-Samuelson effect (for an overview cf. Égert et al, 2004). The study of Kovacs et al. (2002) contains a point estimate of this effect for Hungary and the Czech Republic. During the 1990s the equilibrium real appreciation relative to Germany according to mechanical accounting, i.e. an application of the theoretical model to the data, was 1.6 % for the Czech Republic and 1.9 % for Hungary. However, econometric tests assessed the equilibrium inflation differential at only 0.1 % for the Czech Republic and 1.0-2.0 % for Hungary. Mihaljek and Klau (2004) confirm that the contribution of the Balassa-Samuelson effect to inflation in the Czech Republic was minor during 1994 and 2002 (0.3 percentage points), but perceptible in Hungary (1.6 percentage points, estimation period is 1996-2002). By contrast, in an update of this research, Mihaljek and Klau (2008) find that during the period 2002-2008, the Balassa-Samuelson effect explains most of the inflation rate in the Czech Republic, but nearly nothing in Hungary. All in all, the tests of the Balassa-Samuelson effect have yielded a wide variety of results. However, it seems to be well established that it explains only a minor part of the inflation differential towards the euro area (cf. Égert/Podpiera, 2008).

As regards the effect of other inflation determinants, Mohanty/Klau (2001) included the Czech Republic and Hungary in a panel of emerging market economies to test for the relative importance of the unit labour costs, the exchange rate, the output gap and food prices during the 1990s. For the Czech Republic they determine a strong impact of exchange rate changes on inflation, whereas the role of wage adjustments seems minor. Also for Hungary, inflation depends strongly on import prices. A high pass-through of

nominal exchange rate and foreign prices into domestic prices is found by Brada/Kutan (2002) who claim that the disinflation in the Central European countries at the turn of the century was mainly related to favourable exchange rate developments, whereas the underlying inflation pressures from wages remained elevated. The pass-through from the exchange rate into domestic prices is also studied by Coricelli et al. (2006). For Hungary, they detect a complete pass-through during the period 1993-2002, whereas for the Czech Republic the pass-through appears to be relatively low with 0.5. They explain these differences with the differences in the exchange rate regime. Rather recently, Goretti (2008) estimated wage-price dynamics for a panel of new EU member states. A first result is that real wages react to the growth of labour productivity and the terms of trade. Furthermore, wages do not respond directly to the wage gap to the euro area. A second result of the study, however, is that wages have become a major source of inflation. As a result, wage growth substantially above productivity growth has been a source of inflationary pressures.

The IMF published in its Selected Issues on Hungary in 1999 (IMF, 1999H) estimations of the inflation process and the wage-price dynamics during the 1990s. The results indicate that wage growth was the main driver of inflation. As a consequence, disinflation cannot succeed without a reduction in wage pressures. The nominal exchange rate was found to play an important role in the short run. Therefore, while nominal appreciation can be conducive to disinflation, for low inflation rates to last, wages have to grow in close relation with productivity. Lendvai (2005) estimates a New Keynesian Phillips curve for Hungary in its hybrid specification, i.e. considering backward and forward looking inflation expectations. The estimated time period is 1995-2003. In addition to the past and future inflation, the tested relationship also includes imported prices. The study finds that the inflation process is marked by strong backward looking expectations. Furthermore, inflation in Hungary is substantially more inertial than in the euro area.

For the Czech Republic the IMF (2002C) estimated that inflation was primarily driven by the exchange rate, whereas the effect of wages was less significant. Still, inflation was markedly influenced by the adjustment of regulated prices. In 2004, the IMF presented further estimations, referring to the period of 1998-2003. These tests confirm a strong role of the exchange rate, wage costs and administered prices in the inflation process. The IMF motivated the inclusion of unit labour costs by the Balassa-Samuelson effect because that model suggests that wages in the non-tradables sector grow well above productivity. Rusek (2008) estimates a hybrid New Keynesian Phillips curve for the Czech Republic. According to that research, inflation is related to both expected future inflation and past inflation, while an effect from capacity utilisation cannot be easily determined.

5. Country study Czech Republic

5.1 Growth performance, macroeconomic stability and policy challenges

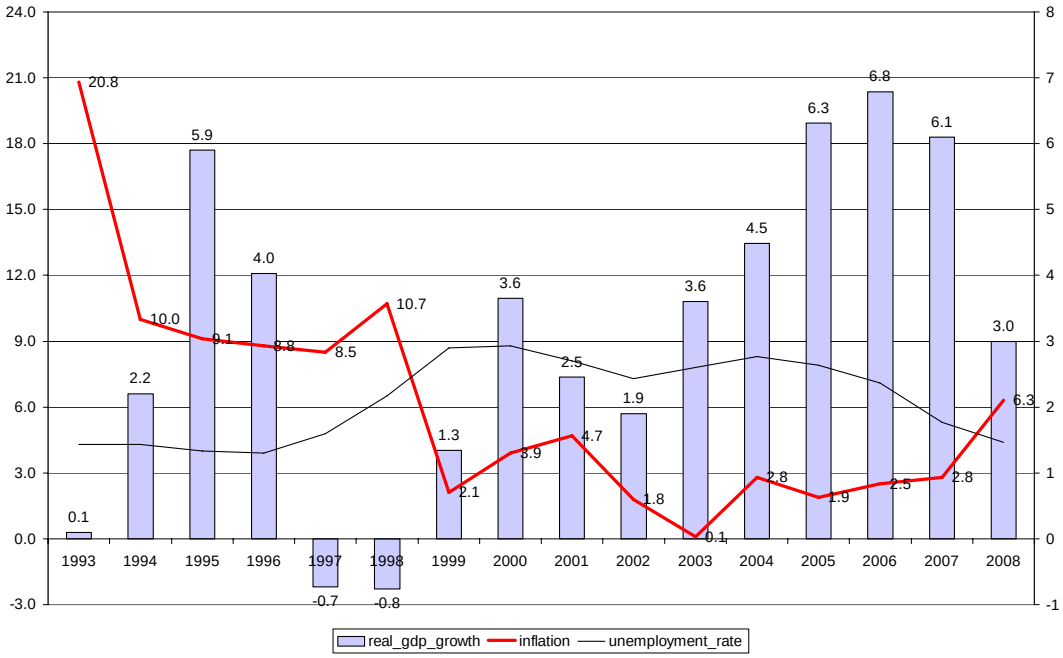
At the outset of the transition, the Czech Republic had relatively stable macroeconomic conditions with low inflation, budget deficits and foreign debt.[60] By contrast, the microeconomic heritage was less favourable as the private sector was virtually non-existent, industry accounted for the largest share in output and the economy was dominated by large enterprises (Zidek, 2006:19). The systemic transition, initiated in 1990, included a rather radical liberalisation of price setting and of foreign trade and strict macroeconomic stabilisation policies. It was accompanied by more gradual structural and institutional reforms. Although numerous privatisation methods were applied, the principal privatisation method for large enterprises was mass privatisation, i.e. the transfer of ownership to the general public. The choice of a major role of mass privatisation was motivated also by the intention to privatise mainly to domestic agents (for a discussion cf. Zidek, 2006; Myant, 2003).

After the onset of transition, macroeconomic stabilisation was achieved quickly. By contrast, growth recovery was substantially impeded by the restructuring at the micro-level. With hindsight, the central role of mass privatisation in the transfer of ownership, which is the most distinctive feature of the Czech transformation, considerably complicated the process of structural and institutional transformation and marked economic developments throughout the 1990s (Myant, 2003). First, the government aimed at transferring responsibility for the firms' restructuring to the new owners. However, many people chose to place their vouchers with funds of state-owned commercial banks, which themselves were included in the privatisation process only to a minor extent. The ownership transfer to private hands was therefore limited; the government nevertheless abstained from intervening into the restructuring process (cf. Mertlik, 1996). Second, the dominance of banks' funds also fostered the mutual dependence of the restructuring firms and banks. Preferential loans were frequent. Furthermore, as mass privatisation did not inject new capital into the firms, investments had to be financed by bank loans. Credits grew vigorously despite an already huge stock of non-performing loans, and the newly granted credits also often turned non-performing. As a result, although bad loans inherited from the planned economy were transferred to specialised government agencies early on (Anderson/Kegels, 1998; IMF, 1999C), the share of such loans and the functioning of the

[60] Average inflation 1980-1990: 2.2 % (Zidek, 2006:17), external debt 1990 4.4 bn USD (Vecernik, 1998:311) which amounted to 11 % of GDP (GDP figure from Pulpan, 1993:279).

banking system did not improve. Both enterprises and banks were subject to corporate governance problems, which hampered restructuring and made the market-based assessment of the viability of investment projects rather complicated (cf. Buch/Heinrich, 1997; Begg, 1998; OECD, 1998C). The slow adjustment at the firms' level also manifested itself in the absence of a hike in unemployment during the transition. Unemployment rates stayed around 4 % between 1992 and 1996, with notable regional differences, but on average they remained markedly below that in other transition economies (Zidek, 2006:124). Third, the reform strategy attached little importance to the design and regulation of the capital market. For a number of years several market segments were nearly unregulated and quickly became opaque. Financial market development was hence rather slow. It was characterised by structural deficiencies such as the lack of adequate market institutions and incentives, also because bankruptcy procedures were introduced rather late during the transition. In the early years of the transition, also government financing needs were relatively small.

Graph 5.1.1: Czech Republic:
Annual growth rate of GDP (right scale), inflation and unemployment rates (left scale), 1993-2008[61]



Source: Eurostat, Czech Statistical Office.

[61] 'Annual growth rate' and 'year-on-year growth rate' are used synonymously in the text.

As a result, the recovery from the transformational recession in 1994 to 1996 entailed vivid domestic demand growth that markedly outstripped supply growth. Inflation remained at high single-digit levels. External imbalances accelerated, with the trade deficit amounting to 7.5 % of GDP in the first half of 1997. Because of an early liberalisation of capital flows, the external imbalances could be financed in part by bank loans and increasingly also portfolio investments. This substantially raised the vulnerability of the Czech economy. Indeed, in May 1997, when risk aversion in international financial markets heightened, the Czech koruna was subject to a speculative attack. The crisis was resolved after the formal floating of the currency, but in its aftermath the reform effort substantially intensified.

In late 1997, a second reform wave was launched. Structural reforms were reinforced in particular as regards consolidation of ownership, the legal framework for bankruptcy, transparency in the economy and in the financial system (OECD, 2000C). In addition, the strong priority attached to the privatisation to domestic investors gave way to a more balanced approach. Sales to foreign investors intensified (Böhm/Zdarsky, 2005). The banking system was again restructured and recapitalised. This time the banks were subsequently sold to foreign investors. All in all, the costs of the recapitalisation and restructuring of the banking sector in the Czech Republic were the highest among the Central European countries (Wagner/Iakova, 2001:56-57). In 1997 and 1998, the Czech economy went through a second adjustment recession (Graph 5.1.1, p. 87). The unemployment rate, which fluctuated between three to four per cent in the years before the currency crisis, rose to more than 7 % in 1998 and to 9 % in 1999. During this second adjustment recession, inflation rates declined to low levels on a lasting basis.

The deep reform process after 1998 including EU related changes in the legal and institutional framework, as well as the more open approach to foreign investments, were followed by a growth recovery starting in 2000 (Graph 5.1.1, p. 87). In 2005-2007, growth of real GDP exceeded 6 %. It was based on vigorous investment and export growth (cf. e.g. OECD, 2008C). Unemployment rates fell to less then 6 % in 2007. The trade deficit declined and since 2004 the Czech Republic has recorded surpluses in its balance of goods and services (cf. Table A1.1 in Appendix 1, p. 234). However, owing to the growing importance of foreign-owned companies, profit repatriation and other income payments to foreign countries have risen steadily. As a result, the current account deficit has amounted to 2-3 % of GDP in recent years. Inflation remained rather low between 1999 and 2007. With the world-wide surge in food and energy prices that started in the second half of 2007, inflation rates rose significantly, reaching 6.3 % in 2008.[62] At the same time, real GDP growth decelerated markedly to 3.0 % in 2008.

[62] Inflation rates denote year-on-year growth rates except where explicitly stated otherwise.

The Czech financial sector and in particular the banking sector went through a long process of restructuring. At the turn of the century, classified and non-performing loans still accounted for about 30 % of all loans (Reininger et al., 2001). Only after the sale of the large banks to foreign investors in 1999-2002 the banking system became increasingly sound. The share of classified loans and of non-performing loans declined from 21 % and 13 % in 2001 to 12 % and 4 % in 2006, respectively (IMF, 2007C:15); while profitability has increased. Owing to the long process of restructuring, for a number of years after 1997 the Czech Republic was characterised by negative or low credit growth. In spite of the pronounced reduction in the central bank's interest rates after 1999, bank loans to the private sector declined by 25 per cent between 1999 and 2002.[63] Lending recovered only in 2002, when loans to households picked up. They have been growing by 30 % p.a. in the period between 2003 and 2007 and slowed down during 2008. Lending to enterprises started to grow vigorously only in 2004 (CNB 2009:78).

5.2 Interest rate determination

5.2.1 Monetary policy

5.2.1.1 The transition phase: fixed exchange rate and monetary targeting

The Czech central bank CNB was created in 1993 after the dissolution of the Czechoslovak federation. The final objective of the CNB and of its predecessor, the State Bank of Czechoslovakia, had been stability of the currency. The amendments effective from January 2001 determine "price stability" as the primary objective. The CNB had been independent from the government as regards the strategy and the targeted inflation since its inception in 1993. Since 2000, the central bank has to agree on the inflation target with the government.

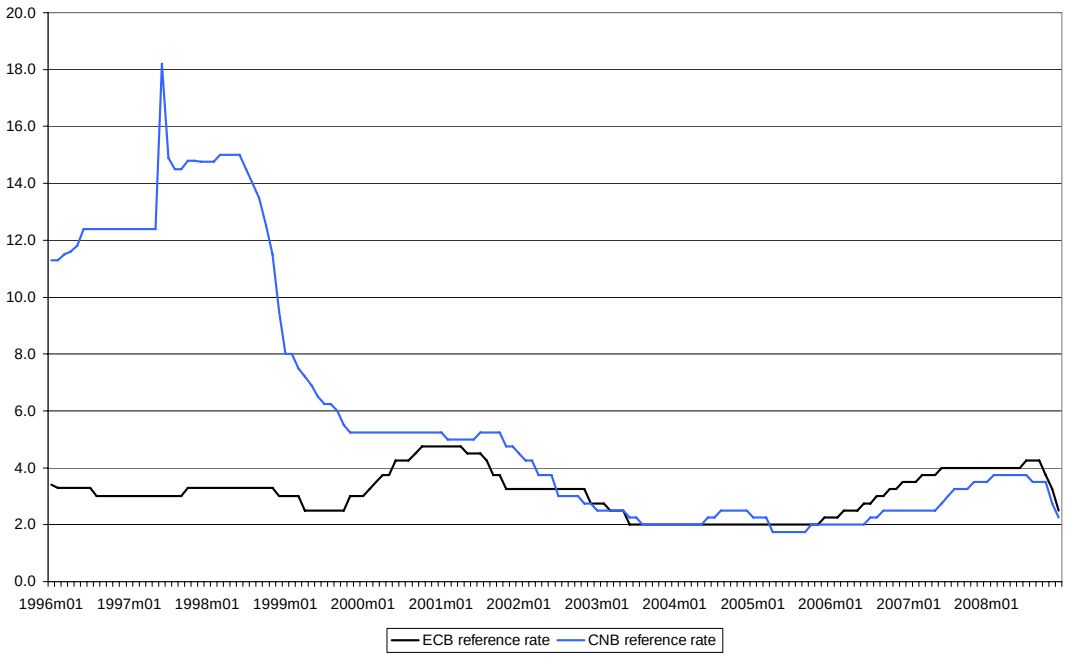
After successful macroeconomic stabilisation in 1990 and 1991 with tight monetary, fiscal and income policies that accompanied price liberalisation, the monetary strategy of the CNB consisted of a fixed exchange rate[64] and a money supply target (Böhm/Zdarsky, 2005:142). Inflation rates declined until 1994, but remained at close to 10 per cent during the following years (Graph 5.1.1, p. 87). With the fixed exchange rate, this implied a steady real appreciation, which was followed by rising current account deficits. At the same time, full current account convertibility was introduced in 1995 and also numerous capital account transactions were liberalised early on.[65] As a result, the growing current account

[63] Loans in CZK in December 2002 compared with December 1999 (CNB, 2003a).
[64] The currency was first pegged towards a basket of five currencies (USD, DEM, ATS, CHF, GBP 1990-91; and USD, DEM, ATS, CHF and FRF until May 1993. Since then it contained only USD (35 %) and DEM (65 %).
[65] Currency liberalisation proceeded as follows: FDI (excluding those into the banking sector) were allowed in the early 1990s. Foreign credits of banks and companies were possible in 1994-1995, short-

deficits were financed through bank loans and increasingly also short-term portfolio investments. While this allowed retaining the central parity of the koruna chosen in 1991, it increased the vulnerability of the economy to currency speculation. In addition, the capital inflows substantially reduced the ability of the CNB to pursue independent monetary policy. Although the CNB sterilised large parts of the additional money supply, the money supply target was overshot in 1994 and 1995 (CNB, 1996:47). In February 1996, the CNB decided to widen the fluctuation bands to ±7.5 %. However, during 1996 the growth rate of GDP decelerated and capital inflows declined. At the same time, the current account deficit widened to 7.5 % of GDP, and had to be financed partly by central bank reserves. As the crisis in Asia raised the sensitivity of investors to risks in emerging markets, the insufficient progress in structural reform combined with a weak commitment of the Czech government prompted devaluation pressures, culminating in the speculation against the koruna in May 1997 (for a detailed assessment of the currency crisis cf. Smidkova et al., 1998). The CNB initially reacted by sharply raising the refinance rates to defend the fixed parity, but after ten days abandoned the fixed exchange rate. The market stabilised and the policy rate could be reduced to 15 % by July 1997 (Graph 5.2.1).

Graph 5.2.1:

Central bank rates of Czech National Bank and European Central Bank, 1996-2008



Source: Eurostat.
Note: For 1996-1998, the "ECB reference rate" is that of the Deutsche Bundesbank.

term portfolio inflows since 1995. The remaining restrictions, mainly related to outflows, were removed in the late 1990s. (cf. Árvai, 2005: 9).

After the floating of the koruna, monetary targets for 1997 remained in place. In addition, while the currency was formally floated, the CNB announced to intervene "in the event of excessive volatility or unjustified exchange rate trends" (i.e. it pursued a regime of managed float, cf. Gersl/Holub, 2006:480). In the summer of 1997, the CNB also announced an "appropriate" exchange rate range for the koruna towards the Deutsche Mark (OECD, 1998C:18). In the meantime, inflation rose from under 7 % in June 1997 to 10 % in late 1997 on the back of the rather pronounced currency depreciation in mid-1997 and substantial adjustments in regulated prices. The CNB feared that monetary targeting created too weak an anchor for reducing inflation and inflation expectations after the currency crisis (CNB, 2008a). Therefore, to increase the credibility of the disinflation efforts, in late 1997 the CNB adopted inflation targeting. The exchange rate regime remained a managed float.

5.2.1.2 Inflation targeting

The Czech inflation targeting framework was initially built around the concept of "net inflation". This measure of inflation excluded regulated items, which had a relatively high share in the CPI and the adjustment of which seemed difficult to predict. "Net inflation" also excluded the impact of indirect taxes. It contained nearly 80 % of the prices in the CPI (OECD, 1998C: 30). However, within net inflation, the rather volatile food prices had a weight of 42 % (OECD, 1998C:30). The inflation targets were defined as year-end targets and were announced one year in advance ("short-term target", cf. Kotlán/Navrátil, 2003). The initial short-term target for year-on-year inflation at the end of 1998 was set at 6 % ± 0.5 percentage point (PP). In addition, a medium-term target was fixed for December 2000 at 4.5% ±1 PP. Subsequently, the target for December 1999 was set at 4.5 % ±0.5 PP (Table 5.2.1).

Table 5.2.1 Targeted disinflation path

Period of Targeted Inflation Rate	Rate of net inflation	Band	Announced in
December 1998	6.0 %	±0.5 %	December 1997
December 1999	4.5 %	±0.5 %	November 1998
December 2000	4.5 %	±1.0 %	December 1997
December 2001	3.0 %	±1.0 %	April 2000
December 2005	2.0 %	±1.0 %	April 1999

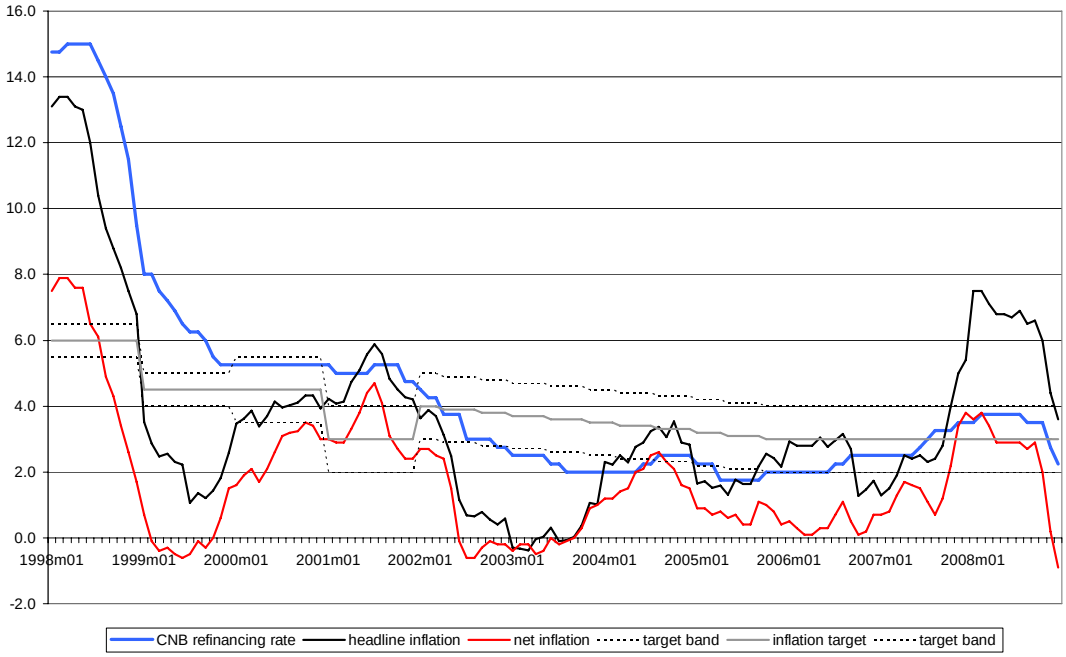
Source: CNB (http://www.cnb.cz/cs/menova_politika/cilovani.html).

In the early years of the inflation targeting regime, high reserve requirements remained the most powerful tool of the CNB.[66] Nevertheless, the instruments were gradually adjusted to those of the ECB. In particular, reserve requirements were reduced to 2 % by 2001, and a

[66] The CNB replaced credit limits, directed credit and interest rate ceilings by reserve requirements, credit auctions and discount policies by the mid-1990s (cf. Smidkova, 1996).

two-week repo tender organised every day has become the main instrument.[67] Contrary to ECB practice, the main policy instrument has served to remove liquidity. Since 1996, the CNB has used the one-weak money market rate as its operating target (CNB, 1997).

Graph 5.2.2:
CNB policy rate, headline and net inflation, and inflation target



Note: The inflation target until 2001 was defined over net inflation. Since 2002 it has been a target for headline inflation.
Source: Czech National Bank, Eurostat.

After the currency crisis the interest rate was kept at the level of close to 15 % during the latter half of 1997. In early 1998, after a further hike in regulated prices, inflation rose to more than 13 %, which reduced the likelihood of meeting the 1998 inflation target (of a maximum of 6.5 % in December 1998). The CNB decided to raise interest rates further. However, inflation rates started to decline quickly and fell from 13.3 % in the first quarter of 1998 to 1 % in July 1999. Net inflation even fell below zero in February 1999. As a result, with net inflation at 1.7 % in December 1998, the end-year target for 1998 was substantially undershot. Similarly, in December 1999, inflation stood at 1.5 %, still three percentage points below target (Graph 5.2.2 above). First, this was the result of the substantial monetary restriction. Second, the stabilisation package of the government in 1997 reduced demand, probably more so than projected by the CNB. Third, the increased effort in enterprise restructuring and bankruptcy caused an increase in unemployment, while stricter regulation of banks led to a sharp deceleration in lending. Real GDP declined

[67] Since May 2006, the frequency of repo tenders of the central bank was reduced to three operations per week.

in 1997 and 1998; the output gap turned negative. Fourth, contrary to central bank's expectations, the exchange rate did not depreciate further in 1998, while raw materials and food prices were unexpectedly weak. Czech price trends hence benefited from "global disinflation" (OECD, 2000C:27; CNB, 2000:18). Finally, in the early years, the CNB could make use only of rather crude forecasting models (CNB, 2008a). The early experience of the Czech Republic with the inflation targeting regime hence demonstrated the difficulties encountered by a transition economy in producing reliable inflation forecasts and adjusting policy instruments in a timely manner.

Because headline inflation was strongly affected by factors beyond the central bank's control such as the decline in prices of food and raw materials, in 1999 the CNB introduced a number of "escape clauses" (Kotlán/Navrátil, 2003:224). The CNB does not necessarily react if fluctuations in food and raw materials prices are assessed as temporary or singular events. The CNB need neither adjust its monetary stance if the exchange rate is affected by factors unrelated to domestic developments. As a consequence, in 2000 and 2001, when some of the earlier influences from food and raw materials prices went into reverse and inflation exceeded the targeted value, the CNB did not raise interest rates, although the year-end inflation rate in 2001 clearly exceeded the upper limit of the inflation target.

Further modifications to the strategy were made in 2000. The central bank started to prepare a forecast of regulated price adjustments, which enabled it to shift the target from net inflation to headline inflation starting in 2002. In addition, the target from 2002 to 2005 was defined as a steady decline of inflation from 4 % ± 1 % in January 2002 to 3 % ± 1 % in December 2005 (Graph 5.2.2, p. 92). The medium-term target of 3 % ± 1 % effective since 2006 and announced in early 2004 was also intended to hold during the convergence process towards the euro area. At the time of the adoption of the target, the CNB expected that the Czech Republic would qualify for euro adoption by 2010 (CNB, 2003b). However, since then the Czech Republic has become more averse towards euro adoption. In mid-2007, the Czech National Bank issued a new preparation strategy towards adopting the euro, without specifying a targeted entry date (CNB, 2007). Furthermore, in March 2007 the Czech National Bank announced a change in the permanent target effective from 2010 of 2 % ± 1 %.

The general performance of inflation was rather positive since disinflation to low inflation levels, i.e. since 2000. Although inflation remained rather volatile, fluctuating between zero and five per cent, it never exceeded the target band throughout the years 2002 and 2007. Spikes occurred in 2001 (mainly owing to a surge in food and energy prices), 2004 (VAT adjustment) and 2006 (energy prices), but these remained temporary. Instead, inflation was on a number of occasions below the lower target band, in some cases substantially so. In

2003, inflation rates were close to zero and for some months even below zero. Also in 2005 and early 2007 rates dropped below the lower target band (cf. Graph 5.2.2, p. 92). As a result, the convergence of inflation rates with the euro area observed during that period is the result of the occasional undershooting of the inflation target and an inflation rate that was often close to the lower target band. After mid-2007, inflation rates have risen sharply and exceeded the upper target band. That was first related to the world-wide surge in food and energy prices. In 2008, hikes in prices of regulated items and in the VAT rate added to the inflationary pressures. Inflation rose by average of 6.3 % in 2008. However, in the second half of the year, as the underlying impulses from food and energy prices abated, it started to decline again.

Thus, considering the inflation outcome, i.e. the relatively low inflation and the fact that inflation shocks have been adjusted to rather quickly, the inflation targeting regime has attained its goals. However, as regards the ability of the central bank to actually meet its inflation targets, the results appear less satisfactory. Between January 2002 and December 2008, i.e. after the shift from a year-end target to permanent targets, inflation was in 37 months out of 84 below the lower target band and in 14 months above the upper target band. Only in 33 months, i.e. in 40 % of the observations, inflation was within the target band.

As regards the interest rate setting of the central bank, Graph 5.2.2 (p. 92) indicates that the central bank's reaction to the spikes in inflation was rather modest in 2001, 2004 and 2007/08. On the one hand, this is in line with the escape clauses – the central bank may have considered these spikes as temporary and inflation expectations well anchored. On the other hand, however, it is striking that real interest rates have been very low, and even negative, since early 2003, apparently without any major impact on inflation (Graph A.3.1 in Appendix 3, p. 244). Also, the definition of the inflation target of 3 % ± 1 % seems to rest on the assumption of a stable exchange rate to the euro. The difference to the ECB target of close to but below 2 % is motivated by the equilibrium real appreciation towards the euro area (CNB, 2004). Therefore, the policy rate setting as well as the inflation outcome have to be related to the nominal exchange rate. It is a distinct feature of the Czech economy that the nominal exchange rate has been on a path of trend appreciation for a number of years (cf. Graph 5.2.3, p. 95, and Table 5.2.2, p. 96). Between 1999 and 2008, the annual average nominal appreciation amounted to 3.5 %. Phases of pronounced nominal appreciation occurred already after the fluctuation bands around the fixed exchange rate were widened in 1996. At that time, it was the consequence of substantial inflows of bank credits. After the turn of the century, appreciation pressures have stemmed mainly from inflows of foreign direct investments and EU funds (cf. Table A1.1 in Appendix 1, p. 234).

Capital flows were also attracted by the expectation of further appreciation and hence yield differentials.

Graph 5.2.3.:

Nominal exchange rate to the euro and real exchange rate (CPI based) towards the euro area

Note: Before 1998, the series referring to the euro area are the ecu and a "synthetic" price series containing the price series of the early euro area member states.
Source: Eurostat and own calculations based on Eurostat data.

The development of the exchange rate has always been a key concern of the Czech National Bank. Until 1997, it operated a fixed exchange rate. After the koruna turbulence, the CNB pursued a managed float until 2002 and intervened regularly in the foreign exchange market. The interventions aimed at reducing the pressures towards currency appreciation (cf. Gersl/Holub, 2006); the effect on money supply was sterilised. Furthermore, in 2000, the central bank and the government agreed on a "Monetary strategy in a period of strong capital inflows" (OECD, 2003C:46). This agreement included the obligation on the part of the government to convert any privatisation revenue through the CNB. In 2002, the agreement was reinforced and additionally maintained that a part of the revenues were freezed for a number of years. In 2008, this strategy was also extended to hold for funds from the European Union.

Table 5.2.2:

Nominal and real appreciation towards the euro and euro area, respectively, annual growth rates in %

	Nominal exchange rate towards euro	Real exchange rate (CPI based)	Inflation rate Czech R.
1994	0.0	-6.5	10.0
1995	1.5	-4.6	9.1
1996	-0.7	-6.6	8.8
1997	4.2	-2.4	8.5
1998	0.4	-8.2	10.7
1999	2.2	1.2	2.1
2000	-3.5	-5.1	3.9
2001	-4.3	-6.5	4.7
2002	-9.5	-9.1	1.8
2003	3.3	5.4	0.1
2004	0.2	-0.4	2.8
2005	-6.6	-6.4	1.9
2006	-4.9	-5.2	2.5
2007	-2.1	-2.8	2.8
2008	-10.1	-12.7	6.3
average	-2.0	-4.7	5.1
average 1999-2008	-3.5	-4.2	2.9

Source: Eurostat.
Note: Negative numbers denote appreciation.

Owing to the growing sterilisation costs, the CNB stopped intervening in the foreign exchange market in 2003 (cf. Égert/Komárek, 2006). Instead, it has focused on interest rate policies as a tool to reduce capital inflows and hence pressures towards appreciation. At times, the CNB interest rate was therefore below the ECB's refinancing rate (Graph 5.2.1, p. 90). However, the continued (or even more pronounced) nominal appreciation after 2003 has implied that in exchange rate adjusted terms, the yields of koruna investments have in general exceeded those in euro. Ihnat and Prochazka (2002) argue that the use of the interest rate as a means to discourage interest rate sensitive capital inflows carried manageable risk due to the fact that the interest rate channel was weak, in particular when compared with the exchange rate channel of monetary transmission. In addition, the appreciation of the currency has entailed tougher monetary conditions than suggested by the low level of nominal and real interest rates.

Although the nominal appreciation is likely to have exerted steady downward pressure on the prices,[68] mainly through the industrial goods prices, but presumably also through energy and food prices, the trend nominal appreciation was accompanied by a rather pronounced

[68] This will be investigated in detail in Chapter 5.3.

real appreciation. It amounted to annually 4.6 per cent for the period between 1993 and 2007, and 4.3 per cent between 1999 and 2007 (Table 5.2.2, p. 96). The overall real appreciation between 1999 and 2007 was 30 per cent. On the one hand, real appreciation could be an equilibrium phenomenon related to the price level convergence process. On the other hand, the speed of appreciation indicates that it might equally create adjustment needs if unsustainable imbalances were to build up. During the most recent years, however, the trade balance has steadily improved. Nevertheless, if the low inflation environment were to critically hinge on a nominally appreciating currency and hence declining tradable goods prices, the low inflation environment may not be preserved when the currency stabilises.

To summarise, inflation targeting has proved a viable monetary policy regime for the Czech economy. Within this regime, inflation rates could be reduced and maintained at a low level. However, the low interest and inflation rates (and the convergence with euro area levels) may have been strongly affected by the steady nominal appreciation of the currency. Real appreciation has been substantial. This raises the question of whether inflation can remain low also with a stable nominal exchange rate, e.g. within the ERM-II or within the euro area. Second, the CNB seems to have reacted strongly to the exchange rate, in particular to prevent a strong appreciation of the koruna. The CNB may have been reacting more systematically to the exchange rate than to the inflation rate.

5.2.2 Interest rates in the money and government bond markets

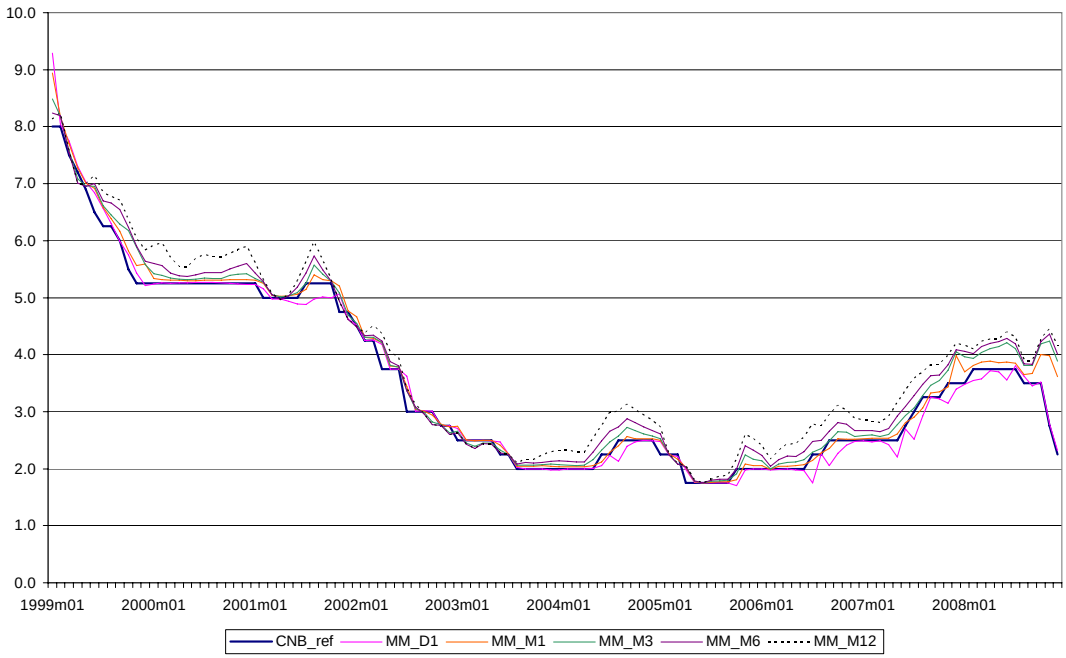
The interbank money market has developed gradually since its inception in 1991. In the early years, the central bank acted as market maker. That ended in 1994 when the number of reference banks was sufficiently high (Smidkova, 1996). Turnover in the market has grown steadily (Ihnat/Prochazka, 2002). It was stimulated by the reduction in repo operations of the central bank in 2006 from daily to three operations per week (CNB, 2006). Nevertheless, most transactions continue to be made in short maturities, i.e. up to two weeks. Graph 5.2.4 (p. 98) shows the money market rates from 1999. The money market rates are close to the repo rate of the CNB until early 2008. Towards the end of 2008, however, the rates started to deviate perceptibly. The overnight rate has in some instances been lower than the repo rate, due to the structural surplus liquidity prevailing in the money market. On the other hand, all yields of maturities of over 1 month exceed the CNB reference rate.

The market for treasury bills was introduced in 1992. Also in this market, the central bank withdrew from its function as market maker by the mid-1990s. Government bonds were initially issued only with a maturity of 2 and 5 years (Ihnat/Prochazka, 2002). Only in 2000 the government started to issue government bonds with a maturity of 3 and 10 years. Graph

5.2.5 (p.99) therefore presents the long- term bond yields starting in 2000. Although the long rates declined with the reference rate until 2003, in 2004 the bond yields rose despite the stable central bank rate. By contrast, the co-movement of the Czech 10-year rate with the euro area 10-year rate has been remarkable since 2002, with only a short divergence in 2004. Note that the convergence in absolute values conceals that in exchange rate adjusted terms, the Czech yields have been substantially higher. As regards the yield curve (Graph 5.2.6, p. 99), it has been upward sloping since the early 2000s, with a rather stable liquidity premium for the longer rates. We also tried to consider interest rates for loans to the private sector (Graph 5.2.7, p. 100). However, these series start only in 2004. During this period, co-movement with the policy rate seems to have been present, in particular for interest rates paid by non-financial enterprises.

Graph 5.2.4:

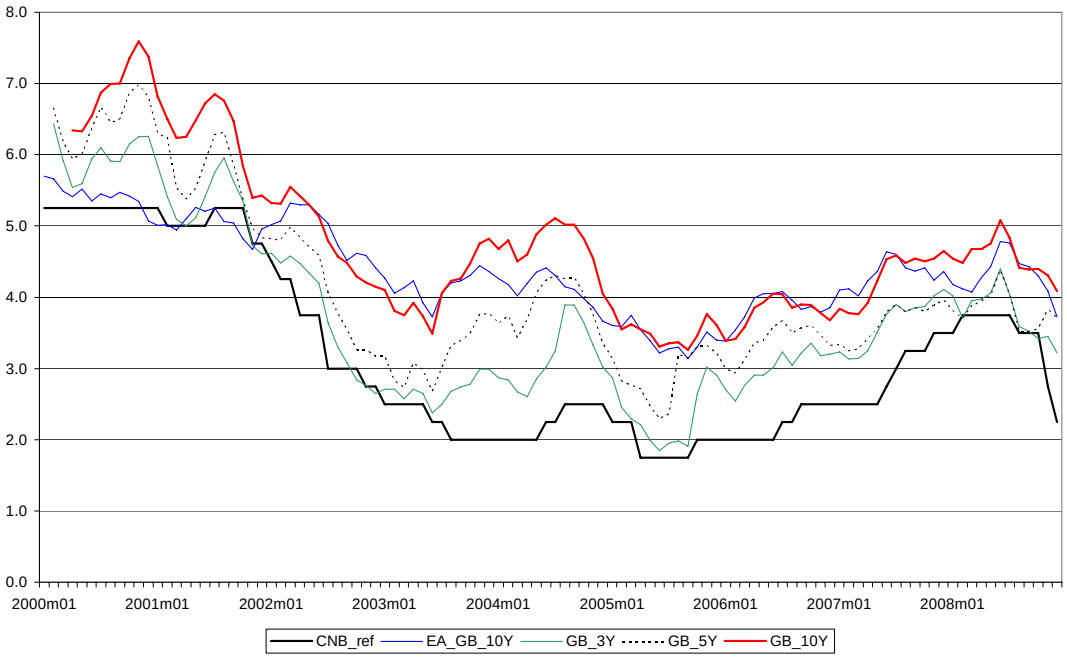
Money market rates in the Czech Republic, 1999-2008



Source: CNB. Notes: 'CNB_ref' denotes the main policy rate of the CNB, 'MM_D1' the 1-day money market rate, 'MM_M1' the 1-month money market rate, 'MM_M3' the 3-month money market rate, 'MM_M6' the 6-month money market rate and 'MM_M12' the 12-month money market rate.

Graph 5.2.5:

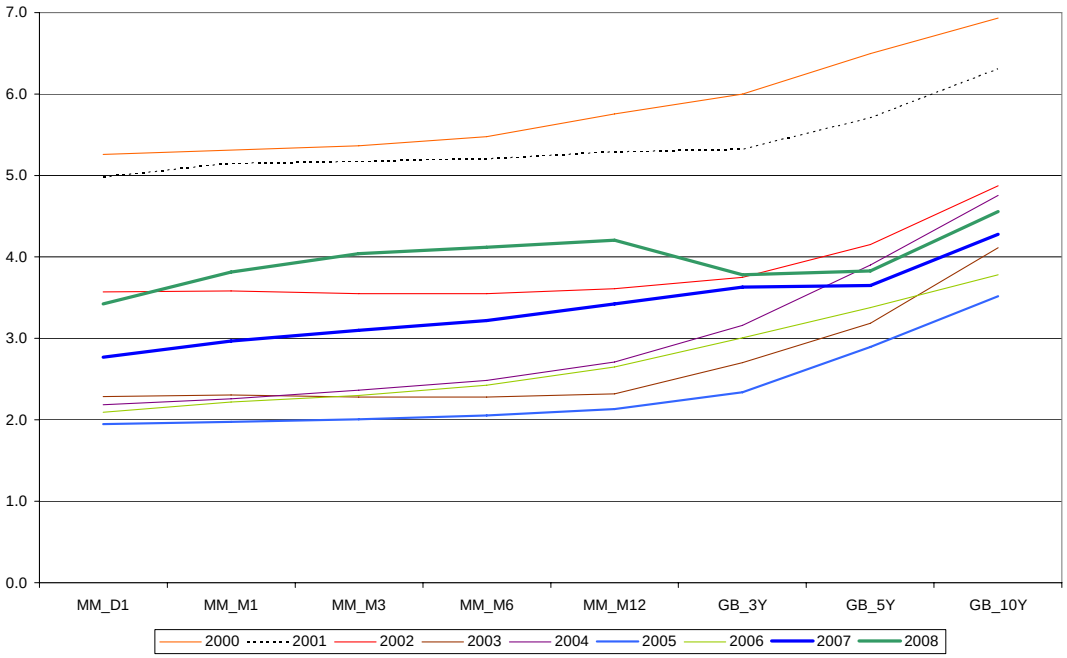
Government bond rates in the Czech Republic, 1999-2008



Source: CNB. Notes: 'CNB_ref' denotes the main CNB policy rate, 'EA_GB_10Y' the euro area 10-year government bond, rate, and 'GB_3Y', 'GB_5Y' and 'GB_10Y' the Czech 3-, 5- and 10-year government bond rates, respectively.

Graph 5.2.6:

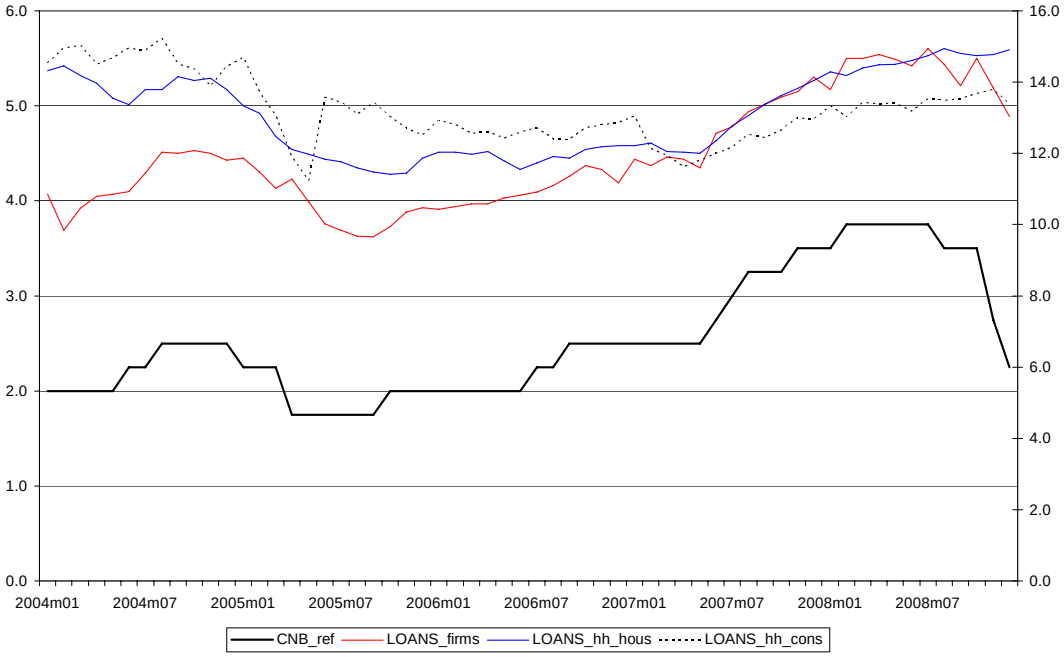
Yield curve Czech Republic



Source: CNB. Notes: as for Graphs 5.2.4 and 5.2.5.

Graph 5.2.7:

Interest rates of loans to non-financial enterprises and to households for housing (left scale) and for consumption purposes (right scale), 2004-2008



Source: CNB. Notes: 'CNB_ref' denotes the CNB main policy rate. 'LOANS_firms' denote interest rates for loans to non-financial firms, 'LOANS_hh_hous' interest rates for residential investments of households and 'LOANS_hh_cons' interest rates for loans to households for consumption purposes.

5.2.3 Econometric evidence of the central bank's reaction function and of the pass-through to money market rates and government bond yields

The econometric investigation consists, first, of a test of the central bank's reaction function and, second, of the pass-through of the central bank rate into money market and government bond rates.

Because most time series included in the investigation are non-stationary, the econometric investigation is carried out with Johansen cointegration tests. The choice of cointegration tests contrasts with the method applied in most of the empirical research on monetary policy rules, which is GMM. That, however, requires the examined time series to be stationary. As a result, we followed the approach of Gerlach-Kristen (2003) and Siklos/Wohar (2006), who also made use of cointegration tests in interest rule estimations. The methodology is described in Appendix 2 (p. 237-243).

5.2.3.1 The central bank reaction function

The tested relation for the central bank's reaction function is grounded on the closed and open economy Taylor rules, with some adjustments. In both specifications, the tested long-run relation does not consider the output gap. Owing to the short time series, it can be determined only with high uncertainty (cf. Benk et al., 2005). Furthermore, it is by definition a stationary process. As a result, the closed economy Taylor rule shown in equation (18) is estimated excluding the output gap:

$$i_t = f(\pi_t - \pi_t^T). \tag{18a}$$

The open economy reaction function is estimated as

$$i_t = f(\pi_t - \pi_t^T, e_t, i_t^{ECB}). \tag{18b}$$

The inclusion of the nominal exchange rateis motivated by the open economy Taylor rules, whereas the ECB rate is considered due to the convergence process towards the euro area.[69] The output gap calculated as percentage deviation of the actual real GDP (interpolated into monthly data) from the HP-filter will nevertheless serve to compare the determined central bank reaction function with the benchmark Taylor rule.

The estimated long-run equation is

$$CNB\_ref_t = f(CPI\_deviation_t, ECB\_ref_t, czk_t).^{70} \tag{66}$$

The dependent variable of the reaction function is the CNB rate for reverse repo operations ('CNB_ref'). This has been the main policy rate because the CNB has been a liquidity absorber for most of the investigated time period. The explanatory variables are the ECB main refinancing rate ('ECB_ref'), the log level of the nominal exchange rate of the CZK to the EUR ('czk'), and the deviation of the observed current headline inflation rate from the target value ('CPI deviation') in percentage points. Because the CNB has been publishing explicit forecasts for inflation six quarters ahead, which is considered the relevant horizon of interest rate transmission, tests could also include the deviation of the forecast value from the inflation target ('forecast deviation'). Graph A.3.2 in Appendix 3 (p. 244) compares the inflation forecast[71] and outcome. The forecast inflation rate has typically fluctuated around the inflation target in a rather narrow band and has exceeded the actual outcome. Only in 2008 inflation exceeded the rates forecasted six quarters earlier. The series included in the econometric tests are shown in Graphs A3.3-A3.4 (Appendix 3, p. 245). Graph A3.5 (p. 246) presents the output gap. The sources of the data are Eurostat

[69] Such approach is in line with research of Eleftheriou et al. (2006), who study the monetary policy rules of current euro area member states during their convergence phase in the 1990s.

[70] All included variables, their abbreviations and sources are listed in Table A3.1 in Appendix 3 (pp. 253-255).

[71] In the early years of inflation targeting, the CNB published a range of inflation in its forecast. In such a case, we included the mean value of the range.

(New Cronos database) and the Czech National Bank (ARAD database). The inflation forecasts stem from the individual CNB inflation reports.

Regarding the estimation period, a natural starting point is 1998 when inflation targeting was introduced. However, because of the high real interest rates in the early years, the interest rate reaction to the current inflation rate will be different in the disinflation phase of the early years and the subsequent phase of low inflation. The tests are therefore made for the period 2000:1 – 2008:12, with 108 observations. Table A3.2 in Appendix 3 (p. 256) contains the results of the unit root tests. The variables are integrated of order 1, except for the deviation of the forecasted inflation rate from the inflation target, which is stationary. The tested relations hence include only the deviation of actual inflation from the inflation target. The ECB policy rate is found to be I(1) only on a significance level of 10 %.

According to the tests, at a 5 % confidence level cointegration is found only for the specification that includes three explanatory variables: the ECB reference rate, the nominal exchange rate in log levels and the deviation of the current inflation rate from the targeted inflation rate (Table 5.2.3). However, the relation that includes only the ECB rate and the nominal exchange rate is significant at a 10 % level. By contrast, the link between the deviation of the inflation rate and the policy rate is not found to be statistically significant.

Table 5.2.3:

Cointegration tests CNB reaction function

2000:1 – 2008:12	LAG LENGTH OF UNRESTR. VAR	NO. OF HYP. COINTEGRATION RELATIONS	TRACE TEST
CNB_ref CPI deviation	SC =1	0 1	11.17 1.35
CNB_ref ECB_ref	SC =1	0 1	13.42 1.05
CNB_ref ECB_ref czk	SC=1	0 1 2	35.04# 5.92 2.27
CNB_ref CPI deviation ECB_ref czk	SC =1	0 1 2 3	65.21** 26.67 9.04 2.17

Note: The estimated VECM model assumes a constant term in the long-run cointegration relation, but no constant in the short-term dynamics. The interest rates are in per cent, the deviation of observed inflation from target is in percentage points, the nominal exchange rate is included in log levels. # denotes significance at 10 %, * significance at 5% and ** significance at 1 %.

Table 5.2.4:

Parameters of the cointegration vector, CNB reaction function

COINTEGRATION RELATION			
CNB_ref	ECB_ref	czk	constant
1	-1.03 *(-9.17)*	-5.00 *(-5.04)*	-0.45 *(-1.14)*
ADJUSTMENT TO COINTEGRATION RELATION			
Δ(CNB_ref)	Δ(ECB_ref)	Δ(czk)	
-0.12 *(-4.50)*	-0.00 *(-0.19)*	-0.01 *(-2.59)*	

COINTEGRATION RELATION				
CNB_ref	CPI deviation	ECB_ref	czk	constant
1	-0.19 *(-4.28)*	-0.84 *(-9.22)*	-6.75 *(-9.36)*	-1.59 *(-4.49)*
ADJUSTMENT TO COINTEGRATION RELATION				
Δ(CNB_ref)	Δ(CPI deviation)	Δ(ECB_ref)	Δ(czk)	
-0.19 *(-6.07)*	-0.27 *(-2.38)*	0.00 *(0.02)*	-0.00 *(-0.65)*	

Note: as for Table 5.2.3. In parentheses are t-values.

The estimation of the cointegration vector within the VECM framework indicates that the link between the CNB's policy rate and the ECB rate is strong (Table 5.2.4). The estimated parameter is 1 in the relation that considers the ECB rate and the nominal exchange rate and 0.8 if the deviation of observed inflation from the target is also included. Also the parameter of the nominal exchange rate is highly significant. Based on the estimation that includes the CPI-deviation, starting at a level of CZK 27 per euro, an appreciation of the koruna by 1 CZK goes with a decline in the policy rate of 0.25 percentage points. The decline would become larger with further currency appreciation. The parameter in front of the deviation of inflation from target confirms a modest link with the policy rate. The VECM estimation indicates that the CNB policy rate and the inflation rate (through the deviation from target) adjust to this long-term relation. Whereas the ECB rate is (weakly) exogenous as it is insignificant in both specifications, the reaction of the exchange rate cannot be determined with certainty.

The estimation of the short-term dynamics of CNB interest rate setting is made with OLS. The estimated equation included, firstly, the residuals of the determined cointegration relation between the CNB policy rate, the ECB policy rate, the log of the nominal exchange rate and the deviation between headline inflation and the inflation target shown in Table 5.2.4 above. The residual process is denoted 'ECM', which stands for 'error-correction mechanism'. Secondly, we considered current and lagged changes in the nominal exchange

rate, inflation rate and ECB policy rate. The estimation output is shown below. According to the Lagrange multiplier test the residuals of the OLS estimation follow a white noise process. Furthermore, the Jarque-Bera test indicates that the hypothesis of the residuals' normal distribution cannot be rejected:

$$\Delta CNB\_ref_t = \underset{(-5.19)}{-0.17\ ECM_{t-1}} + \underset{(+3.75)}{0.28\ \Delta ECB\_ref_t} + \underset{(+2.61)}{0.07\ \Delta CPI\_rate_{t-1}} \underset{(-2.15)}{-0.18\ \Delta CNB\_ref_{t-1}}$$

$$+ \underset{(+2.74)}{0.23\ \Delta CNB\_ref_{t-3}} + \underset{(+1.73)}{0.14\ \Delta ECB\_ref_{t-1}} \underset{(-0.43)}{-0.01} + \mu_t$$

t-values in parentheses. 'ECM' stands for the residuals of the long-term relation shown in Table 5.2.4 that includes the CNB policy rate, the ECB policy rate, the log of the exchange rate between CZK and EUR and the deviation of the contemporaneous inflation rate from the targeted rate.
$R^2 = 0.48$; Jarque Bera test =4.77 (probability 0.09);
Breusch-Godfrey Serial Correlation LM Test: Lag (1): Prob. F (1,100) =0.16; Lag (4): Prob. F (4,97) =0.57, Lag (8): Prob. F (8,93) =0.33

The residual process of the long-term relation has the expected sign and is highly significant. However, the adjustment is rather slow, which points to persistence in the CNB's rate setting and interest rate smoothing. In addition, in the short-run the CNB has reacted to the contemporaneous change in the ECB rate and to the change in inflation ('CPI_rate'). By contrast, no systematic reaction to the exchange rate in the short run could be determined. All in all, the tests show that the CNB has directed its policies not only to domestic factors such as the inflation rate, but also to external factors such as the ECB policy rate as it has tried to reduce the pressures towards currency appreciation. The tests confirm the earlier proposition that the CNB has focused on the exchange rate and a reduction in appreciation pressures. In its inflation targeting regime it appears to have relied heavily on the effect of the nominal exchange rate on prices, i.e. the nominal exchange rate transmission channel.

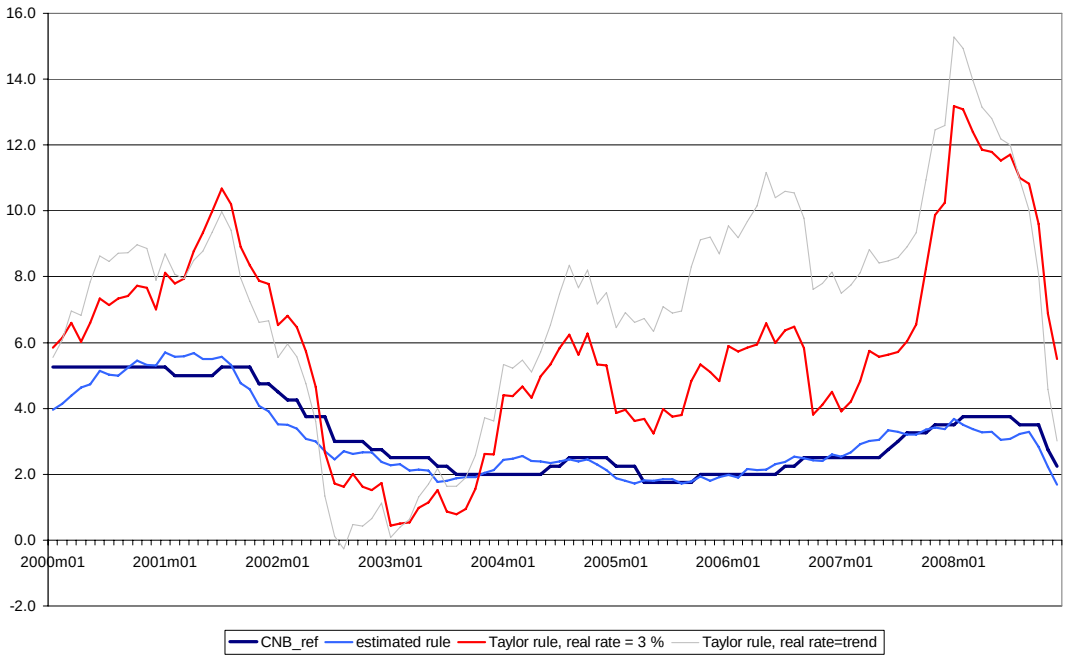
Whether or not the Taylor principle is satisfied cannot be verified within this framework because of the inclusion of the ECB rate and the nominal exchange rate in the tested relation. In that case, the constant cannot be viewed as reflecting the joint effect of the equilibrium real rate and the contemporaneous inflation rate. Therefore, for comparison, we calculated a closed economy Taylor rule as in equation (19):

$$i_t = \pi_t + r_t^{eq} + 0.5 \cdot (\pi_t - \pi_t^T) + 0.5 \cdot (Y_t - Y_t^{POT}) . \qquad (19)$$

The equilibrium real rate was set either at 3 per cent[72] or at the trend rate determined by the HP filter. The 'estimated rule' in Graph 5.2.8 below shows the link determined as the cointegration relation, i.e. the long-term link.

Graph 5.2.8:

Comparison of estimated reaction function and closed economy Taylor rule



Source: Eurostat, own estimations.
Note: 'Estimated rule' stands for the long-term relation shown in Table 5.2.4 (p.103) that includes the CNB policy rate, the ECB policy rate, the log of the exchange rate between CZK and EUR and the deviation of the contemporaneous inflation rate from the targeted rate. The Taylor rule is calculated as in equation (19). 'Taylor rule, real rate = 3%' denotes the rule that is calculated assuming a constant trend growth rate of 3 %; 'Taylor rule, real rate = trend' denotes the rule which incorporates a trend growth rate approximated by the HP filter.

The graph indicates a rather close approximation of the actual rate setting by the estimated (long-term) rule as the maximum deviations are close to 1 percentage point. But whereas the estimated rule traces the actual policy rule rather closely, the Taylor rule deviates substantially from the policy rate. According to the Taylor rule, the policy rate should have been substantially higher (and also more volatile), in particular after the inflation hikes.[73] However, the rule cannot account for the trend appreciation of the currency. The comparison hence also shows the limits of a mechanical application of the Taylor rule.

[72] The "equilibrium real rate" can be approximated by the trend growth rate. A recent approximation of the potential growth rate in the Czech Republic sets potential growth at 5 % (OECD, 2008C). Three per cent is closer to the average rate throughout the investigated period.
[73] The hikes in the Taylor interest rate are induced by the higher current inflation rate; the effect of the output gap is negligible.

Because of the trend appreciation of the currency, monetary conditions in the Czech economy have been stricter than what the low interest rates indicate. Still, the deviation between the Taylor rate and the rule followed by the central bank suggests that the independence of the Czech National Bank in setting interest rates based on domestic factors might have been limited.

5.2.3.2 Tests of the interest rate pass-through

The pass-through into the money market rates and the government bond yields is tested based on the expectations hypothesis of the term structure (EHT) shown in equation (12) in Chapter 2:

$$l_{t,n} = i_t + \sum_{j=1}^{n-1} \frac{n-j}{n} E_t(\Delta i_{t+j}) . \qquad (12)$$

Owing to the bounded nature of interest rates in the long run, the expected future changes of the short-term interest rate are stationary. In the cointegration tests, the expected sequence of differences in the future short rates is therefore reflected in the stationary residual. Furthermore, a stable liquidity premium will appear as a constant. If EHT is driving the link between the short and long term yields, the suggested parameter in front of the short-term rate is 1. Because the estimations include also money market rates of short-term maturities, the dependent variable is not necessarily a "long-term" interest rate.

The money market rates used in the tests include the rates for 1 day, 1 month, 3 months, 6 months and 12 months. The government bond yields refer to maturities of 3, 5 and 10 years. The average interest rate of loans to the private sector is excluded because of the short time series available. The graphs of these series are shown in Section 5.2.2 (pp. 98-100). However, the estimation period here is 2000:1 – 2007:12.[74] The unit root tests assess all series as integrated of order 1 (Table A3.2 in Appendix 3, p. 256). The cointegration tests find cointegration between all investigated rates and the policy rate, the notable exception being the 10-years government bond (Table 5.2.5, p. 107). The tests could not detect cointegration between the Czech 10-year government bond and its euro area counterpart either (results not shown here). However, when testing only for a short-term link between the Czech and euro area 10-year government bond yields, i.e. in first differences, the co-movement appears to be rather strong (cf. Appendix 3, Table A3.4, p. 258).

As regards the cointegration vectors and the causality structure, in the money market, the rates for one day (MM_D1) and for 1 month (MM_M1) adjust to the CNB rate, whereas

[74] The exclusion of the 2008 data is owing to the recent deviation of the money market rates (except for the overnight interest rate) from the central bank rate. An estimation that included the most recent observations could not confirm the results found for the earlier period.

rates for higher maturities (where only few deals are being made) seem to adjust to the expected future changes in the CNB rate (Table 5.2.6, p. 108). The 6-month and 12-month money market rates carry a significant liquidity premium of 0.12 to 0.24, respectively, over the CNB rate. The 1-day and 1-month rates adjust quickly to the central bank rate, whereas the adjustment to the long-term equilibrium is slow for the 3-month rates and higher. Note that in the pass-through estimations the sign of the short-term adjustment of the CNB rate is positive because in these estimations it is the money market rates that are normalised to 1.

As regards the 3- and 5-year government bond yields, they also seem to fully react to the CNB reference rate as the parameter in front of the CNB rate is close to 1. As a result, during 2000-2007 the Czech government bond yields of low maturity seem to have been linked to the CNB policy rate as suggested by the expectations hypothesis of the term structure. In line with liquidity preference theory, the liquidity premia exceed those of the money market rates, ranging from 0.7 percentage points for 3-year government bonds to 1 percentage point for the 5-year government bond yield.

Table 5.2.5:

Cointegration tests of pass-through in the money market rates and government bond yields

2000:1 – 2007:12	LAG LENGTH OF UNRESTR. VAR	NO. OF HYP. CI RELATIONS	TRACE TEST	ADJUSTED TRACE TEST
CNB_ref MM_D1	SC =1	0 1	131.04 3.84	128.31** 3.76
CNB_ref MM_M1	SC =3	0 1	30.51 2.73	28.62** 2.56
CNB_ref MM_M3	SC=2	0 1	32.91 2.16	31.53** 2.07
CNB_ref MM_M6	SC=2	0 1	41.51 2.99	39.77** 2.86
CNB_ref MM_M12	SC=2	0 1	45.32 3.62	40.45** 3.47
CNB_ref GB_3Y	SC=2	0 1	36.90 2.92	35.36** 2.79
CNB_ref GB_5Y	SC=2	0 1	19.04 3.18	18.24# 3.05
CNB_ref GB_10Y	SC=1	0 1	14.04 2.56	13.75 2.51

Note: The estimated VECM model assumes a constant term in the cointegration relation, but no constant in the short-term dynamics. '#' denotes significance at 10 %, * at 5 % and ** at 1 %. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2, p. 243).

Table 5.2.6:
Parameters of the pass-through tests

COINTEGRATION RELATION			ADJUSTMENT TO COINTEGRATION RELATION	
MM_D1	CNB_ref	Constant	Δ(CNB_ref)	Δ(MM_D1)
1	-0.98 *(0.008)*	+0.02 *(0.71)*	-0.07 *(0.10)*	-0.85 *(0.053)*
MM_M1	CNB_ref	Constant	Δ(CNB_ref)	Δ(MM_M1)
1	-1.02 *(0.005)*	+0.01 *(0.016)*	+0.96 *(0.43)*	-0.61 *(0.25)*
MM_M3	CNB_ref	Constant	Δ(CNB_ref)	Δ(MM_M3)
1	-1.02 *(0.010)*	-0.03 *(0.035)*	+0.82 *(0.18)*	+0.01 *(0.12)*
MM_M6	CNB_ref	Constant	Δ(CNB_ref)	Δ(MM_M6)
1	-1.02 *(0.014)*	-0.12 *(0.05)*	+0.49 *(0.11)*	-0.12 *(0.09)*
MM_M12	CNB_ref	Constant	Δ(CNB_ref)	Δ(MM_M12)
1	-1.03 *(0.023)*	-0.24 *(0.077)*	+0.28 *(0.07)*	-0.16 *(0.07)*
GB_3Y	CNB_ref	Constant	Δ(CNB_ref)	Δ(GB_3Y)
1	-0.98 *(0.04)*	-0.68 *(0.135)*	+0.16 *(0.05)*	-0.16 *(0.065)*
GB_5Y	CNB_ref	Constant	Δ(CNB_ref)	Δ(GB_5Y)
1	-0.99 *(0.08)*	-1.03 *(0.28)*	+0.10 *(0.037)*	-0.10 *(0.05)*

Note: The estimated VECM model assumes a constant term in the long-run cointegration relation, but no constant in the short-term dynamics. In parentheses are standard errors. The estimation period is 2000:1 to 2007:12. The first three columns show the cointegration relation, the final two columns the adjustment in the VECM.

5.2.4 Conclusions and summary of interest rate investigation

Monetary policy of the Czech National Bank was conducted within the framework of a fixed nominal exchange rate and monetary targeting until 1997. Since 1998, the CNB has been targeting inflation. Disinflation to low inflation levels was achieved rather quickly after the introduction of inflation targeting, helped by the adjustment recession following the currency crisis and high real interest rate policies. However, the disinflation process was faster than envisaged by the central bank due to numerous unforeseen factors that fostered disinflation such as the decline in commodity prices or the stabilisation of the exchange rate. Between 1999 and 2007, inflation was in general low and close to euro area levels, albeit more volatile. As regards the CNB's track record in hitting the inflation target, however, the result is ambiguous because inflation rates were often below the inflation target and even below the lower target band. Because the inflation target of the CNB has exceeded that of the ECB by at least one percentage point, convergence with the euro area in terms of inflation is also a consequence of a rather frequent undershooting of the

inflation target. The main source of the undershooting of the target appears to be the trend nominal appreciation of the exchange rate, which is apparently not considered in the definition of the inflation target. In the early years of the inflation targeting regime, the central bank intervened in the foreign exchange market to weaken the appreciation pressures. However, due to high costs, the central bank stopped interventions in 2003 and has since relied on interest rates to reduce appreciation pressures. It is therefore that the policy rates have at times been lower than those of the ECB. In currency adjusted terms, yields in Czech koruny have still exceeded yields in euro. All in all, the inflation targeting framework has served the Czech economy well as inflation has been low. Still, the inflation targets were not always met. Both interest rate and inflation convergence seem to have been the consequence of nominal currency appreciation. The fact that the low inflation environment is also related to the nominally appreciating exchange rate has its perils. Given the magnitude of the real appreciation, it is not clear whether inflation and inflation expectations will remain anchored once the exchange rate stabilises on a lasting basis.

The econometric tests showed that the central bank has systematically reacted to the ECB rate; furthermore, the long-term link is close to 1. At the same time, the policy rate is systematically linked also to the nominal exchange rate and, more modestly, to the deviation of the inflation rate from target. The fact that the CNB has systematically responded to the ECB rate and the nominal exchange rate is not necessarily in line with inflation targeting. However, only few examples of monetary policy with a trend nominal appreciation exist. A comparison of the actual policy rule and the Taylor rule shows that the actual rule has often implied a markedly lower interest rate. This difference shows that with a strongly appreciating currency due to capital inflows, the scope for independent monetary policy of the CNB might be limited. Furthermore, because of the nominally appreciating exchange rate, monetary conditions are stricter than indicated by the interest rate level. Euro adoption would hence still lead to a substantial easing of monetary conditions even if the actual decline in interest rates were small.

As regards the pass-through from the policy rate to the rates in the money and government bond markets, the tests suggest a rather strong reaction of the money market rates. With cointegration vectors determined as (1; -1), the necessary condition for the expectations hypothesis of the term structure to hold was fulfilled during the rather tranquil times that prevailed in the money market in 2000-2007. The government bond yields with a maturity of 3 and 5 years also reacted systematically to the policy rate. The link to the policy rate is equally strong as for the money market rates. In line with liquidity preference theories, these rates carry significant liquidity premia. The link between the policy rate and the 10-year government bond yield could not be verified on a statistically significant basis. In the

short-term, the 10-year government bond yield has been strongly related to the euro area long-term interest rate and relatively weakly to the central bank policy rate.

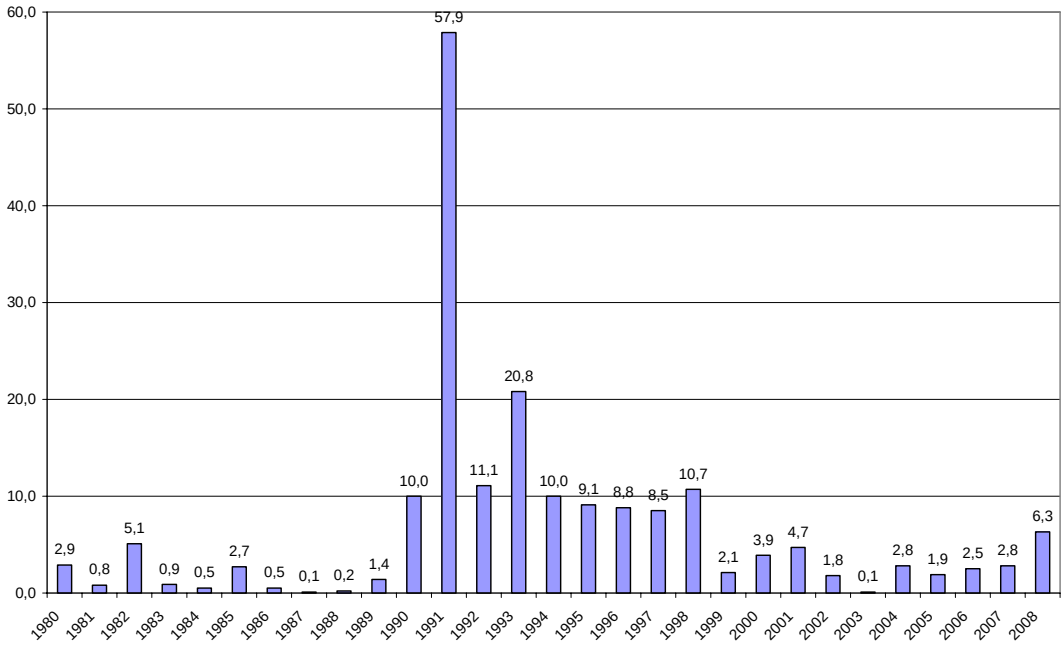
5.3 The inflation process

5.3.1 Legacy of the planned economy

During the planned economy times, inflation rates were relatively modest (cf. Graph 5.3.1 below). During 1980-1989, the average official inflation rate amounted to 1.5 % (Drabek et al., 1992). Also alternative estimations (Sujan cited in Zidek, 2006:17) point to relatively low inflation as the annual average was estimated at 3.5 %. However, in the late 1980s, the Czechoslovak economy was characterised by a monetary overhang, i.e. excessive savings relative to the supply of consumption goods. Furthermore, the absence of any private firms in the Czechoslovak socialist economy made the establishment of a competitive environment and market based price setting particularly difficult.

Graph 5.3.1:

Inflation rates in the Czech Republic (Czechoslovakia prior to 1993), 1980-2008



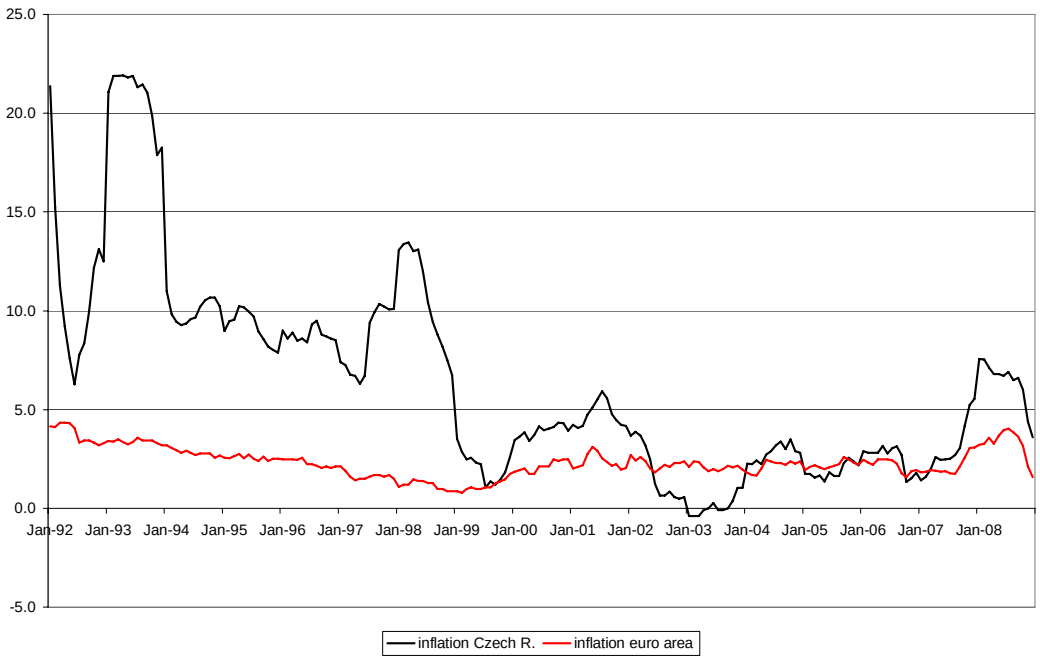
Source: Czech Statistical Office for 1992-2008; Drabek et al. (1992) for 1980-1991.

5.3.2 Inflation during the transition and the fixed exchange rate regime

Already in 1990, during the preparation phase for the main reform package, price subsidies for some products were cut and inflation surged to 10 %. In January 1991 the main reform package was introduced, which included the liberalisation of most prices and of external trade. The liberalisation process was accompanied by devaluations of the exchange rate. The overall devaluation between mid-1990 and early 1991 amounted to 70 % (Zidek, 2006:52). A hike in inflation to close to 30 % on a month-on-month basis followed in January 1991. To counteract the inflationary impulses from currency devaluation, monetary overhang and lack of competition in the domestic economy, the liberalisation phase was accompanied by tight fiscal and monetary policies (e.g. credit ceilings) and income policies (controls of wage growth). This contributed to the swift decline in inflation rates to a month-on-month increase of less than 1 % in mid-1991 (cf. Drabek et al., 1992). The overall increase in 1990 nevertheless stood at nearly 60 %. In 1992, inflation declined markedly to 11 % on average and stood at 7 % in mid-1992. Owing to the introduction of the value-added tax in early 1993, inflation rose to 20.8 % during that year (Graph 5.3.2). The tax reform was planned to have a neutral impact on price growth, however (cf. Zidek, 2006:128).

Graph 5.3.2:

Inflation rates in the Czech Republic and euro area, 1992-2008



Source: Eurostat, CNB.

In 1994-1997, inflation rates stabilised at moderate levels, with only a slowly declining trend. In the early years of that period it was claimed that the higher inflation rates were due to the sharp and possibly excessive devaluation of the koruna in 1991. This devaluation had created a "cushion" against the adverse effects of real appreciation and a marked loss of competitiveness (Dedek, 2000). Yet, the stabilisation of inflation at moderate levels meant a challenge for the central bank because the CNB operated a fixed exchange rate with very small fluctuation bands (of ± 0.5 %) since early 1991. The fixed exchange rate regime was meant to stabilise prices and to support low inflation, directly through the imported products, but also indirectly through its effect on the expectations of wage and price setters. Also according to the "cushion theory" inflation rates would decline to rates close to those in the anchor country once the effect of the excessive devaluation had tapered off. In reality, however, inflation rates started to decline from the levels of around 10 % to 8 % only after the introduction of wider fluctuation bands and currency appreciation in 1996. At the same time, the trade and current account deficits kept rising. Therefore, the suggested equilibrium appreciation related to the correction of excessive devaluation was only one source of the inflation differential towards Germany, the main anchor country. A second reason was that the two intermediate targets of a fixed nominal exchange rate and money targets were not strong enough to anchor expectations of wage and price setters. In 1996 growth of real wages exceeded that of average labour productivity by more than 5 percentage points (CNB, 1997:23).

Thirdly, the corporate governance problems mentioned in Section 5.1 played a role. The newly privatised firms and banks were strongly mutually dependent and firms' financial discipline was weak. The pressure on firms to lay off workers was relatively low, in particular when compared with the other transition economies. The firms' privatisation into the hands of small shareholders or state banks' investment funds implied that investments for the restructuring of enterprises had to be financed by bank loans. Credit expansion was vigorous, while the ability to assess risks based on market information was impaired. As a result, weak corporate governance combined with ample loan expansion enabled the firms to pay higher wages and raise demand and thus contributed to steady inflationary pressures.

Finally, strong capital inflows created problems for monetary control. Sizeable capital inflows started in 1993. Because of the fixed exchange rate regime with narrow fluctuation bands (of 0.5 % in 1993-1995) all capital inflows were converted into Czech koruny. These inflows led to liquidity surplus in the money market and extensive sterilisation on the part of the Czech National Bank. Still, the CNB could not prevent money supply from growing frequently in excess of the targeted rate. As a result, moderate inflation in the 1990s was the result of the slow progress in microeconomic restructuring, weak competition, loose credit

and wages growing well above productivity. Moreover, the fixed exchange rate, instead of disciplining the wage setters, constrained the central bank.

5.3.3 Inflation during the inflation targeting regime

With the shift to inflation targeting in 1998, the CNB aimed to facilitate a disinflation to low inflation levels through anchoring inflation expectations by the inflation target and the central banks' communication strategy. In addition to the inflation target as a signalling device, the central bank can exploit the interest rate and the exchange rate channels. However, at the time of the introduction of inflation targeting, the interest rate channel was assessed to work poorly. At the same time, while the exchange rate channel was assumed to be relatively strong as regards its direct effect on tradable goods' prices (cf. Ihnat/Procházka, 2002), the nominal exchange rate could anchor inflation expectations only to a limited extent.

To briefly recall, for the early years of the inflation targeting regime, the central bank defined a steadily declining inflation target (Table 5.2.1, p. 91, and Graph 5.2.2, p. 92), but the actual disinflation was much faster. After a rebound towards the end of 1997 and early 1998 owing to exchange rate depreciation and the adjustment of regulated prices, inflation declined swiftly from 13 % in May 1998 to 2.5 % in March 1999. Net inflation recorded even negative values in early 1999. The sharp deceleration in inflation was the consequence of monetary restriction, but also of an exchange rate depreciation that turned out lower than forecasted by the central bank, a deceleration of food prices and the increased reform effort that sped up restructuring of enterprises and lifted unemployment. After the disinflation episode, inflation remained rather low and fluctuated between 5 % in 2001, slightly negative rates in 2003, and rates of 2 to 3 per cent between 2004 and mid-2007. The spikes in 2001, 2004 and 2006 remained temporary. The pick-up in 2007/08 was higher than before; inflation rates climbed well above the inflation target for the first time since 2002. That resulted from the world-wide surge in food and energy prices, but also from an increase in the lower VAT rate from 5 % to 9 % and severe adjustments in regulated prices in early 2008. The government measures alone appear to have contributed 4 percentage points to headline inflation (CNB, 2008b:27). Inflation peaked at 7.5 % in January and February 2008. In early 2009 inflation rates have returned to the target band.

As a result, Czech inflation rates have been rather volatile and certainly more volatile than in the euro area. Furthermore, as it was already indicated above, the observed convergence of inflation rates with the euro area has been due to a frequent undershooting of the inflation target. Only in 2008 inflation exceeded the upper target band. An important contribution to the favourable development of inflation was apparently made by the trend

appreciation of the nominal exchange rate. Given the strong real appreciation we suggested that the underlying price trends might lead to higher inflation once the nominal exchange rate stabilises.

5.3.4 Decomposition of inflation

The most often used decomposition of the CPI is that according to consumption purpose, i.e. the internationally standardised COICOP (Classification of individual consumption by purpose). It decomposes the CPI items into categories such as food, clothing, transport, housing etc. However, some inflation theories derived above refer to certain specifics of the products such as their international tradability. A decomposition of the CPI that is more suitable for tests of the possible sources of inflation therefore splits the items in the CPI into industrial goods (which can approximate tradables; their prices are the most likely to be affected by the nominal exchange rate and the international price level), food (which are also tradables, but which are strongly influenced by weather conditions and other exogenous factors), energy (which is nearly not affected by monetary policy) and services (which can approximate non-tradables; their prices are the most likely to be affected by the Balassa-Samuelson effect or other wage pressures). In addition, sometimes also items with prices regulated by public authorities are separated. These are most often services such as public utilities, but they can also be found in other categories (e.g. some energy prices or water supply).

For the Czech Republic, an official decomposition into the five categories of food, industrial goods (excluding energy), market services, regulated items and energy is not available for a period starting in the mid-1990s. Therefore, we will evaluate several data sets to assess the development of these components. The first data set is published by the Czech National Bank in its Inflation Reports. It contains the inflation rates – and a series of the respective contribution to headline inflation[75] – of regulated prices, food prices and the "other" components. These "other" components can be interpreted as a measure of "core inflation", i.e. growth of prices that are the most likely to be influenced by monetary policy instruments. In this decomposition of the CNB, it includes industrial goods and market services, but also energy prices. That decomposition can be obtained for the time period starting in 1995 on a monthly basis. Since 2003, the decomposition is extended to energy prices. The second data set is also published by the CNB in its Inflation Report, and it contains inflation rates of food prices, tradables excluding food prices, non-tradables and regulated items. The inflation rates are reported for December of each year. The weights of these items in 1999 were 32.7 % for food, 34.6 % for other tradables, 18.3 % for regulated

[75] 'Contributions' are calculated by weighting the inflation rate of a particular sub-category with its share in the consumer basket.

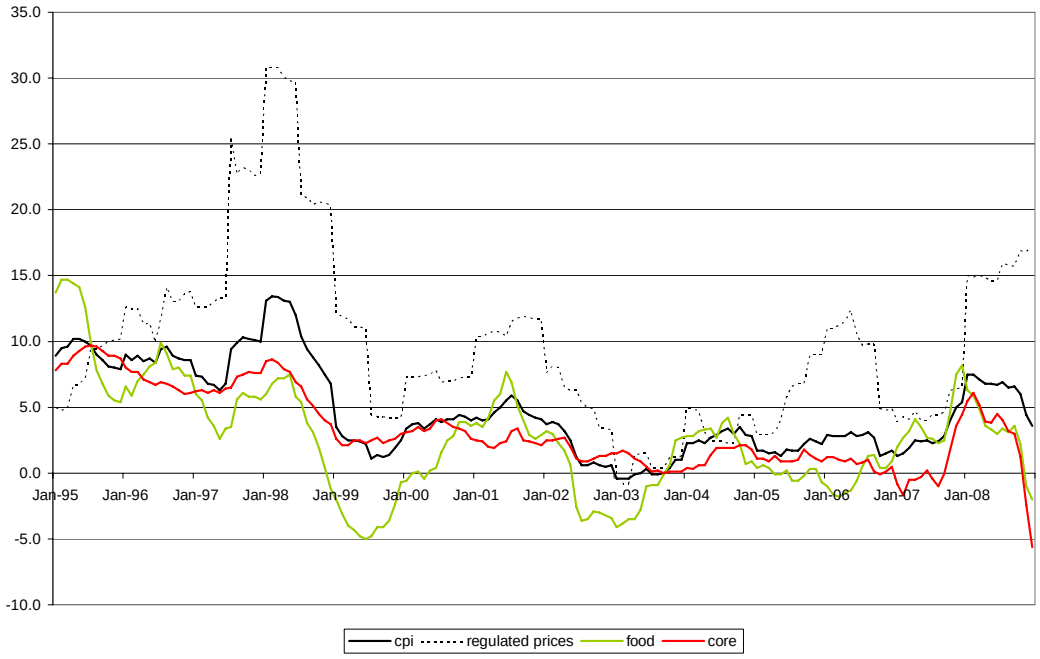
prices and 14.4 % for other non-tradables. As a result, the "core" components mentioned above made up less than 50 % of the consumer basket. This second data set is available starting in 1994. The third data set is the decomposition of the HICP[76] into the twelve main COICOP categories. It is available from Eurostat (database New Cronos) on a monthly basis starting in 1995. Eurostat also publishes a decomposition of the HICP into industrial goods prices (excluding energy), services, food and energy. These series start in 2000; inflation rates based on these data start in 2001. Eurostat also publishes weights of the twelve components, which enables us to derive proxy variables of market services and industrial goods prices for the period of the 1990s. As a result, some decomposition does not separate energy prices (these are part of core inflation or of tradables), whereas another does not separate regulated items. Still, when combined, these data sets allow us to draw some general conclusions about the development of all five components.

Graph 5.3.3 on next page presents the development of the series included in the first data set: regulated items, food prices and 'other' components (i.e. industrial goods, market services and energy prices; they are called "core" in Graph 5.3.3). A first observation is that before the disinflation process, all components showed inflation rates of at least 5 %. During the disinflation period in 1998, inflation decelerated in all categories. The strongest deceleration was observed for food prices, which even fell in nominal terms in 1999. Hence the deceleration of inflation in 1998 and 1999 to rates well below the targeted disinflation path was also the consequence of food price trends, which are less easily affected by central bank policies. After 1999 food prices have remained highly volatile, fluctuating between -5 % (June 1999) and +8.2 % (December 2007).[77] Their average growth rate stood at one per cent p.a. Second, core inflation has in nearly all months been lower than headline inflation. On average, core prices rose by 1.7 % during 1999-2008, compared with an increase of headline inflation of 2.9 %. Thirdly, inflation rates of regulated items considerably exceeded those of the other components not only in average terms (7.2 % during 1999-2008), but also in nearly all months. In mid-1997, when the government introduced harsh adjustment measures following the currency crisis, the inflation rate of regulated items surged to 30 %. Particularly strong adjustments were made also in 2001, 2006 and 2008, although none matched the hike of 1997/98. The adjustment of regulated prices varied considerably and, together with food prices, caused the pronounced volatility observed in headline inflation.

[76] The HICP (Harmonised Indices of Consumer Prices) differ from the national CPI only slightly.
[77] They have also fluctuated more heavily than in the euro area. During the period of 2001 to 2007, the average inflation rate of food was 2.4 % in the Czech Republic and 2.7 % in the euro area. However, standard deviation was 3.8 percentage points in the Czech Republic and 1.2 percentage points in the euro area.

Graph 5.3.3:

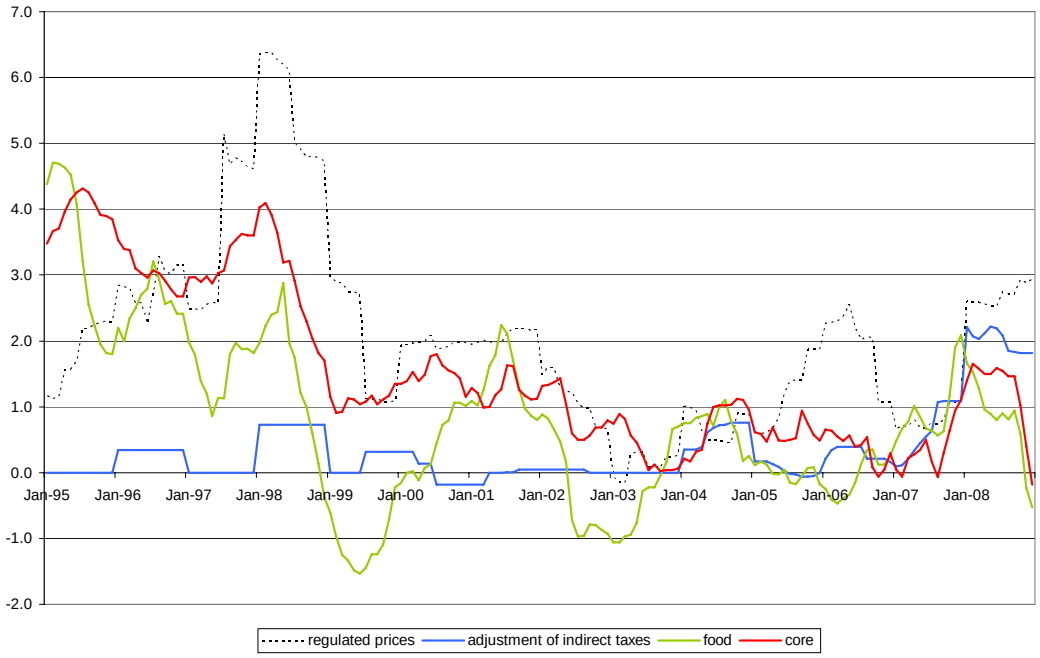
Inflation rates of headline CPI, core prices, regulated items and food prices



Source: CNB. 'Core' includes the prices of industrial goods, market services and energy.

Graph 5.3.4:

Contributions of core inflation, regulated items, adjustments of indirect taxes and food prices to headline inflation

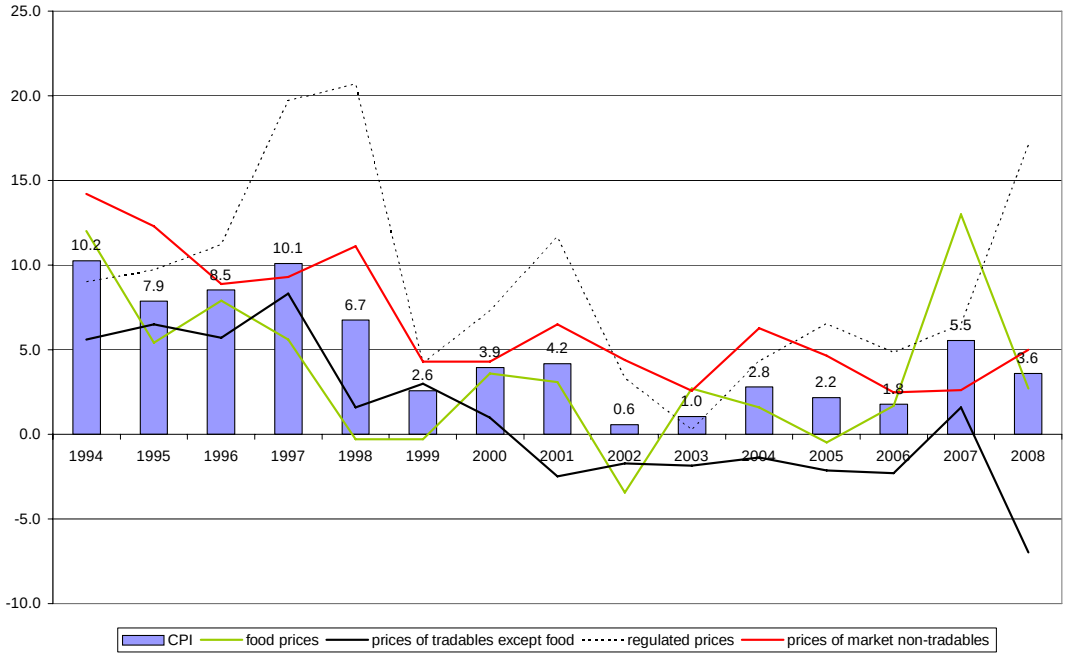


Source: CNB. Note: Contributions to the inflation rate are calculated by weighting the inflation rate of the respective sub-category with its share in the consumption basket. 'Core' includes the prices of industrial goods, market services and energy.

Turning to the contributions of the sub-components to headline inflation, which depends on both the growth rate and its share in the consumer basket, between January 1995 and December 2008, the average contribution of regulated items was 2.0 percentage points, while the average inflation rate during that period amounted to 4.7 % (Graph 5.3.4 on previous page). After the disinflation process, i.e. between January 1999 and December 2008, the contribution of regulated prices amounted to 1.5 percentage points of an average inflation rate of 2.9 %. Thus half of the inflation rate has been the consequence of adjustments in regulated items. Core inflation contributed on average 1.5 percentage points in the period starting in 1995, and 0.8 percentage points in 1999-2008. This is less than a third of the overall inflation rate. Food prices have contributed modestly with 0.8 percentage points in the longer period and 0.3 percentage points in the period starting in 1999. Graph 5.3.4 also shows the contributions from changes in indirect taxes. These amounted to 0.3 in 1995-2008 and to 0.4 percentage points in 1999-2008. Between 2003 and 2008, energy prices contributed on average 0.1 percentage point to inflation.

Graph 5.3.5:

Inflation rates of headline CPI, food prices, other tradables, regulated items and other non-tradables in December of respective year



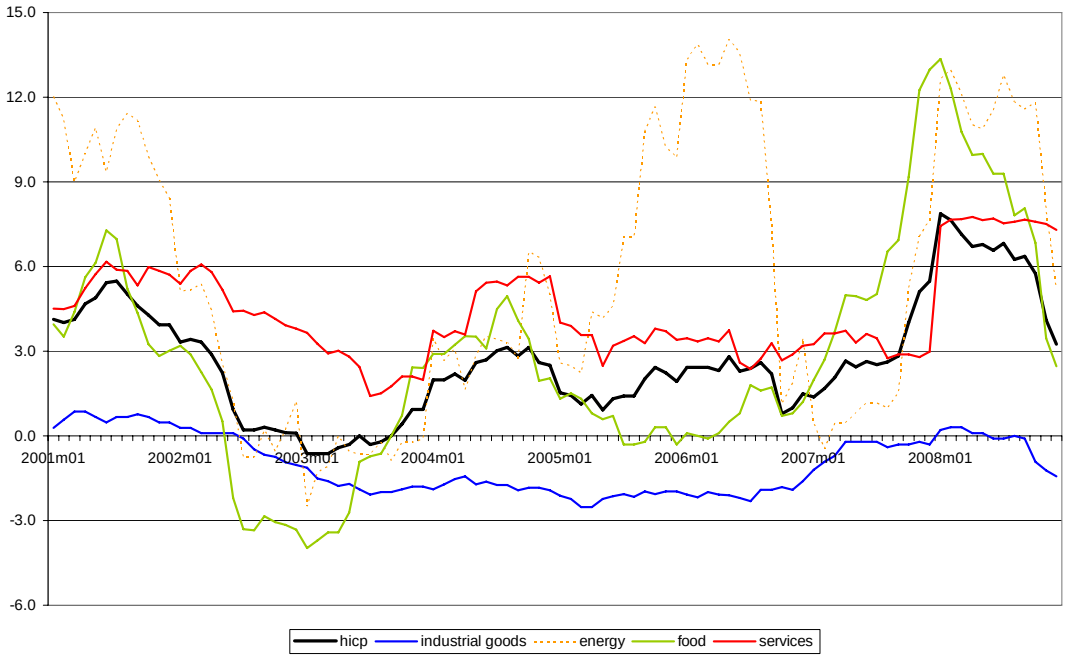
Source: CNB.

The second decomposition of the CNB contains the December year-on-year inflation rates for the CPI and the categories of food, other tradables (which may correspond to industrial goods), regulated items, and other non-tradables (market services; Graph 5.3.5 above). Also

according to this decomposition, the highest average inflation rate was registered for regulated items, while food price inflation was on average relatively modest. However, our main focus now is the decomposition of core inflation into tradables and non-tradables. In particular after the disinflation phase in 1998, these two components (tradables – industrial goods, and non-tradables – market services) have shown divergent trends. Whereas industrial goods prices were often declining between 2001 and 2008, market services prices grew by average of 4.4 %. For most of the time, inflation of non-tradables has been well above headline inflation. Therefore, a strong adjustment of relative prices occurred within the core components, which is in line with theoretical considerations about the catching-up growth process (Balassa-Samuelson effect). Hence the positive contribution of core inflation to headline inflation indicated in Graph 5.3.4 (p. 116) apparently stems mainly from the growth in market service prices. Industrial goods prices have put downward pressure on inflation, which might have been expected owing to the steady appreciation of the exchange rate.

Graph 5.3.6:

Inflation rates according to the HICP decomposition of Eurostat



Source: Eurostat.

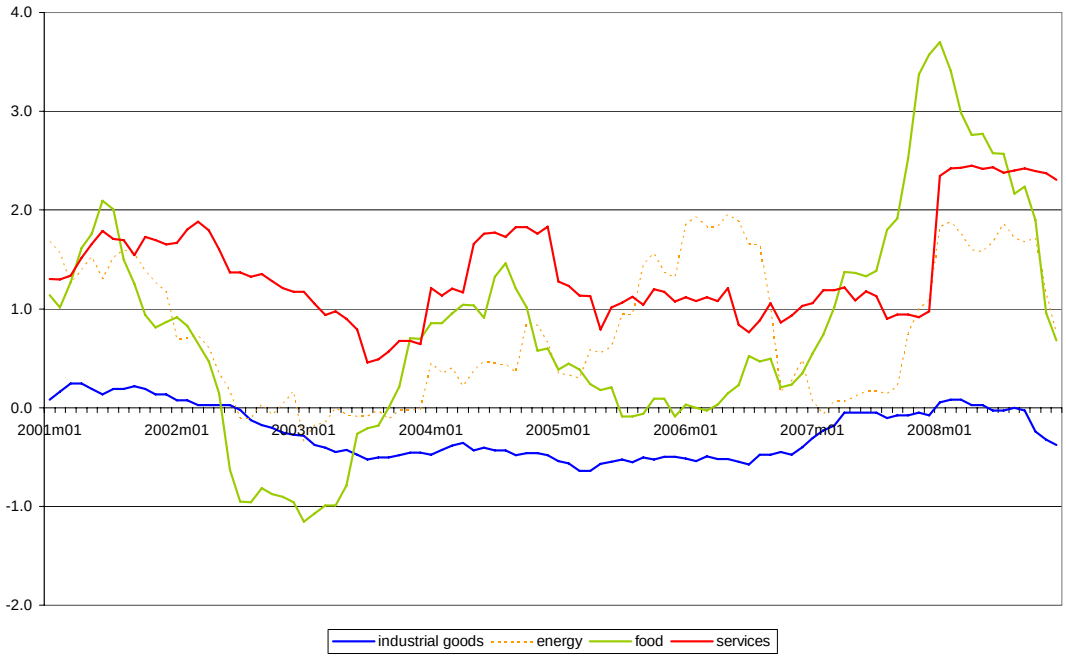
Our third data set contains the decomposition of the HICP into industrial goods prices[78], energy, food prices and services by Eurostat (Graph 5.3.6, above). Year-on-year inflation rates for these series start in 2001. The main additional information from this data set is the

[78] These exclude energy goods.

development of energy prices, which have fluctuated even stronger than food prices. In addition, the average inflation rate of energy goods (of 5.6 % during 2001-2008) clearly exceeded headline inflation (of 2.7 % in 2001-2008). The HICP data confirm the earlier observation of a sharp adjustment in relative prices between industrial goods and services (in the Eurostat classification these include most of the regulated items). Graph 5.3.7 below shows that except for the period of very low inflation in 2002/2003, only industrial goods prices have contributed negatively to inflation (average in 2001-2007: -0.7 percentage points). All other components have recorded positive contributions (services: 1.2 percentage points, energy 0.7 and food 0.6 percentage points).

Graph 5.3.7:

Contributions of HICP subcomponents to headline inflation



Source: Own calculations based on data from Eurostat. Contributions to the inflation rate are calculated by weighting the inflation rate of the respective sub-category with its share in the consumption basket.

The picture that emerges from these three data sets is that inflation was substantially affected by hikes in regulated prices, which have accounted for half of the observed headline inflation rate since 1999. Food prices fluctuated heavily, but on average contributed to inflation only moderately. Energy prices showed even stronger swings and contributed substantially to inflation in particular since 2006. On the other hand, core inflation, which excludes the effect of regulated prices and of food prices, has stayed below headline inflation in nearly all months since 1995. On average, it has added only one third to the headline inflation rate. However, among the core components, market services prices

grew markedly and their inflation rate often exceeded headline inflation. By contrast, industrial goods prices have declined on average. As a result, the adjustment of the relative price of industrial goods and market services, which is characteristic of catching-up economies, can clearly be found in the Czech data.

5.4 Econometric analysis of the inflation process

The estimated relations are motivated by the theories presented in Chapter 3. The econometric tests of the inflation process focus on the market based prices; the estimations are made for headline CPI and sub-indexes such as industrial goods, food and market services' prices. In every section, we will first conduct a preliminary analysis of the suggested link and then turn to the results of the econometric tests. The estimation period for the inflation tests is 1996-2007; the data set contains quarterly data. As most series contain a unit root, the econometric analysis is carried out with cointegration tests (cf. Appendix 2, pp. 237-243).

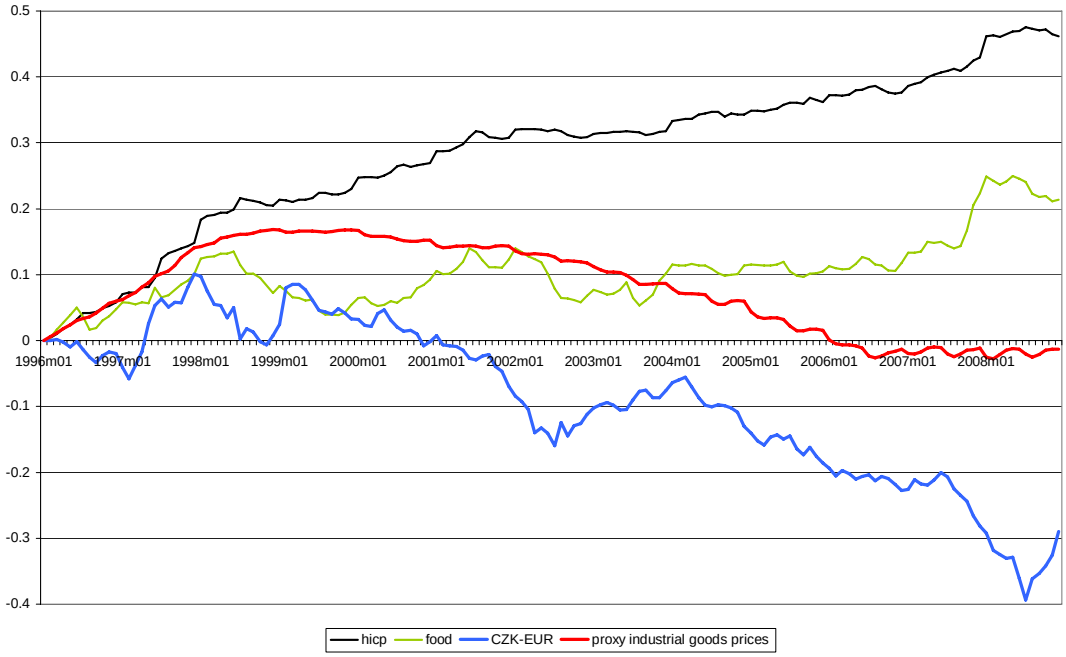
5.4.1 Purchasing Power Parity

5.4.1.1 Preliminary data analysis

Purchasing Power Parity refers to tradables. Of the product classes included in the CPI, industrial goods prices and food prices are the most likely to be influenced by foreign prices and the exchange rate. The econometric tests of PPP are therefore carried out for headline CPI, industrial goods prices and food prices. Because no official long time series of industrial goods' prices is available, a proxy series for the industrial goods prices was calculated by merging the components clothing and furniture from the HICP decomposition according to COICOP. Graph 5.4.1 on next page shows the development of the nominal exchange rate, the HICP, industrial goods prices (proxy series), and food prices (excluding alcohol and tobacco, COICOP category 01). All series are provided by Eurostat. The nominal exchange rate appreciated slightly in 1997, and then fluctuated strongly after the currency crisis in 1998-1999. Since 2000, it has been on a path of trend appreciation. Industrial goods prices have declined along the nominal appreciation of the exchange rate. However, the transmission of the nominal appreciation into tradables' prices appears to be limited. In addition, the rather pronounced fluctuations of the nominal exchange rate were not translated into equally strong fluctuations of the industrial goods prices. Specifically, phases of currency depreciation did not stop the industrial goods prices from declining. At the same time, the sharp appreciation in 2008 was barely translated into prices of industrial goods. Food prices rose slightly, while the HICP followed a steady upward trend, diverging from the development of the exchange rate.

Graph 5.4.1:

HICP, industrial goods prices, food prices and the nominal exchange rate of the CZK towards the euro



Note: All series are shown as logs of the respective data normalised to January 1996. The proxy series for industrial goods prices is defined in Table A3.1 in Appendix 3 (p. 253). Prior to 1999, the euro is approximated by the ecu.
Source: CNB, Eurostat.

5.4.1.2 Results of the econometric tests

We estimated three equations relating to PPP (cf. Chapter 3.2). The first equation tests for the direct link between prices and the nominal exchange rate as suggested by equation (25) in Chapter 3.2:

$$p^d = f(e)\,. \qquad (67)$$

The relations are now presented in logs. The second equation includes also the effect of the foreign prices:

$$p^d = f(e, p^{EA})\,. \qquad (68)$$

The third equation is of the Balassa-Samuelson type. It is tested whether the real appreciation of the Czech currency (based on the CPI) might be related to the higher productivity growth:

$$p^d = f(e, p^{EA}, q^{BS2})\,. \qquad (69)$$

q^{BS2} stands for the dual productivity differential, i.e. the deviation of the Czech productivity differential from the one observed in the euro area. The link is derived from the internal Balassa-Samuelson effect summarised in equation (40). If the Balassa-Samuelson effect

holds true for the euro area also and the two economies share the same technology, the foreign price level can be expressed in terms of the tradables' price level and the impact of the productivity differential as in equation (38). In logs:

$$p^f = p_T^f + \beta_{NT}^f \cdot \ln\left[\frac{b}{c}\frac{Y_T^f / L_T^f}{Y_{NT}^f / L_{NT}^f}\right]. \tag{70}$$

As a result, the domestic price level can be expressed as

$$p^d = p^f - \beta_{NT}^f \cdot \ln\left[\frac{b}{c}\frac{Y_T^f / L_T^f}{Y_{NT}^f / L_{NT}^f}\right] + e + \beta_{NT} \cdot \ln\left[\frac{b}{c}\frac{Y_T / L_T}{Y_{NT} / L_{NT}}\right]. \tag{71}$$

or

$$p^d = p^f + e + \beta_{NT} \cdot \left(\ln\left[\frac{b}{c}\frac{Y_T / L_T}{Y_{NT} / L_{NT}}\right] - \ln\left[\frac{b}{c}\frac{Y_T^f / L_T^f}{Y_{NT}^f / L_{NT}^f}\right]\right). \tag{72}$$

q^{BS2} relates the two productivity differentials and, in terms of equation (72), stands for the expression in parentheses. In the estimation the weight of non-tradables is assumed to be the same in the domestic and foreign economies: $\beta_{NT} = \beta^f_{NT}$.

The dependent variables are

- headline CPI (in logs, 'cpi'),
- industrial goods prices (in logs, 'ind'), which is the proxy series created by merging the components of furniture and clothing from the COICOP classification of the Czech HICP. The source of these series and of their weights in the Czech consumer basket is the NewCronos database of Eurostat.
- food prices within the HICP (in logs, 'food').

The explanatory variables include

- the nominal exchange rate towards the euro (or Deutsche Mark before 1999; 'czk', in logs),
- the euro area HICP (in logs, 'ea-hicp') and the euro area industrial goods prices excluding energy (in logs, 'ea-ind'),
- euro area food prices (in logs, 'ea-food'),
- the dual productivity differential (in logs, 'bs2'). The data on real value added and employment in the respective sectors are taken from the national accounts statistics in New Cronos (Eurostat). The definition is given in Section 5.4.3, which deals with the Balassa-Samuelson effect in detail.

In some tests, in the short-term dynamics of the VECM, we also considered the regulated price and indirect tax adjustments. The latter series corresponds to the 'adjustment of indirect taxes' shown in Graph 5.3.4 (p. 116). It does not reflect the individual adjustments of the tax rates but already the pass-through of the tax changes into inflation determined by

the CNB. The definitions and sources for all variables are summarised in Table A3.1 in Appendix 3 (pp. 253-255).

The results of the unit root tests are in Table A3.3 in Appendix 3 (p. 257). According to these tests, nearly all considered series can be regarded I(1). Notable exceptions are industrial goods prices and the euro area HICP, which possibly might be I(2), and food prices, which might be regarded stationary. We nevertheless included also these series in the cointegration tests, but the results have to be treated with due caution.

Table 5.4.1:

Cointegration tests between the logs of CPI, the nominal exchange rate and euro area HICP

1996:1-2007:4	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
cpi	SC=1	0	21.01	20.13*
czk		1	1.72	1.65
cpi	SC=1	0	47.78	44.78**
czk		1	9.98	9.35
ea-hicp		2	2.31	1.99
cpi	SC=1	0	64.89	59.56**
czk		1	23.41	21.45
ea-hicp		2	8.70	7.97
bs2		3	1.96	1.79

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'BS2' stands for the dual productivity differential. ** denotes significance at 1 %, * at 5 % and # at 10 %. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).

The graphs of the series considered in the estimations for headline CPI are shown in Appendix 3 (Graphs A3.6-A3.7, pp. 246-247). The cointegration tests found a long-term link between the logs of headline CPI and of the nominal exchange rate (Table 5.4.1 above), but the sign of the nominal exchange rate was opposite to the one suggested by theory: a nominal appreciation was associated with an increase in inflation (Table 5.4.2, next page). The parameter estimation is not statistically significant, however. When the euro area inflation rate is considered in addition to the nominal exchange rate, the tests not only confirm the cointegration relation, the signs of the parameters are also in line with theory (Table 5.4.3, next page). The nominal exchange rate is translated into prices markedly (parameter is 0.8), but Czech prices react more than proportionately to euro area prices. This could reflect the process of real appreciation. Therefore, in a third equation we included the log of the productivity differential ('bs2'). However, the tests detect only one cointegration relation (Table 5.4.1), apparently that determined already earlier. These tests therefore do not support the proposition that the observed real appreciation is primarily

based on catching-up productivity. As regards the adjustment to the long-term relation, the tests find that the Czech prices adjust and that both the nominal exchange rate and the euro area prices can be considered (weakly) exogenous. The speed of adjustment, however, is rather low (0.13).

Table 5.4.2:

Parameters of the cointegration relation between the logs of CPI and nominal exchange rate

COINTEGRATION RELATION			
	cpi	czk	constant
Coefficient *(t-statistic)*	1	*+0.24* *(1.04)*	-0.30
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(cpi)	Δ(czk)	
Coefficient *(t-statistic)*	*-0.05* *(-4.28)*	*-0.06* *(-1.94)*	

Note: As for Table 5.4.1. In parentheses are t-values.

Table 5.4.3:

Parameters of the cointegration relation between the logs of CPI, nominal exchange rate and euro area HICP

COINTEGRATION RELATION				
1996:1-2007:4	cpi	czk	ea-hicp	constant
Coefficient *(t-statistic)*	1	-0.78 *(-4.73)*	-2.07 *(-9.07)*	-0.11
ADJUSTMENT TO COINTEGRATION RELATION				
	Δ(cpi)	Δ(czk)	Δ(ea-hicp)	
Coefficient *(t-statistic)*	-0.13 *(-6.49)*	-0.05 *(-0.63)*	0.01 *(1.63)*	

Note: As for Table 5.4.1. In parentheses are t-values.

Therefore, while the test results can be interpreted in favour of a statistically significant link between the logs of Czech headline CPI, the nominal exchange rate and euro area HICP, the coefficients are not fully in line with theory. In particular, the observed real appreciation of the currency is reflected in a more than proportionate reaction to euro area prices, instead of the productivity differential. Furthermore, there is only a partial pass-through of the nominal exchange rate (and the nominal appreciation) into domestic prices.

In the tests for the subcomponents, a potential problem arises from the fact that the industrial goods prices series was assessed as I(2) by the unit root tests. We have nevertheless used this series in cointegration tests with the nominal exchange rate and euro area industrial goods prices. The series are shown in Graph A3.8 in Appendix 3 (p. 247).

The tests find cointegration for both tested specifications, i.e. for one that links Czech prices to the nominal exchange rate and one where the Czech prices are related to a combined series of the nominal exchange rate and euro area prices (Table 5.4.4 below).[79] The parameters are reasonable (Table 5.4.5, next page). The test results show that the nominal exchange rate was translated into the development of industrial goods prices only partially, the coefficient being 0.6 when the combined effect of the nominal exchange rate and euro area prices is considered. The exchange rate and foreign prices can be regarded (weakly) exogenous; it is the Czech industrial goods prices that adjust to this long-run relation. Yet, the adjustment of the industrial goods prices is (again) rather slow.

As regards the link between food prices, the nominal exchange rate and foreign food prices,[80] the tests do not find cointegration (Table 5.4.4 below). On a lower significance level (of 10 %), the tests detect cointegration between Czech food prices and euro area food prices. The rather low coefficient of 0.3 indicates a weak reaction of Czech food prices, which however might be the consequence of the trend nominal appreciation (Table 5.4.5, next page).

Table 5.4.4:

Cointegration test between logs of components of the Czech HICP, corresponding euro area price indices and the nominal exchange rate

1996:1-2007:4	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
ind czk	SC=2	0 1	19.73 1.54	18.09* 1.41
ind czk+ea-ind	SC=3	0 1	20.34 3.71	18.65* 3.40
food czk+ea-food	SC=2	0 1	10.27 0.41	9.41 0.37
food ea-food	SC=2	0 1	16.67 2.53	15.28# 2.32

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'ea-ind' stands for the log of industrial goods prices in the euro area HICP. 'ea-food' stands for the log of food prices in the euro area HICP. ** denotes significance at 1 %, * at 5 % and # at 10 %. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).

[79] In an estimation that included the nominal exchange rate and euro area prices separately, the trace test detects also only one cointegration relation.

[80] Graphs of these series are in Appendix 3, Graph A3.9 (p. 248). This relation also includes the tax adjustments in the short-term dynamics.

Table 5.4.5:

Parameters of the cointegration relation between the logs of components of the Czech HICP, corresponding euro area price indices and the nominal exchange rate

COINTEGRATION RELATION			
1996:1-2007:4	ind	Czk	constant
Coefficient *(t-statistic)*	1	-0.50 *(-5.09)*	-0.11
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(ind)	Δ(czk)	
Coefficient *(t-statistic)*	-0.03 *(-3.64)*	0.09 *(0.85)*	
COINTEGRATION RELATION			
1996:1-2007:4	ind	czk+ea-ind	constant
Coefficient *(t-statistic)*	1	-0.61 *(-4.64)*	-0.08
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(ind)	Δ(czk+ea-ind)	
Coefficient *(t-statistic)*	-0.03 *(-3.15)*	0.13 *(1.23)*	
COINTEGRATION RELATION			
1996:1-2007:4	food	ea-food	constant
Coefficient *(t-statistic)*	1	-0.29 *(-3.15)*	-0.06
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(food)	Δ(ea-food)	
Coefficient *(t-statistic)*	-0.27 *(-2.87)*	0.01 *(0.38)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'ea-ind' stands for industrial goods prices in the euro area HICP. In parentheses are t-values.

To summarise the results of the PPP tests, we found that the nominal exchange rate is translated into headline CPI only partially. At the same time, the parameter in front of the euro area prices is very high. While that could reflect the process of price level convergence in line with the Balassa-Samuelson model, this is not confirmed in the tested relation that includes the productivity differential. As regards the components of the CPI that are the most likely to be influenced by the nominal exchange rate and foreign prices, the cointegration tests detect a long-term link between industrial goods prices, their euro area counterparts and the nominal exchange rate. Also according to these tests, the nominal appreciation has been translated into Czech prices only partially. As a result, the real appreciation of the exchange rate based on headline CPI stems to some extent from the partial pass-through of exchange rate movements into tradables' prices. Admittedly, the possibility of an equilibrium appreciation also for industrial goods prices and tradables was

discussed in the literature (Lommatzsch/Tober 2004). However, the exact amount is open to discussion and cannot be tested within this framework. At the same time, the insufficient pass-through of the nominal appreciation into prices could indicate cost pressures, e.g. from wages. For food prices we found only a (weak) link between the two price series, without a direct influence of the nominal exchange rate. This might reflect a common component in the agricultural goods' prices.

5.4.2 Balassa-Samuelson effect

5.4.2.1 Preliminary data analysis

According to the Balassa-Samuelson model, non-tradables' prices are driven by industrial goods' prices and the productivity differential between market services and industry (Chapter 3.2). By log-differencing, equation (36) can be restated in terms of growth rates. Because of the log-differencing, this relation holds in approximation:

$$\pi_t^{NT} = \pi_t^T + (\Delta q_t^T - \Delta q_t^{NT}) . \qquad (73)$$

As a result, inflation rates of non-tradables depend on inflation in tradables' prices and the difference in productivity growth between the traded and non-traded goods sectors.

The Balassa-Samuelson effect is defined as a medium-term relation. Short-term fluctuations due to the business cycle or exchange rate movements can interfere with the general trend. The size of the effect should hence be gauged based on average growth rates over a number of years. Furthermore, an assessment of the Balassa-Samuelson effect requires a division of the economic sectors into those producing tradables and those producing non-tradables. In line with a number of earlier investigations of the Balassa-Samuelson effect (for an overview of this literature cf. Lommatzsch/Tober 2006), we approximate the tradables' sector by the national accounts sector of industry (manufacturing, energy, mining), and the non-tradables' sector by construction, retail and wholesale trade, finance and business services. This definition need not necessarily reflect the "true" decomposition into the sectors producing tradables and non-tradables. However, these data are the most easily available and they still convey the general trend in the productivity differential between the two sectors.

Table 5.4.6 (next page) contains the growth rates of productivity in industry and market services for the period 1997-2007. However, before the productivity and the inflation differentials can be compared, we have to make sure that a crucial precondition of the Balassa-Samuelson effect is verified: wage equalisation among the sectors. According to Graph A3.10 in Appendix 3 (p. 248), wage growth in the two sectors was indeed rather balanced. Turning to the productivity differential between industry and market services, it was positive on average during the entire period, and amounted to 3.0 %. In the period

since 1999 (i.e. after the introduction of major reform measures), the productivity differential was even higher (4.9 %). This compares with an average inflation differential of 5.6 percentage points based on the (second) CNB dataset introduced in Section 5.3.4 during both mentioned periods (cf. Graph 5.3.5, p. 117). These data refer to December of each year. Thus, we have also calculated the inflation differential for the decomposition of the HICP based on the 12 main COICOP groups available from Eurostat. As previously, the industrial goods price proxy is calculated by merging the subcategories furniture and clothing. Market services contain transport, communication, recreation, restaurants and miscellaneous goods and services. Based on this decomposition, the average inflation differential amounted to 3.8 percentage points in the overall period and 4.4 percentage points in 1999-2008. Thus, after the turn of the century, the productivity differential might have slightly exceeded the inflation differential.

Table: 5.4.6:

Year-on-year growth rates of productivity and prices in the industrial goods' and market services sectors

	1997	1998	1999	2000	2001	2002	2003
			PRODUCTIVITY				
industry	-2.9	-5.2	16.1	10.7	-2.9	4.9	2.1
market services	-0.1	4.8	-1.6	0.7	5.2	-0.4	6.3
difference	-2.7	-10.1	17.6	10.1	-8.0	5.3	-4.3
			INFLATION CNB DATASET				
tradables	8.3	1.6	3.0	1.0	-2.5	-1.7	-1.9
non-tradables	9.3	11.1	4.3	4.3	6.5	4.4	2.6
difference	1.0	9.5	1.3	3.3	9.0	6.1	4.4
			INFLATION HICP DECOMPOSITION				
industrial goods	7.0	5.9	0.8	-0.9	-0.7	-1.1	-3.1
market services	7.3	7.2	3.5	5.4	3.3	1.8	0.9
difference	0.3	1.3	2.6	6.3	4.0	2.9	4.0

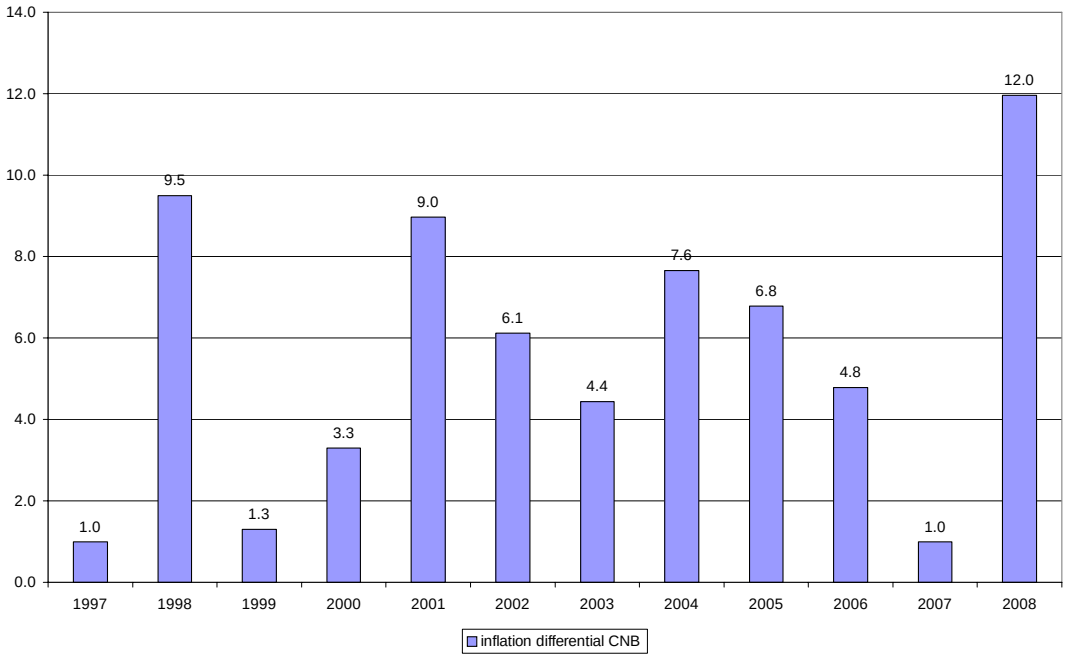
	2004	2005	2006	2007	2008	average 1997-2008	average 1999-2008
			PRODUCTIVITY				
industry	12.7	8.8	11.1	5.8	5.1	5.5	7.5
market services	0.1	4.5	5.6	3.9	1.1	2.5	2.6
difference	12.6	4.3	5.5	1.9	4.0	3.0	4.9
			INFLATION CNB DATASET				
tradables	-1.4	-2.1	-2.3	1.6	-7.0	-0.3	-1.3
non-tradables	6.3	4.6	2.5	2.6	5.0	5.3	4.3
difference	7.6	6.8	4.8	1.0	12.0	5.6	5.6
			INFLATION HICP DECOMPOSITION				
industrial goods	-3.1	-3.8	-3.9	-0.4	-0.3	-0.3	-1.7
market services	3.7	2.3	2.1	1.3	2.7	3.5	2.7
difference	6.8	6.1	5.9	1.7	3.0	3.8	4.4

Source: CNB, Eurostat, own calculations. Figures may not add up due to rounding.
Note: 'CNB dataset' refers to 'second' data set from CNB introduced in Section 5.3.4 and presented in Graph 5.3.5 (p. 117). 'Inflation HICP decomposition' refers to the data shown in Graph 5.3.6 (p. 118).

The data presented in Table 5.4.6 (previous page) and in Graph 5.4.2 below indicate that wage pressures related to the catching-up growth process could indeed be a source of inflation. However it has to be kept in mind that this is only a 'mechanical' application of the model. In addition, the overall effect on headline inflation depends not only on the size of the productivity and inflation differential, but also on the weight of market services in the CPI. That weight can be rather small. In the CNB decomposition the weight of market services is specified as 14.4 % (year 1999). Applying equation (73) mechanically to the data and assuming an "equilibrium" inflation differential of 5 percentage points and inflation of all other CPI components of 1.5 % p.a., the average inflation rate would amount to 2.3 %. Yet, the weight of market services increases during the catching-up growth process and with the liberalisation of services that are still regulated, which raises the impact of the productivity differential on headline inflation.

Graph 5.4.2:

Inflation differential between market services and industrial goods prices



Source: Czech National Bank. Calculation is based on the data set shown in Graph 5.3.5 (p. 117).

5.4.2.2 Results of the econometric tests

The estimated relation is based on equation (36) in Section 3.2. The link between tradables, non-tradables and the productivity differential is tested in log-levels. The estimated equation is

$$p_t^{MSERV} = f(p_t^{IND}, q_t^{BS1}). \qquad (74)$$

The dependent variable is the log of market service prices ('mserv'), which is the proxy series derived from the HICP subgroups and which was introduced above. The explanatory variables are the log of industrial goods prices ('ind', proxy series based on HICP subgroups) and the log of the domestic productivity differential ('bs1', which relates productivity in industry to that of market services and which was calculated from national accounts data). In the VECM, regulated prices were included in the short-term dynamics. This might be explained by the fact that the series used in the estimation are calculated based on the twelve main COICOP groups. Regulated prices are likely to form part of the categories transport (e.g. public transport) and miscellaneous (several fees). A proper consideration of regulated prices was not possible.

The unit root tests (Table A3.3, Appendix 3, p. 257) for market service prices indicate that these are I(1), while the industrial goods prices were already earlier determined as I(2).The combined series of the industrial goods prices and the productivity differential is assessed as I(1), however. Graph A3.11 in Appendix 3 (p. 249) exhibits the series.

Table 5.4.7:

Cointegration tests between the logs of market services prices and industrial goods prices

1996:1-2007:4	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
mserv ind	SC=2	0 1	12.87 1.97	11.79 1.80
mserv ind+bs1	SC=1	0 1	22.65 3.56	21.70** 3.41

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'bs1' stands for the productivity differential between industry and market services. Regulated prices (in first differences) are included in the VECM in the short-term dynamics. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 5.4.8:

Parameters of the cointegration relation between the logs of market services prices, industrial goods prices and the productivity differential

COINTEGRATION RELATION			
1996:1-2007:4	mserv	ind+bs1	constant
Coefficient *(t-statistic)*	1	-0.71 *(-4.71)*	-0.13
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(mserv)	Δ(ind+bs1)	
Coefficient *(t-statistic)*	-0.05 *(-3.33)*	0.23 *(2.16)*	

Note: As for Table 5.4.7. In parentheses are t-values.

In line with the Balassa-Samuelson model, the cointegration tests do not detect a cointegration relation between the prices of market services and industrial goods alone, but for a link that includes in addition the productivity differential (Table 5.4.7, previous page). The long-term coefficient determined in the VECM is below the coefficient suggested by theory, which is 1 (Table 5.4.8, previous page). At the same time, both series adjust to this relation, which also does not confirm the theoretical argument of a causal link between industrial goods prices and market service prices. And finally, the speed of adjustment of market services prices to this long-term link is slow. As a result, while this estimation confirms that the productivity differential can be regarded a source of inflation through the adjustment of relative prices, the empirical link does not fully comply with theory. This was already suggested in the previous section since the productivity differential was found to have exceeded the inflation differential. Nevertheless, this link implies that the nominal appreciation has a dampening effect on the inflation of market services also.

5.4.3 Wage-price dynamics

5.4.3.1 Preliminary data analysis

Wages as the main economy-wide cost factor can be a dominant factor of inflation if prices are set as mark-up over costs (in line with equation (49) in Section 3.3.1). Inflationary pressures arise if wage growth perpetually exceeds productivity growth, so that unit labour costs steadily rise. At the same time, in wage setting (as shown in equation (56)), the expected development of prices plays a crucial role. If inflation expectations are high, this feeds into wages and – with mark-up pricing – into prices. In addition, with backward looking inflation expectations, cost-driven inflation can be perpetuated.

In the Czech Republic, wage bargaining takes place predominantly at the company level (Du Caju et al. 2008). A tripartite body (government, unions and employers) exists, which negotiates social standards and the minimum wage.[81] If no agreement is achieved, the minimum wage is set by the government. In the previous years, these wages were adjusted at least once every year (Bastyr, 2005; Bastyr, 2007).

Graph 5.4.3 on next page shows the development of nominal wages in the private sector,[82] unit labour costs,[83] average labour productivity and inflation in 1996 – 2007. In 1996, i.e.

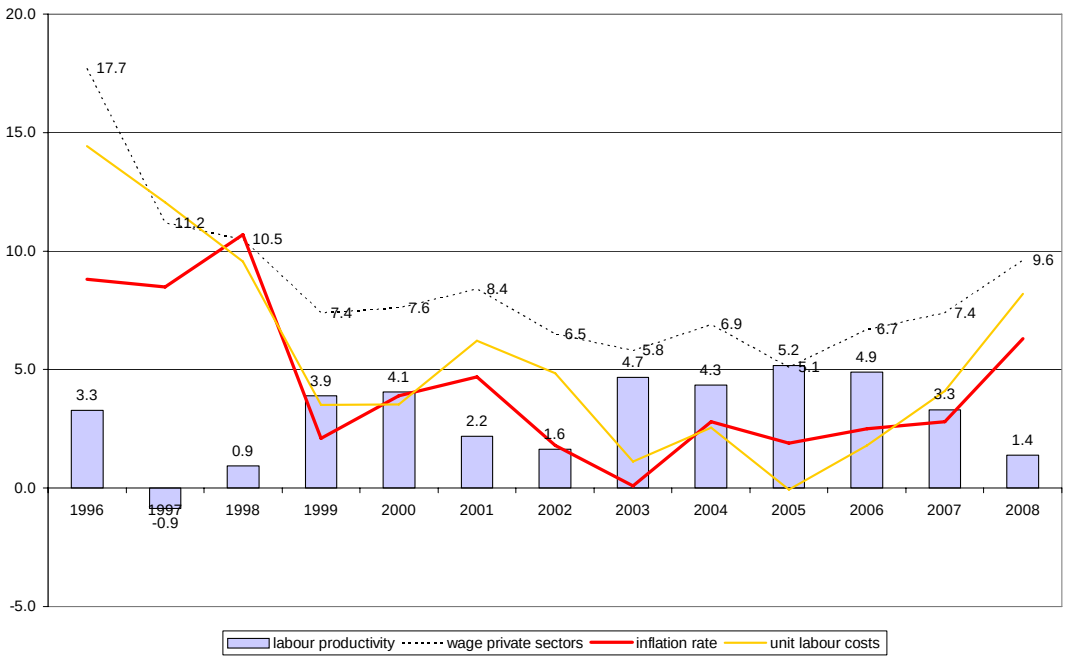
[81] cf. Czech Ministry of Labour and Social Affairs at http://www.mpsv.cz/cs/6434.

[82] This measure was chosen because it is the market sector that is most likely to react to the central bank policies. At the same time, the differences between the growth rates of wages in the private sector and the public sector are small in the Czech Republic.

during the moderate inflation period, wages grew by 15.6 % and unit labour costs by more than 12 %. In that period, wage and unit labour costs apparently contributed to economy-wide inflationary pressures. During the second adjustment recession in 1998 and 1999, wage growth declined to less than 8 %. In addition, in 1999, productivity growth accelerated. As a result, the marked decline in unit labour costs in 1999-2000 was also the consequence of higher productivity growth. Afterwards, wage growth fluctuated between 5 % and 7 % for a number of years. In 2008, however wages climbed by 9.6 %, possibly as a reaction to the surge in inflation. Because of the rather stable wage growth during most of the 2000s, fluctuations in unit labour costs growth reflected the productivity dynamics. Between 2003 and 2007, productivity rose by 5 % p.a., implying unit labour costs growth of a maximum of 3 % p.a., in line with the inflation target. In 2008, however, productivity rose only marginally; with surging wages, unit labour costs advanced by more than 8 %.

Graph 5.4.3:

Annual growth rates of productivity, wages in the private sectors, CPI and unit labour costs



Source: Productivity: Czech Statistical Office. CPI and wages in the private sectors: Czech National Bank. Unit labour costs growth is calculated based on these productivity and wage data.

5.4.3.2 Results of the econometric tests

In the estimations of the wage-price dynamics, we first estimated the link between prices and unit labour costs. In a second step, we investigated the importance of inflation and labour market conditions (unemployment) in wage setting.

[83] Unit labour costs growth is calculated as nominal wage growth minus growth of average labour productivity.

5.4.3.2.1 Price equations

The price equations include only unit labour costs as explanatory variable:

$$p_i = f(ulc_i)\,. \tag{75}$$

The dependent variables in this test are, respectively,

- log of headline CPI
- log of industrial goods prices,
- log of food prices, and
- log of market services prices, all as introduced in Section 5.3.4.

Unit labour costs are calculated by subtracting the log of productivity in the whole economy from the log of the respective nominal wage series. The log of headline CPI is regressed on the log of unit labour costs in the private sectors ('ulc-private') and in the total economy ('ulc-total') as published by the Czech National Bank. We considered both wage series because the order of integration of unit labour costs in the private sectors could not be determined unambiguously (cf. Table A3.3 in Appendix 3, p. 257). Unit labour costs in the total economy are I(1). Food prices were also regressed on unit labour costs in the total economy. Industrial goods prices were related to unit labour costs in industry ('ulc-ind', all variables in logs). The latter relate compensation of employees in industry to productivity in industry (national accounts data from Eurostat). Also for market services prices the relevant unit labour costs series ('ulc-mserv', in logs) stems from the national accounts. The series included in the tests are shown in Graphs A3.12-A3.15 (Appendix 3, pp. 249-251).

Table 5.4.9:

Cointegration test between the log of headline CPI or subcomponents and unit labour costs in the private sectors

1996:1-2007:4	LAG LENGTH OF UNRESTR. VAR	NO OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
cpi ulc-private	SC =2	0 1	10.89 1.69	9.98 1.55
cpi ulc-total	SC =2	0 1	7.76 2.63	7.11 2.41
food ulc-total	SC =2	0 1	17.10 1.86	15.67* 1.71
ind ulc-ind	SC=2	0 1	25.04 2.61	22.95** 2.39
mserv ulc-mserv	SC=1	0 1	16.38 0.59	15.69* 0.54

The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 5.4.10:

Parameters of the cointegration relation between the logs of CPI and its components and unit labour costs

COINTEGRATION RELATION FOOD PRICES			
	food	ulc-total	Constant
Coefficient *(t-statistic)*	1	-0.82 *(-5.16)*	0.21
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(food)	Δ(ulc-total)	
Coefficient *(t-statistic)*	-0.03 *(-1.04)*	+0.06 *(3.63)*	
COINTEGRATION RELATION INDUSTRIAL GOODS PRICES			
	ind	ulc-ind	Constant
Coefficient *(t-statistic)*	1	+4.13 *(+4.33)*	-0.99
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(ind)	Δ(ulc-ind)	
Coefficient *(t-statistic)*	-0.00 *(-4.98)*	-0.01 *(-0.96)*	
COINTEGRATION RELATION MARKET SERVICES PRICES			
	mserv	ulc-mserv	Constant
Coefficient *(t-statistic)*	1	-0.61 *(-13.36)*	-0.05
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(mserv)	Δ(ulc-mserv)	
Coefficient *(t-statistic)*	-0.18 *(-2.52)*	0.55 *(2.46)*	

Note: As for Table 5.4.9. In parentheses are t-values.

The tests do neither detect cointegration between headline CPI and unit labour costs in the private sector, nor between headline CPI and unit labour costs in the whole economy (cf. Table 5.4.9, p. 133). The same result was found for core prices, which combine the series of industrial goods prices and market services prices (results are not shown here). Instead, the tests find cointegration for the subcomponents of food prices, industrial goods prices and market services prices. However, only in the links for food prices and market services, the signs of the coefficients are in line with theory (Table 5.4.10 above). For industrial goods prices, the tests indicate that industrial goods prices fell with rising unit labour costs. In addition, in the relation between unit labour costs and food prices, it is unit labour costs which adjust. It is therefore no relation that might explain the development of food prices. As regards market services, unit labour costs are translated into prices only partially. However, this test for the market services prices can be regarded as a restatement of the Balassa-Samuelson model. Also in the latter model, market services prices are driven by unit labour costs, i.e. wage growth exceeding productivity growth. However, in contrast to the Balassa-Samuelson approach, the present approach does not consider the source of

wage growth. It need not necessarily be tied to productivity growth in industry and industrial goods prices.

In sum, the tests indicate that only prices of market services can be linked to the development of unit labour costs. This result coincides with that of the Balassa-Samuelson effect. For the other price series, in particular for headline CPI and industrial goods prices, a statistically significant link between prices and unit labour costs could not be verified.

5.4.3.2.2 Wage equation

The estimated wage equation includes prices, productivity and the unemployment rate:

$$w^{PR} = f(p,q,u)\,. \tag{76}$$

The dependent variable is the log of wages in the private sectors provided by the Czech National Bank ('wage-private'). The explanatory variables are

- log of CPI ('cpi'),
- log of core prices (these merge industrial goods prices and market services prices, 'core1'),
- log of productivity in the overall economy ('prod') and
- the unemployment rate ('UNEMP').

According to the unit root tests shown in Table A3.3 (Appendix 3, p. 257), all series are integrated of order 1; however, wages in the private sectors only at a 10 % level of significance. The graphs of the series are presented in A3.16-A3.18 (pp. 251-252).

Table 5.4.11:

Cointegration tests between the logs of wages in the private sectors and of CPI, and the unemployment rate

1996:1-2007:4	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
wage-private cpi	SIC=1	0 1	42.03 0.15	40.28** 0.14
wage-private cpi+prod	SIC=1	0 1	26.06 0.68	24.97** 0.65
wage-private core1+prod	SIC=1	0 1	32.68 1.28	31.32** 1.23
wage-private unemp	SIC=1	0 1	61.98 3.69	59.39** 3.53
wage-private unemp cpi+prod	SIC=2	0 1 2	79.04 18.70 1.18	74.10** 17.53* 1.11

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2). ** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 5.4.11 (previous page) contains the results of the cointegration tests between the log of wages, prices and productivity. The tests find cointegration between wages and prices, however, the parameter in front of prices is relatively high (Table 5.4.12 below). Furthermore, both adjustment coefficients are positive. Therefore, we re-estimated this relation with the explanatory variable being the sum of prices and productivity. If wages are raised in line with inflation and productivity growth, the real wage grows with productivity. The tests find cointegration between wages and the combined effect of headline CPI and productivity on the one hand, and between wages and the combined effect of core CPI and productivity on the other. In both cases it is wages that adjust to this relation, although rather slowly. The CPI and productivity are now weakly exogenous. The parameter in front of the combined series of core prices and productivity is rather close to 1, whereas CPI plus productivity is translated into wages less then proportionally. This indicates that one-off effects such as hikes in regulated items, which should entail an adjustment in the relative prices and hence should not be perpetuated through second round effects, were indeed (at least to some extent) taken into account.

Table 5.4.12:

Parameters of the cointegration relation for wage determination

COINTEGRATION RELATION WAGES AND CPI			
1996:1-2007:4	wage-private	cpi	constant
Coefficient *(t-statistic)*	1	-3.34 *(-18.05)*	+0.48
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(wage-private)	Δ(cpi)	
Coefficient *(t-statistic)*	+0.02 *(+6.97)*	+0.03 *(+4.93)*	
COINTEGRATION RELATION WAGE, CPI and PROD			
1996:1-2007:4	wage-private	cpi+prod	constant
Coefficient *(t-statistic)*	1	-0.88 *(-27.92)*	-0.08
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(wage-private)	Δ(cpi+prod)	
Coefficient *(t-statistic)*	-0.08 *(-5.56)*	-0.01 *(-0.42)*	
COINTEGRATION RELATION WAGE, CORE and PROD			
1996:1-2007:4	wage-private	core1+prod	constant
Coefficient *(t-statistic)*	1	-1.06 *(-42.33)*	-0.07
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(wage-private)	Δ(core1+prod)	
Coefficient *(t-statistic)*	-0.11 *(-6.52)*	-0.02 *(-0.51)*	

Note: As for 5.4.11. In parentheses are standard errors.

The cointegration test between wages and the unemployment rate strongly supports the proposition of cointegration (Table 5.4.11, p. 135). Both the unemployment rate and wages adjust to that relation. Again, wages react rather sluggishly (Table 5.4.13 below). A system that includes both the CPI plus productivity series and the unemployment rate supports the evidence found earlier. The test detects two cointegration relations, to which the wage adjusts. It is also confirmed that only the CPI plus productivity series can be regarded (weakly) exogenous (Table 5.4.14 below). As a result, the estimation of the wage-price dynamics leads to the conclusion that wage pressures are translated into prices only through market services. Wages do react to prices, but only taking productivity trends into account. The real wage seems to be related to productivity growth. Furthermore, wages are mutually dependent with unemployment. Consequently, wage growth exceeding productivity growth may be felt more strongly in the labour market than in inflation.

Table 5.4.13:

Parameters of the cointegration relation between the log of wages in the private sectors and the unemployment rate

COINTEGRATION RELATION			
1996:1-2007:4	wage-private	UNEMP	Constant
Coefficient *(t-statistic)*	1	0.04 *(3.09)*	-0.79
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(wage-private)	Δ(UNEMP)	
Coefficient *(t-statistic)*	-0.01 *(-5.97)*	-0.75 *(-5.46)*	

Note: As for 5.4.11. In parentheses are standard errors.

Table 5.4.14:

Parameters of the cointegration relation between the log of wages in the private sectors, headline CPI, productivity and the unemployment rate

COINTEGRATION RELATION				
1996:1-2007:4	wage-private	cpi+prod	UNEMP	Constant
Coefficient CI1 *(t-statistic)*	1		0.05 *(3.80)*	-0.81
Coefficient CI2 *(t-statistic)*	1	-1.28 *(-51.07)*		0.08
ADJUSTMENT TO COINTEGRATION RELATION				
	Δ(wage-private)	Δ(cpi+prod)	Δ(UNEMP)	
Coefficient CI1 *(t-statistic)*	-0.02 *(-5 44)*	-0.00 *(-0.45)*	0.28 *(1.02)*	
Coefficient CI2 *(t-statistic)*	-0.06 *(-2.95)*	-0.00 *(-0.04)*	5.69 *(4.10)*	

Note: As for 5.4.11. In parentheses are standard errors.

5.4.4 Summary and conclusions of the inflation analysis

The Czech Republic inherited a favourable inflation performance from the planned economy. Also during the transition process, stabilisation could be achieved quickly. Moderate inflation, which prevailed during the 1990s, came to an end in the late 1990s during the adjustment recession after the currency crisis in 1997. Between 1999 and 2007, inflation rates were relatively low and close to the euro area's level. That notwithstanding, they were more volatile. Starting in the second half of 2007, inflation rose markedly to exceed 7 % in early 2008. That was due to higher food and energy prices, but also numerous adjustments in taxes and regulated prices. When these effects started to abate, inflation rates declined to low levels again.

Since the turn of the century, i.e. during the period of low inflation, the adjustments of relative prices within the CPI have been pronounced. Regulated prices have recorded the highest inflation rate on average with close to 5 % p.a., followed by market services with a nearly equally strong rise. By contrast, food prices rose only slightly, and industrial goods prices even declined in a number of years. The latter was linked to the nominal appreciation of the exchange rate. However, the nominal appreciation of the exchange rate was translated into lower industrial goods prices only to some extent. Therefore, the positive headline inflation rate has gone with a strong real appreciation of the currency, also based on industrial goods prices.

According to the econometric tests, only half of the nominal appreciation is translated into the Czech industrial goods prices in the consumer basket. As regards the productivity related relative price adjustment, a mechanical comparison of the productivity differential between industry and market services with the inflation differential suggests that different productivity growth might indeed have driven market service inflation. The link between industrial goods prices and market services prices is supported by the cointegration tests. Concerning the wage-price dynamics, both the analytical investigation and the econometric tests point to an absence of strong wage related inflation pressures. Instead, unit labour costs have grown only mildly for a number of years. In general, wage growth has exceeded productivity growth by less than the inflation rate. The econometric tests detect that prices have been driven by unit labour costs only for the subcomponent of market services. That, however, is an alternative statement to the Balassa-Samuelson effect found earlier. At the same time, the missing link between wages and industrial goods prices indicates that the only partial pass-through of nominal exchange rate appreciation into prices is not the consequence of wage pressures. With a stabilisation of the exchange rate, headline inflation

may therefore rise less than suggested by the magnitude of real appreciation observed in recent years. The tests of wage determinants show a close link of wages to prices and productivity. The link between wages and prices indicates that as long as inflation remains at low levels, wage pressures may also remain small. However, a higher headline inflation rate could (at least temporarily) trigger higher wage growth in the following periods. Because only market services prices react directly to higher wages, the impact of a wage hike on headline inflation (e.g. following the recent increase in inflation) could remain temporary. At the same time, the tests detect a strong link between wages and unemployment, to which both variables adjust. Hence strong wage growth might not necessarily lead to strong inflation pressures, but might instead be rather quickly felt in the labour market.

6. Country study Hungary

6.1 Growth performance, macroeconomic stability and policy challenges

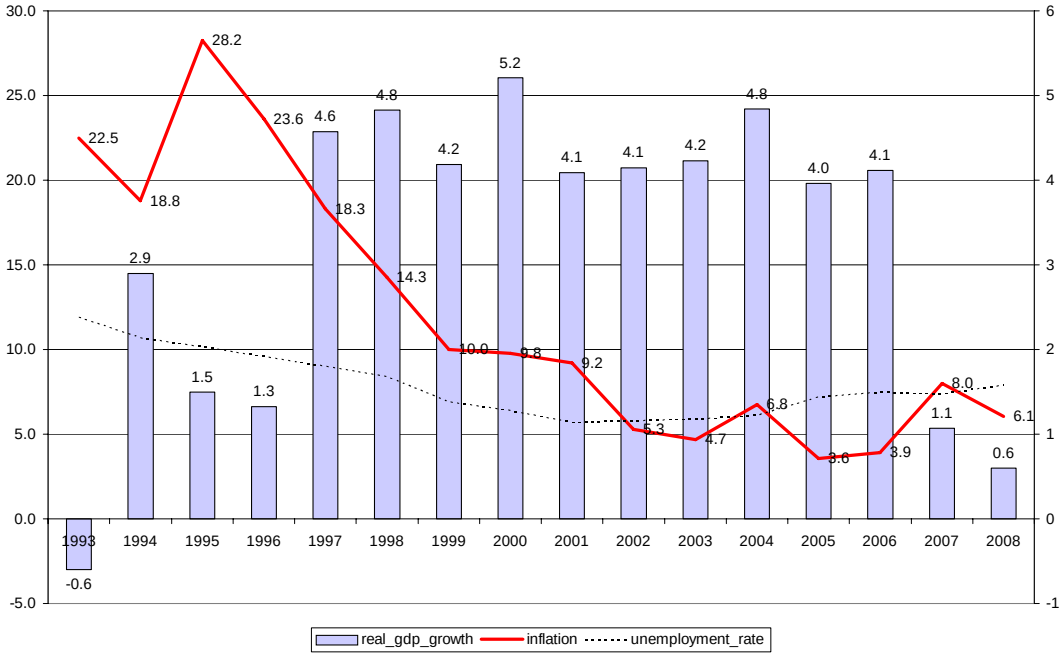
Hungary departed from the rigidly planned economic system already in 1968 (cf. e.g. Berend/Csato, 2002). However, while the economy became more decentralised as regards decision making and price setting, it remained a socialist economy with dominant state ownership, soft-budget constraints and government intervention into price setting. In the second half of the 1980s, reform efforts towards a market economy strengthened with the adoption of a bankruptcy law (1986) and the transition to a two-tier banking system (1987). That notwithstanding, a transition to a fully-fledged market economy became possible only with the political break in 1989. In 1991 a four-year government programme was adopted, which outlined the basic requirements for the transition to a market economy with dominant private ownership (cf. OECD, 1993H:11). This included the liberalisation of most of the remaining administrated prices, external liberalisation, privatisation and microeconomic restructuring. Because some reform steps were made already before 1990, the transition process was viewed as more gradual.

The reform strategy was marked by Hungary's huge foreign debt, which amounted to 65 % of GDP in 1990 (OECD, 1991H:37). In order to maintain access to the international capital markets, it was decided not to default or ask for restructuring. This decision meant that economic policy would be restrained in a number of ways. Any depreciation of the currency would have raised the foreign debt measured in domestic currency, while a real appreciation might have worsened the competitiveness of Hungarian products and thus the trade balance. As a result, the reform programme rested on gradual liberalisation of the remaining regulated prices and of foreign trade. Privatisation occurred mainly by direct sales, including to foreign investors. Also inward FDI was liberalised early on. At the same time, Hungary adopted a rather radical microeconomic transformation strategy entailing a host of enterprise bankruptcies in the early years of the 1990s (cf. Csaba, 1998).[84] Bank restructuring and recapitalisation required a number of recapitalisation waves (cf. World Bank, 1999:74-76), but since the privatisation of the largest banks in the second half of the 1990s, the Hungarian banking system has remained principally sound with a rather low proportion of non-performing loans (Wagner/Iakova, 2001; IMF, 2008).

[84] In 1992 Hungary implemented a bankruptcy law, which i.a. foresaw that enterprises themselves had to declare bankruptcy if they had debts overdue for more than 90 days (cf. Anderson/Kegels, 1998:110). This law was changed into a less strict one in 1993, but the major result of its implementation – that Hungarian enterprises have been facing market incentives since – was retained.

Graph 6.1.1:

Annual growth rate of GDP (right scale), inflation and the unemployment rate (left scale), 1993-2008



Source: Eurostat, MNB.

Growth rates resumed after the transformational recession in 1994, but were accompanied by rising fiscal and current account imbalances (cf. Table A1.2, p. 235, containing the balance of payments and Graph A1.1, p. 236, showing the fiscal deficits). A radical stabilisation package was implemented in March 1995, which led to a reduction in government spending by 10 % and a decline in the current account deficit. During the decade between 1996 and 2006, Hungary experienced rather steady growth of about 4-5 % p.a. based on strong investment and export growth (Graph 6.1.1 above). However, fiscal policy has continued to threaten a smooth growth and convergence process. In particular, Hungary has been characterised by a strong election related expenditure cycle and has frequently missed the fiscal targets planned in its Pre-accession Economic Programmes and the Convergence Programmes (cf. OECD, 2007H). The generous expenditure programmes adopted before elections had to be followed by consolidation efforts, which has adversely affected growth. As an example, during the latest election year, 2006, the fiscal deficit widened markedly before the elections and was forecast to rise to close to 10 %. After the elections, fierce adjustment measures had to be adopted, also because of strong capital outflows and depreciation pressures on the currency. Owing to the adjustment measures, fiscal deficits could be reduced by 2008 to levels close to the maximum levels stipulated in

the Maastricht Treaty (3 % of GDP). However, the flipside of it was a decline in growth rates below the euro area level.

The fiscal strains coupled with the fact that part of the government debt has been denominated in foreign currency have also increased the vulnerability of the Hungarian economy, which has continued to post high current account deficits also on account of the substantial interest payments. The strong vulnerability of Hungary materialised during the financial crisis in 2008. In the second half of the year, massive capital outflows led to a marked weakening of the exchange rate (MNB, 2009). A stabilisation of the exchange rate was achieved only after the IMF approved support within a stabilisation programme. That programme includes further fiscal consolidation measures.

The uncertainty that has regularly surrounded the fiscal outlook has also impacted interest rates, not only of government bonds and bills but also the central bank's refinancing rate. It has reduced the credibility of economic policy in general and monetary policy in particular, i.e. the fixed exchange rate in the 1990s and the inflation targets since 2001 (see next section). The impaired predictability of inflation has also complicated the disinflation process. So far, Hungarian inflation has not declined to euro area levels.

As regards the Hungarian banking sector, its restructuring during the systemic transition was nearly completed in the second half of the 1990s. Since the early 2000s, the share of non-performing loans amounted to less then 2 % of all loans (IMF, 2004H; IMF, 2008). The consolidation of the banking sector permitted a recovery of lending in the second half of the 1990s. In the early 2000s, credits to households increased by more than 60 %, mainly in mortgages. Due to the sizeable interest rate differential and the increasing currency convertibility, lending has to a substantial degree taken place in foreign currency. In 2002, the share of foreign currency loans in all loans amounted to close to 20 %, whereas in 2006 this share stood at more than 50 % (IMF, 2005H:24; IMF, 2007H:43). A large part of the foreign currency loans are unhedged mortgages of households. This has raised the impact of changes in the exchange rate on the balance sheets of both banks and households, and may have reinforced the importance of a stable exchange rate for the Hungarian economy.[85]

[85] The fact that an increasing share of the loans is denominated in Swiss franc, whereas the exchange rate is fixed to the euro increases vulnerabilities.

6.2 Interest rate determination

6.2.1 Monetary policy

6.2.1.1 Transition period

A two-tier banking system was introduced in 1987. During that period, however, the central bank was only to some extent legally independent from the government (Anderson/Kegels, 1998:81-82). The main aim of the central bank was to secure "internal and external stability of the currency". In view of the high foreign debt and frequent strains in the balance of payments, this objective meant that the Hungarian central bank (Magyar Nemzeti Bank, MNB) focused primarily on keeping the country solvent and retaining access to the international financial markets. Hungary decided not to ask for rescheduling of debt services despite the mounting strains stemming from the decline in activity during the early transition period. Further pressures on the current account were added by the dissolution of the Council of Mutual Economic Assistance (Comecon), the ensuing transition to payments in hard currency with the former partner countries and the cut of subsidies for oil. Consequently, "external stability" was interpreted as a sustainable position of the current account (Krzak/Schubert, 1997:37). Up to mid-1992, the MNB used the exchange rate as its policy instrument to secure a particular position of the current account and to prevent a further increase in the foreign debt (Halpern/Wyplosz, 1998:3).[86]

In the period between 1990 and 1994, the MNB had no clearly announced strategy. The regime of a fixed exchange rate with deliberate changes to the central rate was retained from the earlier periods. In addition, the central bank also specified targets related to credit growth.[87] Inflation, which stood already at levels of close to 20 % in the late 1980s, rose to more than 30 % in 1990 owing to price liberalisations, direct credits to the government,[88] directed credit to state banks and a number of devaluations of the forint to counteract the effect of the higher inflation rates. In 1991, inflation accelerated further to 34.2 %.

Starting in 1992, the inflow of capital reduced the pressures related to the current account. That allowed the central bank to promote stabilisation and disinflation through smaller devaluation steps. These could be conducive to disinflation through the direct impact of stable import prices but also through a signalling effect if the policy of a fixed exchange rate were regarded credible. However, fiscal policy became stimulating in 1993 after a

[86] "There was no clearly announced policy rule, but it was tacitly understood that maintaining some long-run real exchange rate target, defined by the Producer Price Index, was the government's goal." Hamecz et al. (1998: 87). However, a real exchange rate target can imply any outcome for the inflation rate.
[87] According to Krzak/Schubert (1997:38) the additional targets were defined over net domestic loan stock in 1990-1991, net domestic assets in 1993 and net domestic lending in 1994.
[88] "The central bank financed the deficit resulting from the transitional recession 1990/92 without limits and at preferential rates" (Halpern/Wyplosz, 1998:3).

decline in output for three years in a row. But whereas domestic demand grew rapidly on the back of the fiscal expansion and a rapid growth in firms' borrowing, output contracted further. The current account and the trade balance deficits exceeded 10 % in 1993. At the same time, the fiscal deficit rose to 7 % of GDP. That, however, was not only the result of the more stimulating policy, but also of transition related factors such as an increase of interest rate payments to domestic borrowers.[89] In 1994, the current account deficit could not be financed by capital inflows, while the government's primary balance, i.e. excluding the interest payments, was in deficit as well (-2.2 %, cf. World Bank, 1999:21). As a reaction to the twin deficits, the central bank used devaluations more often in 1993 and 1994. Although this seemed necessary due to the rising current account deficit, as a side-effect it rendered the strategy of a fixed but adjustable peg meaningless. It was neither a credible peg anymore as the banks speculated on the timing and magnitude of the next devaluation, nor could it anchor inflationary expectations. At times, devaluations were forced by speculation on the timing of the next exchange rate adjustment (Szapary/Jakab, 1998:695). Moreover, the two deficits did not decline after the devaluations. It was feared that Hungary could be a prime candidate for currency speculation. As a result, under the threat of a currency crisis, a stabilisation programme was adopted in early 1995. It was accompanied by a change in the monetary strategy and a change in the central bank law that substantially reduced the access of the government to direct lending by the central bank.

6.2.1.2 Crawling peg regime

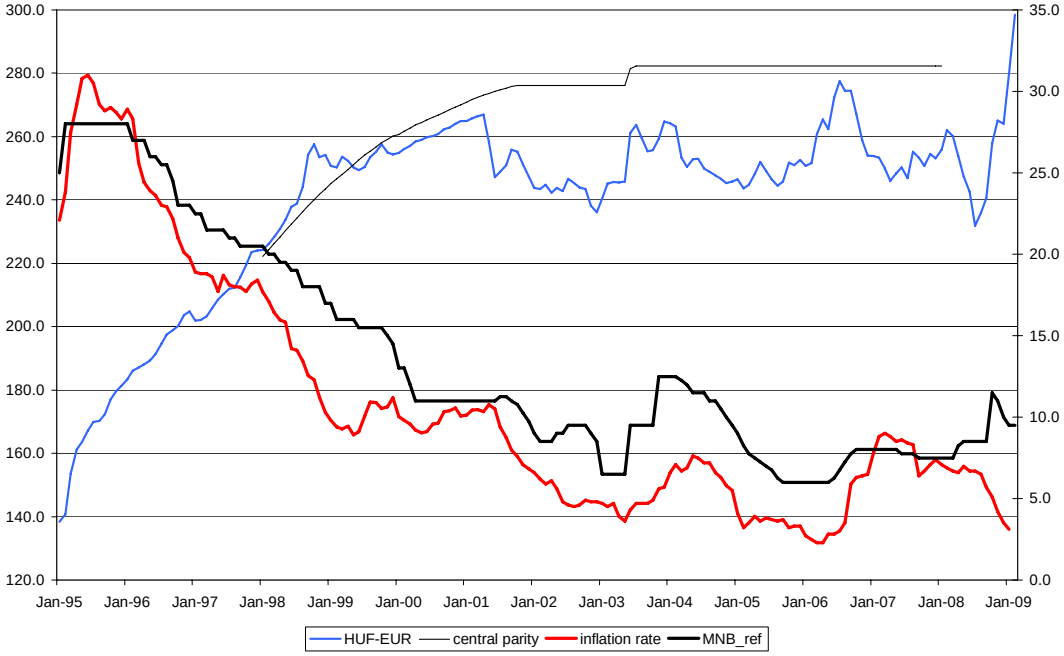
The crawling peg regime introduced in March 1995 was designed to restore the credibility of the central bank through pre-commitment. Within the crawling peg strategy the central bank (re-) establishes credibility if it is able to maintain this regime (i.e. if there is no need of additional devaluations). For this, fiscal and monetary policies have to abstain from any measures that could endanger the regime and the fixed peg. It can serve as a disinflation tool if the rate of crawl can be reduced and if inflation expectations are anchored by the rates of depreciation. The prices of import goods reduce inflationary pressures if the rates of crawl are lower than domestic inflation. The MNB followed a policy of an active crawl, where the rates of devaluation were lower than the inflation rates. The targeted real appreciation was linked to the assumed productivity differential (cf. Szapary/Jakab, 1998:700). The choice of the crawling peg regime instead of a fixed exchange rate was also motivated by the aim to achieve disinflation at low output and employment costs (cf. also Section 6.3.3). The regime included fluctuation bands of ±2.25%; the central parity was

[89] The fiscal difficulties stemmed from the large social transfers and the increasing government tasks due to the recession as well as from the change in the rules for central bank credit to the government. Since 1992, the government was required to pay market interest rates on its debt (which had not always been the case earlier, Gaspar, 1998:29).

defined towards a currency basket.[90] The currency depreciated by a fixed amount per day, and the rate of crawl was announced several months in advance.

The introduction of the crawling peg proved successful in stabilising the exchange rate and expectations, also due to the sizeable adjustments in the fiscal balance. The rate of crawl was 1.9 % per month in 1995, but was subsequently reduced to 0.7 % in 1998 (Szapary/Jakab, 1998:699). Inflation declined to 24 % in 1996 and 10 % in 1998 (Graphs 6.2.1 below and 6.2.2 on next page). For most of the time, the forint was close to the appreciation edge of the currency band, signalling a general acceptance of the regime.

Graph 6.2.1:
Nominal exchange rate (left scale), inflation rate and MNB policy rate (right scale)



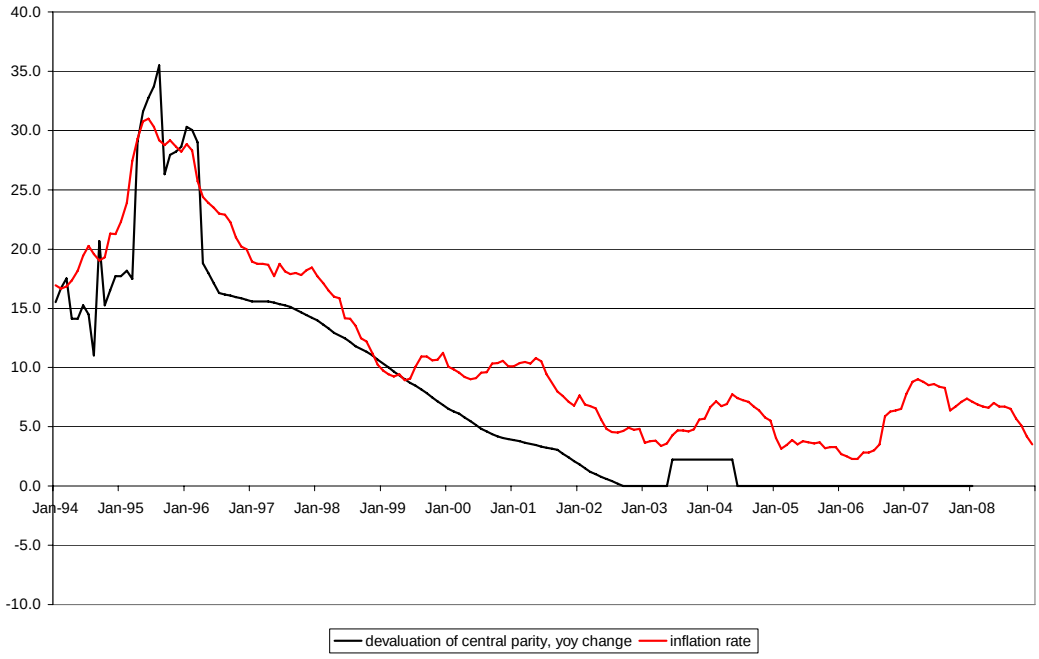
Source: MNB, Eurostat. 'MNB_ref" denotes the MNB main policy rate, "HUF-EUR" the nominal exchange rate of the forint to the euro.

However, the crawling peg substantially restrained the MNB. To keep the exchange rate in the narrow band of ±2.25 %, the MNB had to adjust the interest rate in accordance with the devaluation stipulated by the crawling peg regime and the risk premium, which influences interest rate sensitive capital inflows. It also had to react to autonomous capital inflows. Starting in 1996 and 1997, Hungary experienced large capital inflows, which were connected mainly to the increased effort in privatisation, but included also interest rate sensitive capital flows. The MNB steadily intervened in the foreign exchange market and

[90] The basket consisted of 30 % USD and 70 % ECU in early 1995. In 1997, the ECU was replaced by the Deutsche Mark and in 1999 by the euro. Since 2000, the forint was fixed only towards the euro.

was engaged in substantial sterilisation measures. The challenges changed in 1998, when the Russian crisis prompted capital outflows. In the autumn of 1998, the MNB had to defend the peg on numerous occasions (MNB, 1999:40). In addition, the MNB raised interest rates as the risk premium for Hungarian investments grew. Afterwards however the forint returned to the strong band edge and the MNB had to absorb large amounts of foreign currency stemming from the capital inflows. Specifically, in 2001, interest rates had to be lowered despite an increase in inflation, both headline and core. At the same time, interest rate also had to be adjusted with changes in the international interest rates.

Graph 6.2.2:
Inflation and year-on-year devaluation rate of central parity



Note: 'devaluation of the central parity, yoy change' indicates the change in the central parity relative to same month in previous year.
Source: MNB.

As a result, while the nominal exchange rate regime as such could be maintained, the central bank's rate setting was heavily influenced by the international environment, capital flows and sterilisation operations. The MNB was incurring large sterilisation costs. At the same time, the crawling peg regime became less powerful as a disinflation tool after 1998, as the inflation rate remained at around 10 %, in spite of a decline in the rate of crawl to close to zero by 2000. It is worthy of mention that during the crawling peg regime the main instruments of the MNB were required reserves and sterilised intervention, i.e. interventions to prevent an appreciation above the upper band edge and sterilising operations using MNB bills. The central bank's main rate did not serve any immediate

purpose, instead it was a reference rate from which many other interest rates were derived (MNB, 2006a).

6.2.1.3 Inflation targeting

To raise the commitment to disinflation and because the rate of crawl approached zero, the central bank adopted inflation targeting in May 2001 (MNB, 2002:45). The Central Bank law was amended to clarify that the main objective is price stability in line with the Acquis Communautaire. In addition, the central bank is required to promote nominal convergence as stipulated in the Maastricht criteria and to prepare Hungary for participation in ERM-II and EMU (OECD, 2002H; IMF, 2002H). In its Inflation Report in August 2001 the MNB assumed that EMU could be joined in 2006-2007 (MNB, 2001:35). The Maastricht inflation criterion of an inflation rate exceeding that of the three countries with the lowest inflation rate in the EU by no more than 1.5 percentage points (i.e. 2-3 %), would have to be met one year earlier. All remaining capital controls were eliminated; the forint has been fully convertible since June 2001. The introduction of the new monetary strategy was accompanied by a change in the main instrument of the central bank. The two-week deposit at the MNB, remunerated with the MNB's main interest rate, has become the main policy instrument (MNB, 2002:105). The 3-6-month money market rates remained the operating target. Hence, the institutional preconditions were largely in place. The applicability of inflation targeting in Hungarian conditions was questioned, however (cf. Abel/Siklos, 2002).

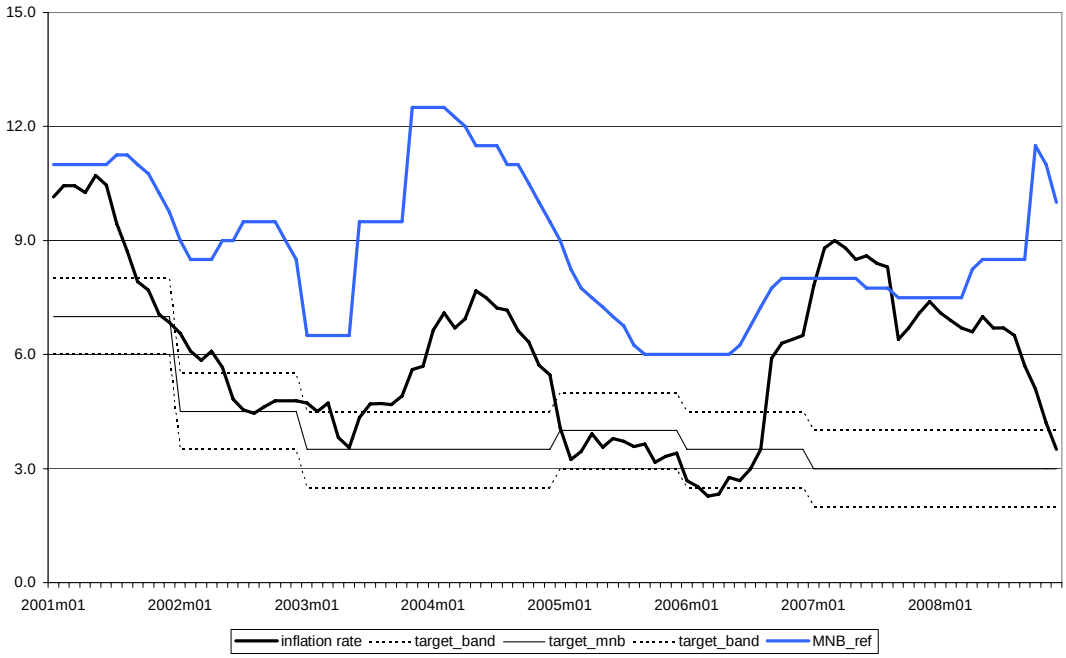
The MNB initially set end-of-year inflation targets that were announced 18 months in advance. The inflation targets were set at 7 % for December 2001, 4.5 % for December 2002 and 3.5 % for December 2003. All inflation rates were defined within a band of 1% on either side of the point target. As regards the exchange rate, the band around the fixed parity was broadened to ± 15 %, and later (in autumn 2001) replaced by a fixed exchange rate with a broad band of ± 15 %. As a result, the MNB did not adhere to pure inflation targeting. The dual objectives reflected the importance attached to the exchange rate channel of monetary transmission when compared with the pure interest rate channel.[91] The two objectives in the inflation targeting framework need not necessarily be conflicting as the interest rates and the nominal exchange rate have in principle a mutually reinforcing effect. Potentially, however, these two objectives can be conflicting. For instance, this might be the case if the nominal exchange rate – due to an interest rate differential to

[91] Csermely et al. (2006:3): "In line with the structural characteristics of the economy, the conduct of monetary policy was based on the assumption that the most important channel of transmission works through the exchange rate and the relevance of the interest rate channel is negligible. As a consequence, deviations of inflation forecasts from target were translated into an attempt to influence the nominal exchange rate path. The question arose as to how much of this should be revealed to the general public."

support disinflation and the ensuing capital inflows – may approach the appreciation edge of the exchange rate band. In such a case, the central bank has to prevent a further appreciation, e.g. through lower interest rates, with adverse consequences for inflation. Another example is a case when a further nominal appreciation might be desirable from the perspective of disinflation, but may hurt competitiveness to an extent deemed intolerable by the central bank. A third example is the situation when a negative supply shock hits the economy, in response to which the real exchange rate should depreciate. If the nominal exchange rate depreciates, but inflation adjusts also, this could endanger meeting the inflation target.

Graph 6.2.3:

Inflation target of the MNB and inflation rate



Source: MNB.

Disinflation resumed shortly after the introduction of inflation targeting. Inflation rates declined from 10.7 % in May 2001 to 3.5 % in May 2003; the inflation targets for 2001 and 2002 were met (see Graph 6.2.3 above, which compares the actual inflation rate with the inflation target). This decline followed a pronounced appreciation of the exchange rate (Graph 6.2.1, p. 145). As a result, during this period, the strategy of the MNB to foster disinflation through the nominal exchange rate worked out. In the second half of 2001, the MNB started to lower interest rates.

However, disinflation stopped when the central bank started to face conflicts between the nominal exchange rate and the inflation target. In 2002, the newly elected government raised wages of state-employees by roughly 50 % and posted a fiscal deficit of close to 9 % of GDP. Real wages in the entire economy rose by 12.7 % in 2002, well above productivity growth. This affected primarily the current account, the deficit of which widened to 8 % of GDP. The pressures towards nominal appreciation of the exchange rate, while conducive to disinflation, contrasted with the MNB's assessment that the fiscal shock required a depreciation of the real exchange rate. Yet, the nominal exchange rate appreciation reinforced the speed of real appreciation. To meet its inflation target in 2003, the MNB would have had to allow nominal appreciation beyond the exchange rate band, which some market participants deemed possible (IMF, 2004H). In early 2003, the forint hit the appreciation edge within a "speculative attack" on the exchange rate band. The MNB, however, did not abandon the exchange rate band, also because the central bank and the government share responsibility for the exchange rate regime. The government also did not support a further appreciation. Instead, interest rates were lowered by three percentage points, and the exchange rate depreciated in January 2003. Moreover, in June the central bank and the government decided to shift the central parity from 276.10 to 282.36 HUF/EUR. After a sharp depreciation of the exchange rate, however, the authorities maintained that the exchange rate target lies within the narrow band of 250-260 HUF/EUR. This rendered a disinflation strategy based on nominal appreciation impossible. After these inconsistent policies, the exchange rate remained weak during the second half of the year 2003. To stabilise the exchange rate in the narrow band, in June and in November the MNB raised interest rates from 6.5 % to 12.5 %. As a result, not only did the depreciation of the exchange rate prevent the inflation target in 2003 from being met, but the actions of the MNB also damaged the credibility of its inflation targeting strategy.

In early 2004, the exchange rate stabilised at levels of around 250 HUF/EUR. The MNB started to lower interest rates. At the same time, inflation rates climbed back to 8 %. This may have reflected the effect of the nominal depreciation in 2003, but it was also due to EU accession related adjustments in indirect taxes and the VAT rate. In 2004, the December inflation rate exceeded the upper target band by more than one percentage point. However, during 2005 inflation rates declined swiftly to below 4 %. This was attributed to favourable international factors (low food price increases) and the effect of the nominal appreciation during 2004. In addition, the interest rate hikes of 2003 may also have played a role. The inflation target for 2005, set at 4 % ± 1 %, was met. All in all, the VAT hike had only a one-off effect on inflation. Interest rates were steadily lowered to 6 % by September 2005.

Nevertheless, in spite of the fact that inflation rates declined to less than 4 % in 2005 and that the 2005 target was met, which was a rather positive result of the Hungarian inflation targeting strategy, the credibility of the central bank had suffered due to the conflicts between the monetary policy targets and the unfavourable policy mix. Given the fiscal policy shocks, the inflation and the nominal exchange rate targets became conflicting. The central bank gave preference to the exchange rate target. Meeting the targeted EMU entry date became highly unlikely. In 2004, the targeted entry date was postponed to 2010.[92] In 2005 the MNB announced that from 2007 on the medium-term inflation target will be a constant target of 3 % ± 1 %.

Aided by a reduction in the higher VAT rate from 25 % to 20 %, in March and April of 2006 inflation fell to its lowest level for a number of decades (2.3 %). However, after the elections in spring 2006, the fiscal deficit was once again forecast to reach close to 10 % of GDP by the end of 2006, which was also a consequence of the tax reductions earlier that year. The exchange rate reacted with a sharp depreciation in mid-2006. Similarly to earlier experience, the MNB raised interest rates to counteract the weakening of the currency. However, the adjustments in the interest rate was neither as sharp as in 2003 (200 basis points compared with 600 basis points in 2003), nor was it followed by a quick return of the nominal exchange rate to the level of 250-260 HUF/EUR. The government announced fierce consolidation measures starting in autumn of 2006, which included also a hike in the prices of regulated items and of the VAT rate. Inflation rates edged up again to 6 % towards the end of 2006. The nominal exchange rate recovered to levels of around 250 HUF per euro by December 2006.

In early 2007, inflation rose to 9 % on the back of further government-induced price hikes. The effect of the numerous government measures on inflation started to abate in mid-2007. However, after then, inflation was heavily affected by the global increase of food and energy prices. The MNB did not raise interest rates further following the spike in inflation. The depreciation of the currency was not counteracted either. Instead, probably because of the subdued real activity following the budget consolidation programme, interest rates were lowered marginally during 2007. All in all, however, the numerous inflation shocks after September 2006 gave rise to inflation rates that stayed substantially above the targeted rate for nearly two years.

As a move to further strengthen the inflation targeting framework, the MNB abandoned the fixed exchange rate in early 2008 and has been pursuing only the inflation target since. In the early months of 2008, presumably to counteract the inflationary pressures, the MNB

[92] Since then the targeted entry date was postponed to 2012.

tightened monetary policy through a number of small interest rate hikes. Indeed, inflation rates have declined after mid-2008 when the pressures from food and energy prices abated. Yet, the financial crisis originating in the developed financial markets, which started in mid-2007 and further accelerated in autumn of 2008, strongly impacted Hungary and its monetary policy. Strong capital outflows put downward pressure on the exchange rate in the second half of 2008, which the MNB reacted to by raising interest rates by 300 basis points in October 2008. Still, financial markets started to stabilise only after Hungary signed a stabilisation programme with the IMF. In spite of the weak growth, interest rates could be reduced only slightly afterwards. Nevertheless, the exchange rate depreciated strongly to the (abandoned) weak exchange rate band edge, while real interest rates have increased substantially.

To summarise, the inflation targeting strategy of the MNB has not yielded disinflation to low inflation levels (as defined by the MNB's permanent target) on a lasting basis yet. Inflation rates declined after the inception of inflation targeting, but returned to levels of 8 % in 2004 and 2007/08. In addition, the inflation targets were often missed. That holds not only for the years for which the MNB set year-end targets, during which the inflation target was missed in three years out of six. It holds also for the period after the introduction of the permanent target. After January 2007, inflation stayed well above the permanent target and the upper target band for nearly two years.

The inflation targeting regime of the MNB was complicated, first, by the fact that the central bank adhered to two targets, which created policy conflicts and may have damaged the credibility of the inflation targeting strategy. Second, the Hungarian economy faced a series of shocks from fiscal policy, which has been characterised by a strong election related spending cycle and high uncertainty. In addition, challenges originated also from the international capital markets. In its disinflation policies the MNB relied on the signalling function of the inflation target and to some extent also on phases of nominal appreciation. It tried to avoid a disinflation phase that would have included high real interest rates. Real interest rates have nonetheless not been low after 2001 (Graph 6.3.3, p. 170), while growth, in particular after 2006, has been meagre. Nevertheless, it appears that the strategy pursued so far has not sufficed to reduce inflation expectations to levels consistent with the inflation target on a lasting basis.

6.2.2 Interest rates in the money and government bond markets

The money market was introduced in the early 1990s, but it has fulfilled an important role in the banks liquidity management only gradually. Because of the high reserve requirements during the 1990s and reserve averaging, transactions on the money market were rather limited. Only with a decline in the reserve requirements and a less automatic access of banks to the standing facilities at the MNB, the interbank transactions rose. However, during the adjustment period in 1998 and 1999, interbank interest rates were rather volatile (Graph 6.2.4, p. 153, and Gereben, 1999). The operating target of the MNB are the 3 to 6-month rates, hence temporary fluctuations in the overnight rate related to liquidity management are compatible with the MNB's policy implementation framework. By contrast, the link between the central bank rate and the 3-month rate should be very tight. Note that in the Hungarian money market, loans with maturities of more than 3 months are rare; while transactions with 1-3 month maturity are also rather infrequent. The series shown in Graph 6.2.4 on money market rates refer to the Budapest Interbank (BUBOR) fixing rates because during some months no money market transactions for higher maturities took place. Transactions of maturities exceeding 1 month are carried out mainly as foreign currency swaps or with collateral such as treasury bills (MNB, 2006b). Owing to the limited liquidity in the money market, the MNB uses rates from the treasury bill market to calculate the yield curve comprising short-term rates. Graph 6.2.4 on next page shows the money market rates since 1999. All rates are close to the central bank main rate, with the largest fluctuations being found for the overnight transactions.

Owing to the large fiscal debt and the financial needs of the government, the Hungarian government bond market is well developed. Already in the 1980s government bonds of maturities up to 4 years were traded (cf. Anderson/Kegels, 1998:125). With the transition process, the number of government bonds and their maturity increased. Liquidity in the government bond market benefited from the admittance of foreign investors. The maturity structure of the government bonds was raised during the latter half of the 1990s, as 10-year government bonds were introduced in 1999.

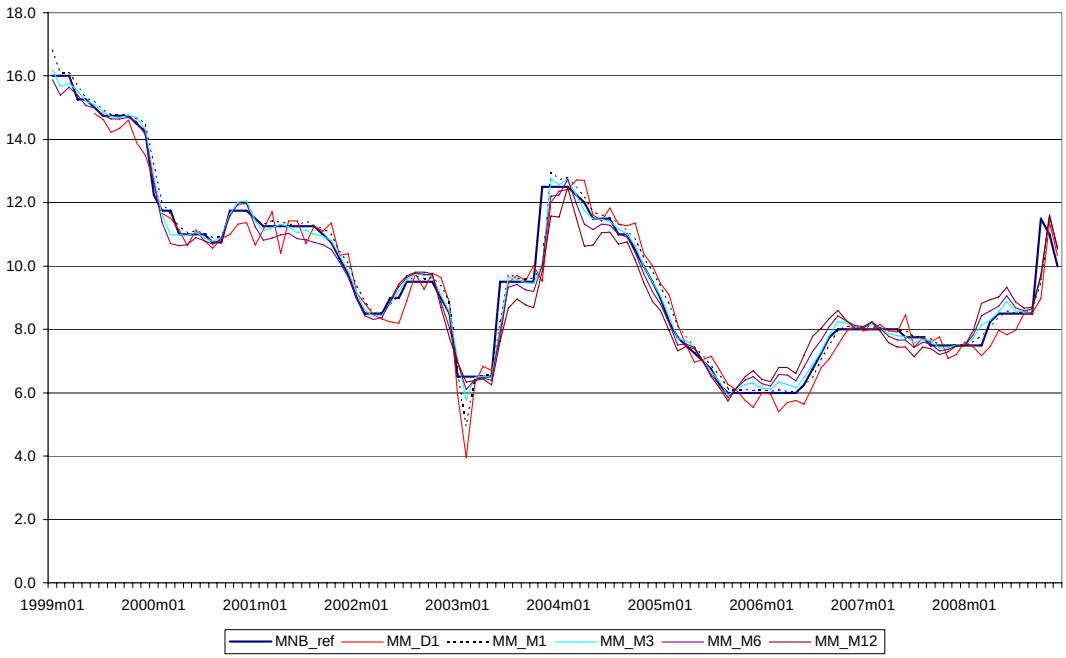
Graph 6.2.5 (p. 154) shows the interest rates of the government bills and bonds. The bills' yields (3-month and 6-month) and the central bank base rate are clearly co-moving. The longer term rates, however, have been lower than the central bank rate until 2005 owing to disinflationary expectations. During 2006, the government bond yields temporarily exceeded the MNB rate. That however changed again in 2007. The 10-year government bond yield showed limited variation during 2006-2007. Also the other yields were rather close to the MNB rate, which may conceal lower expected future interest rates and a significant liquidity premium. During the past years, the Hungarian 10-year government

bond yield has remained well above the corresponding euro area yield. The strongly downward sloping yield curve has flattened since 1999 (Graph 6.2.6, p. 154), but does not yet show the "normal" upward sloping trend.

As regards lending rates to households and firms, the link between the MNB's policy rate and the average interest rate to non-financial firms seems very close. By contrast, the interest rate for housing loans to households not only exceeds the main rate substantially, but it also follows the rate adjustments only broadly (Graph 6.2.7, p. 155).

Graph 6.2.4:

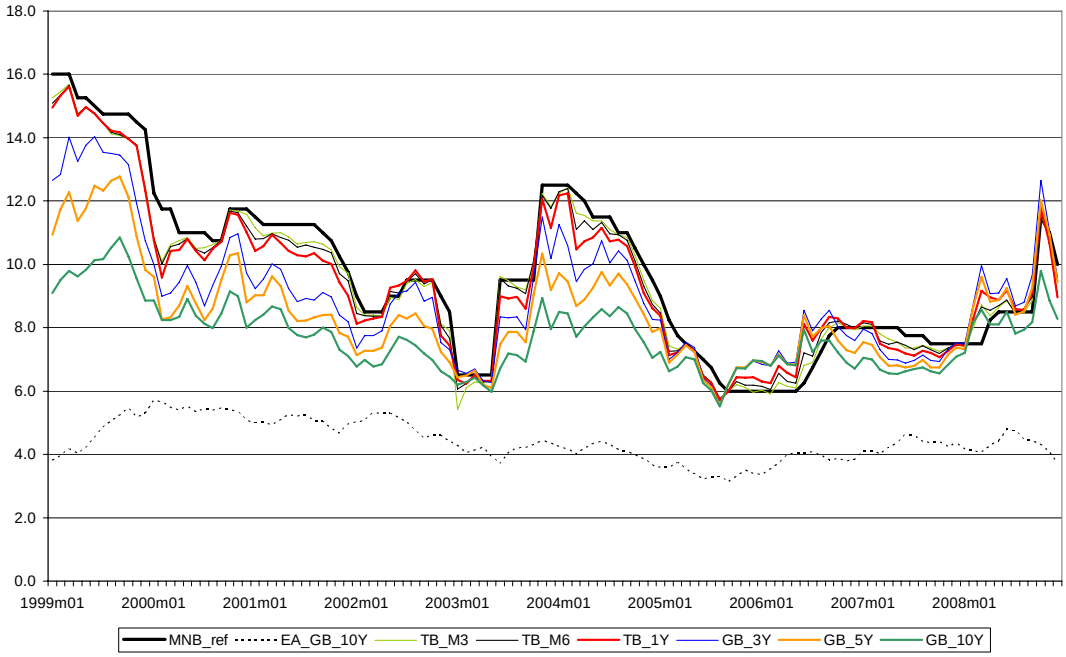
Money market rates, 1999-2008



Source: MNB.
Notes: 'MNB_ref' denotes the main rate of the MNB. All other rates are BUBOR fixing rates. 'MM_D1' stands for the 1-day BUBOR rate, 'MM_M1' the 1-month BUBOR rate, 'MM_M3' the 3-month BUBOR rate, 'MM_M6' the 6-month BUBOR rate and 'MM_M12' the 12-month BUBOR rate.

Graph 6.2.5:

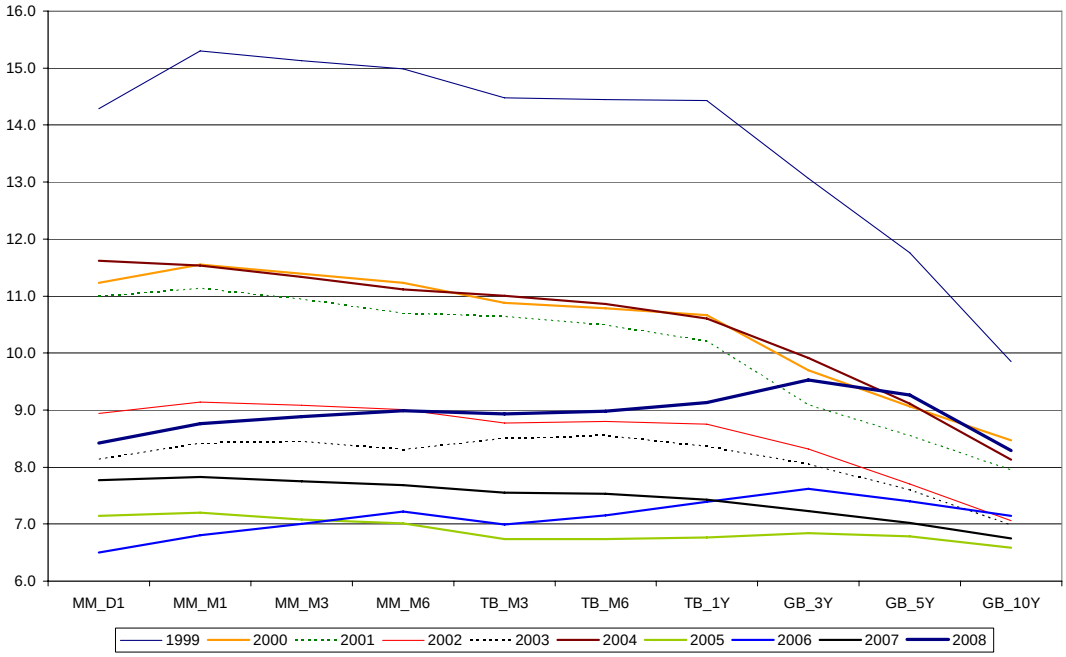
Government bill and bond yields, 1999-2008



Source: MNB, Eurostat.
Notes: 'MNB_ref' denotes the main MNB policy rate, 'EA_GB_10Y' the euro area 10-year government bond, rate, 'TB_M3', 'TM_M6' and 'TB_1Y' the 3-month, 6-month and 1-year treasury bills, respectively, and 'GB_3Y', 'GB_5Y' and 'GB_10Y' the Hungarian 3-, 5- and 10-year government bond rates, respectively.

Graph 6.2.6:

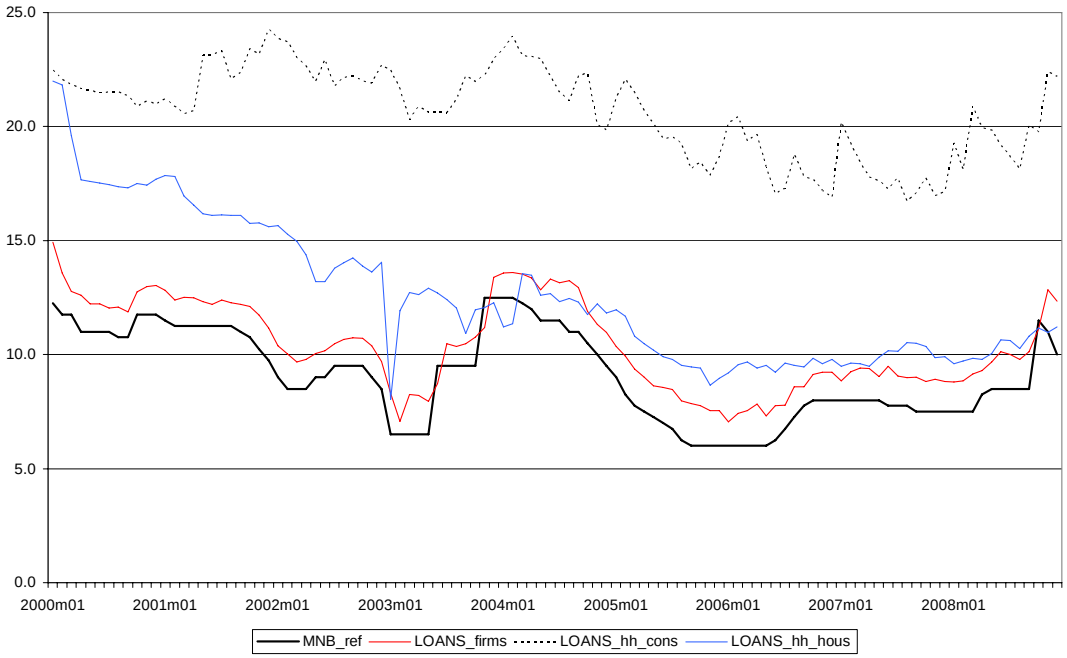
Yield curves, 1999-2008



Source: Eurostat. Notes: as for Graphs 6.2.4 and 6.2.5.

Graph 6.2.7:

MNB main rate, and interest rates for loans to non-financial firms, loans to households for purchases of residential property and for consumption purposes, 2000-2008



Source: MNB. Notes: 'MNB_ref' denotes the MNB main policy rate. 'LOANS_firms' denote interest rates for loans to non-financial firms, 'LOANS_hh_housing' interest rates for residential investments of households and 'LOANS_hh_cons' interest rates for loans to households for consumption purposes.

6.2.3 Econometric evidence of the central bank's reaction function and of the pass-through to money market rates and government bond yields

6.2.3.1 Central bank reaction function

The procedure with the econometric tests is the same as for the Czech Republic (cf. Section 5.2.3.1). However, because the Hungarian central bank followed a dual target of a fixed exchange rate and an inflation target, the estimations include the deviation of the exchange rate from the central parity instead of the nominal exchange rate. The estimation period is determined by the introduction of inflation targeting as monetary strategy in 2001. This choice is also indicated by the fact that until 2001, the main policy instrument of the MNB was sterilised interventions, i.e. automatic interventions at the lower edge of the forint band and subsequent sterilisation. The "base rate" was used to derive other interest rates but served no immediate purpose. The investigation is therefore made with monthly data for the period 2001:1 – 2008:12, which yields 96 observations.

The dependent variable in the central bank reaction function is the MNB main rate ('MNB_ref').[93] The explanatory variables are

- ECB main refinancing rate ('ECB_ref'),
- deviation of the observed current inflation from the CPI target value in percentage points ('CPI deviation'),
- percentage deviation of the nominal exchange rate from the central parity ('HUF deviation').

The graphs of the series are shown in Appendix 4 (Graphs A4.1-A4.2, p. 259). In the cointegration tests we had to include four impulse dummy variables that capture the steepest adjustments in interest rates, these are hence treated as outliers (or one-off effects). They were inserted for January, June and November 2003 and October 2008. The dummy variable has value '1' in the indicated month, and '0' otherwise.

A potential problem in the estimation stems from the fact that according to the unit root tests, all variables are integrated of order 1 except for the series capturing the deviations of the nominal exchange rate from the central parity (see Table A4.2 in Appendix 4, p. 267). That is assessed as I(0). While it is generally possible to include a stationary variable in a cointegration test, the test will only indicate whether there is a long-term link between the variables that are of the same order of integration. We have therefore tested for the reaction of the MNB rate to the exchange rate only within the tests of the short-term adjustment.

The cointegration tests find one link between the MNB main rate and the ECB main refinancing rate, and a second between the MNB policy rate and the deviation of headline inflation from the inflation target (Table 6.2.1 on next page). In a joint estimation, however, the test fails to detect two relations. We will test for the relevance of these two cointegration relations later. According to the parameter estimations, the Taylor principle of a real interest rate adjustment to deviations of headline inflation from the targeted rate is satisfied (Table 6.2.2, next page). The parameter is 0.45. At the same time, the constant term that captures both the contemporaneous inflation rate and the "equilibrium real interest rate" is estimated at 6.5 %. With an average inflation of 6.1 %, this implies a rather low real rate on average. The estimated parameter in the link with the ECB rate suggests a rather high risk premium in the Hungarian interest rates. The bivariate estimations indicate that the MNB main rate adjusts to both determined cointegration relations; both the ECB rate and the inflation deviation are determined as (weakly) exogenous.

[93] The notation is also listed in Table A4.1 in Appendix 4, pp. 265-266.

Table 6.2.1:

Cointegration tests MNB reaction function

2001:1 – 2008:12	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE TEST
MNB_ref	SC=1	0	35.33**
ECB_ref		1	8.48
MNB_ref	SC=2	0	34.08**
CPI deviation		1	3.57
MNB_ref	SC=2	0	43.24**
ECB_ref		1	11.15
CPI deviation		2	2.80

Note: The estimated VECM model assumes a constant term in the long-run cointegration relation, but no constant in the short-term dynamics. In the tested relations that include the ECB rate, we considered the (stationary) deviation of the nominal exchange rate from central parity in the short-term dynamics. In all cases, the estimated relations also include impulse dummies for the policy rate adjustments in January, June and November 2003, and in October 2008. # denotes significance at 10 %, * significance at 5% and ** significance at 1 %.

Table 6.2.2:

Parameters of the reaction functions

COINTEGRATION RELATION			
2001:1-2008:12	MNB_ref	ECB_ref	Constant
Coefficient	1	-1.82	-1.25
(t-statistic)		*(-2.90)*	*(-0.69)*
ADJUSTMENT TO COINTEGRATION RELATION			
	D(MNB_ref)	D(ECB_ref)	
Coefficient	-0.04	-0.00	
(t-statistic)	*(-5.28)*	*(-0.91)*	
COINTEGRATION RELATION			
2001:1-2008:12	MNB_ref	CPI deviation	Constant
Coefficient	1	-0.45	-6.53
(t-statistic)		*(-2.23)*	*(-11.52)*
ADJUSTMENT TO COINTEGRATION RELATION			
	D(MNB_ref)	D(CPI deviation)	
Coefficient	-0.06	-0.01	
(t-statistic)	*(-5.73)*	*(-0.29)*	

Note: As for 6.2.2. In parentheses are standard errors.

In the estimation of the short-term dynamics we first included the residuals of both determined cointegration relations ('ECM'), the deviation of the exchange rate from central parity in percentage points, lagged policy rates of the MNB, the current and lagged policy rate of the ECB and the lagged inflation rate. In addition, we considered the four dummy variables mentioned above. However, in order to yield uncorrelated residuals (according to the Lagrange multiplier test), and in particular not to reject the hypothesis of normally distributed residuals (according to the Jarque-Bera test), further impulse dummies had to be added – for May and July of 2002 and April of 2008.

$$
\begin{aligned}
\Delta MNB\_ref_t = {} & \underset{(-1.13)}{-0.02\ ECM\text{-}CPI_{t-1}} \quad \underset{(-0.62)}{-0.01\ ECM\text{-}ECB_{t-1}} \quad \underset{(+3.19)}{+0.02\ DEV\_HUF_t} \\
& \underset{(+2.23)}{+0.29\ \Delta ECB\_ref_t} \quad \underset{(+1.02)}{+0.04\ \Delta CPI\_rate_{t-1}} \quad \underset{(+5.69)}{+0.04\ \Delta MNB\_ref_{t-1}} \\
& \underset{(+1.96)}{+0.29\ \Delta ECB\_ref_{t-1}} \quad \underset{(+2.58)}{+0.17} \quad \underset{(-8.34)}{-1.49\ D(2003;1)} \quad \underset{(+17.45)}{+3.13\ D(2003;6)} \\
& \underset{(+18.69)}{+3.08\ D(2003,11)} \quad \underset{(+18.22)}{+3.19\ D(2008;10)} \quad \underset{(+4.11)}{+0.89\ D(2003;1)_{t-1}} \\
& \underset{(-3.65)}{-1.09\ D(2003;6)_{t-1}} \quad \underset{(-4.06)}{-1.17\ D(2003,11)_{t-1}} \quad \underset{(-4.47)}{-1.38\ D(2008;10)_{t-1}} \\
& \underset{(+3.62)}{+0.59\ D(2002;5)_t} \quad \underset{(+3.85)}{+0.63\ D(2002;7)_t} \quad \underset{(+4.64)}{+0.76\ D(2008;4)_t} + \mu_t
\end{aligned}
$$

T-values in parantheses. $R^2 = 0.95$; Jarque-Bera test = 2.26 (probability 0.32);
Breusch-Godfrey Serial Correlation LM Test: Lag (1): Prob. F (1,76) =0.55;
Lag (4): Prob. F (4,73) =0.22, Lag (8): Prob. F (8,69) =0.40
ECM-CPI and ECM-ECB stand for the residuals of the cointegration relations between the MNB rate and the CPI, and the MNB rate and the ECB rate, respectively, presented in Table 6.2.2 on page 157. 'D' denotes an impulse dummy variable, μ_t the residual.

The test yields an inconclusive result as regards the relevance of the two cointegration relations. However, in the short term, the MNB has reacted strongly and timely to the nominal exchange rate and to the ECB rate. Because the nominal exchange rate is included as percentage deviation from the central parity, the determined positive parameter implies that the farther the nominal exchange rate is from the central parity, the stronger the reaction in terms of the interest rate. As the nominal exchange rate was permanently on the appreciation side of the band during the period between 2001 and 2007, it has consequently exerted constant downward pressure on the interest rate. The reaction to the inflation rate is not significant. The rather impressive number of dummies for "one-off" effects indicates that Hungarian monetary policy has often reacted ad hoc.

When only one long-term relation is included in the regression, each turns out significant, similarly to the results found in the VECM framework. That might be the consequence of a joint link between both variables and the (omitted) exchange rate. To describe the MNB's rate setting in the short run, we chose the equation that includes the residuals of the cointegration relation with the inflation rate:

$$\begin{aligned}
\Delta MNB_ref_t = {} & -0.03\ ECM\text{-}CPI_{t-1} \quad +0.02\ DEV_HUF_t \quad +0.30\ \Delta ECB_ref_t \\
& \textit{(-2.96)} \qquad\qquad \textit{(+3.86)} \qquad\qquad \textit{(+2.47)} \\
& +0.45\ \Delta MNB_ref_{t-1} \quad +0.29\ \Delta ECB_ref_{t-1} \quad +0.18 \\
& \textit{(+6.33)} \qquad\qquad \textit{(+1.99)} \qquad\qquad \textit{(+2.97)} \\
& -1.47\ D(2003;1) \quad +3.12\ D(2003;6) \quad +3.07\ D(2003,11) \\
& \textit{(-8.32)} \qquad\qquad \textit{(+17.74)} \qquad\qquad \textit{(+18.95)} \\
& +3.18\ D(2008;10) \quad +0.94\ D(2003;1)_{t-1} \quad -1.16\ D(2003;6)_{t-1} \\
& \textit{(+18.29)} \qquad\qquad \textit{(+4.39)} \qquad\qquad \textit{(-4.04)} \\
& -1.23\ D(2003,11)_{t-1} \quad -1.47\ D(2008;10)_{t-1} \quad +0.60\ D(2002;5)_t \\
& \textit{(-4.47)} \qquad\qquad \textit{(-4.93)} \qquad\qquad \textit{(-3.75)} \\
& +0.62\ D(2002;7)_t \quad +0.76\ D(2008;4)_t \quad +\mu_t \\
& \textit{(+3.82)} \qquad\qquad \textit{(+4.65)}
\end{aligned}$$

T-values in parantheses. $R^2 = 0.95$; Jarque-Bera test = 3.16 (probability 0.20);
Breusch-Godfrey Serial Correlation LM Test: Lag (1): Prob. F (1,78) =0.53;
Lag (4): Prob. F (4,75) =0.26, Lag (8): Prob. F (8,71) =0.42
ECM-CPI denotes the residuals of the cointegration relations between the MNB rate and the deviation of the inflation rate from target.

It showed a marginally better fit in the tests for the residual process. However, the adjustment coefficient in front of the ECM, which is very low and which indicates a rather slow reaction, was nearly the same for both specifications.

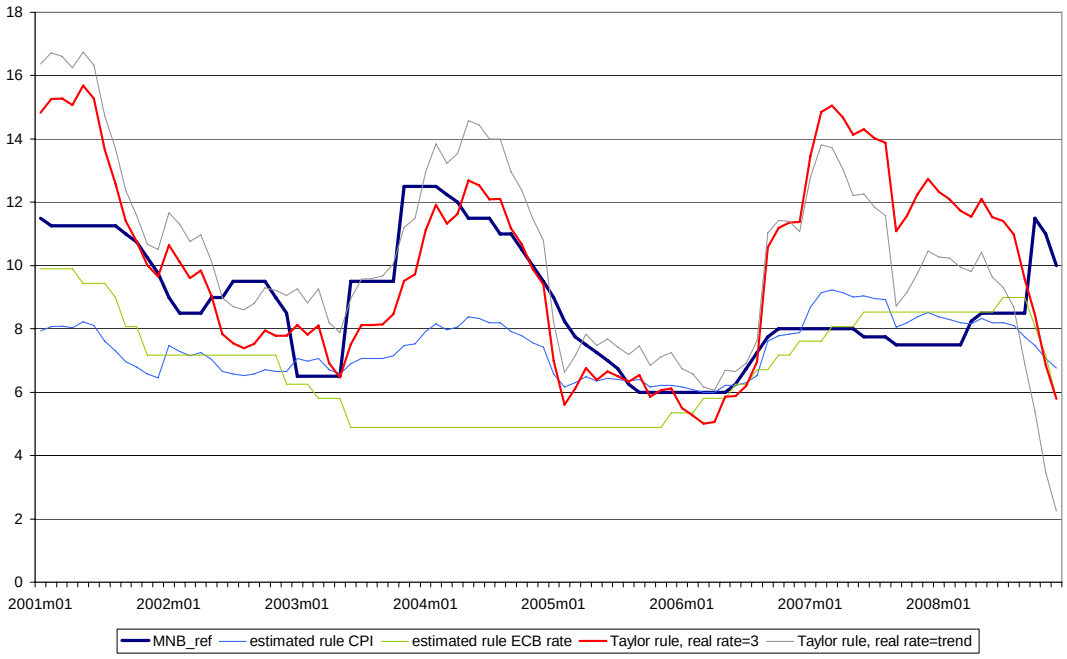
The estimated parameters in front of the change in the ECB rate and in front of the exchange rate to the euro are rather robust across the estimations. All in all, these estimations suggest that the long-term relations are relevant for the MNB rate setting, but their effect is dominated by short-term movements and ad hoc adjustments in the interest rate compelled by shocks from the domestic or foreign economies.

Graph 6.2.8 (p. 161) compares the estimated long-term policy rules with the actual rate setting of the MNB and the Taylor rule. The Taylor rule is calculated based on the same assumptions as that for the Czech Republic, i.e. using the parameters as in equation (19) and under either an equilibrium real rate of 3 % or an equilibrium real rate equalling the

trend rate determined by the HP filter. A first observation is that both estimated long-term rules shown in Graph 6.2.8 differ substantially from the actual rate setting. For one, they are much smoother than the actual rate. That might be the consequence of our neglect of the nominal exchange rate in these estimations. At the same time, however, it shows the dominance of short-term factors in the MNB's rate setting. By contrast, in particular in 2003-2004, the actual policy rate traces the rate suggested by the Taylor rule quite well. Still, according to the Taylor rule, the hike in 2004 is owing to the surge in inflation, whereas the actual rate setting of the MNB was triggered by exchange rate depreciation. During the period of 2007-2008, the Taylor rule suggests again a strong upward rate adjustment, which is not found in the actual rate setting. In 2006, the central bank reacted to the exchange rate depreciation only moderately, which may explain the better fit of the estimated rules. In the most recent months, both the Taylor rule and the estimated policy rules suggest a reduction in the policy rate. Owing to the exchange rate pressures, however, the MNB could reduce rates only to a very limited extent. All in all, while the tests do find a long-term link between, on the one hand, the MNB policy rate and the ECB rate, reflecting the openness for capital flows and the importance of the exchange rate in the policy framework, and, on the other hand, between the MNB rate and the CPI deviation in line with the inflation targeting strategy, short-term factors seem to have dominated the rate setting.

Graph 6.2.8:

Comparison of MNB policy rate with estimated policy rule and Taylor rule



Source: MNB, own calculations.

Note: 'Estimated rule CPI' stands for the long-term relation between the MNB policy rate and the CPI deviation shown in Table 6.2.2 (p. 157). 'Estimated rule ECB' denotes the long-term relation between the MNB policy rate and the ECB policy rate. The Taylor rule is calculated as in equation (19). 'Taylor rule, real rate = 3%' denotes the rule that is calculated assuming a constant trend growth rate of 3 %; 'Taylor rule, real rate = trend' denotes the rule which incorporates a trend growth rate approximated by the HP filter.

6.2.3.2 The pass-through into money market rates and government bond rates

As was already indicated, money market transactions of more than 1 month have been infrequent. Therefore, instead of the money market rates, the interest rate pass-through tests were made with the BUBOR fixing rates for 1 day, 1 month, 3 months and 6 months shown in Graph 6.2.4 (p. 153). Transactions with maturities of more than 1 month are mainly carried out as foreign exchange swaps or with treasury bills. As a result, the tests are also made for treasury bills of 3, 6 and 12 months. The government bond yields refer to maturities of 3, 5 and 10 years. Tests are also carried out for loans in forint for purchases of residential property by households, loans for consumption purposes, and for loans to non-financial corporations. All series are provided by the MNB.

The pass-through tests into the money market and the government bond yields are made for the time period 1999:1- 2008:12, and include 120 observations. Admittedly, until 2001, the MNB base rate was not directly used as a policy instrument. However, it served to derive

other interest rates. In addition, the main rate was set with a view to affecting the operating target (the money market rate for 3-month transactions). According to the unit root tests (Table A4.2 in Appendix 4, p. 267), all series are I(1), except for the interest rates of loans for housing construction, which is stationary. The trace test establishes cointegration between all money market rates and the reference rate, and all government bond yields and the reference rate (Table 6.2.3 below). Of the three loan series, only the interest rates of loans for housing are not significantly linked to the policy rate.

Table 6.2.3:

Cointegration test for the pass-through into money markets and government bonds

1999:1 – 2008:12	LAG OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE TEST
MNB_rate MM_D1	SC =1	0 1	113.06** 6.25
MNB_rate MM_M1	SC =2	0 1	58.14** 7.33
MNB_rate MM_M3	SC=2	0 1	49.16** 7.39
MNB_rate MM_M6	SC=2	0 1	34.66** 7.56
MNB_rate GB_3M	SC=1	0 1	63.71** 7.23
MNB_rate GB_6M	SC=1	0 1	66.33** 7.26
MNB_rate GB_1Y	SC=1	0 1	54.41** 7.32
MNB_rate GB_3Y	SC=1	0 1	41.01** 6.14
MNB_rate GB_5Y	SC=1	0 1	34.57** 5.36
MNB_rate GB_10Y	SC=1	0 1	31.57** 4.89
MNB_rate LOANS-hh-cons	SC=1	0 1	21.18* 4.32
MNB_rate LOANS-hh-hous	SC=1	0 1	17.46 4.03
MNB_rate LOANS-firms	SC=2	0 1	36.08** 4.94

Note: The estimated VECM assumes a constant term in the long-run cointegration relation, but none in the short-term dynamics. The estimations for the loans to non-financial firms and to households are made for the period 2000:1-2008:12. # denotes significance at 10 %, * significance at 5% and ** significance at 1 %.

Table 6.2.4:

Parameters of the interest rate pass-through

COINTEGRATION RELATION			ADJUSTMENT TO CI RELATION	
MM_D1	MNB_rate	constant	D(MNB_rate)	D(MM_D1)
1	-0.99 *(0.019)*	0.07 *(0.18)*	-0.06 *(0.099)*	-0.91 *(0.075)*
MM_M1	MNB_rate	constant	D(MNB_rate)	D(MM_M1)
1	-1.01 *(0.008)*	0.02 *(0.087)*	+0.12 *(0.328)*	-0.75 *(0.176)*
MM_M3	MNB_rate	constant	D(MNB_rate)	D(MM_M3)
1	-0.98 *(0.010)*	-0.20 *(0.106)*	+0.56 *(0.295)*	-0.32 *(0.162)*
MM_M6	MNB_rate	constant	D(MNB_rate)	D(MM_M6)
1	-0.94 *(0.021)*	-0.46 *(0.212)*	+0.34 *(0.190)*	-0.19 *(0.112)*
GB_3M	MNB_rate	constant	D(MNB_rate)	D(GB_3M)
1	-0.95 *(0.016)*	-0.28 *(0.165)*	+0.74 *(0.141)*	+0.32 *(0.17)*
GB_6M	MNB_rate	constant	D(MNB_rate)	D(GB_6M)
1	-0.93 *(0.018)*	-0.46 *(0.179)*	+0.72 *(0.124)*	+0.29 *(0.149)*
GB_1Y	MNB_rate	constant	D(MNB_rate)	D(GB_1Y)
1	-0.91 *(0.028)*	-0.63 *(0.281)*	+0.47 *(0.094)*	+0.07 *(0.11)*
GB_3Y	MNB_rate	constant	D(MNB_rate)	D(GB_3Y)
1	-0.74 *(0.049)*	-1.90 *(0.494)*	+0.27 *(0.065)*	-0.07 *(0.083)*
GB_5Y	MNB_rate	constant	D(MNB_rate)	D(GB_5Y)
	-0.61 *(0.054)*	-2.59 *(0.544)*	+0.25 *(0.066)*	-0.09 *(0.07)*
GB_10Y	MNB_rate	constant	D(MNB_rate)	D(GB_10Y)
1	-0.42 *(0.041)*	-3.75 *(0.421)*	+0.32 *(0.091)*	-0.11 *(0.067)*
LOANS_hh_cons	MNB_rate	constant	D(MNB_rate)	D(LOANS)
1	-0.81 *(0.18)*	-13.21 *(1.74)*	+0.00 *(0.07)*	-0.22 *(0.051)*
LOANS_firms	MNB_rate	constant	D(MNB_rate)	D(LOANS)
1	-0.95 *(0.021)*	-1.65 *(0.195)*	+0.23 *(0.93)*	-0.47 *(0.128)*

Note: The estimated VECM model assumes a constant term in the long-run cointegration relation, but none in the short-term dynamics. In parentheses are the standard errors. The estimations for the money market rates refer to 1999:1-2008:12; the estimations including loans to non-financial firms and to households are made for the period 2000:1-2008:12.

As regards the parameters of the cointegrating vectors, the money market rates for maturities of 3 months and over carry a statistically significant constant term of 0.2 for the 3-months rate and 0.5 for the 6-month rate (Table 6.2.4 above). For all money market rates, the parameter of the reference rate is close to 1. In all cases, it is the money market rate that adjusts to the central bank rate; in the case of the 3-month and 6-month rate, both series

could be regarded endogenous. The reaction in the case of the M3 and M6 is slower, also pointing to the rather low liquidity in this segment. In the treasury bill and government bond market, the interest rates up to one year are linked closely to the reference rate, but the coefficients are marginally lower than in the money market. In these cases, it appears that the MNB adjusts to the long-run relation. The adjustment is furthermore quite quick. The MNB rate is less then fully translated into government bonds with a maturity of more than 1 year, which is an equivalent to an inverse yield curve. However, the liquidity and risk premia increase substantially with the term to maturity. 10-year government bond yields bear a constant premium of more than 3 ½ percentage points. In the treasury bill and government bond market, it is always the MNB rate that adjusts. This supports the idea that due to the higher liquidity, this market is more efficient and changes in the central bank rate are swiftly priced in, in contrast to the money market. Interestingly, the link between the loans to non-financial firms and the MNB main rate is also very strong, with a parameter of close to 1. It is the loans' interest rate that adjusts to this relation; the adjustment is fast. The average risk premium charged of firms amounts to 1.65 percentage points. The reaction of interest rates for consumer loans is slightly weaker; in addition, these loans carry a premium of more than 13 percentage points. It is the loans that adjust to this relation; the speed is much lower than for loans to firms.

6.2.4 Conclusions and summary of interest rate investigation

Monetary policy was conducted within the strategy of a fixed, but adjustable, nominal exchange rate until 1995. Between 1995 and 2001 the MNB operated a crawling peg. Since 2001 it has pursued inflation targeting. Until February 2008, the inflation target was accompanied by a nominal exchange rate target with broad fluctuation bands.

Disinflation became a priority only with the introduction of the crawling peg regime in 1995. However, disinflation was intended to be slow and should not incur substantial costs in terms of output and employment. The crawling peg period did yield disinflation, but although the rate of crawl approached zero by early 2001, inflation rates declined only to the level of 10 %. The limited success of the disinflation strategy based on the crawling peg can be explained by the reluctance on the part of the authorities to back the disinflation strategy by high real interest rates. Because of the narrow currency band, the central bank had to concentrate on stabilising the nominal exchange rate. With strong capital inflows, interest rates had to be kept rather low to engineer devaluations. As a consequence, the wage and price setters could face quite easy monetary conditions. Inflation expectations and wage pressures remained elevated.

Disinflation resumed after the introduction of inflation targeting mainly on the back of currency appreciation. However, disinflation based on nominal appreciation was limited first by the existence of the (wide) fluctuation bands, and second by fiscal policy shocks which made a further appreciation undesirable to the authorities (and most likely also unsustainable). The targeted exchange rate band was narrowed in 2003. Furthermore, the inconsistent policies and an unfavourable policy mix provoked downward pressure on the currency. To stabilise the exchange rate, the central bank had to sacrifice the inflation target. A brief period of inflation below 5 % followed in 2005 and early 2006, when Hungarian price trends benefited from low global inflation. However, also this decline in inflation proved temporary. In the second half of 2006 the government had to adopt harsh adjustment measures including a hike in taxes and regulated prices. Further inflation pressures stemmed from the global oil and food price hike in 2007. All in all, Hungary was subject to a number of adverse inflation shocks. However, the fact that the inflation target was met only in a few instances may have damaged its ability to anchor inflation expectations. The deeply ingrained moderate inflation expectations of wage and price setters need not have been broken yet.

As regards the policy rate setting, the tests prove that the MNB did react to deviations of the observed inflation rate from the targeted rate. However, the determined long-term link appears weak. Rate setting has been dominated by short-term movements and ad hoc adjustments compelled by shocks from the domestic or foreign economies. The Taylor rule shows similarity with the actually observed rules only in some periods. The co-movement is also to some extent by chance. For instance, in 2003, the MNB raised interest rates owing to strong currency depreciation, whereas the Taylor rule would have suggested a rate hike in early 2004 owing to a spike in inflation. In the financial market, the tests find a strong link between the longer-term rates and the policy rate. However, the long rates carry high risk or term premia. In addition, the MNB rate is less then fully translated into the government bond yields. Pass-through to loans to non-financial firms and consumers is strong. Hence, the MNB is able to guide rate setting in the wider economy, at least as regards the loans granted in forint.

6.3 The inflation process

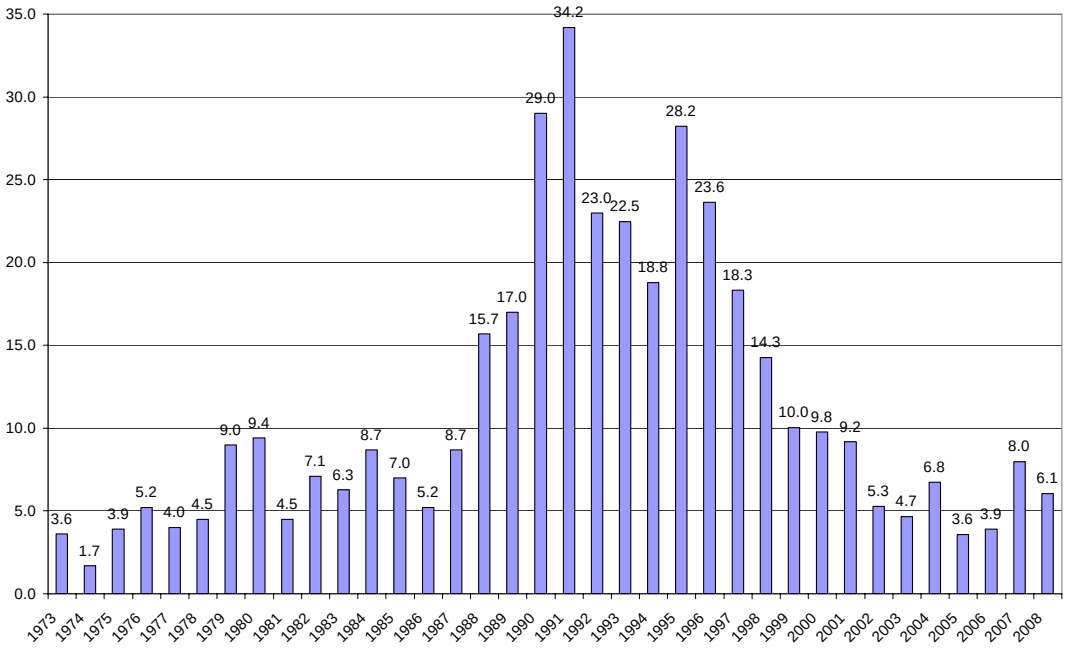
6.3.1 Legacy of the planned economy

Hungary has a long history of inflation. Not only can it claim to have recorded the highest inflation rate ever during the hyperinflation in 1946 (Bernholz, 2003:8), but also during the period of the planned economy inflation rates were substantial. Graph 6.3.1 on next page

shows the CPI inflation rates starting in 1973. The rather high inflation rates – in planned economies terms – in the 1970s and 1980s were in part due to the introduction of market elements into the economic system.[94] On the other hand, administered prices were rather frequently adjusted to excess demand (Commander/Coricelli, 1991:3). At the same time, the high foreign debt combined with weak foreign trade performance increasingly caused strains in the balance of payments and necessitated devaluations in the 1980s. These have fuelled expectations of subsequent higher inflation (Szapáry/Jakab, 1998) and a spiral of devaluation and inflation. As a result, before the outset of the transition process, wage growth was affected by devaluation expectations, and prices reacted to wage pressures as well as the nominal exchange rate (Commander and Coricelli, 1991:14).

Graph 6.3.1:

Inflation rates, 1973-2008



Note: Inflation based on the CPI. Source: IMF IFS

6.3.2 Inflation during the early stage of the transition

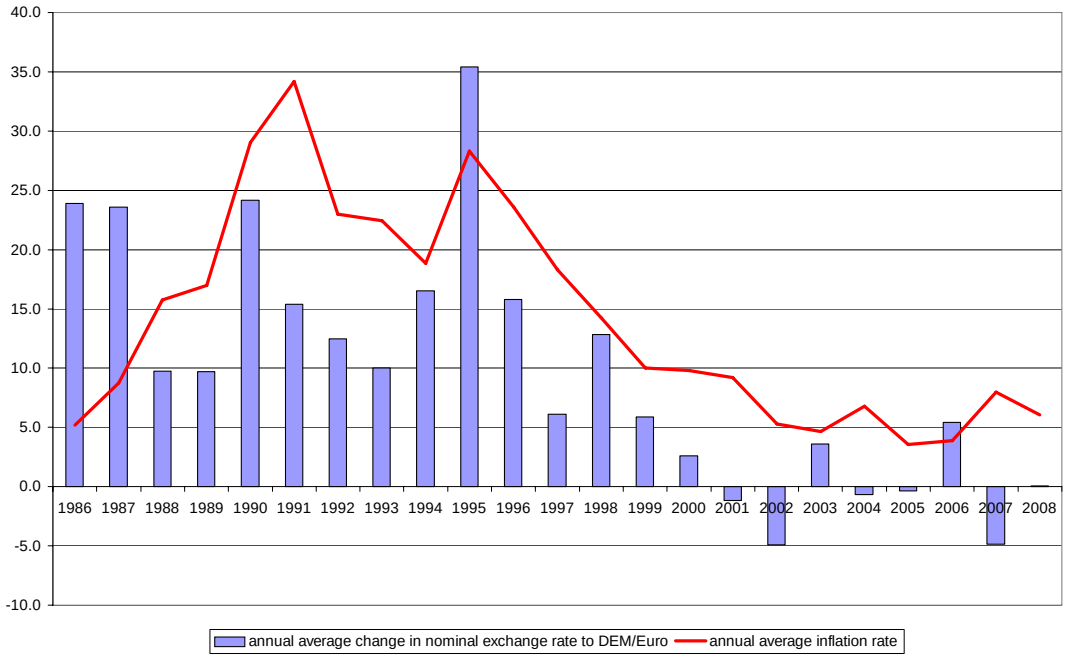
Because of the absence of a significant monetary overhang (Hamecz et al., 1998: 87), fewer prices left to liberalise, and a gradual liberalisation of the remaining regulated prices, Hungary did not experience an inflation shock in the early years of the transition. Inflation nevertheless rose in 1990 and 1991 (Graph 6.3.1 above). In 1990, it climbed to the highest level of the post-1973 era and peaked at 38.7 % in June 1991. This had a number of

[94] "Market determined" prices had to be linked to costs.

reasons. First, it reflected price liberalisation and a correction of relative prices, which was expected to proceed mainly through inflation (Hamecz et al., 1998). Second, the central bank extended direct credit to the government as the recession after 1990 reduced revenues and raised expenditures. Third, the goal of macroeconomic stabilisation ranged behind the objective of retaining access to international capital markets. Monetary policy was targeting the real exchange rate defined over the Producer Price Index. To counteract the effect of higher inflation on the real exchange rate and competitiveness, the forint was devalued a number of times, which in turn fuelled inflation.

Graph 6.3.2:

Annual rates of change of the forint nominal exchange rate to the German mark (until 1998) and to the euro (since 1999), and headline inflation



Source: IFS.

Inflation declined in 1992, when capital inflows relieved the pressures on the current account and the MNB promoted disinflation through lower currency devaluation (Graph 6.3.2 above). Still, inflation fell only to 23 %. The decline was moderate because numerous inflationary factors such as lending of the central bank to the government or directed credit to state-owned enterprises remained in place. Furthermore, the disinflation policy based on smaller devaluation steps in an environment of steady inflationary impulses from the budget proved unsustainable. When imbalances, in both the current account and state budget, widened substantially in 1993 and 1994, the devaluation rates rose again. This did not only raise the inflationary pressures from the nominal exchange rate, but also massively

reduced the credibility of the monetary policy strategy and hence the ability of the nominal exchange rate to anchor inflation expectations.

6.3.3 Inflation during the crawling peg regime

In March 1995, the MNB started to operate a crawling peg regime to stabilise expectations and restore the credibility of monetary policy. It meant a policy change also in that disinflation became a prime objective of monetary policy. To recall, the crawling peg regime can serve as a disinflation tool if the central bank can establish credibility as regards its ability to maintain this regime, and if it steadily reduces the rates of crawl. The crawling devaluation of the nominal exchange rate will directly affect the prices of tradables, due to the import prices and also due to competition and competitiveness considerations. Also food and energy prices, although largely driven by exogenous factors, will react to the nominal exchange rate. At the same time, non-tradables will be affected by the crawling peg regime either through the Balassa-Samuelson effect, according to which market service inflation is tied to industrial goods prices inflation, or through inflation expectations and wage setting. Wage setters will react to the crawling peg regime either directly (inflation expectations are in line with the announced future rate of crawl) or indirectly if wages are adjusted based on the (declining) past inflation.

As it was already described earlier, inflation declined markedly after the introduction of the crawling peg regime. Disinflation in 1995 and 1996 occurred on the back of the stabilisation programme of March 1995. It led to a reduction in government spending by ten per cent (World Bank, 1999:20). It was accompanied by income policies, which reduced real incomes by 9 and 3 per cent in 1995 and 1996, respectively (World Bank, 1999:22). Disinflation was also helped by the sizeable output gap; GDP growth rates in 1995 and 1996 amounted to about 1 %. In 1998, inflation declined to 10 %. However, after 1998 disinflation stopped, and inflation rates remained at the level of 10 % for a number of years, despite a steady reduction of the rate of crawl to close to zero (0.3 % per month) in 2000.

A number of factors might have contributed to the increasingly weak anchoring of inflation by the declining rate of crawl. First, the authorities aimed at disinflation at low output costs. The inertial component of the inflation process was considered so large by the Hungarian authorities that any increase in disinflation effort, e.g. through a more rapid decline in the rate of crawl or through an aggressive real interest rate hike, would prove too costly.[95] This

[95] Suranyi/Vincze (1999: 168): "Professional economists in Hungary usually do not advise the government to proceed hastily with inflation reduction. The pensioners would rather see their pensions indexed than to worry about whether the Social Security Fund could invest in long-term securities... Official inflation forecasts have too often turned out overoptimistic for the government to be able to rely on the unconditional trust of the public." Similarly, the IMF (1999H:49) cites a document of the Ministry

may have reduced the perceived commitment of the central bank to disinflation and hence reduced the signalling effect of the central bank's policies regarding the rate of crawl. Already in the 1990s, however, the structural problems, such as the duration of wage contracts and other labour market frictions, were assessed to be small (Blanchard, 1998; IMF, 1999H). The credibility of the disinflation commitment and hence a faster disinflation could have been enhanced by a more devoted effort (OECD, 1998H; Halpern/Wyplosz, 1998; Blanchard, 1998).[96]

Second, Abel/Siklos (2002) report that the "annual guidelines for monetary policy, published by the MNB relied on estimates of a 'target' for inflation that was determined by the government".[97] On the one hand, this can be considered useful as it implies a coordinated effort by the government and the MNB to promote disinflation. On the other hand, however, these targets for inflation were never achieved, which certainly did not raise the credibility of the inflation forecasts and targets of both the government and the MNB.

Third, the monetary policy regime may have contributed to the halt in the disinflation process in 1998. Interest rate setting that was guided by the foreign interest rate and capital inflows may have created too loose monetary conditions, in particular in 1998-2000. During that time, growth recovered and the unemployment rate declined from 10 % in 1996 to 6 % in 2000. The labour market became increasingly tight, particularly in some dynamic regions of Hungary (OECD, 2002H). Real interest rates were relatively high in 1998 at times of the Russian crisis, but declined during 1999 and were particularly low in 2000 (Graph 6.3.3 on next page). Admittedly, the exchange rate was considered the most important transmission mechanism from the central bank's instruments to prices. Nevertheless, the interest channel may have gained in strength during the latter half of the 1990s, and the low interest rates may have further stimulated the already vivid demand. Therefore, the rather accommodating monetary policy could not break the deeply ingrained inflation expectations, and may have even created inflationary pressures during the boom period in 1999 and 2000.

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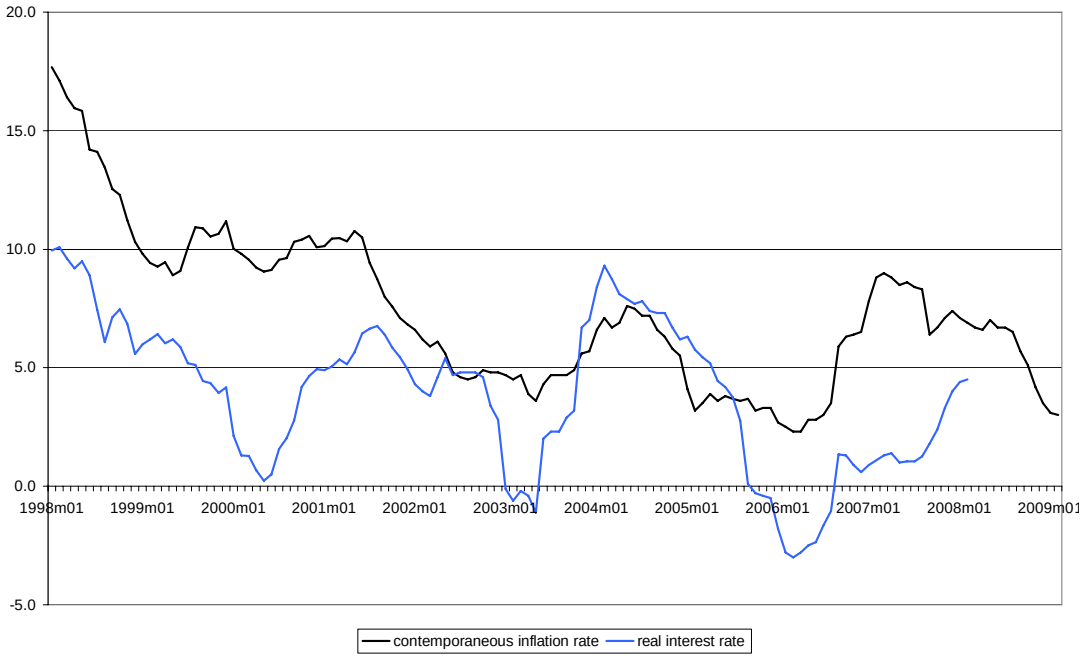
of Finance that argues in favour of a slow disinflation process because of the "difficulties tackling inflation's large inertial component."

[96] Halpern/Wyplosz (1998:15): "Our impression is that inertial inflation has usually been used to justify monetary policies which fall shy of direct attacks on inflation and that there is no reason why… inflation should not be driven by monetary policy. … In setting up modest declines in the rate of crawl the MNB is implicitly accepting that inflation recedes only slowly: central bank inertia rather than inflation inertia?"

[97] Abel/Siklos (2002:319): "The annual MNB publication outlining monetary policy plans for the following year… mentions an inflation objective – based on government budgetary projections – of 12-13 % for 1998, 9 % for 1999 and 6-7 % for 2000. These have never been achieved. In late summer 2001, inflation objectives were announced jointly by the government and the central bank."

Graph 6.3.3:

Real interest rates



Source: Own calculations based on data from MNB. The real interest rates are calculated subtracting the inflation rate one year ahead from the policy rate.

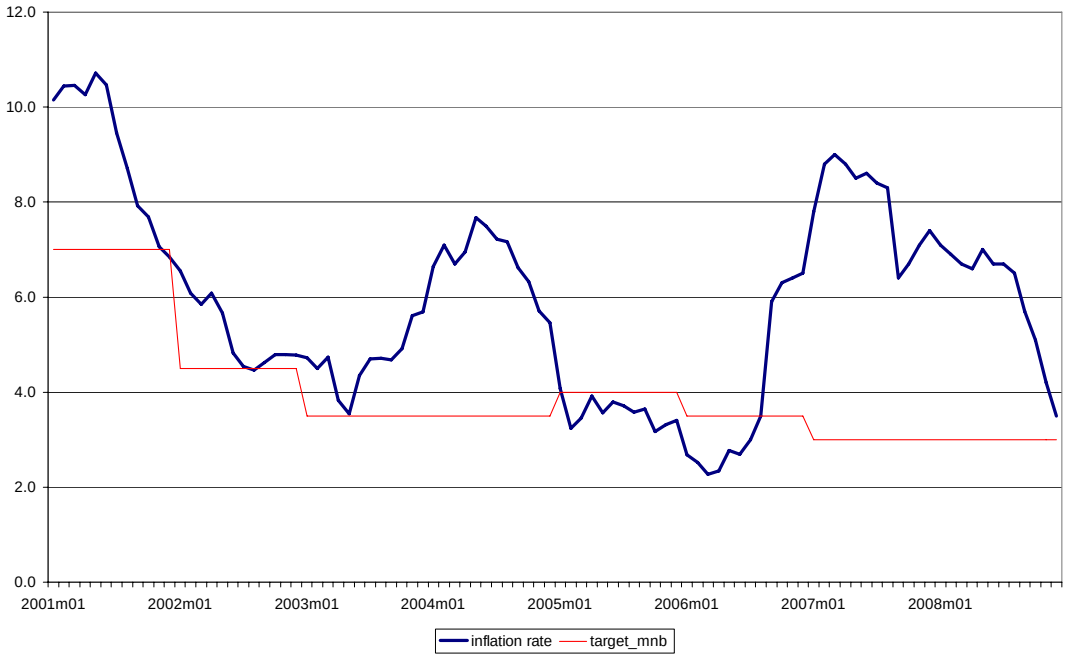
6.3.4 Inflation during the inflation targeting regime

The inflation targeting regime in place since May 2001 consisted of a declining inflation target and a fixed exchange rate within a wide fluctuation band. A stable nominal exchange rate was expected to contribute to disinflation through the prices of tradables and through its signalling function. As it was already argued, the MNB intended to let the exchange rate appreciate, which would put even stronger downward pressure on tradables' prices. This effect would be particularly pronounced if the nominal appreciation was the result of an increase in real interest rates and not of autonomous capital inflows. At the same time, however, the wide bands could imply a weaker pass-through from foreign prices and the exchange rate to domestic tradables prices. As regards non-tradables, within the inflation targeting regime, disinflation should follow if non-tradables inflation is linked to industrial goods' inflation rate (e.g. through the Balassa-Samuelson effect), or if wage setting is guided by the (declining) targeted inflation rate. Disinflation can also occur through a backward looking adjustment of wages to lower inflation if headline inflation declines on the back of lower inflation in industrial goods prices. Finally, the inflation targeting framework also allows for "opportunistic" disinflation after positive inflation shocks.

In the early years of the inflation targeting regime, inflation declined on the back of nominal exchange rate appreciation. However, when evaluating the track record up to now, it is difficult to speak of a trend towards disinflation since then (Graph 6.3.4 below). A first spike in inflation occurred in 2004 and a second period of inflation rates of more than 6 % followed in 2006-2008. Admittedly, in both cases adverse shocks from VAT adjustments and global oil and food price developments contributed to the surge in inflation. However, the phase of relatively low inflation in 2005 was the result of shocks either, but this time positive ones.[98] In early 2006, the decline in VAT in itself reduced inflation by 1.7 percentage points (IMF, 2006H:7); the underlying inflation rate remained at the level of four per cent.

Graph 6.3.4:

Headline inflation rate and inflation target in 2001-2008



Source: MNB.

As a result, whether or not the inflation targeting regime has been able to anchor inflation expectations at a level close to the inflation target remains doubtful. The short episode of low inflation in 2005 and 2006 may have been too short to break the ingrained higher inflation expectations. A rebound in inflation, irrespective of the cause, can reinforce the wage setters' long-standing inflation fears. In other countries in the region, namely in Poland and in the Czech Republic, inflation expectations declined only after an extended

[98] "In 2005, the low rate of trend inflation resulted from a mystery of energy prices and global disinflation." (Csermely et al., 2006:11)

phase of high real interest rates, which Hungary has tried to avoid. Interestingly, the hike in interest rates in 2003 was followed by a drop in inflation (Graph 6.3.3, p. 170), which however was attributed more to "global disinflation" than to the interest rate hike. In addition, this phase was relatively short-lived as the MNB started to reduce interest rates in 2004 immediately after the exchange rate stabilised between 250-260 HUF per euro. The strong preference for the exchange rate target may have undermined the credibility of the inflation target. Hence the fact that inflation rates stayed at an elevated level for two years after 2006, despite a sharp slowdown in growth and a negative output gap, may be evidence of unaltered underlying inflation dynamics.

6.3.5 Decomposition of inflation

A decomposition of the Hungarian CPI into the major categories of food, industrial goods, market services and regulated items is provided by the MNB. The series starts in 1993, and the data are in monthly frequency.

Table 6.3.1 (p. 173) presents the weights of the individual categories in selected years. Since 1993, "core" categories of industrial goods (excluding energy) and market services ("core 1" in Table 6.3.1) have had a weight of less than 50 % in the consumer basket. Industrial goods alone have made up about 30 % of the representative basket. Market services, which are the main category representing non-tradables, have attained a weight of about 22 % during the 2000s. Their weight has increased slightly over time. Food and energy prices, which can also be directly affected by the nominal exchange rate, have had a joint weight close to that of industrial goods. Food prices alone have made up approximately 20 % of the consumer basket. The weight of the most volatile items 'fresh fruit and vegetables' in the CPI has been lower than 4 %. If also food prices are added to the industrial goods and market services, the core inflation measure (denoted 'core 2' in Table 6.3.1) contains two-thirds of the CPI basket. The weight of regulated items has amounted to 16 % in 2008.[99] The increasing weight of regulated items over time is not necessarily the consequence of a rising number of regulated items, but of the price hikes that raised their expenditure share.

Graphs 6.3.5 and 6.3.6 (both on p. 174) show the development of headline inflation and the six major subcomponents since 1994. A first observation is that inflation trends in the crawling peg and the inflation targeting periods have differed perceptibly. First, the crawling peg period was characterised by a trend towards disinflation, which did not continue during the inflation targeting period. In particular the prices of energy and

[99] For comparison, in the German consumer basket regulated prices have a weight of 20 % (Statistisches Bundesamt, 2008).

regulated items have fluctuated strongly around the level prevailing at the inception of inflation targeting. Second, whereas the decline in inflation was rather uniform among the subcomponents in particular during the early years of the crawling peg regime, the inflation targeting period has been characterised by more variation in the inflation rates. Inflation of food, energy and regulated items is far more volatile than inflation of either industrial goods prices or market services prices. At the same time, the inflation differential between industrial goods prices and market services prices has risen noticeably.

Table 6.3.1:

Weights in per cent of product categories in the CPI, MNB classification

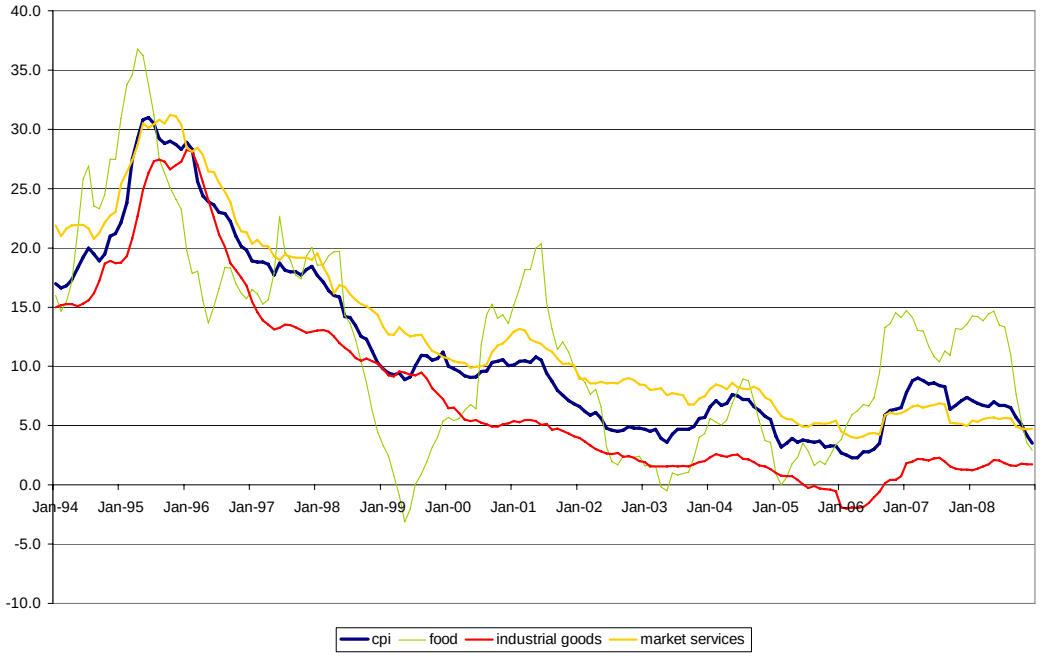
	1993	**1998**	**2003**	**2008**
Food	21	22	19	17
Industrial goods	32	28	28	29
Market services	16	18	22	22
Energy	8	7	6	7
Alcohol/Tobacco	11	9	10	9
Regulated items	12	17	16	16
Core 1	48	46	49	51
Core 2	69	67	68	68

Notes: 'Core 1' includes industrial goods and market services; 'core 2' considers in addition also food prices.
Source: MNB

As regards industrial goods prices, they declined strongly during the initial stage of the crawling peg regime. After 1997, the pace of disinflation slowed down perceptibly, probably as a reaction to decreasing rates of currency devaluation. Inflation rates stabilised in 2000 at 5 %, and started to decline again immediately after the introduction of the inflation targeting regime. They diminished steadily and turned negative in early 2006 when the VAT rate was lowered. In 2007, industrial goods prices started to rise again, but their inflation rate has remained low. Market services inflation diverged from industrial goods inflation already in 1997. However the inflation differential rose markedly after the introduction of the inflation targeting regime. The lowest inflation rate recorded for market services prices was 4.8 % in 2006. In general, the inflation rate of core components was lower than that of the other components, i.e. mainly regulated items and energy prices (Graph 6.3.7, p. 175). In particular, the spikes in 2004 and 2007 were milder, proving the earlier hypothesis of a marked effect of adverse inflation shocks. In addition, for core inflation, a trend towards disinflation may still be acknowledged.

Graph 6.3.5:

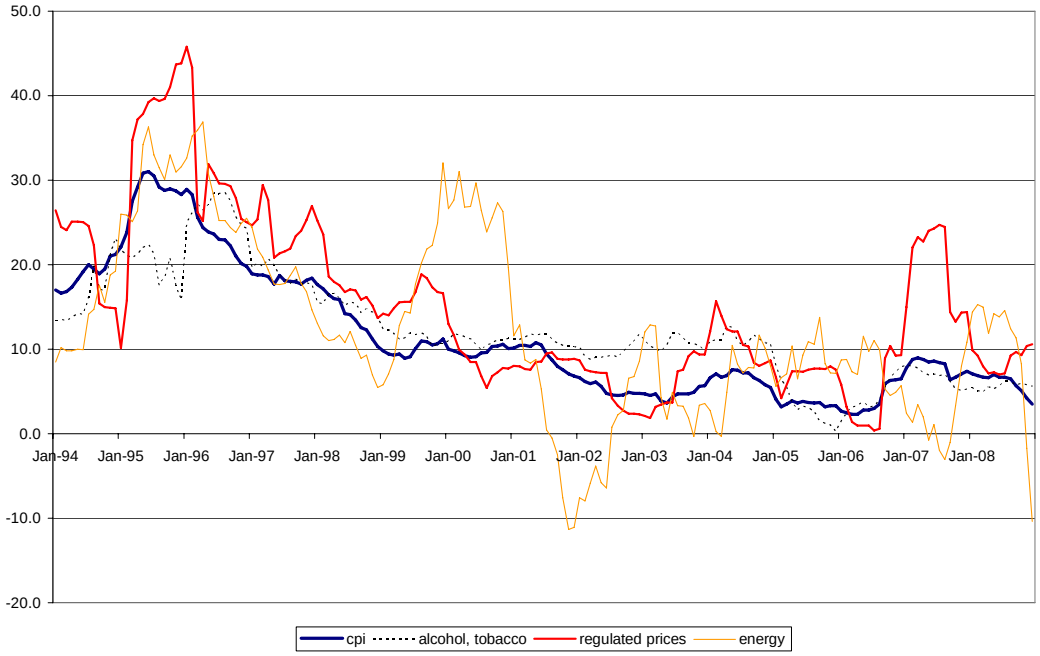
Year-on-year inflation rates of headline CPI, industrial goods, market services and foodstuffs



Source: MNB

Graph 6.3.6:

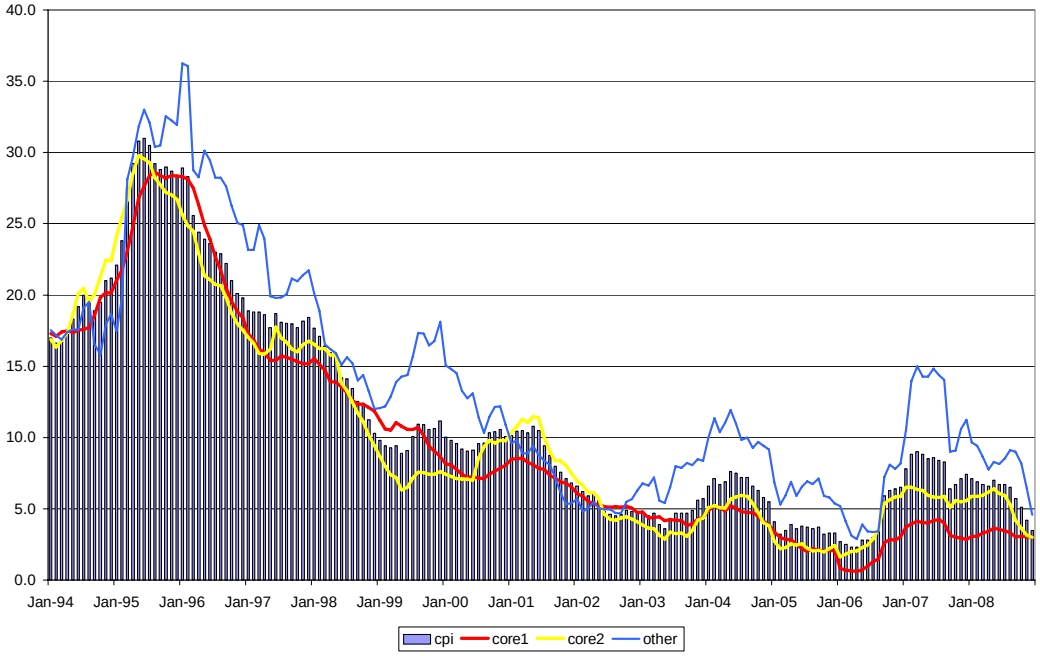
Year-on-year inflation rates of headline CPI and the prices of regulated items, energy, and alcohol and tobacco



Source: MNB

Graph 6.3.7:

Year-on-year inflation rates of core prices and other components



Source: own calculations based on MNB data. Note: 'Core1' includes industrial goods prices and market services prices and 'core2' industrial goods prices, market services prices and food prices. 'Other' contains the prices of regulated items, energy, alcohol and tobacco.

During the period between 2002 and 2008, nearly all categories recorded average inflation rates above headline inflation (cf. Table 6.3.2 below). One exception is energy prices, which rose approximately in line with headline CPI. The other exception is industrial goods prices, which rose by average of 1.3 % p.a. The highest average inflation rates were observed for regulated prices, standing at 8.9 %. Market services prices and food prices each rose by average of 6.6 % p.a.

Table 6.3.2:
Inflation rates of major CPI categories and their contributions to headline inflation

	CPI	FOOD	IND	MSERV	ALC-TOB	REG	EN
annual average growth rate in per cent							
1995-2001	16.2	15.1	13.1	17.9	16.4	20.2	19.0
2002-2008	5.5	6.6	1.3	6.6	7.4	8.9	5.7
annual average contribution in percentage points							
1995-2001	16.2	3.2	3.8	3.2	1.5	3.2	1.3
2002-2008	5.5	1.2	0.4	1.4	0.7	1.5	0.4

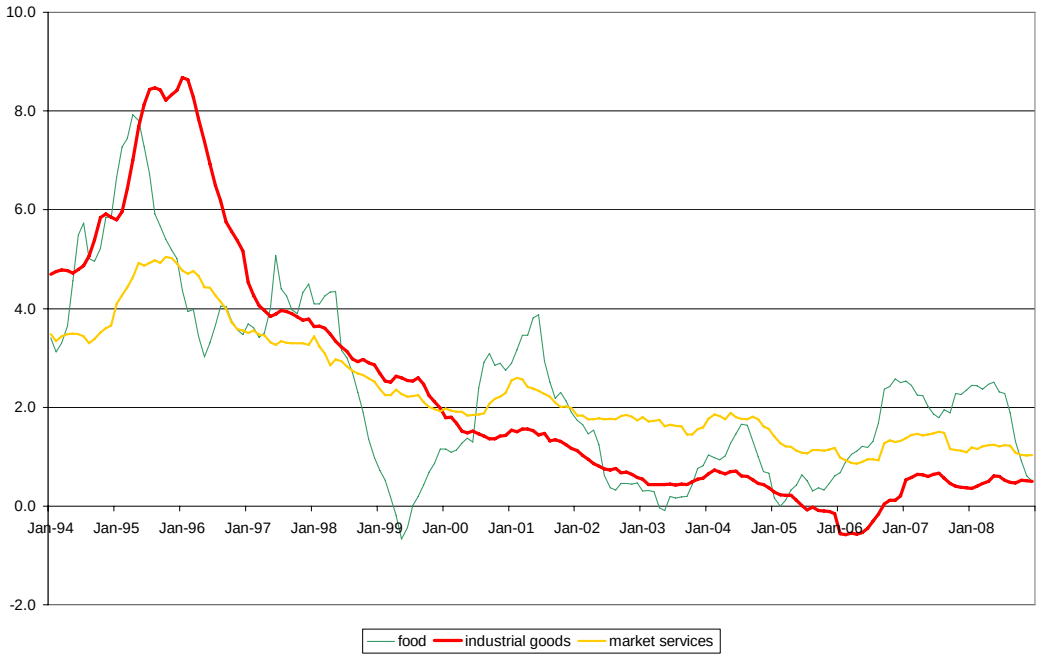
Source: MNB.

As regards the contributions to headline inflation, during the crawling peg period, industrial goods accounted for the highest portion (Table 6.3.2, p. 175, and Graphs 6.3.8 and 6.3.9, both on p. 177). That was the consequence of their high weight and contrasts with the fact that they showed the lowest inflation rate of all categories. During the inflation targeting period, then, industrial goods prices added only 0.4 percentage points to the headline inflation rate of 5.5 %. The strongest impact has now been made by regulated items (1.5 percentage points), market services (1.4 percentage points) and food prices (1.2 percentage points).

In sum, the inflation decomposition indicates that inflation trends may have changed after the inception of the inflation targeting regime. The inflation dynamics appeared more uniform in particular during the early crawling peg period, which may be due to the better anchoring of expectations by the tightly managed exchange rate. Furthermore, during the inflation targeting regime, headline inflation did not follow an appreciable downward trend. During the spikes in 2004 and 2006-08, inflation rates returned quickly to close to 10 %. However, in particular for industrial goods prices, disinflation to low levels has succeeded in the past decade. A trend towards lower inflation rates holds true also for market services, although these remained perceptibly above those of industrial goods prices. The rather pronounced volatility of headline inflation also stems to a large part from the non-core components of regulated prices, energy and foodstuffs. As a result, the inflation performance was indeed marked heavily by factors beyond the central bank's control, which, however, does not diminish the impact that the elevated inflation rates may have on inflation expectations and wage setting. Similarly as in the Czech Republic, the underlying inflation trends are also characterised by a strong adjustment of relative prices. The relative importance for headline inflation of hikes in regulated prices is somewhat lower, while that of food prices and market services prices is higher in Hungary.

Graph 6.3.8:

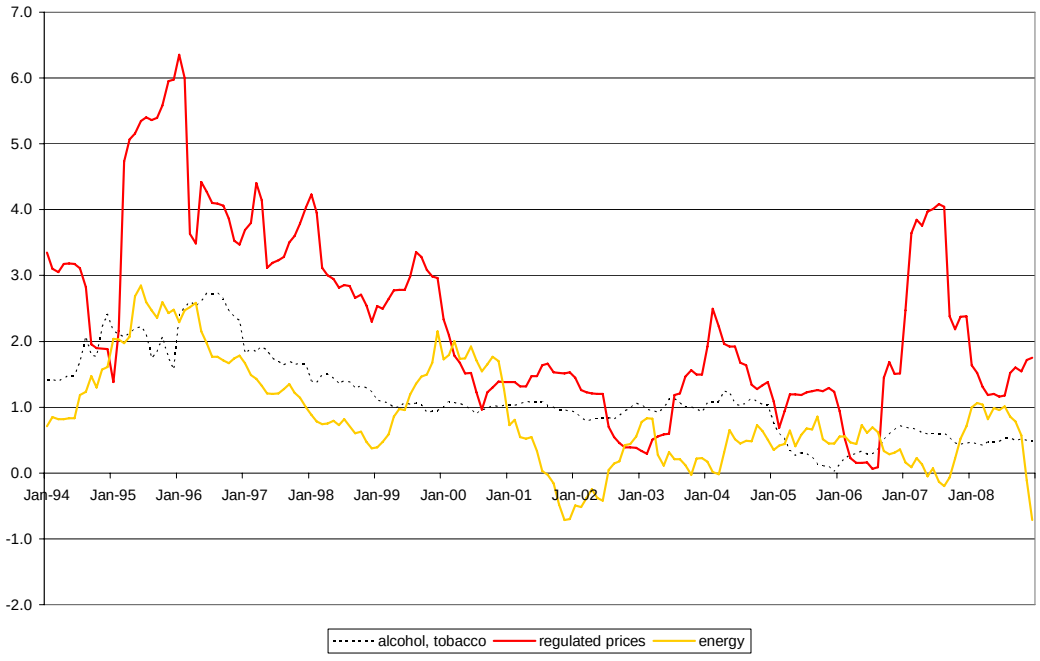
Contributions to headline inflation of food, industrial goods and market services prices



Note: Contributions are specified in percentage points. They are calculated by weighting the inflation rate of the respective component with its share in the consumer basket.
Source: Own calculations based on data from MNB.

Graph 6.3.9:

Contributions to headline inflation of the prices of regulated items, alcohol and tobacco, and energy



Source and note: As for Graph 6.3.8.

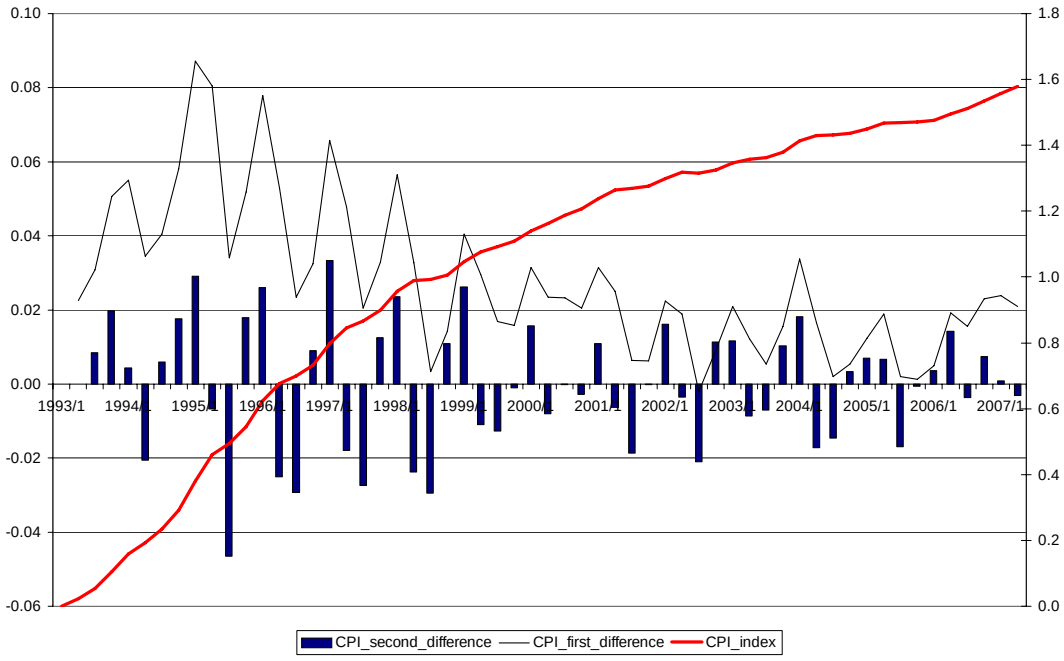
6.4 Econometric analysis of the inflation process

6.4.1 General remarks

The general procedure in this section is similar to that for the Czech Republic in Chapter 5.4. A potential problem of the Hungarian data is that owing to the disinflation process, the CPI as well as the other nominal series (wages, unit labour costs) may be integrated of order 2, at least during the earlier periods. The first or fourth differences are not stationary series but series with a stochastic declining trend (Graph 6.4.1 below). At the same time, a potential stabilisation of the inflation rate towards the end of the sample period can make the determination of the order of integration difficult.

Graph 6.4.1:

Consumer Price Index in levels, and first and second differences



Source: MNB; own calculations.

By contrast, *real* series, such as productivity, are likely to be I(1), with stationary growth rates throughout the period. Because cointegration tests can be made only for variables of the same order of integration, a critical problem arises if the relation is not balanced as in the case of domestic inflation depending on the productivity differential in addition to foreign inflation and the nominal exchange rate (Balassa-Samuelson model). In such a case, we combined the effect of a stationary and an I(1) series. For instance, an explanatory series

is created as the sum of the individual series such as foreign prices and the exchange rate. The estimated parameter is then the same for both series. Within this framework it cannot be tested whether e.g. the pass-through from foreign prices and the nominal exchange rate is indeed the same – it is by assumption. Another approach consisted in the inclusion of the stationary series in the estimated equation. This does not affect the power of the cointegration test. Nevertheless, cointegration (i.e. the existence of a long-term link) is tested always only for the variables of the same order of integration. The parameter restrictions are in all cases in line with theory. All estimations are made in fourth-quarter differences, i.e. for the year-on-year growth rate unless explicitly stated otherwise (all considered variables are integrated of order 1). The estimations are made for two periods: 1994/1-2007/2 and 1998/1-2007/2. The short period is chosen because during most of that time the exchange rate fluctuated around the value of 250 HUF per euro.

The unit root tests for the series included in the inflation tests can be found in Table A4.3 in Appendix 4, p. 268. According to these tests, the fourth-difference series of the exchange rate and the unit labour costs in market services can be considered stationary in the short period, unemployment in the longer period and the productivity differentials in both periods.

6.4.2 Purchasing Power Parity

6.4.2.1 Preliminary data analysis

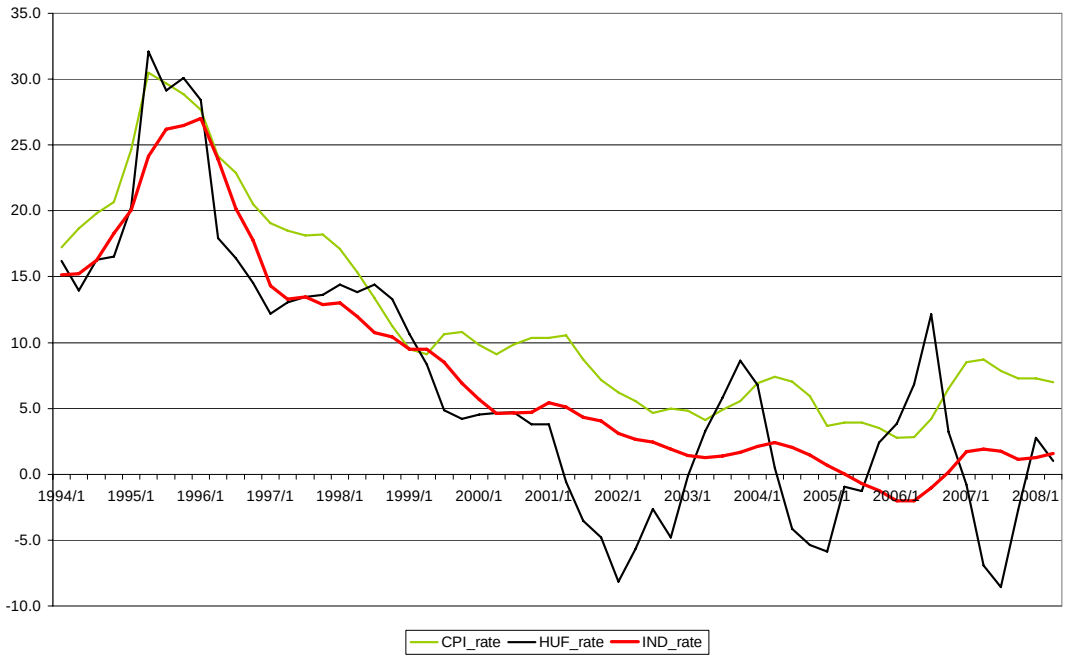
The link between inflation and the nominal exchange rate should be particularly pronounced during the crawling peg period, as at that time the exchange rate was the main policy instrument to guide disinflation. However, also during the inflation targeting regime, the exchange rate has been considered the most important transmission mechanism.

As is shown in Graph 6.4.2 (p. 180), during the early crawling peg period (1995-1999), both headline inflation and inflation in industrial goods indeed developed in line with the nominal exchange rate. In 1999, headline inflation stabilised, while disinflation in industrial goods prices continued. Only in 2000, inflation of industrial goods prices stabilised at 5 %; the depreciation of the nominal exchange rate amounted to 2.3 %. After the introduction of inflation targeting and the fixed exchange rate with broad fluctuation bands, the nominal exchange rate appreciated strongly. The reaction of industrial goods prices was less pronounced, instead, these prices have continued on their steady path of declining inflation rates. In general, the nominal exchange rate has become more volatile since 2001, in line with the experience of flexible exchange rate regimes. The large fluctuations of the nominal exchange rate were not translated into equally fluctuating inflation rates of industrial goods prices. Instead, industrial goods inflation remained at a rather low level since 2005, with

only small reactions to the exchange rate fluctuations. Real appreciation towards the euro area for industrial goods prices is rather small, and amounted to 3 % overall during the period between 2001 and 2007.

Graph 6.4.2:

Inflation rates of headline CPI and of industrial goods prices in the CPI, and year-on-year rate of change of the nominal exchange rate



Source: MNB

6.4.2.2 Results of the econometric tests

In line with the estimations for the Czech economy, we estimated three equations related to PPP. The first equation tests for the direct link between inflation and changes in the nominal exchange rate:

$$\pi^d = f(\Delta e). \qquad (67a)$$

The second equation includes also the effect of foreign inflation:

$$\pi^d = f(\Delta e, \pi^{EA}). \qquad (68a)$$

The third equation is of the Balassa-Samuelson type, which tests whether the real appreciation of the Hungarian currency (based on the CPI) might be related to the higher productivity growth:

$$\pi^d = f(\Delta e, \pi^{EA,}, \Delta q^{BS2}). \qquad (69a)$$

The dependent variables are

- headline inflation (‘CPI_rate’),

- inflation of industrial goods prices ('IND_rate').

The explanatory variables include the

- year-on-year rate of change in the nominal exchange rate defined as the basket of currencies targeted by the MNB ('HUF_rate'). This basket contained from August 1993 to May 1994 50 % USD and 50 % DEM, from May 1994 to January 1997 30 % USD and 70 % ECU, from January 1997 to January 1999 30 % USD and 70 % DEM, and from January 1999 to January 2000 30 % USD and 70 % EUR. From January 2000 until March 2008 the forint was pegged only to the euro,
- euro area headline inflation (based on HICP, 'EA-HICP_rate') and the euro area industrial goods' price (excluding energy) inflation ('EA-IND_rate'),
- the year-on-year growth rate of the dual productivity differential in the estimation of the Balassa-Samuelson effect ('BS2_rate'). The series is a "dual productivity differential" similar as in the tests for the Czech Republic. Due to the fact that the Hungarian quarterly series on value added start in 1995, the fourth difference series starts in the first quarter of 1996. The sources and notation of the series are presented in Table A4.1 in Appendix 4 (p. 265-266).

As a further series we included a proxy series for the tax adjustments. This series is calculated from the headline CPI and a tax-adjusted CPI inflation rate published by the MNB. Hence it does not reflect the individual adjustments of the tax rates but already the pass-through of the tax changes into inflation. The series starts in 1995.

The CPI is found to be I(2) in both periods; the fourth differences are I(1) (cf. Results of the unit root tests in Table A4.3 in Appendix 4, p. 268). The order of integration is ambiguous for the nominal exchange rate (the official currency basket), as the fourth differences are stationary on a 10 % level for the shorter period. Also for the euro area inflation rate the unit root tests are inconclusive. By contrast, the series that measures the joint effect of the nominal exchange rate and the euro area inflation rate can be regarded I(1) in fourth differences, similarly to the Hungarian CPI. Therefore, the tests for the shorter period will be made only for this joint series. The four-quarter growth rate of the productivity differential is stationary. Graph A4.4 in Appendix 4, p. 260, displays the series included in the test equation.

Table 6.4.1 (p. 182) contains the results of the cointegration tests for headline inflation and the change in the nominal exchange rate. This test equation assumes that the change in the foreign prices can be approximated by the constant. The tests find cointegration in the period 1994-2007 on a 10 % level. The coefficient of the nominal exchange rate is 0.8 (Table 6.4.2, p. 182), proving a rather strong pass-through from the nominal exchange rate changes to inflation. The constant is 0.06, indicating a steady inflation rate of six per cent

p.a. The inflation rate adjusts to this relation. The test result is confirmed by the estimation that includes the combined series of the nominal exchange rate changes and the euro area inflation rate.

Table 6.4.1:

Cointegration test between headline inflation and the year-on-year changes in the nominal exchange rate

	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
CPI_rate HUF_rate 1994:1-2007:2	SC=2	0 1	15.53 1.48	14.38# 1.37
CPI_rate HUF_rate+EA -HICP_rate 1994:1-2007:2	SC=2	0 1	16.44 1.47	15.22# 1.36
CPI_rate HUF_rate+EA -HICP_rate 1998:1-2007:2	SC=1	0 1	23.46 0.54	22.2** 0.51
CPI_rate HUF_rate+EA -HICP_rate BS2_rate 1998:1-2007:2	SC=1	0 1 2	33.8 7.89 3.19	31.13* 7.27 2.94

The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 6.4.2:

Parameters of the cointegration relation between headline inflation and the year-on-year changes in the nominal exchange rate

COINTEGRATION RELATION			
1994:1-2007:2	CPI_rate	HUF_rate	constant
Coefficient *(t-statistic)*	1	-0.76 *(-7.9)*	-0.057
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CPI_rate)	Δ(HUF_rate)	
Coefficient *(t-statistic)*	-0.09 *(-2.05)*	0.26 *(1.86)*	

Note: As for Table 6.4.1. In parentheses are t-values.

Owing to the uncertain nature of the nominal exchange rate in the shorter period, the test equation considers only the series that combines the change in the nominal exchange rate and the inflation rate of the euro area. The proxy series for tax adjustments is added in the short-term dynamics. Cointegration is found on 1 % level (Table 6.4.1, p. 182). The coefficient is now 0.25 and hence much smaller than for the entire period (Table 6.4.3 below). According to the tests, the pass-through has indeed substantially declined after the widening of the bands. By contrast, the constant is quite similar to that found for the longer period.

Table 6.4.3:

Parameters of the cointegration relation between headline inflation, the euro area inflation rate and year-on-year changes in the nominal exchange rate

COINTEGRATION RELATION			
1994:1-2007:2	CPI_rate	HUF_rate+EA-HICP_rate	constant
Coefficient *(t-statistic)*	1	-0.75 *(-8.49)*	-0.042
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CPI_rate)	Δ(HUF_rate+EA-HICP_rate)	
Coefficient *(t-statistic)*	-0.105 *(-2.19)*	0.255 *(1.77)*	

COINTEGRATION RELATION			
1998:1-2007:2	CPI_rate	HUF_rate+EA-HICP_rate	constant
Coefficient *(t-statistic)*	1	-0.25 *(-2.6)*	-0.062
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CPI_rate)	Δ(HUF_rate+EA-HICP_rate)	
Coefficient *(t-statistic)*	-0.18 *(-4.98)*	-0.26 *(-1.63)*	
Coefficient Δtax	1.02 *(4.99)*	-2.56 *(-2.81)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'Δtax' stands for the effect of changes in indirect taxes. In parentheses are t-values.

For the shorter period, we further added the stationary dual productivity differential. The test confirms the cointegration found in the previous test. The parameter in front of the exchange rate remains 0.25 and the constant is 5 % (Table 6.4.4 on next page). The productivity differential is only weakly significant. In addition, the parameter in front of the Balassa-Samuelson measure is relatively small, amounting to 0.18. However, this measures up to the small weight of market services in the Hungarian inflation. Therefore, the tests indicate that there might be an effect from the catching-up productivity growth on inflation

and the inflation differential towards the euro area, but the effect might be relatively small. In all cases, it is headline inflation that adjusts to this link in both the longer and the shorter period. All in all, the tests support the idea that Hungarian inflation is driven by the nominal exchange rate. The pass-through was rather strong during the whole estimation period, and it declined to rather low levels since the exchange rate could fluctuate in the broad band. The link is nevertheless still significant.

Table 6.4.4:

Parameters of the cointegration relation between headline inflation, euro area inflation, and year-on-year changes in the nominal exchange rate and in the productivity differential

COINTEGRATION RELATION				
1998:1-2007:2	CPI_rate	HUF_rate+ EA-HICP_rate	BS2_rate	constant
Coefficient *t-statistic*	1	-0.25 *(-2.27)*	-0.18 *(-1.82)*	-0.05
ADJUSTMENT TO COINTEGRATION RELATION				
	Δ(CPI_rate)	Δ(HUF_rate+ EA-HICP_rate)	Δ(BS2_rate)	
Coefficient *t-statistic*	-0.205 *(-4.97)*	-0.14 *(-0.88)*	0.06 *(0.29)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'BS2' stands for the dual productivity differential. In parentheses are t-values.

As regards the subcomponents, the main group affected by foreign prices is industrial goods prices. The unit root tests in Table A4.3 (Appendix 4, p. 268) indicate that both the industrial goods prices in the Hungarian CPI and the series reflecting the combined effect of the nominal exchange rate and the euro area industrial goods prices are I(2), and their fourth-quarter growth rates are I(1). The included series are in Graph A4.5 in Appendix 4 (p. 261). The cointegration tests determine a clear link during the period of 1994-2007 (Table 6.4.5 on next page). The link during the shorter period is found when we take the several adjustments in the taxes into account. During the entire period, the parameter in front of the nominal exchange rate HUF is 0.9 (similar as during the period 1994-2000, which is not shown here), whereas in the period starting in 1998 it is 0.37 (Table 6.4.6, next page). In the entire period, the nominal exchange rate adjusts to the industrial goods prices. This could indicate that initially the signalling effect of the exchange rate was rather strong and price setters adjusted prices in line with the nominal exchange rate path pre-announced by the MNB. In the short period, it is the prices that adjust, but the pass-through is now markedly smaller.

Table 6.4.5:

Cointegration test between industrial goods' inflation in Hungary and the euro area and the year-on-year change in the nominal exchange rate

	LAG LENGTH OF UN-RESTR. VAR	HYPOTH. NO. OF CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
IND_rate HUF_rate 1994:1-2007:2	SC=3	0 1	22.69 2.63	20.17** 2.34
IND_rate HUF_rate+ EA-IND_rate 1994:1-2007:2	SC=5	0 1	14.88 1.93	12.12 1.57
IND_rate HUF_rate+ EA-IND_rate 1998:1-2007:2	SC=2	0 1	17.30 3.38	15.48# 3.02

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'EA-IND' stands for industrial goods prices in the euro area HICP. The 'adjusted trace test' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 6.4.6:

Parameters of the cointegration relation between industrial goods' inflation in Hungary and the euro area and the year-on-year change in the nominal exchange rate

COINTEGRATION RELATION			
1994:1-2007:2	IND_rate	HUF_rate	constant
Coefficient *(t-statistic)*	1	-0.89 *(-10.65)*	-0.013
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(IND_rate)	Δ(HUF_rate)	
Coefficient *(t-statistic)*	-0.06 *(-1.58)*	0.35 *(2.91)*	

COINTEGRATION RELATION			
1998:1-2007:2	IND_rate	HUF_rate+ EA-IND_rate	constant
Coefficient *(t-statistic)*	1	-0.39 *(-3.33)*	-0.02
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(IND_rate)	Δ(HUF_rate+ EA-IND_rate)	
Coefficient *(t-statistic)*	-0.09 *(-3.79)*	-0.22 *(-1.29)*	
Coefficient Δtax *(t-statistic)*	0.53 *(3.69)*	-0.9 *(-0.95)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'Δtax' stands for the effect of changes in indirect taxes. In parentheses are t-values.

6.4.3 Balassa-Samuelson effect

6.4.3.1 Preliminary data analysis

Similarly as in the investigation of the Czech data in Section 5.4.3.1, we investigate the Balassa-Samuelson effect first "mechanically", i.e. by calculating the inflation differential suggested by theory from the observed productivity differential according to the formula:[100]

$$\pi_t^{NT} = \pi_t^T + (\Delta q_t^T - \Delta q_t^{NT}). \quad (73)$$

The definition of the sectors for the calculation of the productivity differential is the same as in Section 5.4.3.1; the inflation data correspond to those shown in Section 6.3.5. Average productivity growth in the industrial sector amounted to close to 6 % p.a. during 1994-2008. Market service productivity grew on average by less than two per cent p.a. The productivity differential during the overall period from 1994 to 2008 thus amounted to 4.5 percentage points (Table 6.4.7).

Table 6.4.7:

Productivity growth in industry and market services, inflation rates of industrial goods and market services in the CPI

	1994	1995	1996	1997	1998	1999	2000	2001	2002
					PRODUCTIVITY				
industry	11.0	13.2	4.2	9.4	3.6	5.5	11.0	-0.8	2.3
market services	8.0	-2.6	0.4	0.6	4.6	-4.7	1.0	3.1	7.1
difference	3.0	15.8	3.8	8.8	-1.0	10.2	10.0	-3.9	-4.8
					INFLATION				
industrial goods	16.3	24.6	22.3	13.6	11.6	8.9	5.5	5.0	2.8
market services	21.8	29.4	25.4	19.6	16.4	12.3	10.7	11.6	8.7
difference	5.5	4.8	3.1	6.0	4.8	3.4	5.3	6.6	5.9

	2003	2004	2005	2006	2007	2008	average 1994-2008	average 1994-2001	average 2002-2008
					PRODUCTIVITY				
industry	10.4	7.6	6.1	6.0	6.3	-5.7	6.0	7.1	4.7
market services	0.3	2.4	2.5	4.8	0.4	-4.4	1.6	1.3	1.9
difference	10.1	5.2	3.7	1.2	5.9	-1.4	4.5	5.9	2.9
					INFLATION				
industrial goods	1.7	2.1	0.1	-0.9	1.8	1.7	7.8	13.5	1.3
market services	7.6	8.1	5.4	4.8	6.1	5.3	12.9	18.4	6.6
difference	5.9	5.9	5.2	5.7	4.3	3.6	5.1	4.9	5.2

Source: MNB, Eurostat. Note: Figures may not add up due to rounding.

During the period of 1994-2008, the productivity differential of 4.5 percentage points was matched by an inflation differential of about 5 percentage points. Hence according to the mechanical calculations based on the Balassa-Samuelson model, the overall increase in the market services prices could be regarded as roughly in line with the model. However, a comparison of the differential in two sub-periods shows marked differences. During the

[100] For this link to hold, wage growth has to be equalised between the sectors. According to Graph A4.6 presented in Appendix 4 (p. 261), this has been roughly the case in Hungary.

period of 1994 and 2000, the productivity differential amounted to more than 7 percentage points, while the inflation differential amounted to less than 5 percentage points. The assessment of the MNB (cf. Kovács/Simon, 1998) that during the 1990s, the catching-up growth process may have justified some real appreciation, seems founded. However, during the period between 2001 and 2008 a rather modest productivity differential was matched by a sizeable inflation differential. As a result, from these data it cannot be easily gauged whether or not the inflation differential can be considered an equilibrium phenomenon.

Graph 6.4.3:

Difference between the inflation rate of market services and industrial goods

Source: MNB. Note: The inflation differential is measured in percentage points.

Graph 6.4.3 above shows the difference between the inflation rate of market services and industrial goods. During the entire period under investigation, this difference has been substantial. A distinct increase in the differential occurred in 2000, when the nominal exchange rate stabilised at around 250-260 HUF/EUR. Throughout most of the 2000s, the inflation differential amounted to at least six percentage points. Only since 2007, i.e. during the phase of weak growth and in particular of weak domestic demand, the differential declined on account of a lower inflation rate of market services.

6.4.2.2 Results of the econometric tests

The estimated equation is

$$\pi^{MSERV} = f(\pi^{IND,}, \Delta q^{BSI}). \qquad (74a)$$

The dependent variable is market services inflation from the MNB decomposition ('MSERV_rate'). The explanatory variables are industrial goods' inflation (from the CPI decomposition, 'IND_rate') and the year-on-year growth rate in the productivity differential between industry and market services ('BS1_rate'). Because the productivity differential series starts only in 1996, also the estimations that include this series start in 1996. The series are presented in Graph A4.7 (p. 262). The unit root tests are in Table A4.3 (p. 268). The series that captures the joint effect of industrial goods' inflation and the growth rate of the productivity differential is found stationary in both investigated periods. It is nevertheless included in the tests.

Table 6.4.8:

Cointegration tests between market services inflation and industrial goods' inflation

	LAG LENGTH OF UNRESTR. VAR	NO. OF HYPOTH. OF CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
MSERV_rate IND_rate 1994:1-2007:2	SC=2	0 1	16.15 2.36	14.95# 2.19
MSERV_rate IND_rate 1998:1-2007:2	SC=2	0 1	19.23 4.02	17.21* 3.59
MSERV_rate IND_rate+ BS1_rate 1996:1-2007:2	SC=1	0 1	25.27 3.28	24.17** 3.14
MSERV_rate IND_rate+ BS1_rate 1998:1-2007:2	SC=1	0 1	16.57 3.19	15.70* 3.02

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'BS1' stands for the productivity differential between industry and market services. The 'adjusted trace statistic' shows the trace statistic adjusted for the small sample size (see Appendix 2). ** denotes significance at 1 %, * at 5 % and # at 10 %.

The tests find a link between market services' and industrial goods' inflation during both the short and the longer period (Table 6.4.8 above), even without considering the productivity differential. The coefficient in the cointegration relation shows that market services prices rise by 0.7 percentage points on average if industrial goods prices rise by one per cent (Table 6.4.9, next page). Therefore, with any decline in industrial goods price inflation, inflation in market services declines also. However, the "inertial component" of market services' inflation, i.e. the constant, is rather high with 7 %. The fact that market services are related to industrial goods prices even without taking the productivity differential into account, does not support the Balassa-Samuelson hypothesis. It is, however, in line with estimations made e.g. for the United States (cf. Peach et al., 2004).

Table 6.4.9:

Parameters of the cointegration relation between market services' and industrial goods' inflation

COINTEGRATION RELATION			
1994:1-2007:2	MSERV_rate	IND_rate	constant
Coefficient *(t-statistic)*	1	-0.82 *(-29.9)*	-0.07
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(IND_rate)	
Coefficient *(t-statistic)*	-0.31 *(-2.21)*	0.21 *(1.45)*	

COINTEGRATION RELATION			
1998:1-2007:2	MSERV_rate	IND_rate	constant
Coefficient *(t-statistic)*	1	-0.70 *(-13.4)*	-0.07
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(IND_rate)	
Coefficient *(t-statistic)*	-0.41 *(-3.33)*	-0.07 *(-0.61)*	

COINTEGRATION RELATION			
1996:1-2007:2	MSERV_rate	IND_rate+ BS1_rate	constant
Coefficient *(t-statistic)*	1	-0.24 *(-2.76)*	-0.08
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(IND_rate+ BS1_rate)	
Coefficient *(t-statistic)*	-0.12 *(-5.20)*	-0.008 *(-0.06)*	

COINTEGRATION RELATION			
1998:1-2007:2	MSERV_rate	IND_rate+ BS1_rate	constant
Coefficient *(t-statistic)*	1	-0.17 *(-2.15)*	-0.08
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(IND_rate+ BS1_rate)	
Coefficient *(t-statistic)*	-0.16 *(-3.86)*	-0.07 *(-0.25)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. 'BS1' stands for the productivity differential between industry and market services. In parentheses are t-values.

The estimation with the series that reflects the combined effect of the growth in the productivity differential and industrial goods' inflation confirms the cointegration relation,

although the result has to be interpreted cautiously due to the result of the unit root tests. In all estimations, it is market services inflation that adjusts. If only industrial goods inflation is considered, the adjustment of market services inflation to the long-term relation is rather fast.

6.4.4 Wage-price dynamics

6.4.4.1 Preliminary data analysis

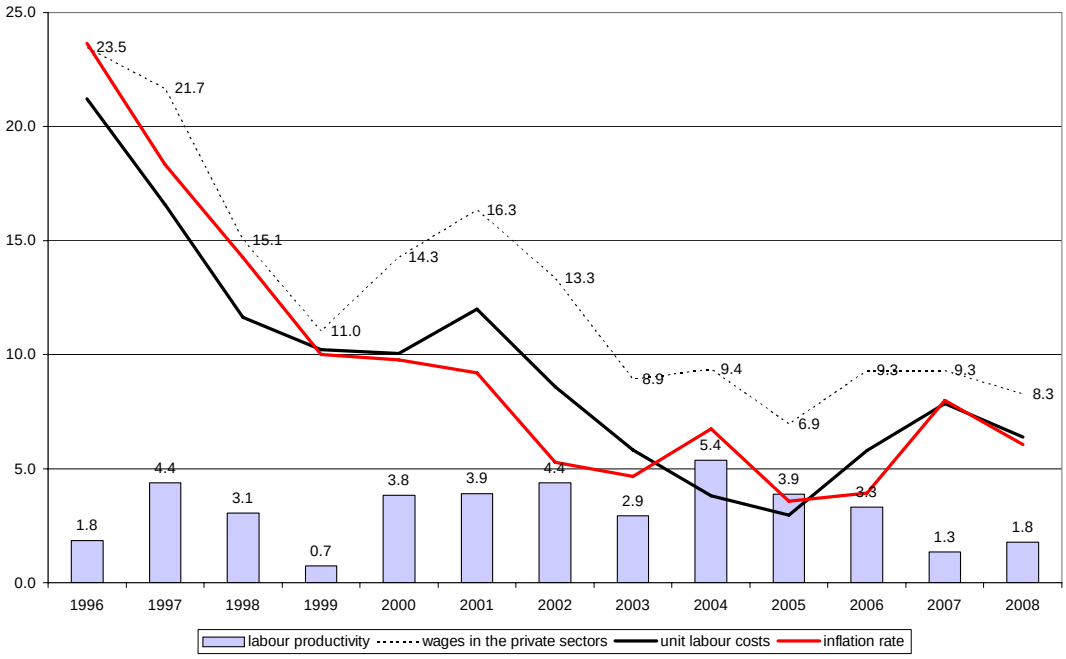
The development of wages is of particular interest in Hungary. As it was stated earlier, a major source of moderate inflation appears to be stubborn backward-looking inflation expectations and wage growth indexed to past inflation. The presumption of a strong inertial component in Hungarian has also been used by the Hungarian authorities to justify a slow disinflation strategy.

Wage bargaining takes place in a decentralised manner in Hungary (cf. Fazekas/Koltay, 2002). At the same time, a central tripartite body, the National Labour Council negotiates the minimum wage and issues guidelines for average wage increases (OECD, 2002). During the crawling peg period, it was intended by the policy makers to use this Council to influence the wage bargaining process and to yield a coordinated decline in wage growth. However, the actual wage setting is made at the enterprise level with no obligation to apply the guidelines proposed by the Council. Thus, reducing wage inflation requires considerable credibility of both policy makers and the inflation target. In practice, however, wage growth has regularly exceeded the level agreed by the Council (cf. OECD, 2002:30; MNB, 2007:10).

Graph 6.4.4 (p. 191) presents the development of wages in the private sector, unit labour costs for the private sector, headline inflation and productivity growth. It shows a strong deceleration of wage growth in the early years of the crawling peg regime. In 1995, wage growth was moderate also because pay rises in firms with government ownership were restricted to a maximum of 15 %. The decline in wage and unit labour costs growth continued during 1996-1999. However, despite the general tendency to decline, the actual pay rises exceeded the maximum wage growth negotiated within the National Labour Council in all years except for 1999, where observed wage growth equalled the recommended maximum rate (OECD, 2002:30). In addition, in 2000, wage growth accelerated despite a rather stable development of average labour productivity and of inflation. As a result, after 1998 the crawling peg regime seems to have been increasingly less able to anchor inflation on the one hand, and to restrain the wage setters on the other. The rise in wage growth in 2000 and 2001 could well have contributed to the rebound in core inflation during that time.

Graph 6.4.4:

Year-on-year growth rates of wages in the private sector, unit labour costs, headline CPI and average labour productivity



Source: Central Statistical Office of Hungary, MNB, Eurostat
Note: Productivity is measured as real GDP per employed person. Wages are measured as average gross wage by the Statistical Office. Note that this does not necessarily correspond to compensation of employees as measured in the national accounts. Unit labour costs are based on the wage and productivity series shown in the graph.

Also after the introduction of inflation targeting, wage inflation decelerated. In the first two years of the inflation targeting regime, it declined from 16.3 % in 2001 to 9 % in 2003. Since 2003, however, the rate of growth has remained relatively stable at 9 %, with labour productivity growing by average of 3.5 %. Hence, in the early years of inflation targeting, the swiftly declining inflation may have convinced the wage setters of the commitment, on the part of the authorities, to disinflation. Likewise, assuming backward looking inflation expectations, the past decline in inflation may have impacted wage growth. However, the fiscal shock in 2002 and the subsequent adjustment measures, as well as the fact that in 2003 the central bank gave priority to the nominal exchange rate target, may have undermined the credibility of the commitment to disinflation and the inflation targets. Also the 50 % wage hike in the public sector in 2002 along with a substantial increase in the minimum wage may have reduced the willingness of the employees in the private sector to contribute to disinflation through reducing the demanded wage growth. The public sector itself did not set an example in wage moderation. Furthermore, although in 2005/06 fiscal policy was temporarily conducive to disinflation, it once again turned out unsustainable.

Even larger lifts in the tax rates and regulated prices were needed in 2006, pushing inflation back to levels not seen since the introduction of inflation targeting. In 2008, wage growth declined. However, considering the sharp deceleration of economic activity, the decline was very modest. All in all, the stagnation of inflation expectations at a moderate level[101] and of wage inflation at close to 9 % may have been the consequence of the unfavourable monetary and fiscal policies. Assuming a trend growth in labour productivity of 4 per cent p.a., unit labour costs rose by average of five per cent p.a. between 2001 and 2008. It is worthy of mention that real wage growth, in particular in the private sectors, has more or less matched productivity growth. This may further reduce the willingness of wage setters to accept a temporary decline in the real wage in order to achieve disinflation.

6.4.4.2 Results of the econometric tests

6.4.4.2.1 Price equations

The dependent variables in this analysis are headline inflation, industrial goods' inflation and market services' inflation, respectively. The explanatory variable is either unit labour costs in the private sectors (calculated by relating wage growth in the private sectors to productivity growth in the total economy, 'ULC-PR_rate') or unit labour costs in market services (relating compensation of employees in market services to their productivity, 'ULC-MS_rate'):

$$\pi_t = f(\Delta ulc_t). \qquad (75a)$$

The data included in the test equations are shown in Graphs A4.8-A4.10 in Appendix 4 (pp. 262-263). The unit root tests (Table A4.3, p. 268) support the idea that the unit labour costs growth series in the private sectors is I(1) in both studied periods.

The tests detect cointegration between headline inflation and unit labour costs growth in both periods (Table 6.4.10, next page). However, differences are in both the parameter in front of unit labour costs, as well as in the series that adjusts to the long-term relationship (Table 6.4.11, p. 194). In the longer period, it is unit labour costs that adjust. This might be the consequence of wages adjusting to prices, because during the crawling peg regime prices were driven by the pre-announced rate of crawl. By contrast, in the second period, prices adjust to unit labour costs. This could indicate that the shift to inflation targeting indeed helped break the backward-looking component of inflation expectations. It might however also mean that wages did not react to a declining inflation rate; inflation expectations may also have remained stuck at an elevated level.

[101] It might be telling that according to the survey of inflation expectations of households published by the MNB in its Inflation Reports (e.g. MNB 2007b:18), economic agents rather constantly perceive and expect inflation at levels of about 10 percentage points above the observed inflation rate.

The tests could not verify cointegration between industrial goods' inflation and unit labour costs growth in the private sectors of the economy. However, the result has to be treated cautiously because owing to the stationary character of the unit labour costs growth in industry, we had to consider unit labour costs in the total private economy.

Table 6.4.10:

Cointegration test between inflation and its components and the year-on-year growth rate of unit labour costs in the private sectors

	LAG LENGTH OF UN-RESTR. VAR	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
CPI_rate ULC-PR_rate 1994:1-2007:2	SC=2	0 1	16.91 1.89	15.66* 1.75
CPI_rate ULC-PR_rate 1998:1-2007:2	SC=2	0 1	20.89 4.1	18.69* 3.67
IND_rate ULC-PR_rate 1994:1-2007:2	SC=2	0 1	10.67 1.65	9.87 1.52
IND_rate ULC-PR_rate 1998:1-2007:2	SC=2	0 1	11.31 4.84	10.12 4.33
MSERV_rate ULC-MS_rate 1996:1-2007:2	SC=2	0 1	18.64 2.85	17.26* 2.69
MSERV_rate ULC-PR_rate 1998:1-2007:2	SC=1	0 1	18.67 3.56	17.69* 3.37
CORE2_rate ULC-PR_rate 1998:1-2007:2	SC=2	0 1	19.37 4.13	17.30* 3.69

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. The core measure used in these tests comprises industrial goods prices, market services and food prices. The 'adjusted trace statistic' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Unit labour costs of the market services are proxied by wages in market services divided by productivity in the total economy. According to the unit root test (Table A4.3, p. 268), the year-on-year growth rate of unit labour costs in market services are integrated of order 1 in the longer period but stationary at a significance level of 10 % in the shorter period. The tests are therefore made using unit labour costs in the market services sector for the period of 1994-2007, but unit labour costs in the private sectors in the period of 1998-2007. The tests find cointegration between unit labour costs and market services prices in both studied periods (Table 6.4.10 above). Similarly as for the entire economy, in the longer period, unit

labour costs adjust (Table 6.4.12, p. 195). Only in the shorter period, the adjustment is made by the market services prices. Hence market services inflation is influenced by unit labour costs growth in addition to the inflation in industrial goods' prices. This means that disinflation in market services prices will benefit from a nominal appreciation, but, as long as wages and unit labour costs do not adjust to the lower inflation environment, market services inflation may decline less then indicated by the nominal exchange rate and industrial goods prices.

Table 6.4.11:

Parameters of the cointegration relation between headline inflation and the year-on-year growth rate of unit labour costs in the private sectors

COINTEGRATION RELATION			
1994:1-2007:2	CPI_rate	ULC-PR_rate	constant
Coefficient *(t-statistic)*	1	-1.44 *(-6.43)*	0.03
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CPI_rate)	Δ(ULC-PR_rate)	
Coefficient *(t-statistic)*	-0.04 *(-1.38)*	0.22 *(3.68)*	

COINTEGRATION RELATION			
1998:1-2007:2	CPI_rate	ULC-PR_rate	constant
Coefficient *(t-statistic)*	1	-0.62 *(-5.19)*	-0.024
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CPI_rate)	Δ(ULC-PR_rate)	
Coefficient *(t-statistic)*	-0.218 *(-4.06)*	0.058 *(0.38)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. In parentheses are t-values.

Because of the stationary character of the food prices on the one hand, but also their relatively strong impact on inflation, the test was repeated for core inflation defined over industrial goods prices, market services and food prices. The tests confirm cointegration between this measure of core inflation and the growth rate of unit labour costs (Table 6.4.10, p. 193). Thus, the fact that headline inflation reacts to unit labour costs growth in the shorter period need not be the consequence of market services prices only. Also some components of industrial goods prices or food prices, in particular processed food, can be affected by the wage developments. The parameter estimation (Table 6.4.12, next page) indicates that the "inertial component" in core inflation is lower (0.1), but the reaction to unit labour costs growth is stronger than for market services inflation.

In sum, the overall inflation rate adjusts to unit labour costs growth, but only during the shorter (latter) period. As a result, constant pressures from wage inflation do indeed complicate the disinflation process. The link between unit labour costs growth and inflation can also be found for market services, but not for industrial goods prices in the CPI. The results suggest that the introduction of inflation targeting marked a regime shift because since then prices have reacted more strongly to cost pressures than during the crawling peg period.

Table 6.4.12:

Parameters of the cointegration relation between market services inflation and the year-on-year growth rate of unit labour costs

COINTEGRATION RELATION			
1994:1-2007:2	MSERV_rate	ULC-MS_rate	constant
Coefficient *(t-statistic)*	1	-1.39 *(-5.98)*	0.01
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(ULC-MS_rate)	
Coefficient *(t-statistic)*	-0.01 *(-0.47)*	0.31 *(4.12)*	

COINTEGRATION RELATION			
1998:1-2007:2	MSERV_rate	ULC-PR_rate	constant
Coefficient *(t-statistic)*	1	-0.55 *(-5.05)*	-0.05
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(MSERV_rate)	Δ(ULC-PR_rate)	
Coefficient *(t-statistic)*	-0.24 *(-3.88)*	0.01 *(0.06)*	

COINTEGRATION RELATION			
1998:1-2007:2	CORE2_rate	ULC-PR_rate	constant
Coefficient *(t-statistic)*	1	-0.67 *(-4.79)*	-0.01
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(CORE2_rate)	Δ(ULC-PR_rate)	
Coefficient *(t-statistic)*	-0.21 *(-3.60)*	0.13 *(0.96)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. In parentheses are t-values.

6.4.4.2.2 Wage equation

The wage relation suggested by the Phillips curve includes as explanatory variables the unemployment rate and the inflation rate. Within the framework of the cointegration tests of fourth-quarter growth rates, the trend real wage is captured by a constant. The dependent variable in the following tests is wage growth in the private sectors ('WAGE-PR_rate'), the

explanatory variables include headline inflation, core inflation, productivity growth ('PROD_rate') and the unemployment rate. The wage series included in the tests is wages in the private sector and not wages in the total economy, i.e. it does not account for those of public employees. The wage growth in the public sector was marked by a specific adjustment in 2002 and later on subject to lower increases due to budget consolidation efforts, which distorts the links suggested by theory. The unemployment rate is included as a four-quarter change (in percentage points, 'UNEMP_4rate'), in contrast to the link suggested by theory and the link tested for the Czech economy. In theory, it is the deviation from the NAIRU, which drives wage growth. If the unemployment rate is below the NAIRU, wages go up. Due to the short time period and the structural change, the NAIRU is particularly difficult to measure for Hungary. At the same time, the change in the unemployment rate could indicate a change in the stance of the labour market. A swift decline in the unemployment rate leads to higher wage pressures and vice versa. Graphs A4.11 and A4.12 in Appendix 4, p. 264, present the investigated series. All series are I(1) (cf. Table A4.3, p. 268), however, the 4-quarter change in the unemployment rate could also be regarded stationary over the longer horizon.

The tests detect cointegration between wage growth and inflation for the longer period, but only at a significance level of 10 % (Table 6.4.13, next page). Wage growth adjusts to inflation, pointing to backward looking inflation expectations. The parameter in front of the prices is 0.7, and the constant amounts to 6 % (Table 6.4.14, next page). For the shorter period, the tests do not find cointegration as the null hypothesis is not rejected twice. The same result applies to the tests which included the combined effect of inflation and productivity growth as the dependent variable.

The link between wage growth and the change in the unemployment rate during the past four quarters in percentage points is found in particular for the shorter period (Table 6.4.13, next page). Both variables adjust to this relation (Table 6.4.15, p. 198). Wage growth reacts negatively to the change in the unemployment rate, i.e. an increase in the unemployment rate is matched by a decline in wage rises. The constant amounts to 11 %; wage growth hence fluctuated around 11 % depending on the change in the unemployment rate during the past twelve months. The parameter of 4.6 indicates a rather strong link to a change in the unemployment rate.

For the longer period, the test was repeated including both headline inflation and the unemployment rate. The test finds two cointegration relations, however one of it only at a significance level of 10 % (Table 6.4.13, next page). During the longer period, on average, wage growth adjusted to both the inflation rate and to a change in the unemployment rate (Table 6.4.16, p.198).

Table 6.4.13:

Cointegration test for wage growth determinants

	LAG LENGTH OF UNRESTR. VAR (SIC)	NO. OF HYPOTH. CI RELATIONS	TRACE STATISTIC	ADJUSTED TRACE STATISTIC
WAGE-PR_rate CPI_rate 1994:1-2007:2	SC=2	0 1	15.44 1.88	14.29# 1.74
WAGE-PR_rate CPI_rate 1998:1-2007:2	SC=2	0 1	16.69 5.42	14.93 4.85
WAGE-PR_rate CPI_rate+ PROD_rate 1994:1-2007:2	SC=2	0 1	12.13 1.31	11.23 1.21
WAGE-PR_rate CPI_rate+ PROD_rate 1998:1-2007:2	SC=1	0 1	18.78 5.03	17.79 4.76
WAGE-PR_rate UNEMP_4rate 1994:1-2007:2	SC=2	0 1	14.71 1.38	13.62# 1.28
WAGE-PR_rate UNEMP_4rate 1998:1-2007:2	SC=2	0 1	23.11 3.52	20.68* 3.15
WAGE-PR_rate CPI_rate UNEMP_4rate 1994:1-2007:2	SC=2	0 1 2	34.87 16.82 2.25	30.99** 14.95# 2.00

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. . The 'adjusted trace statistic' shows the trace statistic adjusted for the small sample size (see Appendix 2).
** denotes significance at 1 %, * at 5 % and # at 10 %.

Table 6.4.14:

Parameters of the cointegration relation between wage growth in the private sectors and inflation

COINTEGRATION RELATION			
1994:1-2007:2	WAGE-PR_rate	CPI_rate	constant
Coefficient *(t-statistic)*	1	-0.67 *(-7.89)*	-0.06
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(WAGE-PR_rate)	Δ(CPI_rate)	
Coefficient *(t-statistic)*	-0.28 *(-3.1)*	0.08 *(1.26)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. In parentheses are t-values.

Table 6.4.15:

Parameters of the cointegration relation between wage growth in the private sectors and the four-quarter change in the unemployment rate

COINTEGRATION RELATION			
1994:1-2007:2	WAGE-PR_rate	UNEMP_4rate	constant
Coefficient *(t-statistic)*	1	9.34 *(5.34)*	-0.10
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(WAGE-PR_rate)	Δ(UNEMP_4rate)	
Coefficient *(t-statistic)*	-0.06 *(-1.48)*	-0.03 *(-3.30)*	

COINTEGRATION RELATION			
1998:1-2007:2	WAGE-PR_rate	UNEMP_4rate	constant
Coefficient *(t-statistic)*	1	4.62 *(6.68)*	-0.11
ADJUSTMENT TO COINTEGRATION RELATION			
	Δ(WAGE-PR_rate)	Δ(UNEMP_4rate)	
Coefficient *(t-statistic)*	-0.28 *(-3.37)*	0.05 *(2.68)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. In parentheses are t-values.

Table 6.4.16:

Parameters of the cointegration relation between wage growth in the private sectors, inflation and the four-quarter change in the unemployment rate

COINTEGRATION RELATIONS				
1994:1-2007:2	WAGE-PR_rate	CPI_rate	UNEMP_4rate	constant
Coefficient CI1 *(t-statistic)*	1		8.38 *(6.13)*	-0.11
Coefficient CI2 *(t-statistic)*	1	-0.66 *(-9.38)*		-0.06
ADJUSTMENT TO COINTEGRATION RELATIONS				
	Δ(WAGE-PR_rate)	Δ(CPI_rate)	Δ(UNEMP_4rate)	
Coefficient CI1 *(t-statistic)*	-0.14 *(-2.97)*	-0.05 *(-1.41)*	-0.026 *(-2.52)*	
Coefficient CI2 *(t-statistic)*	-0.35 *(-3.90)*	0.045 *(0.59)*	0.02 *(0.97)*	

Note: The estimated VECM assumes a constant term in both the long-run cointegration relation and in the short-term dynamics. In parentheses are t-values.

As a robustness check, and because of the inconclusive test results for headline inflation, the tests are repeated for core inflation (the tables containing the results can be found in Appendix 4, p. 270-271). Core inflation is now defined over the components industrial goods and market services, i.e. approximately 50 % of headline CPI. In the longer period, the cointegration relations are established on a rather low level of confidence. In the shorter period, the test results do broadly confirm the links established for headline inflation. For the short period, the tests detect one cointegration relation on a 5 % significance level and a second on a significance level of 10 %. The parameters are similar to the estimation for headline inflation. The elasticity towards the unemployment rate is higher in the long period. In the shorter period, the elasticity towards a change in the unemployment rate has markedly declined. Nevertheless, an increase in the unemployment rate of 1 percentage point still goes with a decline in the wage inflation rate of more than 3.5 percentage points. If the test results are interpreted in favour of two cointegration links, the results indicate that also in the shorter period wage growth has adjusted to both the inflation rate and the unemployment rate. Judging by the estimated parameter in the cointegration relation of one, the link between wage growth and core inflation is rather strong. However, it is not wages that adjust to this relation but the inflation rate.

Hence, the tests for the longer period suggest that earlier wage setters were backward looking as regards inflation. During the shorter period, this link cannot be confirmed; wages do not adjust to observed inflation. Instead, wages react strongly to the situation in the labour market. The missing link between wage setting and the current inflation rate might signal a strong anchoring of inflation expectations by the inflation target. However, in the specific Hungarian circumstances, this is unlikely. Instead it seems to confirm the earlier hypothesis that inflation expectations are rather fixed, leading to wages growing continually by close to 10 % p.a. The lower inflation rate observed in 2005 and 2006 was not passed through to wage growth. On the other hand, also spikes in inflation, as observed in 2007 and 2008, need not necessarily mean higher wage growth.

6.4.5 Summary and conclusions of the inflation analysis

The decomposition of the inflation trends revealed a strong adjustment of relative prices within the consumer price index. Since 2001, industrial goods prices have recorded very low growth on average, whereas regulated prices and market service prices have risen briskly. Also food prices have impacted rather strongly on inflation. Core inflation measured by industrial goods prices and market services prices declined during the inflation targeting regime, but only to close to 4 % in 2007.

The econometric analysis supports the idea that Hungarian inflation has been driven in part by the nominal exchange rate. The pass-through was rather strong during the whole estimation period, but it has declined to rather low levels since the exchange rate could fluctuate in the broad band. The link is nevertheless still present. The same holds for industrial goods' inflation, to which the pass-through is stronger than to headline inflation. For the period after 1998, the pass-through into industrial goods prices has amounted to 0.4, compared with 0.9 for the whole period. Therefore, while a nominal appreciation does help disinflation, its disinflationary impact has become smaller.

The tests establish a strong direct link between the inflation in market services and industrial goods. This contrasts with the Balassa-Samuelson model, which suggests that these two series should be linked through the productivity differential between the two sectors. According to the tests, market services prices rise by at least 0.7 percentage points when industrial goods prices rise by one per cent. The tests also find a strong inertial component in market services inflation.

Changes in unit labour costs as a source of inflation seem to have gained in importance since the introduction of inflation targeting. For the period after 1998, they are found to have been a source of inflation for both headline and market services inflation. In the earlier period, it was unit labour costs that adjusted to the relation between unit labour costs and inflation. During that time, wage growth, a main component of trends in unit labour costs, were linked to inflation in a backward-looking manner. For the inflation targeting period, however, this link could not be confirmed. This could either indicate that the wage setters react more strongly to the predetermined inflation target. That, however, cannot be shown in the chosen framework. Yet, it could also mean that wage growth and inflation expectations have stabilised at the level that need not necessarily correspond with the inflation target or with a low-inflation environment. The rather constant growth of wages of about 8-9 % during the past years and in particular also during the recent marked economic slowdown supports this conclusion. At the same time, wages react strongly to the unemployment rate. A disinflation strategy that tries to minimise output and employment costs may therefore indeed prove protracted. On the other hand, the strong reaction of the wages to the unemployment rate points to low inertia stemming from the wage setting mechanism, which however is counteracted by the effect from inflation expectations.

All in all, nominal exchange rate appreciation can be conducive to disinflation through its effect on both industrial goods prices and market services prices. However, because wages setters seem irresponsive to a change in the inflation rate recently, a decline in the inflation rate need not suffice for steady disinflation. For this, wages and unit labour costs have to

adjust to the low inflation environment, which – according to the tests – would require a period of higher unemployment.

The fact that inflation has started to adjust to unit labour costs during the inflation targeting period, while wages react primarily to the unemployment rate, could imply that any positive productivity shock helps the disinflation process. At the same time, any negative productivity shock or a slowdown in productivity leads to inflationary pressures. For instance, in 2004, productivity picked up and unit labour costs declined since wages remained rather stable. By contrast, during the period of slow growth in 2007 and 2008, productivity has declined markedly. This may have exacerbated the inflationary pressures that were already sizeable due to the adjustment in taxes or the food and energy price shocks.

7 Summary and conclusions

The present investigation dealt with issues of the nominal convergence process in two future EMU member states, the Czech Republic and Hungary. These countries are still emerging market economies in that they aim at rapid and sustainable growth, which will enable them to catch up in income levels with the more developed countries. Their nature of emerging markets implies specific challenges as regards a stable macroeconomic framework including low inflation. These challenges are related to the process of financial deepening and credit growth, vivid investment and domestic demand growth, the integration into international capital markets and the financing of investment through foreign capital, and the process of price convergence that accompanies the convergence in income levels.

At the same time, these countries are required to strive for meeting the Maastricht criteria, which stipulate that in order to qualify for euro adoption, inflation should not exceed the rate of the three countries with the lowest inflation in the EU by more than 1.5 percentage points. In the literature it was doubted whether the countries in the catching-up growth process are able to meet the criteria. These doubts refer mainly to the requirement to attain simultaneously low inflation and a stable exchange rate. This might be difficult because of the equilibrium real appreciation that accompanies the catching-up growth process. However, the experience of catching-up economies that already qualified for the euro area suggests that, at least temporarily, meeting the criteria is feasible and depends mainly on the dedication of the policy makers. It seems more demanding to maintain low inflation when the countries form part of the euro area, i.e. after euro adoption. This is, first, because of the equilibrium real appreciation, which – in the absence of the nominal exchange rate – has to proceed through higher inflation than in the other member states. Second, for the catching-up economies monetary conditions are generally likely to ease in the euro area. That follows from the several risk premia currently attached to their currencies, but also from the higher growth potential that encompasses a higher equilibrium real interest rate than in the more developed euro area countries that dominate the ECB rate setting. Third, if convergence was achieved also on the back of temporary factors, the underlying inflationary pressures will re-emerge. As a result, during the convergence process and in particular within the euro area, monetary conditions will in all likelihood ease. The magnitude of the interest rate shock depends on the monetary policy pursued to meet the Maastricht criterion on the one hand and the rebound in inflation on the other.

Therefore, the current investigation focused first on the monetary policy in the new member states and the numerous factors that have shaped it, i.e. the transition, the integration into

international financial markets, disinflation from moderate inflation levels, the catching-up growth process and the nominal convergence process. Second, we studied the interest rate setting of the central bank and its pass-through within the economy. We were particularly interested in the issue of whether or not the adoption of the euro will imply a loosening of monetary conditions, and if so to what extent. Third, we studied the inflation process and the determinants of inflation convergence. We investigated whether or not convergence as required in the Maastricht criteria can be achieved. In addition, we were interested in the underlying dynamics related to the catching-up growth process and price level convergence on the one hand and the wage-price dynamics on the other. The latter allow us to assess whether or not the disinflation to euro area levels can be regarded lasting. It is also an indicator for the functioning of adjustment mechanisms within the monetary union.

In Chapter 2, we dealt with interest rate theories because nowadays central banks use interest rates as their main policy instrument. By adjusting the policy rates they aim to achieve macroeconomic objectives such as low and stable inflation. In the monetary strategy of inflation targeting, a central bank explicitly commits itself to meet a numerically defined inflation target on a systematic basis. However, the link between the policy rate and inflation is indirect as monetary policy is transmitted through the financial markets to the real economy. The transmission mechanisms include the interest rate channel (a change in the interest rates modifies the financial conditions in the economy through the real interest rate) and the exchange rate channel (a change in the interest rate affects the exchange rate and hence the relative price of domestic and foreign goods). The exact link from policy rates to the final goal of price stability is surrounded by uncertainty. In addition, in open economies with free financial flows, domestic interest rates are not independent of the international interest rates. In liberalised markets, yields for similar financial instruments tend to converge. As a result, if the exchange rate is kept stable, interest rates tend to converge. Central banks are hence restricted in their policies by the “impossible trinity”. With liberalised capital flows, they cannot independently set both the exchange rate and the policy interest rate.

We stressed the specific challenges that central banks in emerging market economies face when pursuing inflation targeting. These specific challenges include a more volatile environment, higher susceptibility to shocks, particular difficulties in forecasting inflation (also because volatile components such as food prices and commodities prices impact more strongly on headline inflation) and limited knowledge of the (evolving) transmission mechanisms.

We further showed that in theoretical models, central bank interest rate setting is often specified as a “Taylor rule”, where the central bank reacts to deviations of the inflation rate

from its targeted rate and to deviations of output from potential output. For small open economies, the central bank reaction function can also include the nominal exchange rate if uncertainty about the determinants of the exchange rate is high.

In Chapter 3 we presented the main inflation theories, the quantity theory, purchasing power parity, and price setting through mark-up over costs including wages. Furthermore, the Phillips curve links the tightness of the labour market or the cyclical stance with price trends. In times of low unemployment and a tight labour market, wages can grow vigorously, putting pressures on prices. We also turned to sources of moderate inflation, i.e. sustained periods of inflation rates in the range of ten to thirty per cent p.a. Phases of moderate inflation can occur only with ingrained moderate inflation expectations or strong backward-looking inflation expectations, which perpetuate the original shock to inflation. A disinflation to low inflation can be achieved only if inflation expectations decline. In theory that can occur with a shift to more credible low-inflation policies or with "opportunistic" disinflation. However, in practice disinflation has been achieved mainly during phases of low growth and higher unemployment, where economic slack reduced wage and price pressures.

We have also dealt in detail with the specifics of monetary policy in the (former) transition economies and in emerging market economies. Numerous factors complicate the task of achieving low inflation there. Firstly, the catching-up growth process entails risks for macroeconomic stability, e.g. through rapid financial market development and investment cycles. Growth rates and inflation rates can be more volatile. Inflation pressures can emerge if wage growth is driven by overly optimistic growth expectations. In addition, the price level convergence process implies a real appreciation towards the more developed economies, which may come about through higher inflation. While that is an equilibrium phenomenon, the higher inflation rate may become ingrained in the inflation expectations and harm competitiveness and growth. Second, the evolving financial markets impact on the monetary strategy and policy. Financial market deepening changes the interest rate sensitivity of the economy and the transmission mechanisms of monetary policy. In addition, the integration into international capital markets creates policy challenges and restricts policy options of the central bank. Finally, the credibility of the central bank and institutions in general is lower in emerging market economies.

The transition economies have experienced a phase of rather high inflation during the early stage of the systemic change. In general, stabilisation was achieved quickly, but it was followed by a phase of (low) double-digit inflation with ingrained moderate inflation expectations and wage-price spirals. Disinflation policies could include high real interest rates, pre-announced reductions in the rate of crawl of the nominal exchange rate, or

inflation targeting with a steady decline in the targeted inflation rate. However, even if disinflation to inflation levels close to those of the euro area could be achieved, the adjustment of regulated prices has continued to exert steady inflationary pressures. Moreover, inflation differentials vis-à-vis the more developed economies are to be expected owing to the process of price level convergence that accompanies catching-up growth. These specific price trends could make meeting the Maastricht convergence criteria difficult. Primarily, however, it is unlikely that the countries will be able to retain low inflation after euro adoption. That follows not only from the price level convergence process, but also from the loosening of monetary conditions that the introduction of the euro will most probably entail. We have pointed out that the risks of a boom in activity that may ultimately harm competitiveness and growth depends on the monetary restriction necessary to achieve low inflation in the preparation phase. Furthermore, the wage-price dynamics, and specifically whether an inflation shock is perpetuated through subsequent higher wage growth, are of crucial importance.

In the country studies, we first investigated the Czech economy. We showed that in the Czech Republic, the inflation targeting regime introduced in 1998 was quite successful in that inflation rates were reduced rather quickly to low levels after the introduction of the strategy. Furthermore, inflation rates have stayed at low levels during most of the time since 2000. Periods with more elevated rates, after negative inflation shocks such as in 2004 and in 2007/2008, remained temporary events. However, the disinflation period showed some perils of inflation targeting in an emerging economy. Disinflation proceeded more quickly than envisaged by the central bank, also on account of unintended effects of the strong monetary restriction. It therefore implied higher costs in terms of lost output and employment than envisaged.

The positive result of inflation targeting by the CNB as regards the low inflation environment conceals that the CNB has missed its inflation target in a number of years, typically by undershooting. The main cause of the undershooting has been the trend appreciation of the nominal exchange rate. The nominal appreciation has also shaped rate setting of the central bank. Because of mounting costs of intervention in the foreign exchange market, from 2003 onwards the Czech National Bank has used the policy rate more actively to fend off capital inflows. It is therefore that the refinancing rate has often been lower than that of the ECB. The trend appreciation of the exchange rate has still implied substantial yield differentials towards the euro area, however.

The estimated policy rule shows that the CNB indeed reacted systematically to the nominal exchange rate and the ECB policy rate. In addition, the tests also determined a link between the policy rate and the deviation of the actual inflation rate from the targeted inflation rate.

Still, a comparison between the estimated policy rule and the Taylor rule shows that interest rates were far below the rate suggested by the Taylor rule. We concluded that the deviation between the Taylor rule and the estimated CNB policy rule indicates that the independence of the Czech National Bank in setting interest rates based on domestic factors might have been limited.

The most striking feature of the inflation process is the strong adjustment of relative prices. Whereas industrial goods prices declined, prices of market services and regulated items grew substantially. The latter have kept headline inflation positive despite the pronounced decline in the nominal exchange rate, and contributed to a strong real appreciation. However, the empirical tests showed that the pass-through of the nominal exchange rate to industrial goods prices is only partial. Hence, a part of the observed real appreciation of the currency is owing to the development of industrial goods prices.

As regards the determinants of inflation, we found that industrial goods prices have been driven primarily by the nominal exchange rate and foreign prices. Also food prices react to the euro area's prices. By contrast, market services prices can be related to the development of unit labour costs. This link can be motivated by the Balassa-Samuelson effect, but holds irrespective of the source of wage growth. Hence, as long as industrial goods prices are tied to the nominal exchange rate and market services to the industrial goods prices through the Balassa-Samuelson effect (i.e. the productivity differential), overall inflation rates can remain rather low provided the nominal exchange rate is stable or keeps appreciating. Given a productivity differential of 5 percentage points, the equilibrium inflation differential related to the Balassa-Samuelson effect is estimated at 0.8 percentage points. However the catching-up related higher inflation rate is also affected by adjustments in regulated prices, which are linked to the rising incomes.

We could not determine a link between headline CPI and unit labour costs. That proves the importance of other factors, such as the nominal exchange rate but also the adjustment of regulated prices, for the price trends in the Czech Republic. However, in any case pressures from the economy-wide unit labour costs were virtually non-existent during 2002-2007 owing to strong productivity growth and moderate wage growth. In 2008, however, wages and unit labour costs grew rapidly presumably related to the surge in inflation. According to the estimated wage equation wages have reacted to inflation and productivity. Thus, as long as inflation is low, wage pressures may also remain contained. At the same time, higher inflation is followed by according wage growth, as shown in 2008. Because of the weak link to headline CPI, more vivid wage growth need not show up in overall inflation. Wages have reacted systematically to the situation in the labour market and vice versa. We thus

conclude that an adjustment to stronger wage pressures would take place through the labour market.

In sum, it seems that the Czech Republic could be able to meet the Maastricht criterion on inflation. That holds in particular if adjustments in regulated prices will be modest and the nominal exchange rate will continue to appreciate. With a stable exchange rate, meeting of the Maastricht criterion could become more of a challenge. After euro adoption, monetary conditions for the Czech Republic will in all likelihood ease. Provided the links determined above will continue to hold, i.e. if wage growth remains affected by current inflation but is in itself translated to inflation only to some extent, wage advances substantially in excess of productivity growth would yield higher unemployment instead of higher inflation. Still, the experience of catching-up countries within the euro area indicates that the adjustment processes within the monetary union may differ from those observed before. In particular, lower risks associated with the financing of external imbalances may reduce the immediate adverse effects of lower competitiveness and hence reduce adjustment pressures.

In contrast to the Czech Republic, Hungary has not yet achieved low inflation and interest rates on a sustained basis. We argued that Hungary has been characterised by elevated inflation for a number of decades and hence deeply ingrained inflation expectations. The higher inflation expectations inherited from the planned economy period, however, were fostered during the transition period and the policies pursued at that time. In the early transition period, a fixed exchange rate coupled with frequent but discretionary currency devaluations kept the inflation-devaluation spiral and expectations thereof intact. The introduction of the crawling peg regime in 1995 raised the dedication of the central bank to disinflation and made the devaluations more predictable. Nevertheless, policy makers aimed at a disinflation at low output costs; a high real interest rate strategy to break the inflation expectations was to be avoided. The crawling peg regime can be regarded successful insofar as inflation rates could be brought down to 10 %. However, with a nearly stable nominal exchange rate in 2000, this implied a marked real appreciation of the currency. In addition, because of a narrow currency band, the central bank had to focus on engineering currency depreciation, which was complicated by strong capital inflows. Specifically, at times, the interest rate was kept rather low, creating easy monetary conditions overall. With a buoyant cycle and a tight labour market in the late 1990s and in 2000, the low real interest rate further promoted wage and price growth.

The introduction of inflation targeting in 2001 was intended to strengthen the policy framework and raise the commitment to disinflation. However, the inflation target was accompanied by an exchange rate target. While the inflation target and the exchange rate target need not necessarily be conflicting, it turned out to be conflicting in Hungary. The

MNB faced a first major conflict in objectives in 2003, when the exchange rate strengthened close to the lower exchange rate band. At the same time, macroeconomic stability and inflation were affected by a hike in the wages of public employees by 50 % and a fiscal deficit of 9 % of GDP in 2002. Although the targeted inflation rate could have been attained only with a further nominal appreciation, the central bank gave priority to the exchange rate target. A further appreciation was prevented, thus sacrificing the inflation target. Also afterwards, when the exchange rate came under depreciation pressures owing to inconsistent fiscal and monetary policies, the policy rate was once more directed to the exchange rate target. A similar, albeit less pronounced reaction to currency depreciation, which again was triggered by fiscal imprudence, occurred in 2006. As a result, in the early years of inflation targeting, where the central bank targeted a disinflation path, the target was missed quite often also because of the dual objectives.

That notwithstanding, the target was nearly constantly missed also after the introduction of the permanent target of 3 % in 2007 and the abandonment of the exchange rate target in early 2008. Admittedly, this was also related to the fierce fiscal consolidation measures introduced in the second half of 2006, and the world-wide hike in food and energy prices, which were both beyond the control of the central bank. At the same time, however, the MNB could not start to focus on inflation and raise the credibility of its inflation target. Instead, shocks from fiscal policy and from the financial crisis originating in the developed financial markets, which started in mid-2007 and further accelerated in autumn of 2008, considerably impacted Hungary and its monetary policy. Strong capital outflows put downward pressure on the exchange rate in the second half of 2008, to which the MNB reacted by raising interest rates by 300 basis points. Afterwards, interest rate setting was driven by the objective of exchange rate stabilisation for a number of months. As a result, the experience of the MNB with inflation targeting has been mixed. Early successes in disinflation were followed by a number of negative inflation shocks, during which inflation returned to levels of close to 10 %. Furthermore, the frequent shocks from fiscal policy, which also triggered some of the shocks to capital flows, did not raise the credibility of a low inflation target. The inflation targeting regime has thus not yet succeeded in breaking the moderate inflation expectations.

As regards the policy rate setting, the tests prove that the MNB did react to deviations of the observed inflation rate from the targeted rate. However, the determined long-term link appears weak. Rate setting has been dominated by short-term movements and ad hoc adjustments compelled by shocks from the domestic or foreign economies. The Taylor rule shows similarity with the actually observed rules only in some periods. The co-movement is also to some extent by chance.

Turning to the inflation process, similarly as in the Czech Republic, the Hungarian price trends have been marked by a pronounced adjustment of relative prices. After the introduction of inflation targeting, the contribution of industrial goods prices to overall inflation has become fairly small, whereas that of market services and regulated items has remained high. As in the Czech Republic, industrial goods prices have been affected mainly by the nominal exchange rate. The pass-through declined after the introduction of the broad currency bands in 2001, but it can still be regarded as robust. Yet, in contrast to the Czech experience, in Hungary the increase in the relative price of market non-tradables has far exceeded the productivity differential, which can be regarded as an indicator of the "equilibrium inflation differential" between market services' inflation and that of industrial goods prices. The tests found that besides a strong inertial component, market services inflation is linked to industrial goods inflation directly as well as to unit labour costs growth. A link to the growth of unit labour costs can also be determined for headline inflation, in particular for the period of inflation targeting. Therefore, in contrast to the Czech Republic, wage pressures do manifest themselves in higher inflation, most probably through non-tradables or non-tradable cost components. As regards wage growth, we could determine a link to inflation and to the unemployment rate. However, for the most recent period, the tests could not find that wages would react to inflation. We suggested that inflation expectations have become rather rigid, leading to a steady wage growth of close to 10 % p.a. They might be modified only when the labour market situations changes markedly. The experience of the past two years seems to prove this proposition as wage growth declined only modestly despite a slump in growth, which was followed by a worsening in the labour market with a delay.

As a result, meeting the Maastricht criterion on inflation could become difficult for Hungary. On the one hand, the recent financial turmoil and the fierce fiscal consolidation measures could help restore macroeconomic equilibrium. Also the more transparent monetary policy framework since the floating of the currency could promote disinflation. On the other hand, however, the need to direct the policy rate to a stabilisation of the nominal exchange rate or of capital flows, as it was the case again in reaction to currency turmoil in late 2008, demonstrates that as long as the shock potential of Hungarian fiscal policy does not decline, monetary policy can hardly become more stable and focused. As long as fiscal policy will not be put on a sustainable path, also monetary policy and its credibility will suffer. At the same time, the ingrained inflation expectations at a level inconsistent with price stability raise the costs of participation in monetary union. Even if Hungary were able to qualify for euro adoption soon, as long as wage setters do not align their inflation expectations with those prevailing in the euro area, any negative inflation shock will be followed by a time-consuming and costly adjustment process.

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