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Project Coordinator: Martin Cincibuch

Fulfilment of the Maastricht Inflation Criterion by the Czech Republic: Potential Costs and Policy Options

Vít Bárta *

Abstract

The purpose of this paper is twofold: firstly, to identify and quantify the potential costs to the Czech economy should fulfilment of the Maastricht inflation criterion (MIC) require disinflation; and secondly, to discuss and suggest policies geared towards minimising the costs related to meeting the MIC. We assume that the real appreciation of the koruna will be about 1.5% during the reference period. Three disinflation simulations are derived from this assumption. The results show that a decline in inflation by 0.5 p.p., 1 p.p. and 1.5 p.p. leads to a cumulative loss of output reaching about 0.5%, 1% and 1.6% respectively of annual potential GDP over a period of four years. The time restriction imposed on the simulations implies that the shorter the time to reach a given lower level of inflation, the higher the initial increase in the interest rate and the more aggressive the policy rule needed. The simulation results and the likely application of the monetary convergence criteria are relevant to the discussion of policy options. We argue that due to the asymmetry of the Maastricht exchange rate criterion (MERC), allowing for nominal appreciation rather than depreciation, fulfilment of the MIC should be superior. Also, we suggest that the main task for the CNB will be to focus on reaching a level of inflation consistent with the presumed level of the MIC sufficiently early before the reference period. This may require a downward adjustment of the CNB's inflation point target and an extension of the current policy horizon.

JEL Codes: E31, E32, E47, E52, E58, E63.
Keywords: Disinflation, EMU entry, euro adoption, Maastricht inflation criterion, policy options, real exchange rate appreciation, output loss.

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* Vít Bárta, Czech National Bank (vit.barta@cnb.cz).
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1. Introduction

In comparison with the majority of the new EU countries, inflation in the Czech Republic (CR) is relatively low and will presumably stay so in the foreseeable future. Consequently, the fulfilment of the Maastricht inflation criterion (MIC) at some more or less distant future time is not considered an issue either domestically or internationally. We challenge this and present some arguments suggesting that meeting the MIC may not be that easy.

It is well documented that the new EU countries are enjoying fast real appreciation of their currencies. However, high real appreciation may drive their inflation above the average EMU inflation and possibly even above the level consistent with the MIC. This is evidenced by existing inflation patterns in the EMU: the countries with the highest levels of inflation are typically those which are catching up towards the EMU average. If most of the less advanced countries have higher inflation than the more advanced ones, why should the new EU countries not follow suit? Is it so unrealistic to assume that in the medium run Czech inflation will reach the level that prevails in the less advanced EMU economies and will tend to fluctuate around that level? Should this prove to be the case, fulfilment of the MIC may be more difficult than is often argued. Therefore, we find it useful to deepen the knowledge of the potential costs of meeting the MIC and to better understand the policy options which policy-makers are likely to face before adopting the euro.

The above questions set the stage for our paper. It focuses both on positive analysis and on normative policy advice. Specifically, we attempt to:

- identify the factors that are likely to determine inflation in the CR in the medium term,
- form plausible assumptions about the possible extent of these factors and thereby quantify the difference between the expected level of inflation in the CR and the MIC,
- simulate the costs of potential disinflation and the impact of some inflation shocks,
- discuss the available policy options geared towards minimising the costs of meeting the MIC.

Several points deserve to be stressed:

Firstly, the very idea of the CR joining the EMU is not questioned here. The readiness of the country to benefit from using the euro over the long run is investigated by the growing optimum currency area-based literature. Recently, it has become the focus of regular yearly assessments carried out jointly by the Ministry of Finance and the CNB. Most of the euro-related studies thus examine the costs and benefits of *having* the euro. Instead, we investigate potential costs of *adopting* the euro when fulfilling the MIC, irrespective of the costs and benefits of using the euro thereafter. In other words, we study how the Czech economy could temporarily reach the required nominal monetary convergence in the least costly way.

Secondly, since the adoption of inflation targeting in the CR in 1998, decision-makers have focused mainly on seeking such a path of interest rates which could enable the existing inflation targets to be attained. The monetary policy costs (in terms of output loss) usually have not played the dominant role and have been of secondary importance in the decision-making. The innovation of this paper is that the modelling framework of the CNB (used for forecasting inflation) is applied to quantify the costs that may be incurred by the potentially needed disinflation. The

results of our simulations are relevant to the discussion of the policy options available in the period before the adoption of the euro.

Thirdly, the Maastricht fiscal criteria are beyond the attention of this paper. Their fulfilment is taken for granted and no conflict between them and the monetary criteria is envisaged. For the sake of simplicity, fiscal policy also remains outside the framework of our analysis, except for one simulation that quantifies the impact of a fiscal policy shock on inflation.

The paper is structured as follows. In *Section 2*, we present evidence on the inflation differentials of the EU-15 economies vis-à-vis the level of the MIC during 1999–2004. In *Section 3*, we investigate three groups of factors which could potentially complicate the fulfilment of the MIC. Initially, we focus on level factors that are supposed to persist over the long term and that are likely to keep inflation above the expected level of the MIC on a sustained basis. Then we discuss cyclical factors that lie behind the volatility of inflation over the business cycle. Also, we deal with shocks and explain some of the reasons why the sensitivity of inflation to shocks could be higher in the new EU countries than in the EMU. Finally, we make assumptions about the expected size of the level factors in the years to come. In *Section 4*, we define two loss functions in order to quantify the cost of disinflation and to discriminate between various disinflation scenarios. We justify the policy assumptions of the disinflation shocks and present the results of the simulations of the level factors and of five inflation shocks. In *Section 5*, we focus on the very Maastricht criteria against which the monetary performance will be assessed. We discuss the possible application of the MIC and the Maastricht exchange rate criterion (MERC) and derive the implications for the policy options. These are the subject of *Section 6*. We introduce three kinds of fulfilment of the MIC, which we call "hard fulfilment", "soft fulfilment" and "cheap fulfilment". We define "flexible" and "fixed" approaches towards the adoption of the euro. We organise the discussion of the available policy options around several key questions and sum it up in the simplified form of a decision-making tree. We formulate some advice for the decision-making framework of the CNB. *Section 7* summarises and outlines topics for further research.

2. Inflation in the EU-15 during 1999–2004: Empirical Evidence

Below, we look briefly at the inflation patterns in the EU-15. They display several features that serve as a point of departure for this paper. *Table 1* shows the differentials between inflation in each country and the MIC during 1999–2004.

The comparison of HICP inflation in the EU-15 countries relative to the level of the MIC leads us to the following observations. Firstly, we can identify three groups of countries: those with relatively high average negative differentials vis-à-vis the MIC (such as Germany, France, Austria, Finland, the United Kingdom and Sweden), those with moderate average negative differentials (such as Italy, Luxembourg and Denmark) and those with positive average differentials (such as Greece, Spain, Ireland and Portugal). Secondly, the last two columns of the table show how many times in the given years each country "missed" the hypothetical MIC and how many times in the given years inflation would have constituted the basis for computation of the MIC. Again, we can identify three groups of countries: those whose inflation performance (during the given period) always satisfied the MIC (such as Belgium, Germany, Austria, Sweden, the United Kingdom and Denmark), those whose inflation performance (on a calendar year basis)

never served as the basis for computation of the MIC (such as Greece, Spain, Ireland, Italy, Luxembourg, the Netherlands and Portugal) and those whose inflation sometimes missed the MIC but in other years served as the basis for computation of the MIC (such as France and Finland).

Table 1: Inflation differentials vis-à-vis the MIC during 1999–2004

	1999	2000	2001	2002	2003	2004	Average differential	MIC missed	MIC determined
EU-15	-0.9	-0.8	-0.9	-0.8	-0.7	-0.2	-0.6		
EMU	-1.0	-0.6	-0.7	-0.6	-0.6	-0.1	-0.6		
Belgium	-1.0	0.0	-0.7	-1.3	-1.2	-0.3	-0.7	0	1
Germany	-1.5	-1.3	-1.2	-1.6	-1.7	-0.4	-1.3	0	5
Greece	0.0	0.2	0.6	1.0	0.7	0.8	0.6	5	0
Spain	0.1	0.8	-0.3	0.7	0.4	0.9	0.4	5	0
France	-1.5	-0.9	-1.3	-1.0	-0.5	0.1	-0.8	1	2
Ireland	0.4	2.6	0.9	1.8	1.3	0.1	1.2	6	0
Italy	-0.4	-0.1	-0.8	-0.3	0.1	0.1	-0.2	2	0
Luxemburg	-1.1	1.1	-0.7	-0.8	-0.2	1.0	-0.1	2	0
Netherlands	-0.1	-0.4	2.0	1.0	-0.5	-0.8	0.2	2	0
Austria	-1.6	-0.7	-0.8	-1.2	-1.4	-0.2	-1.0	0	2
Portugal	0.1	0.1	1.3	0.8	0.6	0.3	0.5	6	0
Finland	-0.8	0.3	-0.4	-0.9	-1.4	-2.1	-0.9	1	2
Sweden	-1.5	-1.4	-0.4	-0.9	-0.4	-1.2	-1.0	0	3
Great Britain	-0.8	-1.9	-1.9	-1.6	-1.3	-0.9	-1.4	0	3
Denmark	0.0	0.0	-0.8	-0.5	-0.7	-1.3	-0.5	0	1
Addendum							Average		
MIC	2.1	2.7	3.1	2.9	2.7	2.2	2.6		

Source: Eurostat, author's computations
Note 1: The data show the 12-month moving averages of the HICP on a calendar year basis
Note 2: Positive values (marked in red) signify higher inflation as compared to the level of the MIC in the given year; some of the negative differentials (those marked in blue) mean that the level of inflation in the given country in the given year would have served as the basis for computation of the MIC.

The above evidence leads us to the following conclusions. On the one hand, we can see a relatively narrow set of low inflation countries which have determined the level of the MIC (primarily Germany, followed by Sweden and the United Kingdom). On the other hand, we can clearly identify a set of countries which typically missed the hypothetical MIC either in all six years under consideration (Ireland and Portugal) or in five years (Greece and Spain). Needless to say, inflation in all these four countries never served as the basis for computation of the MIC.[1]

[1] There are two possible methodological objections against the legitimacy of a simple comparison of the inflation patterns between the current EMU members and the new EU countries. Firstly, the EMU countries are subject to a common monetary policy that is largely exogenous to them and need not respond to their "needs" (interest rates may not meet their "needs" both from the level point of view and from the timing point of view). Inflation in each particular country after the inception of Stage Three of the EMU may not be a good proxy for the inflation they would have had if they had maintained an independent monetary policy. While for low inflation countries a given ECB interest rate can still be too tight, for high inflation countries the same level of rates can be too loose. The second objection is related to the "locked" exchange rate channel. The real appreciation of less advanced EMU countries cannot now materialise through appreciation of the nominal exchange rate, but takes

The above evidence indicates the existence of common inflation patterns shared by the less advanced EU-15 economies (with the possible exception of Ireland) which push up their level of inflation persistently above that consistent with the MIC. As the MIC appears to be quite demanding for those countries, it may be even more so for the new EU Member States. This leads us to the hypothesis that fulfilment of the MIC may turn out to be more challenging for them than is generally believed and than is sometimes argued. In other words, should the features which still characterise the inflation patterns in the less advanced EU-15 countries persist in the Czech Republic over the next four or five years, fulfilment of the MIC may become costly. Another difficulty may arise from possibly higher inflation volatility in the Czech economy, either due to business cycle effects or due to the higher sensitivity of Czech inflation to external shocks. An inspection of the potential costs and a policy-oriented discussion of their minimisation establish the mission of this paper.

3. Possible Patterns of Inflation in the Czech Republic before Adoption of the Euro

When investigating the sources of inflation, Arratibel/Palenzuela/Thimann (2002) found a strong influence of the oil price, nominal wage growth and fiscal developments on tradable goods and a high impact of wage and fiscal policy, price liberalisation and productivity development on non-tradable inflation. Also, they identified a continuing high level of inflation inertia in the new EU countries. This is consistent with the findings of Hondroyiannis/Lazaretou (2004), who found a high persistence of inflation in Greece from 1975 until recently. Backé et al. (2002) studied a number of factors driving the price dynamics in the former accession countries, with (i) the completion of price deregulation (especially in the energy sector) and the adjustment of agricultural prices upon EU membership, (ii) productivity developments, and (iii) wage developments in the tradables sector playing the major role. Also, they stressed the paramount importance of relative price adjustments in explaining medium-term inflation development. The same factor was investigated by Holub/Čihák (2003). They studied the relationship between relative price adjustments and price level development, concluding that if inflation is around the inflation target, the process of economic adjustment is unlikely to lead to declines in prices. In addition to the Balassa–Samuelson effect (BSE), Mihaljek/Klau (2003) identified an important impact on inflation in the Czech Republic and Croatia stemming from adjustments in administered prices and indirect taxes, imported inflation, and shifts in demand towards non-tradables brought about by rising real income. On the other hand, in Hungary, Poland, Slovakia and Slovenia they found strong price inertia fostered by a boosting of external competitiveness, high pass-through of the exchange rate, the dominance of backward-looking expectations, wage convergence and inconsistencies between fiscal and monetary policies to be significant. Ådhal (2003) found that the deregulation of controlled prices, tax adjustments and the alignment of agricultural prices due to the Common Agricultural Policy (CAP) had the strongest influence on inflation in the short run, and that the BSE and shifts in demand for non-tradables are important over the long run. Cincibuch/Vávra (2001) pointed to the risks of the rigidity of nominal

place rather through inflation differentials. On the other hand, for the euro applicants the channel of nominal appreciation is still "open" and the real appreciation may be only partly reflected by the inflation figures. The inflation differentials can thus provide a comparison of inflation patterns only when the nominal exchange rate is fixed. We are aware of these qualifications, but we disregard them to make our analysis tractable.

variables, especially nominal wages, for the adjustment of real variables, with negative implications for inflation and its persistence.

The inflation factors are very different in nature and their impact on inflation has varied over time depending on the stage of economic transformation and the phase of accession to the EU. Currently, some of the factors are relatively modest (deregulation of some administered prices) or almost non-existent (price liberalisation of the majority of tradable goods), but other factors may still be relevant in the short run (adjustment of food prices due to adoption of the CAP), in the medium run (changes in indirect taxes) and in the long run (real appreciation of the currency due to productivity differentials).

In this paper we divide the inflation factors into three groups: level factors, cyclical factors and shocks. Discussion of these factors will enable us to formulate quantitative assumptions about the likely pattern of future inflation, which will be used in our simulations in *Section 4*. We collect evidence that makes our simulation assumptions realistic and reasonably acceptable.

3.1 Level Factors

Level factors are expected to push inflation in the Czech Republic (and the other new EU countries) above that in the EMU over the long run, i.e. until real convergence is basically achieved.[2] Among the level factors, prominent attention has been directed towards the BSE.

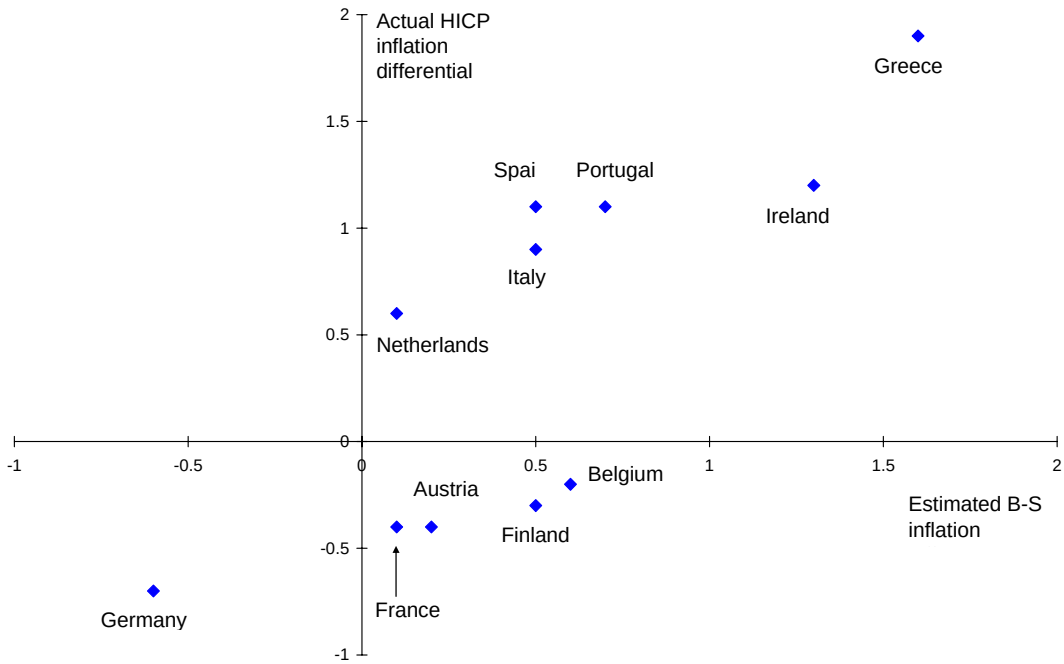
3.1.1 Balassa–Samuelson Effect

Much effort has been made to quantify the BSE for old and new EU countries over recent years. A study by the ECB (2003) shows that the BSE can be an important cause of inflation differentials among EMU economies. It summarised several empirical findings quantifying the size of the BSE and compared the implied inflation differentials due to the BSE with the actual HICP inflation differentials during 1995–2002 (*Figure 1)*.

The study finds that inflation is broadly consistent with the estimates of the BSE, although the gap between actual inflation in the group of countries with relatively higher inflation (as compared to the group of countries with relatively lower inflation) is higher than the BSE estimates would imply. The BSE thus cannot be the only explanatory variable for inflation differentials, as the examples of Belgium and Finland show. Similarly, actual inflation in the Netherlands requires another explanation than that offered by the Balassa–Samuelson framework. The above evidence supports the hypothesis that the less advanced EMU economies are converging towards the euro area average in terms of price level (economic development) and that some part of this catching-up may be associated with the BSE.

[2] We are aware of factors that may act in the opposite direction (i.e. towards lower inflation). These include further deregulation and liberalisation of some still regulated markets, which is intended to enhance competition and thereby dampen inflation. Presumably these factors will counteract the pro-inflationary pressures.

Figure 1: Implied inflation differentials to the euro area average due to the Balassa–Samuelson effect compared with actual inflation differentials during 1995–2002



Source: ECB (2003).

However, the search for the importance of the BSE in the new EU members, including the Czech Republic, has been somewhat surprising. Although one would expect quite a significant BSE (due to the sizeable GDP per capita gap between the EU-15 and the new EU countries), numerous authors have arrived at meagre, if not disappointing, results. *Table 2* (taken from Égert et al., 2004) summarises some of the empirical studies quantifying the contribution of the BSE to inflation for the Czech Republic.

Table 2: Inflation due to the Balassa–Samuelson effect for the Czech Republic

Author (year)	Inflation (in percentage points)
Golinelli/Orsi (2001)	4.3
Sinn/Rutter (2001)	2.9
Halpern/Wyplosz (2001)	1.2
Rosati (2002)	1.2
Flek et al. (2002)	0.2
Mihaljek (2002)	0.3
Kovács et al. (2002)	0.7
Égert (2002a)	0.8
Égert (2002b)	0.8
Égert (2003)	0.4
Backé et al. (2003)	0.6

***Source*:** Égert et al. (2004).

The table indicates that the importance of the BSE has been diminishing over time. While the earlier research discovered a relatively robust BSE, recent studies suggest a very modest impact of productivity differentials on inflation differentials (real appreciation).[3]

There are several possible reasons for the poor evidence for the BSE so far. Firstly, it may be the case that the BSE is present in the Czech economy (and in other countries) but due to statistical mismeasurement its existence is difficult to prove. The authors of empirical studies typically point to such deficiencies (Flek et al., 2002), namely short time series, a lack of disaggregated data, the blurred and variable distinction between tradables and non-tradables, etc. Statistical limitations may also account for the fact that the size of the BSE differs substantially across the new EU countries (Égert et al., 2004), despite the fact that these countries resemble in many respects relating to catching-up over the long run.

Secondly, it can be argued that overall productivity growth is relatively high in the Czech economy but materialises outside the Balassa–Samuelson framework. Unfortunately, there is a lack of reliable statistical evidence on productivity growth in services. Should this explanation be correct, a more significant BSE might start emerging from the data when the productivity growth in services slows down. This hypothesis has been suggested, for example, by Flek et al. (2002), who said that "the BS mechanism in its standard form works predominantly, if at all, in more advanced economies", where productivity growth in services (unlike in the tradable sector) is limited.[4] This conclusion is supported by the above-mentioned study by the ECB (2003), which does find evidence for the BSE in less developed EU-15 countries, and also by Égert et al. (2004), who survey several studies focusing on the EMU area.

The modest success of empirical economists in identifying any significant BSE has led many (see Flek et al., 2002; Mihaljek/Klau, 2003; Bulíř/Šmídková, 2005) to conclude that a remarkably high proportion of the observed real exchange rate appreciation remains unexplained by the BSE. The weak explanatory power of the BSE has thus prompted a search for other explanations (see, for example, Holub/Čihák, 2003).

The purpose of the above discussion is to express the suspicion that the empirical evidence for the BSE collected to date may serve as a reliable guide for assuming what the level of inflation in the Czech economy might be in five years' time or so. Nevertheless, the failure of the BS framework to deliver satisfactory empirical results should not imply that a connection between productivity and real appreciation does not exist.

3.1.2 Real Exchange Rate Appreciation

Below, we survey the studies focusing on approximating the future equilibrium real exchange rate appreciation of the Czech koruna. We expect to obtain some quantitative idea about this crucial variable co-determining potential inflation over the medium run.

[3] The Czech Republic, together with Slovenia and Slovakia (but unlike Hungary and Poland), is among the countries with a smaller BSE (see Mihaljek/Klau, 2003). A rather higher, but still modest, BSE for the Czech Republic (amounting to about 1%) was identified by Beneš/Klíma (2001).

[4] Ådhal (2003) argues that the BSE may be weakened by strong productivity gains in services enabled by the heavy undercapitalisation of this sector under the period of central planning.

Overviews of the methods used to assess the equilibrium exchange rate of the Czech koruna (and summaries of the quantitative results) are provided by Babetskii et al. (2004) and Komárek/Melecký (2004). These authors applied a wide array of approaches to estimating the paths of equilibrium real exchange rates.[5] To list some of the most recent, we refer to the concept of the FRER (Šmídková et al., 2002), the macroeconomic balance approach to the determination of the equilibrium real exchange rate (Komárek/Melecký, 2004), the concept of the SRER (Bulíř/Šmídková, 2005) and the arbitrage-based model decomposing the real exchange rate between substitution and pricing-to-markets components (Cincibuch/Podpiera, 2005). But while a great number of authors have investigated the equilibrium real exchange rate of the koruna in the past, few of them have attempted to deliver real exchange rate appreciation forecasts or simulations.[6] Those few studies are mentioned briefly below.

Šmídková et al. (2002) applies the FRER model and investigates whether real exchange rates are in line with economic fundamentals. Her simulations imply quite modest, if any, real appreciation pressures in the middle of this decade and leave the question about the pace of equilibrium real appreciation at the end of the decade unanswered.

Integrating the BS model of the equilibrium exchange rate with a model of capital accumulation and the demand side of the economy, Holub/Čihák (2003) carry out two simulations. The "baseline scenario" in both simulations shows that the converging country should (over a 25-year period) achieve a growth differential vis-à-vis the EU of about 2% a year initially, with a gradually declining tendency. The implied equilibrium real exchange rate starts from about 1.5–2.0% a year and declines to below 1% at the end of the 25-year period.

Bulíř/Šmídková (2005) apply the concept of the sustainable real exchange rate (SRER) and simulate the equilibrium real exchange rate for the period 2004–2010. Their simulations imply a modest real appreciation until the end of this decade, despite an expected appreciation of the sustainable real exchange rate. In other words, the inflation potential stemming from the real exchange rate appreciation is relatively small.

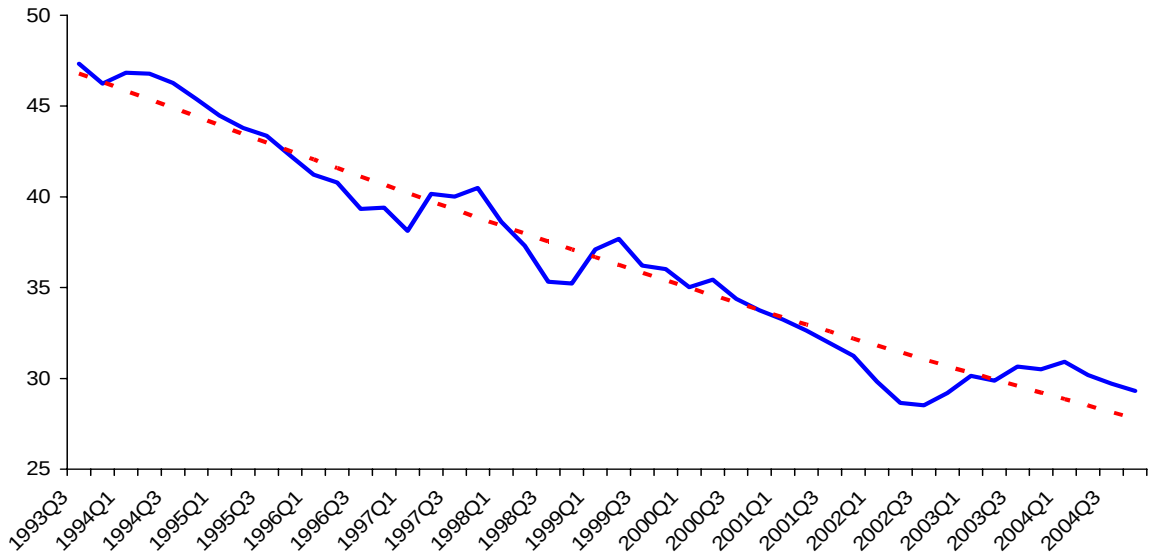
Analyses and forecasts of the real appreciation of the Czech koruna are regularly provided by the inflation projection team at the CNB.[7] In its recent forecasts (from 2005), the team maintains that the current pace of equilibrium real appreciation is between 2.5% and 3% and that its future pace may diminish to 2% in the first half of 2007. This assumption is derived from different analyses and reflects a wide consensus within the CNB. We basically adopt this assumption and extrapolate it to obtain the likely pace of real appreciation (shortly) before the fulfilment of the MIC. This justifies our assumptions applied in the simulations in *Section 4*. *Figure 2* shows the history of the real exchange rate of the koruna between 1993 and 2004.

[5] The forthcoming preparation for the adoption of the euro has put issues concerning ERM II entry and a successful stay in this mechanism at the top of the research agenda in all the new EU countries (see e.g. Čech et al., 2005). The recommendation of the ECB (2003) that the choice of the central rate should reflect the best possible assessment of the equilibrium exchange rate and that this assessment should be based on a broad range of economic indicators underlines the prominence of this topic.

[6] While some of them have carried out only short term forecasts (Komárek/Melecký, 2004), others have left this topic for future research (Babetskii/Égert, 2004).

[7] The forecasting framework within the CNB has been described in "The Czech National Bank's Forecasting and Policy Analysis System" (edited by W. Coats, D. Laxton and D. Rose), Czech National Bank, 2003, and outlined in the CNB's regular Inflation Reports.

Figure 2: Real exchange rate of the Czech koruna vis-à-vis the euro during 1993–2004



Source: CNB.

3.1.3 Relative GDP/Price Level "Mismatch": Empirical Evidence

Below, we look at the empirical evidence supporting the hypothesis that the Czech koruna will go on appreciating in real terms over the rest of the decade. We have used data from Eurostat on GDP per capita in PPS (Purchasing Power Standards)[8] and comparative price levels[9] in selected European countries over the period 1995–2003 (see *Table 3*).[10]

Table 3: Relative GDP per capita and relative price levels in selected countries in 1995 and 2003 (EU-25 = 100)

	GDP per capita in PPS			**Comparative price levels**		
	1995	2003	03-95	1995	2003	03-95
Czech Republic	70.1	68.8	-1.3	41.2	55.2	14.0
Estonia	35.6	48.5	12.9	42.4	62.2	19.8
Hungary	49.6	60.5	10.9	44.0	58.0	14.0
Slovenia	68.5	76.8	8.3	77.1	77.1	0.0
Ireland	99.3	132.5	33.2	98.9	127.0	28.1
Germany	119.5	108.1	-11.4	119.6	108.9	-10.7

Source: Eurostat, author's computations.

[8] Gross domestic product (GDP) is a measure of economic activity. It is defined as the value of all goods and services produced less the value of any goods or services used in their creation. The volume index of GDP per capita in Purchasing Power Standards (PPS) is expressed in relation to the European Union (EU-25) average set to equal 100. Basic figures are expressed in PPS, i.e. a common currency that eliminates the differences in price levels between countries, allowing meaningful volume comparisons of GDP between countries.

[9] Comparative price levels are the ratio between purchasing power parities (PPPs) and the market exchange rate for each country. PPPs are currency conversion rates that convert economic indicators expressed in national currencies to a common currency called the Purchasing Power Standard (PPS), which equalises the purchasing power of different national currencies and thus allows meaningful comparisons.

[10] According to Eurostat, the index, calculated from PPS figures and expressed with respect to EU-25 = 100, is intended for cross-country comparisons rather than for temporal comparisons. Our exposition is only approximate and reflects the overall tendencies.

The data show that between 1995 and 2003 the GDP level per capita (relative to the EU-25 level) increased in Estonia, Hungary and Slovenia by between 8 and 13 percentage points and in Ireland by a full 33 percentage points. On the other hand, relative GDP declined by 11 percentage points in Germany and by 1 percentage point in the Czech Republic.

The right-hand part of the table shows that the comparative price level in Germany declined in proportion to the decline in relative GDP and the price level in Ireland increased in proportion to the increase in relative GDP. Similarly, the price levels increased in Estonia and Hungary, although more than proportionately (by 20 percentage points in the former and by 14 percentage points in the latter). In Slovenia the comparative price level remained the same in 2003 as in 1995, but in the Czech Republic it increased by 14 percentage points. In other words, while the relative GDP in the Czech Republic between 1995 and 2003 remained basically unchanged, the relative price level increased by a wide margin.

There is, indeed, no "iron rule" that all countries must be located on the 45º straight line (see, for example, Holub/Čihák, 2003, for a detailed discussion) and that any "mismatch" between the two variables must disappear quickly should it emerge. Nevertheless, as the examples of Ireland, Germany, Hungary and Slovenia show, a certain proportionality between the comparative price level and comparative GDP may tend to exist and persist.

Although we do not aspire to explain fully the relationship between relative GDP levels and relative price levels, the empirical evidence may suggest the following. The increase (decrease) in relative GDP in Ireland and Hungary (Germany) was accompanied by a roughly proportionate increase (decrease) in the relative price level in these countries. The stagnation of the relative price level in Slovenia between 1995 and 2003 occurred in spite of an increase in the relative GDP level, implying the possible existence of a "correction mechanism" leading to alignment of the two relative variables. On the other hand, the relative price level of Estonia seems to be too high compared to its relative GDP level, implying the possibility of lower real appreciation (inflation potential) in the future. Just the opposite may be implied for the Czech Republic: its relative price level seems to be below the level suggested by its relative GDP level, implying scope for further real exchange rate appreciation.

We are far from claiming that the above evidence should "cause" a real appreciation in the Czech economy. We just posit that this evidence is consistent with views indicating that some real appreciation may still be "in the pipeline", as suggested in the literature surveyed above, with the possible exception of Šmídková et al. (2002) and Bulíř/Šmídková (2005).

Considering the observed narrowing of the productivity gap vis-à-vis the EU11, high and accelerating productivity growth in manufacturing12, steadily improving export performance (see, for example, Benáček et al., 2003) and ongoing microeconomic restructuring of the economy, often driven by large inflows of FDI, we conclude that the Czech Republic has embarked on a sustainable growth path that outpaces the average EU-15 growth.13 Although the growth of the Czech economy may not be currently as high as that of some of the less advanced new EU

[11] Relative productivity per person employed (EU-25 = 100) increased from 57.7% in 1995 to 62% in 2003, and according to a Eurostat forecast it may reach 66.4% in 2006.

[12] Labour productivity in manufacturing increased from 5–6% during 2002–2003 to above 10% in 2004.

[13] The CNB assumes that the growth of potential output will be between 3% and 3.5% over the next few years.

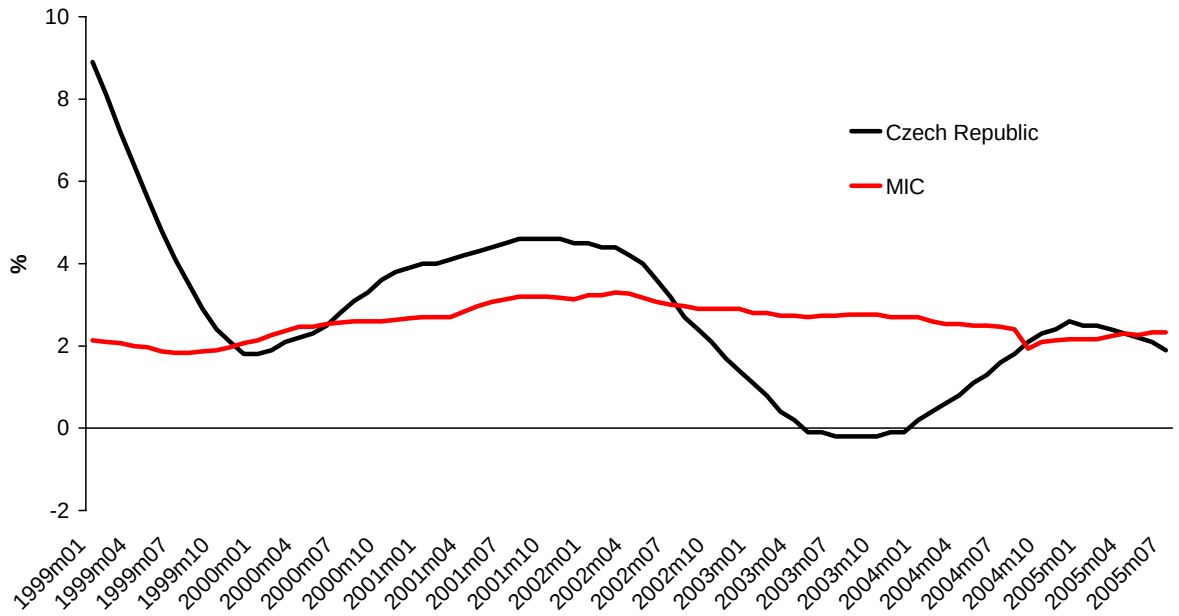
members (such as the Baltic countries), its catching-up is likely to be associated with a non-negligible real exchange rate appreciation.

Most of the literature surveyed above supports the view that the real appreciation may be 1.5% over the next five years or so (when the Czech Republic's readiness for adopting the euro will probably be examined). This assumption is consistent with the relative price level of the Czech Republic (vis-à-vis the EU-25 average), which is somewhat below the level implied by relative GDP per capita. We believe that we have enough evidence suggesting non-negligible inflation potential in the Czech Republic over the medium run.14

3.2 Cyclical Factors

Under certain circumstances, the fulfilment of the MIC may be complicated by cyclical factors. *Figure 3* shows the evolution of Czech inflation as measured by the HICP and of the MIC since the inception of the EMU.

Figure 3: HICP in the CR and the MIC: 12-month moving averages during 1999/1–2005/7



Source: Eurostat, author's computation.
Note: The MIC is computed on the basis of the EU-15 until April 2004 and the EU-25 until July 2005 (the negative inflation values in Lithuania during May–August 2004 are excluded).

Figure 3 shows that the volatility of Czech inflation was substantially higher than that of the MIC. Hypothetically, had the Czech Republic applied to adopt the euro, it would have failed to pass the inflation test during 2001 and most of 2002, but would have passed during 2003 and most of

[14] Although Ådhal (2003) does not focus exclusively on the Czech Republic, he suggests that in the ten new EU countries the accumulated impact of price deregulation, CAP price convergence and tax adjustments may account for an annual increase in inflation of between 0.5 and 2 percentage points in the first years following EU entry. Allowing for the BS effect, overall inflation could be very roughly 1–3 percentage points above inflation in the euro area.

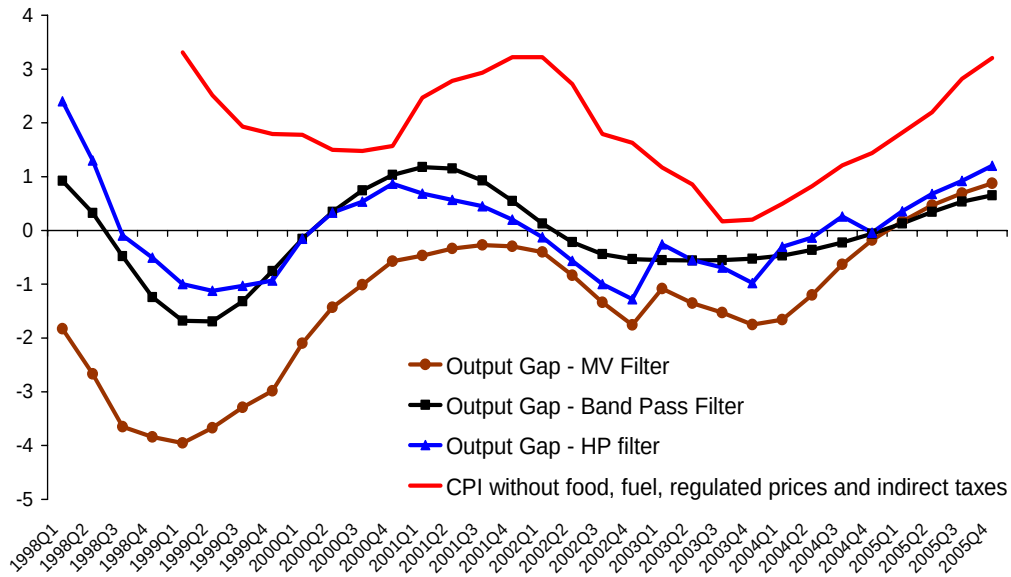
2004. The evolution of inflation in the CR and the reasons for its volatility have been described in detail in the Inflation Reports of the CNB. The past evidence clearly suggests that Czech inflation fluctuated due to a combination of cyclical factors, administrative measures (increases in regulated prices and indirect taxes) and shocks. We discuss below the cyclical factors and their implications for the future patterns of inflation.

3.2.1 Higher Volatility of Inflation

Cyclical factors are related to the evolution of the output gap and its varying impact on inflation at different stages of the business cycle. Under normal circumstances, inflationary pressures increase during booms and diminish during recessions. *Figure 4* reflects this pattern for the Czech Republic. It juxtaposes the output gap (measured by three different methods) with narrow inflation defined as the CPI excluding food, fuel, regulated prices and indirect taxes, i.e. items which are less influenced by the cycle.

The evidence indicates the relatively high volatility of "narrow" inflation over the cycle during the given period. Although the decline in inflation at the end of 2001 and during the first half of 2002 was partly due to the strong appreciation of the Czech koruna, the cyclical pattern of Czech inflation over the last six years remains obvious.

Figure 4: The evolution of the output gap and "narrow" inflation in the Czech Republic



***Source*:** Czech National Bank.

There is hardly any strong theoretical argument suggesting that the inflation volatility in the new EU countries should be higher than that in the old countries. Nevertheless, two reasons can be mentioned. Firstly, the newly-formed market economies are not yet as settled as their more advanced counterparts in the EU. The post-transformation period may still generate vibrations uncommon in a stabilised market environment. Süppel (2003) finds that the Central European new Member States are growing faster than the EU-15 countries and are subject to wider cyclical fluctuations. The higher amplitudes of output are due to the fact that the investment-to-GDP ratios

in the majority of the new EU economies are still well above those in the more advanced EU economies. As capital spending is typically more volatile than non-investment components, the business cycle in the new EU economies implies higher output volatility and, indeed, higher inflation volatility. Secondly, the fact that the rates of inflation in the new Member States tend to be somewhat higher than in the EMU implies possibly higher fluctuations in inflation. This is in conformity with the empirical evidence accumulated across countries over an extended period of time. Thirdly, we believe that the different inflation or disinflation shocks impacting on the new EU economies in the past have exacerbated the cyclical volatility of their inflation. As shocks are a different issue, we deal with them separately.

3.2.2 Phase Difference

The second cycle-related reason for the mismatch in inflation patterns between the new EU countries and the EMU countries may stem from imperfect synchronisation of their business cycles. The lack of cyclical synchronisation implies that a country may be disqualified from meeting the MIC even if its average inflation complies with the MIC over an extended period. Needless to say, this works both ways. It could be just this phase difference which enables the given country to meet the MIC even if its average inflation is somewhat higher (but "sufficiently" volatile) than the MIC basis over the long run.

The empirical evidence on the synchronisation of the Czech cycle with the cycle of its main trading partners is fairly inconclusive. On the one hand, it is a common experience that domestic economic activity is strongly influenced by German import demand (see also the CNB's Inflation Reports). On the other hand, some modelling techniques (based on correlation analysis and on VAR models) do not yet confirm a closer synchronisation of the Czech cycle with the euro area cycle. As the Ministry of Finance (2005) recently stated, the cyclical alignment of the Czech economy with the euro area did not increase during 1995–2003. Specifically, while the occurrence of demand shocks converged with the euro area, the differences in supply shocks widened (see also Babetskii, 2004). In addition, the ministry argues that the structural differences between the Czech economy and the euro area have recently been widening slightly.

It is not easy to summarise the progress with cyclical synchronisation between the Czech economy and the euro area. The ensuing uncertainty leads us to the tentative conclusion that some risks of imperfect synchronisation still exist and may persist in the foreseeable future.[15] However, we believe that these risks will diminish over the medium run.

3.3 Shocks

Shocks are substantial determinants of inflation. Their impact depends on dozens of features which may vary over time and which are conditioned by the structural characteristics of the economy. For example, the prominent factors of external exposure include the degree of oil dependency, the degree of openness towards foreign trading partners, the geographical trade structure, and the commodity composition of imports (see ECB, 2003). But this is only a fraction of a much larger set of characteristics that matter. The question that policy-makers usually ask is

[15] Numerous aspects of the nominal, real, structural and institutional convergence of the former accession countries to the euro area are comprehensively discussed by Backé/Thimann (2004).

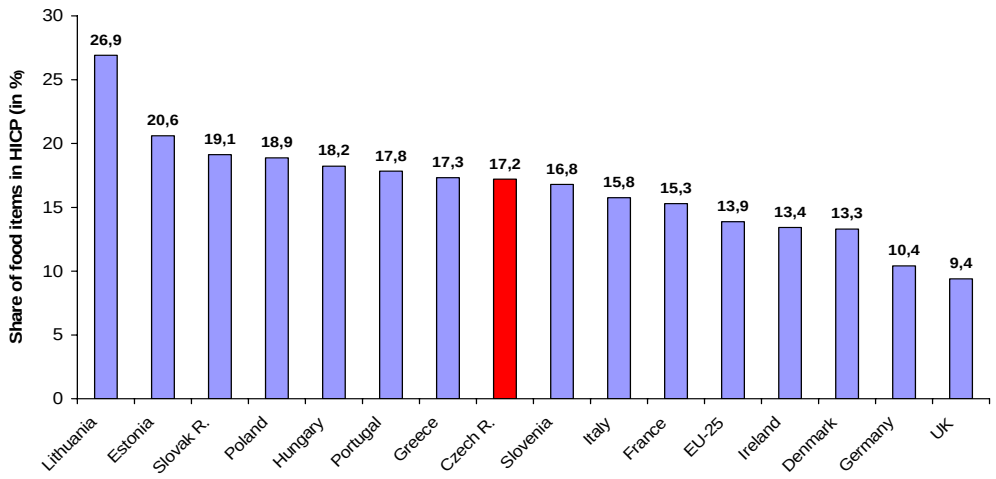
what quantitative impact a particular shock can have on domestic inflation and what policies should be adopted to minimise the costs to the economy.

However, when considering the costs of meeting the MIC, we ask a modified question, namely how a given shock can increase domestic inflation *as compared to inflation abroad* (which serves as the basis for computation of the MIC). In other words, we are interested in identifying the impacts of asymmetric shocks on the ability to meet the MIC. We briefly discuss several points suggesting that inflation in the new EU countries may be more sensitive to shocks than inflation in the more advanced EU economies.

3.3.1 Share of Food in the CPI

It is a common pattern in the new EU economies that the proportion of food items in consumer baskets is higher than the EU average. Due to the higher volatility of food prices as compared to non-food items, the volatility of inflation in the new EU countries should be higher than in the advanced economies, other things being equal. *Figure 5* compares the share of food items in the HICP between selected EU-25 countries.

Figure 5: Share of food items in the HICP in selected EU countries in 2004



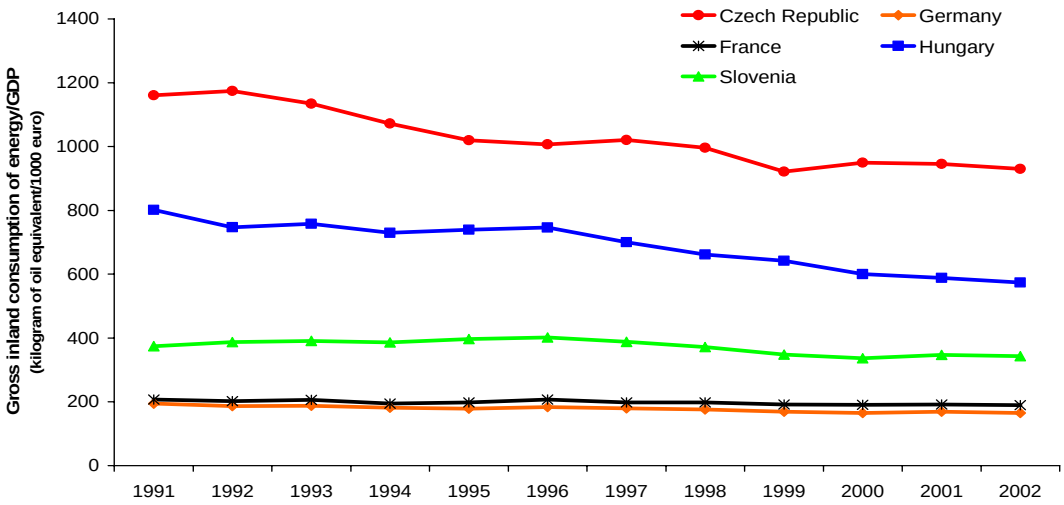
Source: Eurostat, NewCronos.

3.3.2 Energy Intensity of Output

Another characteristic structural feature of the new EU economies inherited from the period of central planning is the higher energy intensity of their output. *Figure 6* compares the energy intensity of the Czech Republic with several other EU economies.

Although the energy intensity of output in the Czech Republic (and also in Hungary) declined over the given period, it is still substantially higher than in Germany and France. This implies that energy shocks are likely to generate higher inflation in the Czech Republic than in other countries with lower energy intensity, other things being equal. The inflation volatility due to the shocks is supposed to remain higher until the structural convergence has been completed. In *Section 4*, we simulate the impact of several shocks on inflation to get an approximate view of how these could complicate the meeting of the MIC in the case of the Czech Republic.

Figure 6: Energy intensity of GDP in selected EU countries during 1991–2002

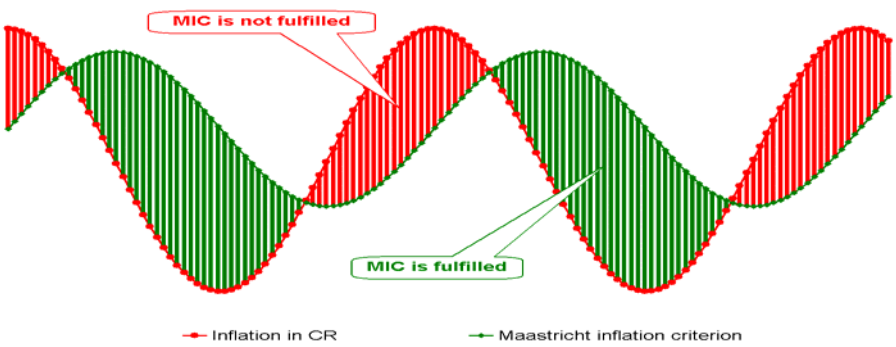


***Source*:** Eurostat, NewCronos.

3.4 Likely Inflation Patterns: Summary

We have tried to show that inflation in the Czech Republic in the medium and long run will be different from that typical of the advanced EU economies. Specifically, level factors are likely to keep Czech inflation systematically above the EMU average if the real appreciation of the koruna is not accompanied by equally high nominal appreciation. Also, it can be argued that cyclical factors may keep the volatility of inflation above that recorded in the more developed economies. Finally, we suggest that the sensitivity of Czech inflation to food and energy shocks should be higher than in countries where the share of these items in the HICP is lower.[16] The combined effect of the above factors on inflation is shown in a stylised way in *Figure 7*.

Figure 7: Hypothetical evolution of Czech inflation and the MIC over the cycle



[16] We are well aware that the above features do not fully describe the overall inflation patterns. There are many other factors which matter as well. These include, for example, the type of exchange rate regime, the patterns of pass-through from the exchange rate, the credibility of monetary policy, the process of wage formation, fiscal policy, etc. The majority of the relevant aspects are captured by the model which we use for our simulations.

The figure suggests that during some periods inflation in the Czech Republic is below the MIC, while over the remaining periods it may be above it, implying potential failure to meet the MIC (these periods are shown in red). It is obvious that the timing of the reference period is of crucial importance. From the cyclical point of view, the window of opportunity for the adoption of the euro thus need not always be open, and postponement of the adoption of the euro may thus be a feasible policy option under certain circumstances.

It should be noted that the above inflation patterns are determined by factors that can be subsumed under the heading of a structural gap (see Backé/Thimann, 2004) between the Czech economy and the euro area. We believe that as structural convergence progresses, the cyclical pattern of inflation in the Czech Republic will flatten and the relatively higher sensitivity of inflation to shocks will diminish. For the same reason, real convergence will lead to a closing of the gap in relative income levels, implying a slowdown in real appreciation. As a consequence of structural convergence, the risks of possibly missing the MIC should diminish over time. Nevertheless, structural convergence will hardly be completed in less than one decade, so some risks of failure to meet the MIC will persist unless actively opposed by economic policies (see *Section 6*).

4. Simulations of Disinflation and Inflation Shocks

The discussions in the preceding sections allow us to formulate the set of conditions for the simulations investigating the impact of meeting the Maastricht criteria. Specifically, we study the costs of three scenarios of disinflation in terms of output loss (sub-sections 1 to 5). In the final subsection we study the impacts of several shocks to inflation.

4.1 The Model Used

For the simulation of disinflation shocks we use the Quarterly Projection Model (QPM) applied in the CNB for forecasting inflation. The QPM is a simple forward-looking semi-structural flow model of the monetary business cycle with calibrated parameters describing the dynamics of the main macroeconomic variables in the medium term. It captures the main channels of monetary transmission and specifies the nexus of output, employment, interest rates, exchange rates and inflation within a framework where monetary policy influences the economy and inflation. The model is a version of what has been called a “gaps” model. Its task is to explain the dynamics of disequilibrium paths and, in particular, how “gaps” (deviations of economic variables from their equilibrium values) evolve and dissipate over the medium to long run. In “gap” models, nothing is said about the nature of the levels of equilibrium, and, in particular, there is no supply side, no stocks, and no attention to asset equilibrium as part of the model. The core of the model consists of these four equations:

- *a PC curve* that captures the relationship between inflation and the output gap based on the assumption of staggered price- and wage-setting;
- *an IS curve* which represents the relationship between the real monetary conditions index and the output gap;
- *a UIP equation* that relates the nominal exchange rate to movements in domestic and foreign interest rates;

- *a reaction function* representing a monetary rule for setting interest rates with the aim of minimising the deviations of the variables from their targets (inflation, potential output) with respect to other preferences and limitations.[17]

Although the QPM may not, for methodological reasons, be ideal for our exercise, it is undoubtedly the best model currently available. We should keep in mind that the purpose of our simulations is to get an approximate idea of the order of the potential output losses.

4.2 Output Loss: 1st Loss Function

For every monetary policy action it is necessary to have a criterion by which its impact can be assessed. This criterion is indispensable for comparing the different monetary policy strategies followed by the central bank. In general, the bank's loss function is defined as the weighted deviations from targets and is used as a fundamental measure of loss. Engineering a disinflation typically involves short-term costs associated with a corresponding loss of output. The reason disinflationary episodes have this effect on economic activity is that prices are to a great extent characterised by persistence and inertia. The output costs of a disinflationary policy are usually referred to as the sacrifice ratio. For our simulations we define the loss function as a sacrifice ratio. The loss function is the cumulative loss in output associated with a permanent reduction in inflation. The cumulative loss of output is not normalised by the amount of the inflation decrease in order to enable a comparison of different disinflation experiments.[18]

In the case of QPM experiments, the cumulative sum of the output gap has to be divided by four, because the output gap is expressed on a quarterly basis. The loss function is then the loss (in percentage points) from the cumulative sum of the potential output over the whole period of the simulation. The "best" fulfilment of the MIC is then defined as that which minimises the loss function, thus being the friendliest towards real convergence.

4.3 Assumptions of Simulations

In this sub-section we summarise the basic assumptions used in the simulations.

4.3.1 Technical Assumptions

- At the beginning of each simulation the economy is operating at its potential and there is no difference between the inflation target and actual inflation.
- The initial nominal exchange rate is equal to the ERM II central parity.
- The disinflation shock is technically implemented through a change in the inflation target, i.e. the rate of inflation has to change from some initial level defined by the "old" target to another level given by the "new" target.
- The increase in regulated prices will be identical to the pace of CPI growth throughout the simulation period.

[17] For a detailed description of the QPM, see Czech National Bank (2003): *The Czech National Bank's Forecasting and Policy Analysis System,* edited by W. Coats, D. Laxton and D. Rose, Prague, February.

[18] Understandably, a higher decrease in the targeted level of inflation implies higher cumulative losses.

- The MIC is considered to be fulfilled if the rate of inflation (the 12-month moving average of the HICP) reaches a level which is not higher than one tenth of a percentage point (10 basis points) above the MIC expressed to one decimal point.
- The CPI is equal to the HICP.[19]

The QPM has no parameters or equations to account for the ERM II regime. As a result, the simulations suppose that the monetary authority controls both the exchange rate and inflation by interest rates only. The choice of target is thus not independent. Should we wish to control inflation and keep the exchange rate close to fixed in the long run, the properties of the economy embodied in the model would constrain it. The authority cannot change the real variables over the long run, so the Uncovered Interest Parity (UIP) condition must be fulfilled.

4.3.2 Policy Assumptions

The discussion in *Section 3* implies that inflation in the Czech Republic is likely to be somewhat above the EU-25 average and that fulfilling the MIC might require disinflation. Therefore, we simulate disinflation shocks. The assumption about the inflation level in the EU is derived from average inflation in the EU-25 during 1999–2004 (see *Table 5*).[20]

Table 5: Inflation in the EU during 1999–2004 (y-o-y HICP in %)

	1999	2000	2001	2002	2003	2004	Average	
							1999-04	2000-04
EU-25	1.6	2.4	2.5	2.1	1.9	2.1	2.1	2.2
EU-15	1.2	1.9	2.2	2.1	2.0	2.0	1.9	2.0
Eurozone-12	1.1	2.1	2.4	2.3	2.1	2.1	2.0	2.2

***Source*:** Eurostat, author's computations.

The assumption about the real appreciation of the koruna is derived from the discussion in *Section 3.1.2*. We define three disinflation alternatives, believing that a 1.5% real appreciation of the koruna vis-à-vis the euro over next five years (as a basic scenario) is consistent with the prevailing opinion. A somewhat lower (1%) and somewhat higher (2%) pace of real appreciation represent, respectively, a slightly more and slightly less conservative alternative. Also, we assume that the real appreciation is fully transformed to inflation. This assumption is derived from the fact that the CNB's point inflation target (effective from January 2006) was set above the ECB inflation target to allow for real convergence of the Czech economy also through the inflation differential (see CNB/2004).[21] The assumption about the level of the MIC is derived from the average value of the

[19] This assumption is not entirely realistic. In reality, the difference between the CPI and HICP is about 0.2–0.3 percentage points (for more details see the *Appendix*).

[20] This assumption can be considered balanced. On the one hand, the value of 2.1% includes the relatively high inflation rates of the former accession countries during their disinflation periods. On the other hand, the level of inflation in this period was influenced by the positive disinflation shock in 1999, as is obvious by comparison with the average during 2000–2004.

[21] In *Section 6.5*, we discuss a lowering of the CNB point inflation target to get better guidance towards meeting the MIC. The possible downward adjustment of the target can be considered a disinflation shock.

MIC during 1999–2004 (see *Table 1* in *Section 2*).[22] All the initial policy assumptions are contained in *Table 6*.

Table 6: Basic policy assumptions of the simulations

Simulation	Inflation in EU (%)	Real appreciation (%)	Initial inflation in the CR (%)	MIC (%)	Disinflation shock (in p.p.)
	(1)	(2)	(3) = (1) + (2)	(4)	(5) = (3) – (4)
A	2.1	1.0	3.1[23]	2.6	0.5
B	2.1	1.5	3.6	2.6	1.0
C	2.1	2.0	4.1	2.6	1.5

The policy assumptions yield three initial inflation levels and thus three disinflation shocks: of 0.5 p.p. (simulation "A"), 1 p.p. (simulation "B") and 1.5 p.p. (simulation "C"). Even in simulation "C", let alone simulations "A" and "B", the initial inflation (4.1%) is almost consistent with the point inflation target of 3% (which has a tolerance band of ± 1 p.p.).

The second set of assumptions is derived from the length of time required to meet the MIC. In an "unrestricted" simulation "0", we study how much time would be required to reach the requested inflation level. Should the time horizon be too long we would then investigate what policies are needed to fulfil the targeted level of inflation within a shorter period. *Table 7* shows four alternative time limits.

Table 7: Time restrictions for disinflation simulations

Simulation	Time required to meet the MIC
0	no limit
1	10 quarters
2	8 quarters
3	6 quarters[24]

We carry out simulations that combine both sets of criteria.

4.4 Simulation Results

The simulation results are summarised in Table 8. Each simulation is marked according to aggressivity of the rule (the number) and the size of the inflation decrease (the letter). The second column contains the time restrictions imposed on the simulations. The "MIC" column shows how many quarters are needed for fulfilment of the MIC (for example, in the case of simulation "0.A" it takes 13 quarters to decrease inflation by 0.5 p.p.). The "MERC" column shows the performance of the MERC criterion. This performance is measured over two years, namely one

[22] This assumption may be a bit conservative. As we shall see in *Section 5*, even lower values of the MIC are conceivable when one applies the EU-25 or EU-27 set as the basis for computing the MIC.

[23] The initial inflation level in simulation "A" (3.1%) is consistent with the average inflation level in Spain, Portugal and Greece during 1999–2004.

[24] The horizon of six quarters is identical to the so-called "horizon of most effective transmission" which is typically used in the CNB for policy-making.

year before the fulfilment of the MIC and over the whole year that the MIC is fulfilled. The extent of the overall nominal appreciation over two years is expressed as a percentage. For example, simulation "3.B" (disinflation by 1 p.p. reached in six quarters) implies that the nominal exchange rate will appreciate against the ERM II central parity by 2.27% over the two-year probationary period.

Table 8: Simulation results of disinflation shocks

Simulation	**Fulfilment of criteria**		**1st loss function: output gap[2]**	**2nd loss function: initial change in interest rate**
	MIC	MERC[1]		
	quarters	%	in % of GDP	in p.p.
0.A	13	0.71	-0.5	0.06
0.B	13	1.42	-1.0	0.13
0.C	13	2.14	-1.6	0.19
1.A	10	0.97	-0.5	0.59
1.B	10	1.93	-1.0	1.17
1.C	10	2.90	-1.6	1.76
2.A	8	1.06	-0.5	0.94
2.B	8	2.12	-1.0	1.89
2.C	8	3.18	-1.6	2.83
3.A	6	1.14	-0.5	1.56
3.B	6	2.27	-1.0	3.13
3.C	6	3.41	-1.6	4.70

Notes:
1) The MERC is measured over a period of 24 months (ERM II).
2) The output gap is measured over a period of 16 quarters.

The fourth column shows the loss function in terms of the output gap related to each simulation. A decline in inflation of 0.5 p.p., 1 p.p. and 1.5 p.p. leads to a cumulative loss of output of about 0.5%, 1% and 1.6% respectively of annual potential GDP over a period of four years.[25,26] It is intuitive that a steeper disinflation implies a greater output loss, and vice versa. Because of the linearity of the model, the output gaps are proportional to the disinflation shocks.

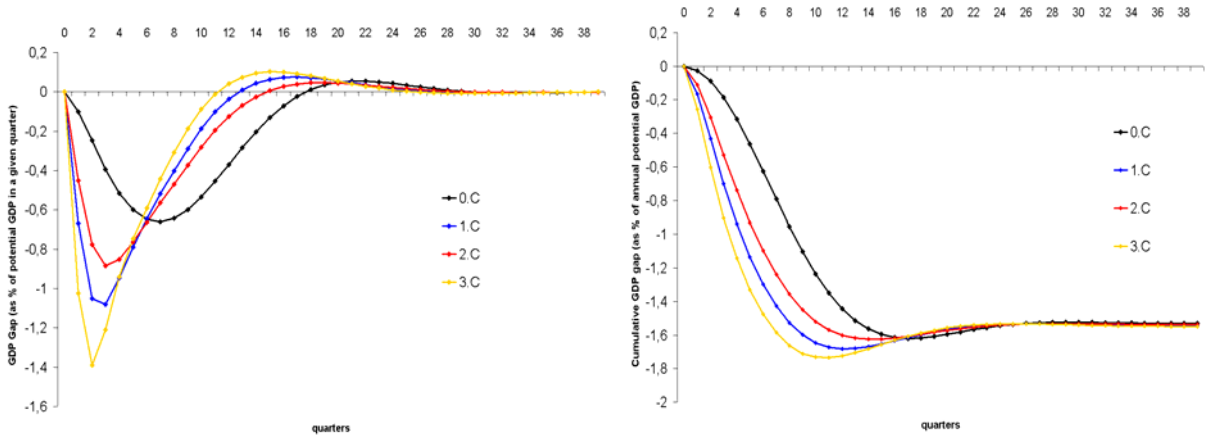
Although the cumulative losses are identical in corresponding cases over the long run, the individual trajectories of the output losses differ. *Figure 8* illustrates this on the example of simulation "C", which engineers a disinflation of 1.5 p.p.

[25] The costs of the disinflation shocks seem quite significant in all the simulations. In money terms, the four-year cumulative loss of GDP caused by a 1.5 p.p. disinflation amounts to about CZK 40 billion. This is equivalent to the budget of the Ministry of Defence for one year or to the budget of the Ministry of Health for four years.

[26] To compare, the National Bank of Poland (2004) simulated the impact of lowering inflation by 1 p.p. below the MPC target for a period of one year. Simulations show that this would be associated with GDP falling by 0.3–0.8% below the baseline scenario at the two-year horizon.

Figure 8: Output loss in simulation "C"

a) Quarterly b) Cumulative



The left-hand panel shows that the fastest disinflation "3.C", lasting for six quarters, generates the steepest widening of the output gap and also the steepest narrowing of the gap in the following period. On the other hand, the slowest disinflation "0.C" generates a modest output gap, but this gap persists longer. The right-hand panel shows the same story in cumulative terms. Approximately 17 quarters after the initiation of the disinflation shock, the cumulative output gaps of the individual trajectories become practically identical. The same conclusion applies to simulations "A" and "B" (so-called simulation reports containing details of the simulations are available from the author on request).

4.5 Initial Change in Interest Rates: 2nd Loss Function

It should be noted that if we change the aggressivity of the monetary policy rule for a given disinflation, the output loss remains the same (for example, simulations "0.B", "1.B", "2.B" and "3.B" all imply an output loss of –1.0%). This is due to the fact that a change in the policy rule does not change the properties of the model. The crucial parameter does not change in these simulations and therefore a central bank (at least from this point of view) can use any rule irrespective of the extent of aggression.

To be able to discriminate between simulation experiments dealing with a given disinflation shock, a second loss function has to be introduced. There are no *a priori* rules according to which the loss function should be defined. The loss function can basically reflect any economic or non-economic variable which is taken into account by decision-makers. Changes in interest rates are the pivotal variables for central bankers. Although they represent the basic tool of monetary policy, their very use may also be subject to some limitations. One of them consists in the smoothing of interest rates. The observed tendency of many central banks to smooth interest rates is motivated by their desire to avoid surprising the markets. Central banks believe that the less surprising their decisions are, the more credible, predictable and effective their policy will

become. Interest rate smoothing thus may be subject to explicit or implicit optimisation, which requires defining the kind of loss function.[27]

In *Table 8*, the second loss function is in the fifth column and refers to the interest rate change in the first period of the simulation. This additional criterion enables us to compare scenarios which only differ in the rule chosen. In the case of the standard reaction (simulation "0") it takes 13 quarters to reach the new level of inflation. In order to be able to fulfil the MIC in a shorter period, the central bank has to implement a more aggressive policy, which is modelled through a more aggressive reaction function.[28] This is done in simulations "1.A."–"3.C.", with all other circumstances remaining unchanged.

The QPM contains the so called inflation forecast based (IFB) rule. Its equation is as follows:

$$rs_t = m_0 rs_{t-1} + (1-m_0)(rr_t^{eq} + E_t\pi 4_{t+4} + m_1(w_1(E_t\pi 4_{t+4} - \pi_t^{Tar}) + w_2 ygap_t) + \varepsilon_t^{rs}$$

The reaction function has four parameters. The parameter m_0 denotes the persistence of the reaction function. This coefficient reflects the uncertainty about inflation forecasting and the inertia in monetary policy decisions. The parameter m_1 expresses the aggressivity of the rule. The higher the value of this coefficient, the higher the response of the interest rate to the deviation of the inflation forecast from the inflation target and to the output gap. The two remaining parameters are the relative weights w_1 and w_2. These reflect the relevance of each variable to the monetary policy decision. *Table 9* shows the monetary policy rules used, in terms of persistence, aggressivity and weights.

Table 9: The four interest rate rules used in the simulations

Simulation	Persistence of rule m_0	Aggressivity of rule m_1	Weight on inflation : output
0	0.75	1.2	3:1
1	0.25	4.8	12:1
2	0.25	9.6	24:1
3	0.25	19.2	48:1

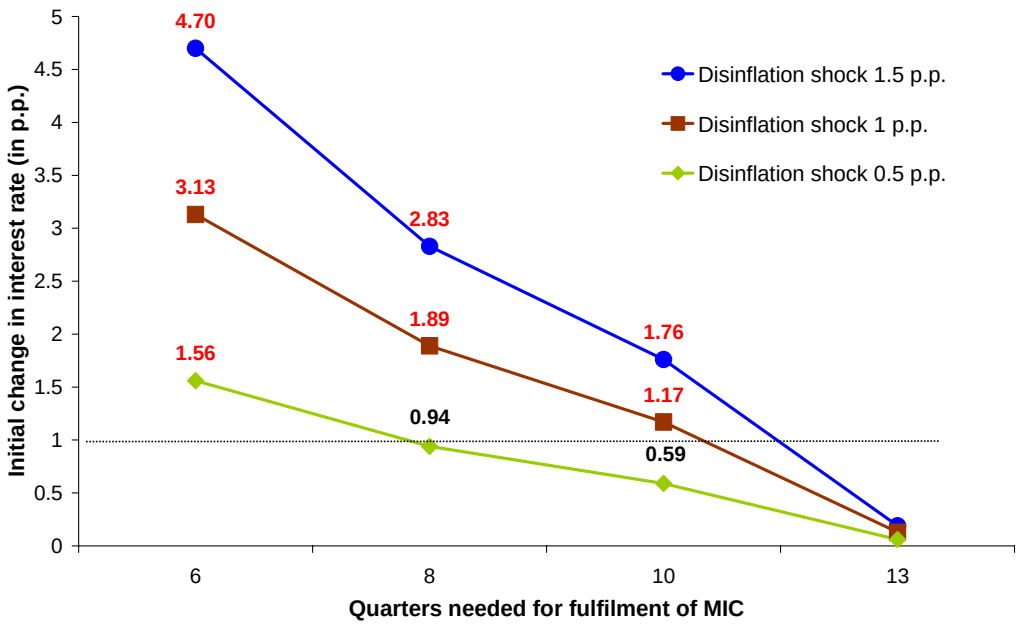
The parameters of the rule were chosen in such a way as to enable the desired level of inflation to be reached within 10, 8 and 6 quarters. Along with the change in the aggressivity of the rule, the weight on the deviation of inflation from the target was increased and the interest rate persistence was lowered from 0.75 to 0.25.

The graphical interpretation of the interest rate changes (the last column in *Table 8*) is provided in *Figure 9*. It shows the trade-off between the time needed to fulfil the MIC and the initial interest rate change.

[27] When discussing the policy rules for an inflation targeting regime, Rudebusch/Svensson (1998) develop a model in which the loss function also includes some weight on the variability of interest rate changes.

[28] In the reaction function the decisions on where to set the policy instrument (the short-term interest rate) today are made by considering what is likely to happen in the future. The equation says that if headline CPI inflation is forecast to be above the target rate, π^{Tar}, where the forecast is for the next four quarters, then the central bank acts to push up the short-term (one-quarter) interest rate, all else being equal.

Figure 9: Initial changes in interest rates required



The results confirm that the second loss function enables us to discriminate between different steepnesses of a given disinflation path. It is apparent that the shorter the time available for fulfilment of the MIC (at a given disinflation shock) the higher the initial interest rate increase must be. It would then be up to the decision-makers to opt for such an interest rate change that would not provoke unnecessary (= too costly) reactions of major macroeconomic variables (their simulated paths are available in the simulation reports).[29]

The third column of *Table 8* shows the percentage change in the exchange rate at the end of the 24-month reference period. In accordance with intuition, no simulated disinflation shock yields a depreciation of the exchange rate. Also, it is obvious that smaller disinflation shocks imply less nominal appreciation than bigger disinflation shocks. Finally, the speed of disinflation does not seem to be so important a factor when discriminating between the four different time horizons within a given disinflation shock. The results show that even if we consider the fastest and strongest disinflation shock ("3.C") the nominal exchange rate at the end of the reference period should not be higher than 3–4%. The nominal appreciation in the other simulations remains rather modest. As we shall see in *Section 5*, an appreciation of this order should not provoke any worries.

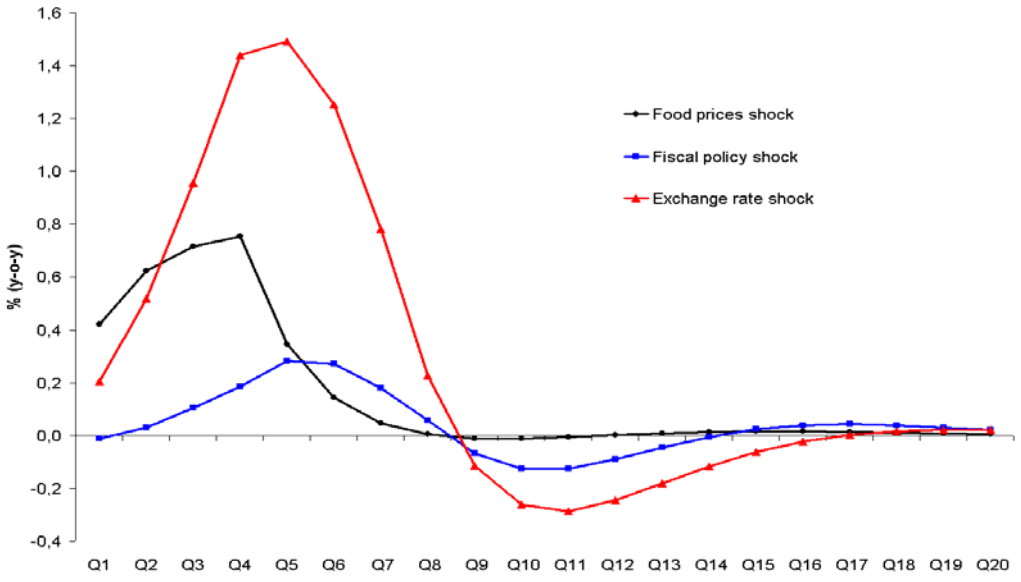
[29] If we arbitrarily adopt a one percentage point change in the interest rate above the baseline (the non-Maastricht trajectory of interest rates) as the highest feasible (and affordable) increase in rates, we see that the scope for monetary action shrinks remarkably. Meeting the MIC is feasible only if a disinflation of 0.5 p.p. is engineered and if at the same time we do not need to meet the MIC faster than within eight quarters. The other possibilities (steeper disinflation together with faster fulfilment) are presumably beyond the reach of reasonable monetary policy. Attempts to implement a more aggressive policy increase the risk of undermining macroeconomic stability and can hardly be considered justified and advisable.

4.6 Simulation of Shocks: Results

In this sub-section, we briefly study (with the help of the QPM) the impacts of several shocks to Czech inflation. We assume that these shocks increase inflation but the central bank does not act to mitigate their impact. The purpose is to see to what extent the shocks can potentially complicate the fulfilment of the MIC.

The domestic shocks are specified as follows. The food shock consists in an increase in food prices of 5 p.p. over one year.[30] The exchange rate shock is generated by a CZK/EUR depreciation of 5% over one year.[31] The fiscal policy shock is generated by an increase in the fiscal impulse of 1 p.p. of GDP over one year.[32] *Figure 10* summarises the results of the simulations.

Figure 10: Impact of food price shock, fiscal policy shock and exchange rate shock on inflation



It is obvious that the exchange rate shock has about twice as great an impact on inflation than the food price shock. Both shocks have a sizeable impact on inflation. Were they to occur just during the reference period they could easily push inflation above the MIC, though only temporarily. On

[30] The choice of a food price shock of this magnitude is straightforward. Food prices in the Czech Republic, as in many countries, are very volatile and their impact on overall inflation has been significant. Prices of food increased by 4.4% (y-o-y) in 1998, by 5.1% in 2001 and by 3.4% in 2004. The magnitude of the food price shock, reaching 5% over one year, is in line with the Czech experience in recent years.

[31] The exchange rate shock of this magnitude has its parallel in 2003, when the nominal exchange rate of the koruna depreciated against the euro by more than 5% (on a y-o-y basis) throughout most of the year.

[32] It can be argued that the likelihood of the emergence of a positive fiscal shock (especially during the probationary period, when consolidation of the fiscal position can be envisaged) is not particularly high. The purpose of simulating this shock is to provide a benchmark for the relative size of the other simulated shocks. Moreover, it cannot be ruled out that the Czech Republic will adopt the euro several years after 2010 and that the budget consolidation achieved in the meantime will permit some fiscal policy manoeuvring.

the other hand, the fiscal policy shock seems to be less worrying, as it implies an increase in inflation of about 0.25 p.p. after one year.

In addition to the three domestic shocks, we simulated the impacts of two external shocks.[33] The first – an oil shock – is specified as an increase in the price of oil of 30% over one year. This shock causes an increase in inflation of 0.3 p.p. above the baseline scenario in Germany, of 0.4 p.p. above the baseline in the euro area, and of 1 p.p. above the baseline in the Visegrad countries. The simulation confirms the hypothesis of a higher energy intensity of output and possibly stronger pass-through to inflation in the new EU countries. In other words, should an oil shock hit the European economies, we can expect a higher increase in inflation in the new EU countries than in the EMU countries. This implies that meeting the MIC should be more difficult, because the shock would increase Czech inflation more than in those countries whose inflation will probably constitute the reference value for the MIC.

The second external shock is specified as a shock to GDP growth in Germany of 1.2 p.p. above the baseline persisting for two years.[34] This is an example of an asymmetric shock, with rather more favourable implications for domestic inflation. While inflation in Germany would increase by 0.6–0.7 p.p. on a permanent basis, inflation in the Visegrad countries would increase by about 0.2 p.p. over two years. Under certain circumstances[35] this implies less demanding conditions for meeting the MIC by the new EU countries. This outcome is consistent with intuition.

To summarise, the shock simulation implies a large dispersion of the impacts of the different shocks. The strongest impact on inflation (at the given shock magnitudes) is caused by the exchange rate shock, followed by the food price shock and the oil shock. A relatively minor (negative) impact stems from the fiscal policy shock, and a positive impact would possibly be generated by the German GDP growth shock.

4.7 Accuracy and Robustness of the Results

Below, we touch upon the issue of the accuracy and robustness of the simulation results. Uncertainty may be associated with the following aspects:

a) *The QPM itself.* The simulations are carried out by the model at the core of the forecasting process in the CNB. Although the model does not capture all possible interactions within the economy, its results can be considered sufficiently robust. Ideally, the robustness check would require us to carry out the same simulations with some other models. However, this does not seem feasible with the available analytical tools.
b) *The parameters of the model.* Testing the robustness would consist in defining probability intervals for each parameter and generating probability intervals for the model outputs using the Monte Carlo method.

[33] The two external shocks are analysed using the NIGEM. This model (developed by the National Institute of Economic and Social Research) is used in the CNB for analysing issues not captured by the QPM, in particular the relationship between the Czech economy and the European economy.

[34] The productivity shock in Germany can be justified by the initiation of economic reforms focused on enhancing the flexibility of labour markets and on increasing the competitiveness of the economy.

[35] These circumstances are far from being trivial. They depend on the "net impact" of the shock to inflation in each EU country possibly changing the composition of the countries whose inflation would be included in the computation of the MIC during the evolution of the shock.

c) *Possible alignment of Czech long-term interest rates with foreign interest rates, or a modification of monetary policy.* The application of the QPM in its current shape assumes an unchanged economic environment and also an inflation targeting framework. It could be presumed that Czech long-term interest rates will be aligned with foreign rates. This very fact, along with announcing the central parity, might require some adjustments to the model (especially the UIP condition). However, the potential impact of this adjustment is currently difficult to assess. In any case, it is important to be aware of the fact that it is impossible to set targets which may be contradictory.
d) *Shocks.* The simulations performed are deterministic only. Otherwise, it would be necessary to carry out Monte Carlo simulations and assess the uncertainty on their basis.

It is obvious that integrating the accuracy and robustness of the simulation results into this paper would stretch it excessively. In fact, the paper focuses on the fulfilment of the MIC and on discussing relevant policy implications, rather than on assessing uncertainty. Therefore, we omit the assessment of accuracy and robustness altogether.

5. Maastricht Monetary Criteria: Likely Application and Open Issues

European integration is largely a political process. Therefore, it can be assumed that the examination of the Maastricht criteria will be carried out with a certain dose of judgement and tolerance. In this section we discuss several areas that may invite some discretion into the application of the MIC and the MERC. The findings will provide insights into the preferable ways of meeting these criteria and the corresponding policies.

5.1 The Maastricht Convergence Criteria: Spirit Versus Letter

The Maastricht Treaty provided the legal basis for the EMU. The idea of the union is simple, but its implementation rests on numerous details. This gives rise to a dilemma between the spirit of the Maastricht process and its inherent complexity on the one hand, and the limited number of macroeconomic variables which are translated to the convergence criteria on the other. While integration refers to low inflation, a flexible economy and disciplined policies all being achieved on a sustainable basis, the Maastricht convergence criteria represent an attempt to be a bit explicit and quantitative in those areas. The major problem is that the very criteria may stimulate an over-preoccupation with “convergence accounting”, which may eventually drive attention away from long-term considerations towards short-termism. Such an approach might be fostered by the existence of relatively short reference periods (mostly one year only), as if these would be sufficient to prove that nominal convergence is sustainable. The critical issue of sustainability might then be resolved by referring to the past performance and future prospects of the relevant macroeconomic variables. However, the reference can be quite vague and the sustainability insufficiently defined. It is thus the discrepancy between the concept of sustainability and the simplicity of the convergence criteria that invites discretion when applying the criteria. This discrepancy can generate uncertainty about whether reference to the spirit will be sufficient if a euro applicant country fails to meet the letter.

This uncertainty has been fostered by several decisions made by European institutions in the past. These have challenged not only the quantitative requirements, but also the spirit of the integration,

leading to the emergence of precedents.[36] Moreover, many policy-makers and researchers acknowledge that the new EU countries (due to their substantial income gaps vis-à-vis the EMU average) are in a different situation than the founding members of the EMU were. Therefore, they propose that the convergence criteria should take this into account accordingly (e.g. Buiter/Grafe, 2002).[37] All this raises the question of how "seriously" the letter of the Maastricht criteria should be considered and what the implications could be for the strategy of the next EMU applicants.

5.2 Inflation Criterion

5.2.1 Definition

Article 121 (1), first indent, of the Treaty requires: "*the achievement of a high degree of price stability; this will be apparent from a rate of inflation which is close to that of, at most, the three best-performing Member States in terms of price stability*". [38] Article 1 of the Protocol on the convergence criteria referred to in Article 121 of the Treaty stipulates that: "*the criterion on price stability referred to in the first indent of Article 121 (1) of this Treaty shall mean that a Member State has a price performance that is sustainable and an average rate of inflation, observed over a period of one year before the examination, that does not exceed by more than 1.5 percentage points that of, at most, the three best-performing Member States in terms of price stability. Inflation shall be measured by means of the consumer price index on a comparable basis, taking into account differences in national definitions*."

Be it intentional or accidental, the reference value for inflation is not very precisely defined, thus allowing for some discretion in its application. This is the case in spite of the fact that the equal treatment principle – requiring the Treaty to be applied as consistently as possible across countries and across time – limits the discretion.[39] When assessing this discretion not only the Treaty, but also the evolution of the application framework has to be taken into account.[40]

5.2.1 Notion of "Member State"

One area for discretion relates to the notion of "Member State". This issue has already arisen in the European Commission's 1998, 2000 and 2002 Convergence Reports. The reports discussed the implications of the third stage of EMU for the operational definition of the MIC. Specifically,

[36] In the case of the exchange rate criterion, the letter of the Treaty and Protocol has been challenged three times. Although the Treaty and Protocol do not explicitly require ERM membership as a part of the exchange rate requirement, they do require the normal fluctuation margins provided for by the exchange rate mechanism of the European Monetary System to have been met during the last two years before the examination. Similar flexibility in interpreting the rules was manifested when the debt criterion for Belgium was examined.

[37] Suggestions to redefine the MIC upwards are very frequent. One typical proposal is to set the MIC at 3.5% (= the inflation target of the ECB + 1.5 percentage points), see Schadler et al. (2004).

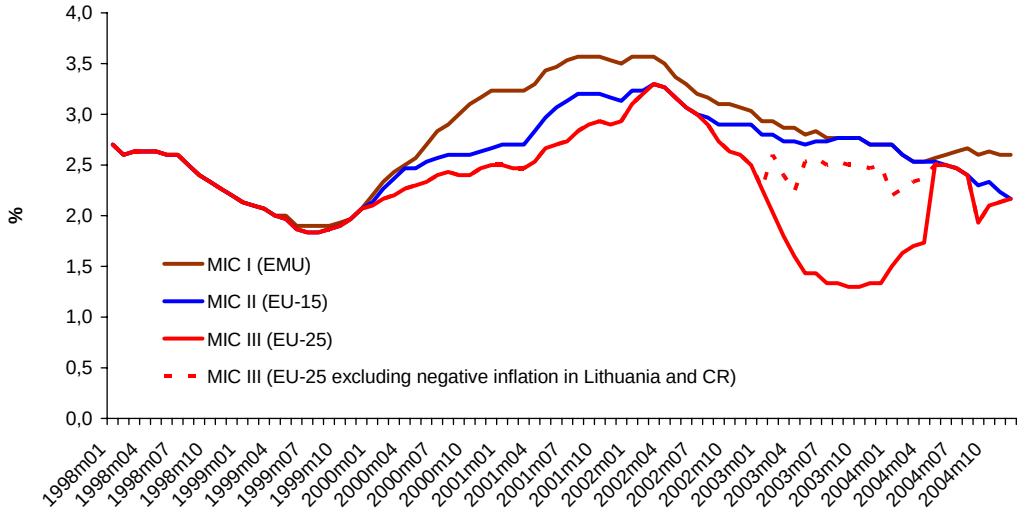
[38] It is useful to remember that at the time the Treaty was drawn up, no widely accepted definition of price stability existed. The reference to the "best performers in terms of price stability" provided the standard long before the start of the monetary union.

[39] The principle of equal treatment implies that, as far as possible, Member States joining later should not be confronted with additional hurdles nor be allowed to join on looser terms than the first-round entrants.

[40] In 2004, the ECB introduced a more precise definition of price stability, which is now "below but close to 2%". It can be argued that this definition excludes unusually low levels of inflation (e.g. 0.3%) from the basis for calculating the MIC and that the MIC at a level such as 3.3% (= 1.8% + 1.5 p.p.) or even 3.5% is not in contradiction with the letter of the Treaty. The ECB in a letter to the CNB (dated 3 September 2004) stated that it does not want to depart from the original interpretation of the criteria as introduced in the 1990s.

they reflected on the fact that the Treaty did not anticipate the distinction between initial and late entrants to the euro area and that the Third Stage was already underway. Considering that the Treaty was not explicit as to whether or not the Member States outside the euro area should be part of the group of reference countries, the 2000 and 2002 Reports calculated the reference values based on both sets of countries, i.e. the euro area (the 11 founding countries) and the EU-15.

Figure 11: Different values of the MIC computed on three sets of countries (1998–2004)



***Source*:** Eurostat, author's computations.

***Note*:** For the purposes of illustration, the solid MIC III includes negative values of inflation in the Czech Republic (during 5/2003–12/2003) and in Lithuania (during 2/2003–8/2004). The dotted MIC III excludes these values.

Figure 11 shows three trajectories of the MIC based on the EMU-12, EU-15 and EU-25. The difference between the reference values derived from the different sets of countries is striking.

The initial period, until mid-1999, was characterised by disinflation. Institutionally this was driven by preparation for Stage Three of the EMU, and economically by a positive supply shock. The inflation of the former accession countries was at that time too high to divert MIC III from either MIC I or MIC II. In the subsequent period, until mid-2002, a differentiation between the three measures emerged. The difference between MIC I and MIC II reached almost 0.5 percentage points at one point, due to low inflation in Sweden and the UK. A dramatic development occurred during 2003–2004. While MIC I was quite close to MIC II, MIC III diverged by a huge margin, reaching almost 1.5 percentage points in mid-2003. This was due to two reasons. On the one hand, inflation in the former accession countries decreased to lower levels than before as a result of their disinflation efforts. On the other hand, inflation in the newly-acceding countries turned out to be more volatile than inflation in the EU-15. During 2003, when European economies were exposed to disinflation shocks, inflation in Lithuania, the Czech Republic and Poland entered the computations either in the range of "statistical deflation" or close to it.

When the inflation of a country defines the basis for computation of the MIC, there is no need to worry about the ability of this country to meet the MIC. Nevertheless, it is easy to imagine what such a situation would imply for countries like Sweden or the United Kingdom if they were to undergo their probationary period simultaneously with countries characterised by rather volatile inflation. Instead of the more advanced countries imposing demanding requirements on the less

advanced countries, such a development would paradoxically imply that the less advanced countries would impose (unnecessarily) demanding requirements on the more advanced countries. The equal treatment clause thus could acquire an unexpected meaning unthinkable several years ago. In any case, the differences between MIC I, MIC II and MIC III provide an incentive for EMU candidate countries to negotiate the application of a narrow (less demanding) set of countries (EMU) rather than of a wide (more demanding) one (EU-25) for the computation of the MIC.[41]

5.2.3 Inflation "Outliers": "Normal" Versus "Abnormal" Inflation

The second area for judgement relates to inflation performance which might not be considered "normal". The ECB has repeatedly declared that negative inflation rates, should they occur, would not be consistent with price stability. This approach is rooted in the 1998 EMI Convergence Report, which introduced the concept of "outlier" to deal appropriately with potential significant distortions in individual countries' inflation paths. The purpose of this procedure is to exclude from the calculation of the reference value such inflation figures which would reduce the usefulness of the reference value as an economically meaningful benchmark.

The "outlier" approach was applied in the Convergence Report 2004. The price performance of Lithuania was found to be exceptional ("abnormal") and therefore not included in the computation of the MIC. The 12-month moving average of the HICP in Lithuania during the reference period (September 2003–August 2004) reached -0.2%. The basis for the MIC benchmark was established by inflation in Finland (0.4%), Denmark (1.0%) and Sweden (1.3%), whose rates were considered to be "normal". Scope for possible discretion could be seen in the fact that Lithuania might potentially have served (although it did not do so, due to its unusual price performance) as the basis for computation of the MIC, having been a fully-fledged (EU) Member State for only one third of the reference period.[42] A similar situation may potentially occur when Bulgaria and Romania become EU members and some of the euro applicants simultaneously go through their reference periods.

Generally, the inflation patterns observed in the 25 European countries during 2003–2004 were somewhat untidy. Lithuanian inflation, which in August was excluded from the computation of the MIC, reached 0.5% (on a y-o-y basis) in October (i.e. within only two months), becoming higher than inflation in Finland, which declined to 0.3% in that month and on down to 0.1% in December. It can only be speculated whether Finnish inflation would also have been considered "abnormal" had the reference period included the December values.[43] Most likely, inflation in the Czech Republic during May 2003–December 2003 would also have been found "abnormal", as it stayed in negative territory throughout the period. Unusual price development was also observed

[41] The average levels of MIC I, MIC II and MIC III during January/1998–December/2004 were 2.8%, 2.6% and 2.3% respectively.

[42] Lithuania (like the other new EU members) joined the EU in May 2004, being a "Member State" for only 4 out of the 12 months of the reference period.

[43] The issue of excluding negative inflation is actually trickier than it seems at first sight. It is difficult to justify why the "whole" negative inflation is excluded. It can be argued that instead of negative inflation, zero inflation should be used for the computation. Indeed, the simultaneous occurrence of negative or close to zero inflation in several countries conveys some relevant information about macroeconomic and monetary circumstances. Had this approach been applied in October 2004, the MIC would have been 2% instead of 2.4%. The reference countries would have been Lithuania (0%), Finland (0.4%) and Denmark (1%).

in Poland, where inflation remained below 1% for almost a year (between April 2003 and February 2004).

All this seems to say that the enlargement of the EU created a more heterogeneous set of countries which may display quite disparate inflation patterns.[44] Consequently, the examination of these patterns for the purposes of calculating the "correct" level of the MIC will have to be quite sensitive in order to comply with economic rationale on the one hand and the equal treatment principle on the other. By the same token, this diversity opens up possibilities for discretionary decision-making and for political pressures.

5.3 Exchange Rate Criterion

The exchange rate criterion is a hotly debated topic. This is because the definition of the criterion is not unambiguous and the examination approaches of the European authorities have evolved over time. Also, past application practice has given rise to precedents that provoke discussions among researchers and policy-makers. Although guidance on the application of the criterion is provided by the Treaty, complementary position papers from Ecofin and the ECB, and the Commission and ECB Convergence Reports, the existing framework still allows for some degree of judgement.

Major uncertainty is connected with the numerical values of the exchange rate amplitudes that will be still considered compliant with the requirement for exchange rate stability. Particular attention has been directed towards the ±2.25% band. It should be noted that some documents contain an explicit reference to this band while others do not. For example, the European Commission in its 2002 Convergence Report requires the "*exchange rate to have been maintained within a fluctuation band of ±2.25% around the currency's central parity against the euro in the context of the ERM II*". On the other hand, the ECB in its 2003 Policy Position and in the 2004 Convergence Report makes no quantitative reference to such a band when examining exchange rate stability. The Report says that "*the assessment of exchange rate stability against the euro focuses on the exchange rate being close to the ERM II central rate while also taking into account the factors that may have led to an appreciation…*" and adds that "*the width of the fluctuation band within ERM II does not prejudice the assessment of the exchange rate stability criterion*". The 2004 Convergence Report repeats what had already been said in previous documents, namely that the "*issue of the absence of 'severe tensions' is generally addressed by i) examining the degree of deviation of exchange rates from the ERM II central rates against the euro; ii) using indicators such as short-term interest rate differentials vis-à-vis the euro area and their development; and iii) considering the role played by foreign exchange interventions*". It thus seems that the MERC is not open to more specific *ex ante* quantification than that expressed in the 2004 ECB Convergence Report.

Taking into account the relevant legislation together with the precedents, the likely application of the MERC could be as follows (compare with Komárek/Čech/Horváth, 2003).

[44] We do not want to suggest that the former EU-15 was free from inflation volatility. Finland was on the verge of deflation in the first half of 1996, and inflation in Sweden and Austria was below 0.5% in the middle of 1999.

The MERC is fulfilled if:

- the exchange rate stays within the band of –2.25% to +15% over the reference period;[45]
- the exchange rate appreciates above the +15% upper margin of the ERM II over the reference period due to the catching-up process;
- the country revaluates its central parity during the reference period and the new parity proves to be sustainable over the rest of the period;[46]
- the exchange rate breaches the –2.25% lower margin and:
    - the breach does qualify as severe tension,
    - the amplitude of the breach is modest,
    - the breach is temporary.[47]

The MERC is not fulfilled if:

- the breach of the –2.25% lower margin persists for an extended period of time;
- the amplitude of the breach is high (for example above 10%);
- the breach qualifies as severe tension;
- the country adjusts its central parity downwards.

The second uncertainty as regards meeting the MERC is related to the length of the reference period. All recent relevant EU documents stress that the authorities will examine whether the country has participated in ERM II for a period of at least two years prior to the examination. However, the wording of the 2002 European Commission Convergence Report implies that participation in ERM II for at least two years is "*expected*" and that exchange rate stability during the period of non-participation before entering ERM II can also be taken into account. The precedents of Italy and Finland show that it is also possible to fulfil the MERC on an *ex post* basis.[48] The equal treatment principle should thus allow for shorter participation in ERM II at the time of the examination. In other words, we presume that the MERC duration test will be passed if the Member State is in ERM II at the time of the examination and if the period between its ERM II entry and adoption of the euro is no shorter than two years.

6. Discussion of Policy Options

In *Section 4*, we quantified the costs of disinflation and in *Section 5* we studied the likely scope for discretion in applying the MIC and the MERC. In this section, we put the above analyses together and summarise the policy options that seem to be available for meeting the Maastricht requirements.

[45] The Irish pound was on average 4.6% above its central parity during the reference period, with its appreciation peak reaching almost 11%. The Greek drachma was on average more than 6% above its central parity, with the maximum deviation reaching 9% (Schadler et al., 2004).

[46] Shortly before the fixing of the conversion rate, the central parity of Irish pound was revaluated by 3% and the central parity of the Greek drachma by 3.5% (Schadler et al., 2004).

[47] The Irish pound entered the two-year reference period around 4% below the central parity and remained below the -2.25% margin for 32 business days (Komárek/Čech/Horváth, 2003).

[48] At the time the decision to admit Italy and Finland was made (on 2 May 1998), Italy had spent 17 months in the ERM (having rejoined on 25 November 1996) and Finland 18 months (having rejoined on 14 October 1996). In the case of Greece, the time that elapsed between its joining the ERM (on 1 January 1999) and the decision to admit the country as a member of the EMU (on 19 June 2000) was 17 months (see Buiter/Grafe, 2002).

6.1 Trade-off between the MIC and MERC: Fiction or Reality?

For many economists, a major source of uncertainty relating to the fulfilment of the Maastricht monetary criteria is whether the MERC is symmetric or asymmetric. A symmetric understanding of the MERC led many to believe in a trade-off between the MIC and the MERC. The trade-off implies that if a country maintains a fixed exchange rate regime (such as a currency board) the real appreciation of the currency will cause either a potential difficulty on the inflation front or a recession caused by disinflation. If, on the other hand, a country practises inflation targeting (with a flexible exchange rate), fulfilment of the MIC should be easier, but there is a risk of inconsistency with the MERC and ERM II.

Perceiving this dilemma as given, Buiter/Grafe (2002) require a re-definition of the MIC in terms of the inflation rate of traded goods if an EMU candidate wants to maintain a fixed exchange rate during the reference period and to avoid an unnecessary recession. Or, they propose negotiating a derogation (waiver) from the exchange rate requirement for those EMU candidates that wish to maintain inflation targeting.[49]

Natalucci/Ravenna (2002) study the consequences of large productivity gains on the choice of exchange rate regimes in new Member States during the process of accession to the EMU. They develop a GE model of an emerging market economy and show that under a fixed or heavily managed exchange rate the BSE might prevent compliance with the MIC unless a contractionary policy is adopted. They claim that the requirement of membership in ERM II and the MIC constrain the policy choice while providing no additional benefit to countries credibly committed to joining the euro. They conclude that relaxation of one criterion or another has strongly differentiated business cycle implications for EMU candidates. Specifically, they show that policy rules allowing for higher exchange rate flexibility lower the volatility of the economy in terms of the inflation rate and the output gap.

Bulíř/Šmídková (2005) suggest that the fact that currencies will be fixed during ERM II implies a possible conflict between trend appreciation of the real exchange rate and the EMU criteria of low inflation and a stable nominal exchange rate. However, for them the main risk relates to the fact that considering the current (and presumably persisting) over-appreciation of the koruna (and also the zloty and forint) a too early fixing at an improper parity during ERM II may set in motion a costly adjustment process running through domestic prices and wages.

In *Section 5*, we tried to show that the MERC is asymmetric: while a nominal appreciation basically has no limit (especially if it can be attributed to catching-up), a nominal depreciation beyond -2.25% may become inconsistent with the MERC. This implies that the trade-off between the MIC and MERC is avoidable (at least from the "legal" point of view).

The crucial issue is whether the relationship between nominal appreciation and inflation is under the control of policies. If it is under control, advisable policies should transform the real

[49] They perceive meeting the criteria as an investment without any return. They consider the Maastricht exercise to be pointless and costly because the reputational capital accumulated through a costly and risky investment process (= the effort to fulfil the MIC and MERC) will be scrapped at the moment of EMU entry.

appreciation to nominal appreciation to limit the risk of missing the MIC. On the other hand, if this control is weak, real appreciation may lead to failure to meet the MIC.[50]

The answer to the question in the title of this sub-section is thus conditional. If policies have the relationship between nominal appreciation and inflation under control, the trade-off between the MIC and MERC is a fiction. If this control is limited or non-existent, and, moreover, the country enjoys fast real appreciation, simultaneous fulfilment of the MIC and MERC may become problematic.

6.2 "Hard" Versus "Soft" Fulfilment of the Criteria

Because the relationship between nominal appreciation and inflation may not always be fully under control, policy-makers may be interested in having some "safety measures" at their disposal. Below, we develop a taxonomy of fulfilment of the Maastricht criteria.

There are basically two ways of dealing with the Maastricht requirements: policy-makers can either respect the Maastricht criteria and adjust their policies accordingly, or attempt to "adjust" the criteria themselves. Respecting the criteria also leads to two possibilities. Either the Maastricht criteria can be taken at their face value and met via adjustment of the real economy (we could call this "hard fulfilment"), or fulfilment of the criteria can be attempted by cheating in some way (we could call this "cheap fulfilment").[51]

"Adjustment" of the convergence criteria themselves (achievable through political negotiations) would be motivated by a softening of their possibly adverse impact on the real economy (we could label this approach as "soft fulfilment"). Again, two kinds of "soft fulfilment" are conceivable. The first involves re-negotiating some of the criteria: e.g. instead of a 1.5 percentage point margin, a 2 percentage point margin could be demanded (along the lines of Buiter/Grafe, 2002). This version would be an explicit one and might require a derogation granted in an *ex ante* manner.[52] The second possibility involves relaxed interpretation of the criteria (e.g. higher tolerance to wider fluctuations of the exchange rate or the acceptance of an inflation outcome that is a small margin above the MIC). This possibility is implicit, ad-hoc based and "granted" in an *ex post* manner.

6.3 Fixed Versus Flexible Approach Towards the Euro

We can differentiate between two approaches or phases towards the euro: a fixed approach and a flexible approach. In the case of a *fixed* approach, the date of adoption would be stipulated

[50] An investigation of whether the Czech economy and its policy framework allow for having control over this relationship is beyond the attention of this paper.

[51] "Cheap fulfilment" could be attained in a number of ways. One of them could consist (for example) in purposeful manipulation of indirect taxes or administered prices just during the reference period. This kind of "fulfilment" is achievable basically through government action. An extreme version of "cheap fulfilment" in the case of the fiscal criteria was applied by Greece by hiding its actual budgetary situation during the period of the examination. The option of "cheap fulfilment" is available to policy-makers at basically any time and it would be at the discretion of all parties engaged in the examination process to decide whether it is acceptable. However, there is probably nothing useful to be said about "cheap fulfilment" from the economic point of view.

[52] An example of an attempt to facilitate the fulfilment of the Maastricht criteria in an *ex ante* manner is provided by the letter sent by the CNB Bank Board to the ECB on 13 August 2004.

(possibly a long time) in advance and all economic policies would be tuned accordingly (most probably irrespective of the costs incurred). On the other hand, under a *flexible* approach the conditions for meeting Maastricht would be assessed on a continuous basis and the decision about entry into the EMU would be made when the conditions were found to be favourable.[53] The risks of a fixed approach are that the costs of fulfilling Maastricht may unexpectedly become too high, especially if cyclical factors turn out to be unfavourable. By the same token, the loss of credibility could be rather painful if the country decides to retreat from the commitment given earlier and fails to adopt the euro at the pre-announced time. On the other hand, the risks of a flexible approach consist in the fact that the intention to adopt the euro may seem to be too loose. The approach may lack credibility and may not anchor expectations effectively, especially when it comes to dealing with exchange rate expectations.

6.4 Issues to be Resolved

The very purpose of using the common currency is to maximise the economic benefits over the long run. Presumably, the same principle of maximising the benefits (or alternatively minimising the costs) should apply to the very procedure of adopting the euro. Below, we discuss several issues that decision-makers are likely to face. These will have to be resolved in order to minimise the potential output loss while passing the Maastricht entry test.

Issue 1: Speed of real appreciation The first issue to be taken into account is the real appreciation of the currency. For monetary policy, the real appreciation is basically an exogenous process and policy should not act against it. It has been argued that fast real appreciation might lead to difficulties with meeting the Maastricht monetary criteria. In contrast, slow real appreciation is supposed to provide more comfort in meeting the criteria, although there is no guarantee of "automatic" fulfilment. The speed of real appreciation sets the overall background for meeting the Maastricht monetary criteria.

Issue 2: Relationship between nominal appreciation and inflation The second issue is the above-discussed uncertainty regarding to what extent the relation between nominal appreciation and inflation is predetermined exogenously, or rather to what extent this relationship is under the "control" of policies. Conversion of real appreciation into nominal appreciation can thus be considered a "first line of defence" against the potentially costly fulfilment of the MIC.

An important question emerges concerning to what extent the level of the CNB inflation target will be conducive to meeting the MIC. It should be noted that the future CNB point target is defined in terms of annual CPI inflation of 3%. On the other hand, the MIC is defined in terms of the HICP. In recent years, Czech inflation expressed in terms of the CPI has been about ¼ of a percentage point higher than that expressed in terms of the HICP (see the *Appendix*, which analyses the difference between the CPI and HICP in greater detail) and it is likely that this difference will persist over the medium term (until the envisaged harmonisation of price indexes is completed). It can be inferred that the CNB's point target of 3% is slightly above the average

[53] From reading the strategy of the Czech Republic towards the euro, one is tempted to conclude that it represents an in-between approach. On the one hand it declares that the euro is envisaged to be adopted during 2009–2010, but on the other hand the eventual adoption of the euro is made conditional on the readiness of the adjustment mechanisms to cope with shocks and/or business cycle asynchrony. This dichotomy thus blurs not only the timing of the adoption of the euro, but also the way in which the decision will be made.

level of the MIC of 2.6% (based on the EU-15 during 1999–2004). Higher safety in meeting the MIC may thus require a downward adjustment of the inflation target.

Issue 3: Ready (and willing) to disinflate? When monetary policy does not have "control" over the relationship between nominal appreciation and inflation (and at the same time the real appreciation is high) the situation becomes rather awkward. Policy-makers will have to opt either for "hard fulfilment" or for "soft fulfilment" through negotiation. With respect to "hard fulfilment", our simulations imply that the feasibility of disinflation increases the earlier the desirable level is announced and targeted.[54]

Issue 4: Try to soften the MIC! Under certain circumstances, the costs of "hard fulfilment" may turn out to be "excessively" high and therefore unaffordable. An economy-friendly option would then consist in an explicit softening of the MIC. The success of any negotiation towards softening is impossible to assess in advance, as the outcome depends on numerous factors. They include the envisaged margin of missing the MIC, the overall performance of the given economy, its ability to meet the other Maastricht criteria, the performance of other EMU acceding economies, the possible existence of new precedents, the overall state of affairs in European integration, the general political mood in Europe, etc.[55]

Issue 5: What about cheap fulfilment? If policy-makers discard "hard fulfilment" and fail to re-negotiate the MIC, "cheap fulfilment" may represent one of the last hopes. If it becomes too late to implement disinflation policy (without risking excessive costs), or should there be no economically justified reasons why the inflation rate should divert from the MIC, such a "safety measure" might remain available in the policy-makers' toolbox. Needless to say, this attitude would depart explicitly from the spirit of Maastricht and revert to the letter thereof instead. However, this attitude is not unprecedented in the history of European integration, and there are basically no effective mechanisms to prevent euro applicants from behaving in such a manner.

Issue 6: Just postpone it! The only way of meeting the MIC without incurring unnecessary costs while resorting neither to "cheap" nor to "soft" fulfilment, is to postpone the adoption of the euro until the unfavourable circumstances possibly change and inflation ultimately meets the test.

The above discussion is summarised in *Figure 12* in terms of a decision-making tree. The tree shows the main questions to be asked on the way towards the euro and the implications of "Yes" and "No" answers to these questions for the implementation of different policies and kinds of fulfilment.

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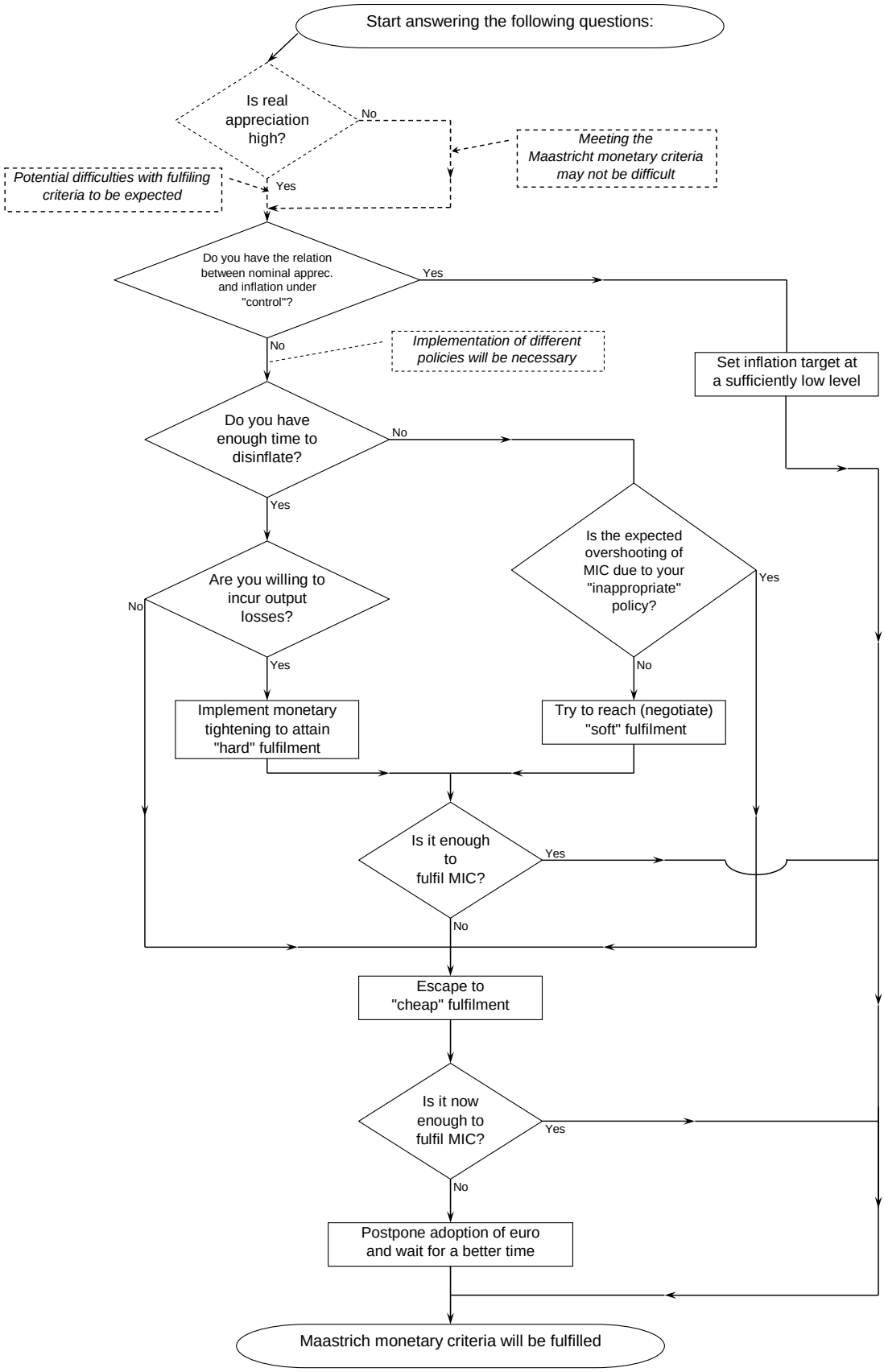
[54] From a practical point of view, this would require a modification of the policy decision-making process currently applied in the CNB. While the smoothest adjustment of the economy (see the simulations denoted "0") needs 13 quarters to be completed, the standard monetary policy horizon (called the "horizon of most effective transmission") is between 4 and 6 quarters. Based purely on the results of our simulations, the CNB is advised to extend its monetary policy horizon.

[55] One could object that it may not be in the interests of the prospective member of the EMU to strive for a softening of the MIC and that the application of the criteria in an economically meaningful manner should be insisted on instead. As a matter of fact, the difference between "softening" and "application in an economically meaningful manner" is quite subtle and formal rather than conceptual. It could be suggested that at the end of the day these terms may allow for a comparable scope of tolerance to inflation performance if inflation fails to comply with the rigorously computed value of the MIC. The difference thus probably boils down to the following: a) while "softening the MIC" is feasible on an *ex ante* basis, "application of the MIC in an economically meaningful manner" seems to invoke an *ex post* approach; b) "economically meaningful application" sounds more politically correct than "softening the inflation criterion", which seems to contradict explicitly the principle of equal treatment.

Figure 12: Decision-making tree: A hypothetical policy questionnaire for a central bank preparing to meet the MIC



6.5 What Does All This Imply?

Let us integrate the policy discussion with our other findings:

- In *Sections 2* and *4*, we assumed that the MIC (measured by the 12-month moving average of the HICP) may be about 2.6%. Actually, it might be even lower. As we saw in *Section 5*, the wider the set of countries is, the lower the MIC tends to be. If based on the EU-25 (excluding all negative national rates of inflation) the MIC III average since the inception of the EMU until July 2005 is 2.44%.[56]

- Due to the currently used price index statistical methodology, 3% inflation in terms of the CPI translates into approximately 2.75% inflation in terms of the HICP (see more in the *Appendix*). This implies that the CNB's point target may require a downward adjustment to better guide inflation towards fulfilment of the MIC. This should increase the likelihood of meeting the MIC, other things (such as cyclical factors) being equal.

- A downward adjustment of the inflation target (for example from 3% CPI to 2.5% CPI) can be considered a disinflation shock. As we saw in *Section 4*, disinflation shocks imply output losses. According to our findings, the earlier the disinflation is implemented, the less aggressive are the policies required. Our simulations show that 13 quarters are needed to achieve the least costly disinflation (in terms of the initial interest rate increase).

- A downward adjustment of the inflation target is supposed to convert the expected real appreciation into nominal appreciation. Nevertheless, the extent of the nominal appreciation (see *Table 8* in *Section 4*) consistent with the lower inflation target will not contradict the fulfilment of the MERC, due to its asymmetry (see *Section 5*).

- Assuming that the euro is adopted in 2010, the MIC reference period is likely to extend from the second quarter of 2008 to the first quarter of 2009 (if the assessment by the Council takes place in May 2009) or from September 2008 to August 2009 (if the assessment takes place in October). This implies that the monetary policy action aiming for "hard fulfilment" would need to have started in the first quarter of 2005 (or in the second quarter of 2005). Instead, the current horizon of CNB monetary policy is focused on the period from the fourth quarter of 2006 to the second quarter of 2007. In other words, should the operational and decision-making framework within the CNB remain unchanged, the "attention" of monetary policy will focus on fulfilling the MIC in the fourth quarter of 2006 (or the first quarter of 2007) at the earliest. The remaining time span for achieving the desired disinflation will thus be only six quarters. According to our simulations, this would require the implementation of rather aggressive disinflation policies.

[56] The level of the MIC may be further lowered due to the enlargement of the EU to include Romania and Bulgaria in 2007.

Based on our analysis, the CNB[57] is advised the following:

i) To lower the inflation target to a level which would increase the likelihood of meeting the MIC by creating a sufficient "safety margin". Should, for example, the new inflation target be 2.5% in terms of the CPI (which translates to about 2.25% in terms of the HICP) and the level of the MIC about 2.45% (see above), the "safety margin" would be 0.2 p.p.. We argue that the adjustment of the target should indicate the commitment of the Czech Republic to duly meeting the MIC.[58] Although the width of the tolerance interval (± 1 p.p.) of the inflation target is wide enough to overlap with the expected value of the MIC, neglecting the risk of missing the MIC may turn out to be risky.

ii) To adjust the decision-making process in the CNB by extending its policy horizon. The purpose is to avoid the implementation of an unnecessarily aggressive tightening.

iii) To refrain from attempting to achieve "soft fulfilment" *ex ante* if this possibility proves to be unworkable. By setting the inflation target at a level which would provide enough comfort for meeting the MIC, the CNB might facilitate "soft fulfilment" on an *ex post* basis should anything "go wrong" unexpectedly during the reference period.

iv) To resort to "cheap fulfilment" shortly before or during the reference period if the policies turn out to be insufficiently aggressive and/or too inert to yield the desired results during the reference period. Government participation in "cheap fulfilment" is indispensable.

v) To postpone the adoption of the euro if the above measures fail to reduce inflation to a level consistent with the future level of the MIC.[59]

[57] This is conditional on the fact that the Czech Republic intends to adopt the euro in 2010 and that the government will adopt policies conducive to meeting the fiscal criteria.

[58] Polish policy-makers seem to be strongly committed to fulfilling the MIC. Although Poland used to record higher inflation than the Czech Republic on average, the National Bank of Poland set its inflation target at a horizontal level of 2.5% back in 2003.

[59] This option will be feasible about one or two years before the reference period, i.e. so far in advance that it can be reasonably well predicted by the inflation forecast. This requires maintaining a flexible approach towards the euro and also keeping Czech inflation at a desirable level over a certain period of time. Postponement would be even more justified when coping with adverse cyclical factors or dealing with negative shocks which would have a higher impact on Czech inflation than on inflation abroad. Although it seems attractive to follow the flexible approach (i.e. to be able to decide on adopting the euro according to the given situation) rather than the fixed approach, the advantage of the flexible approach may be somewhat illusory. Postponement of the adoption of the euro is probably easy when it is still several years away, but it certainly becomes more difficult when the reference periods are close or have already started. In any case, the border between a fixed and a flexible approach towards the euro is less sharp than a first impression would suggest, being very much dependent on a number of additional considerations.

Conclusion

We have attempted to show that under certain circumstances the fulfilment of the MIC by the Czech Republic may imply some difficulties. These concern a possible mismatch between the expected level of the MIC and the likely inflation pattern in the Czech Republic during the reference period. The mismatch may be due to level factors, cyclical factors and shocks. The purpose of the study is twofold: to simulate the impacts of potential disinflation in terms of output loss, and to investigate the policy options available for meeting the MIC requirement in the least costly way.

In the case of level factors, we present evidence suggesting a continuing real appreciation of the koruna over the medium to long run. Considering the results of several studies, we make the assumption that the real appreciation of the koruna is likely to be about 1.5% during the period relevant to examining the nation's eligibility to adopt the euro. In addition, we assume that the future level of the MIC will be 2.6% (in terms of the 12-month moving average of the HICP), which is equal to the average level of the MIC over the period 1999–2004 (actually this value may be even lower due to the enlarged EU). Supposing the average level of inflation in the EU to be 2.1% (which equals the value of inflation in the EU-25 during 1999–2004) we formulate three disinflation scenarios of 0.5 percentage points, 1.0 p.p. and 1.5 p.p. To assess the costs of these disinflations we define the loss function in terms of output loss.

According to our simulations (carried out using the Quarterly Projection Model applied in the CNB for forecasting inflation) a decline in inflation by 0.5 p.p., 1 p.p. and 1.5 p.p. leads to a cumulative loss of output reaching about 0.5%, 1% and 1.6% respectively of annual potential GDP over a period of 4 years. The costs of disinflation seem to be non-negligible in all the simulations, be they in relative or monetary terms.

Because a change of policy rule does not change the properties of the model, the loss function based on the output loss does not enable us to discriminate between simulation experiments dealing with a given disinflation shock. To overcome this, a second loss function is introduced. This refers to the size of the initial increase in interest rates needed to achieve the new (lower) level of inflation.

We impose several time constraints to see how policies should be adjusted to complete the disinflation within 10, 8 and 6 quarters. The introduction of time restrictions is essential for the simulation outcomes. They imply that the shorter the time to reach a given lower level of inflation, the higher the initial increase in the interest rate and the more aggressive the policy rule needed.

If we adopt the assumption that a one percentage point change in the interest rate above the baseline is the highest feasible (and affordable) increase in rates, the scope for monetary action shrinks remarkably. Fulfilment of the MIC would be possible only if disinflation by 0.5 p.p. is engineered and, at the same time, if we do not need to meet the MIC faster than within 8 quarters. Attempts to implement a more aggressive policy increase the risk of undermining macroeconomic stability.

In addition to the level factors, we simulated the impacts of several shocks. Their impacts are quite dispersed. An exchange rate shock would have the strongest impact on inflation (given the shock magnitudes adopted), followed by a food price shock and oil shock. Relatively minor impacts stem from a domestic fiscal policy shock and a German GDP growth shock.

Furthermore, we study the likely application of the MIC and the MERC and the interaction of these criteria. Some people argue that relatively fast real appreciation leads inevitably to a trade-off between them. In their opinion, either policies manage to keep inflation down and the resulting nominal appreciation will violate the requirement of exchange rate stability, or the exchange rate will be fixed and the real appreciation will drive inflation above the MIC. After discussing the wording of the relevant documents and the application practice we conclude that the trade-off is only partial: while a higher rate of inflation is unlikely to be tolerated, there is basically no limit to a nominal appreciation, especially if it is associated with real convergence over the long run.

The simulation results obtained and the investigation of the likely application of the Maastricht monetary criteria set the stage for a discussion of policy options. Conceptually, we introduce the three "kinds" of fulfilment of the MIC. We argue that if there is enough time to implement policy and if there is a political willingness to incur output losses, it is feasible to engineer "hard fulfilment" of the MIC. However, with a shortage of time and a lack of political willingness, a need to opt for "cheap fulfilment" emerges. Along with postponement of the adoption of the euro, this remains the only option if the economy is hit by an asymmetric inflation shock or if the MIC turns out to be inconsistent with excessively volatile domestic inflation. "Cheap fulfilment" is basically achievable only through government action. "Soft fulfilment" *ex ante* does not seem to be an easy option considering the current slight inconsistency between the CNB's point inflation target and the expected value of the MIC. A downward adjustment of the CNB target would presumably facilitate "soft fulfilment" on an *ex post* basis. We visualise the available policy options in the simplified form of a decision-making tree.

Based on the findings obtained from the disinflation simulations and the analysis of the Maastricht monetary criteria we suggest that the CNB reconsider its current decision-making framework in two ways. Firstly, the CNB is advised to adjust its inflation target downwards sufficiently early before the reference period. This adjustment should increase the likelihood of meeting the MIC by creating a sufficient "safety margin". This suggestion is justified by the fact that the 3% inflation point target in terms of the CPI translates into about 2.75% inflation in terms of the HICP (according to current statistical methodology), which is still slightly above the expected level of the MIC (expressed in terms of the HICP). Even full transformation of the real appreciation into nominal appreciation should not endanger the fulfilment of the MERC, due to its asymmetry. Secondly, the CNB is advised to extend its policy horizon. The currently applied horizon of 4–6 quarters is justified by the delays between monetary policy actions and their strongest impact on inflation. Our simulations show that a horizon of no shorter than 3 years permits minimisation of the costs incurred by the potentially necessary disinflation.

As the success of the Czech Republic in meeting the MIC depends on the ability of policies to transform real appreciation into nominal appreciation, further research might concentrate on the feasibility of doing this. Particular attention should be focused on the downward flexibility of prices and wages in the Czech economy and on identifying areas which may represent the major bottlenecks. A better understanding of these bottlenecks should provide insights into the

assessment of the cost and benefits of having the euro in general and the evaluation of the costs of entering the EMU in particular.

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Appendix

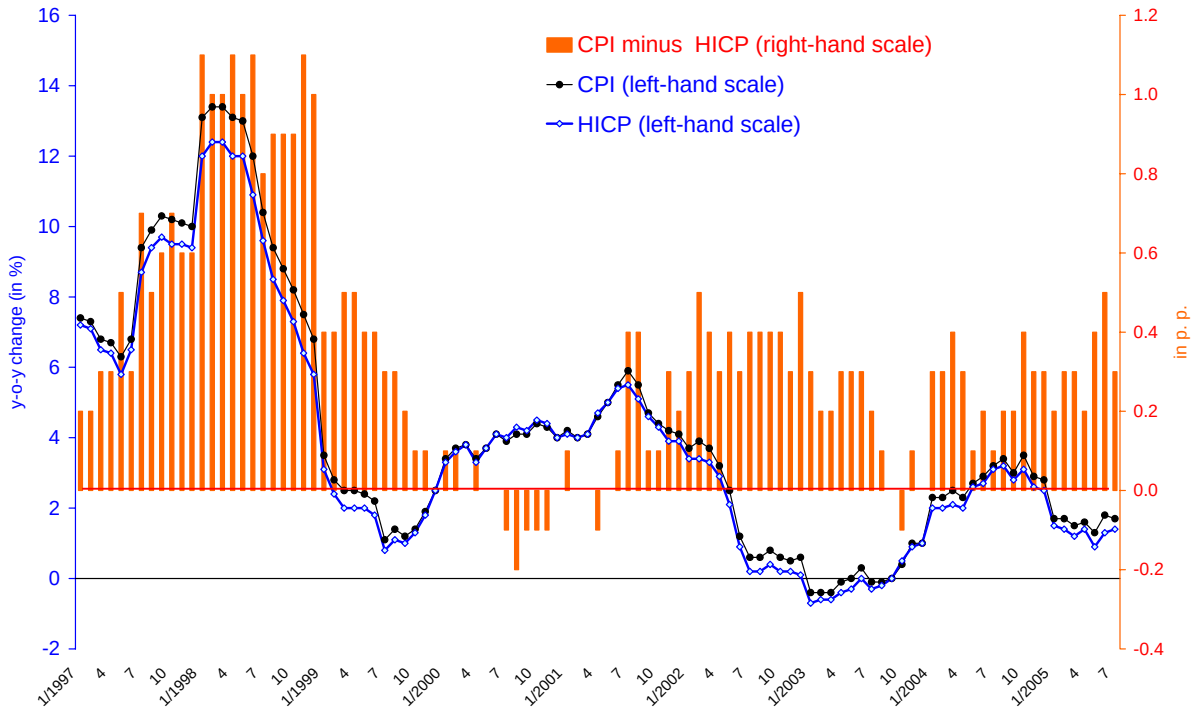
The Difference between the CPI and the HICP[60]

Whereas the Czech inflation target for the period after 2005 has been defined in terms of the annual rate of change of the CPI, the MIC has been defined for the moving 12-month average rate of change of the HICP. In this appendix, we investigate the reasons for the difference between the CPI and the HICP in the past and we discuss the factors which are likely to determine the relationship between the two indexes in the future. Also, we outline the implications of our discussion for the fulfilment of the MIC.

1. Past Development

Figure A1 portrays the difference between the two indexes during 1997/1–2004/7. It is obvious that with the exception of several months (especially in the second half of 2000) the level of the CPI was above that of the HICP. While the difference between the two indexes reached about 1 percentage point in 1998, it moved downwards thereafter and since 2003 the CPI has been above the HICP by about 0.2–0.3 percentage points on average.

Figure A1: Inflation in the Czech Republic in terms of the CPI and HICP during 1997/1–2004/7 (y-o-y rate of change)



***Source*:** Czech Statistical Office, Eurostat, author's computations.

[60] The background information in this *Appendix* has been kindly provided by Robert Murárik (CNB) and Jiří Mrázek (Czech Statistical Office).

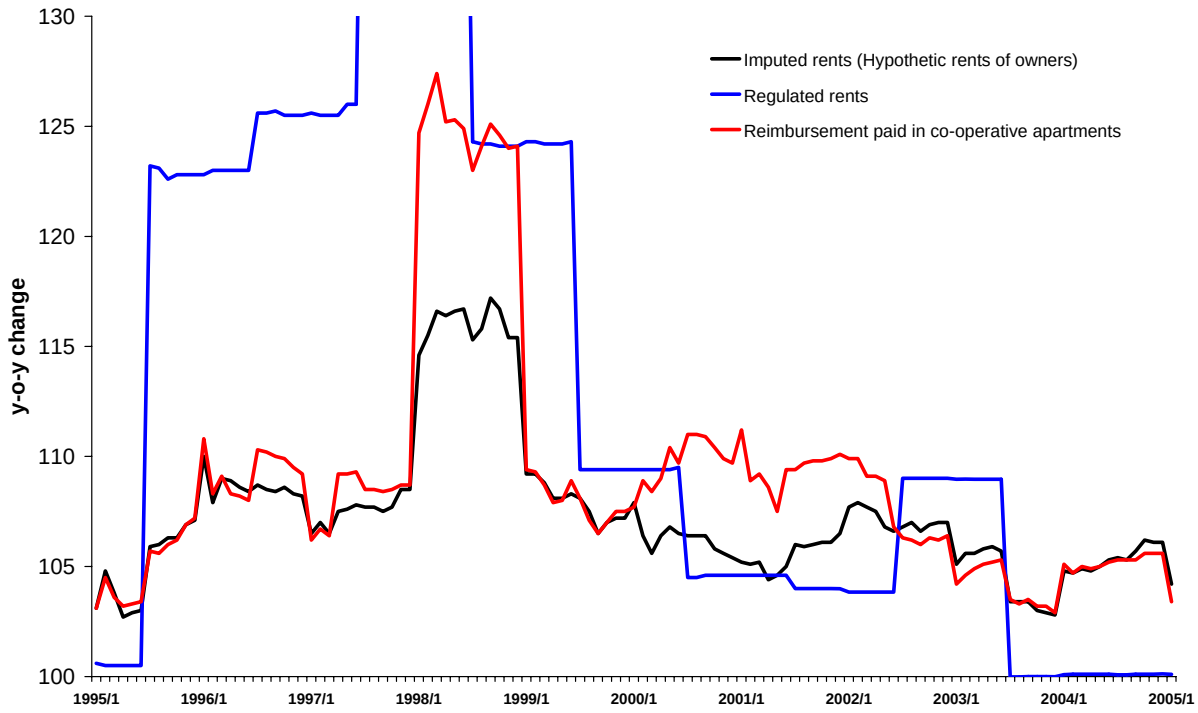
2. Reasons for the Difference between the CPI and the HICP

There are basically three reasons for the discrepancy between the indexes:

1. The dominant reason is that the consumer basket used for the computation of the HICP does not include so-called "imputed rents" ("hypothetical rents of owners"), unlike the basket used for the computation of the CPI.[61] An approximation of the difference between the CPI and the HICP can be derived from the given change in "imputed rents" multiplied by the constant weight of "imputed rents" in the consumer basket used for the computation of the CPI (which is 0.0809). If the rate of growth of "imputed rents" was approximately 3% (to correspond with the level of the CNB inflation target) the resulting difference between the CPI and the HICP would be 0.24 percentage points.

   The indicators used for the computation of "imputed rents" invite the question about the relationship between "imputed rents" and other variables which could be relevant to its development. Understandably, regulated rents are among the prime candidates.[62] *Figure A2* compares the evolution of "imputed rents" ("hypothetic rents of owners") with regulated rents and with the reimbursement paid in co-operative apartments.

Figure A2: Imputed and regulated rents in the Czech Republic during 1995–2004



***Source*:** Czech National Bank.

[61] Since January 1996, "imputed rents" have been calculated as the weighted average of items from the group of so-called "reimbursement paid in co-operative apartments". This group of items includes outlays for several types of apartments (2-room, 3-room, 4-room, etc.), annuity, outlays for maintenance, payments to janitors, outlays for lighting, and repayments for the land below co-operative houses. The individual outlay items in housing co-operatives are, for the purposes of computing imputed rents, weighted differently than in the consumer basket used for computing the CPI.

[62] The most recent decision by the Czech government (announced in summer 2005) is to increase the maximum regulated rents by 9.3% in October 2006 and then by about 9% each July until 2011. Afterwards, the rents will be fully determined by the market.

The evolution of the above variables shows that changes in regulated rents have a very loose relationship, if any, with "imputed rents". It could be assumed that an increase in regulated rents (which are under control of the government) can provide an impetus for the movement of "imputed rents". However, neither the scope nor the timing of the latter is in any way pre-determined by the former. The apparent coincidence of the movements in the two variables observed several times in the past may be attributed to the fact that the price changes in these areas usually occur in January and/or July. The pace of regulated rent growth thus seems to be a poor guide for the evolution of "imputed rents".

2. The second reason for the discrepancy between the two indexes is that the weights of the CPI do not include purchases of goods by foreigners, while these purchases are included in the weights of the HICP. It should be noted that this reason is quantitatively much less important than the first.

3. The third reason for the difference between the CPI and the HICP concerns the discrepancy between the weights of the main groups of items in the CPI as compared to the weights in the HICP. *Table A1* shows the differences in the weights between the two indexes.

Table A1: Weights of the CPI and the HICP

		CPI constant weights 1999	HICP weights for 2005	difference CPI - HICP
01	Food and non-alcoholic beverages	197,57	191,00	6,57
02	Alcoholic beverages and tobacco	79,24	104,69	-25,45
03	Clothing and footwear	56,93	55,53	1,40
04	Housing, water, electricity, gas and other fuel	236,40	162,49	73,91
05	Furnishings, household equipment and maintenance	67,92	54,03	13,89
06	Health	14,35	20,12	-5,77
07	Transport	101,41	112,66	-11,25
08	Communications	22,54	36,28	-13,74
09	Recreation and culture	95,53	109,47	-13,94
10	Education	4,50	6,43	-1,94
11	Restaurants and hotels	74,15	82,28	-8,13
12	Miscellaneous goods and services	49,46	65,02	-15,56
		1000,00	1000,00	

Source: Czech Statistical Office, Eurostat, author's computations.

Whereas the CPI is nowadays (still) based on constant weights derived from 1999 consumption patterns, the HICP is based on variable (or "moving") weights which differ each year. The difference between the two indexes has been increasing since 2000 and its maximum will be reached in 2006, i.e. in the last year for which the 1999 constant weights of the CPI will be used. Once the 2005 weights have been introduced into the new CPI (to be used from 2007 onwards), the difference between the two indexes will be reduced and the remaining difference will predominantly reflect the effect of imputed rents.

3. Envisaged Development of the Price Index Methodology

As indicated above, the CPI and the HICP will have the same weights in 2007 (derived from the consumption patterns in 2005). However, like in the past, the HICP weights will start "drifting" after 2007 to reflect the evolution of consumption expenditures. On the other hand, the weights of the CPI (like in the past) will remain fixed throughout the next five years (over the period 2007–2011).

In addition to the effect of weights, the future relationship between the CPI and the HICP will be influenced by two envisaged modifications to statistical practices. Firstly, "regulated rents" will remain a component of the CPI over the long run. However, the computation methodology will be changed. Future computations will be based on the so-called "acquisition approach", reflecting the net acquisition of real estate by households.[63] Secondly, "imputed rents" will also become a component of the HICP. But this is unlikely to happen before 2010. Nevertheless, once "imputed rents" have been incorporated into the HICP, the difference between the CPI and the HICP is expected to become negligible.

4. Implications for the Fulfilment of the MIC

Taking monetary policy considerations into account, the above insight into the price index methodology can be summarised as follows:

1. As "imputed rents" are unlikely to become a component of the HICP before the end of the decade, the difference between the CPI and the HICP will almost certainly still exist by the time the readiness of the Czech Republic to adopt the euro comes to be assessed.
2. The difference between the CPI and the HICP may be increased by the fact that the weights of the CPI will remain stable over the period 2007–2011 whereas the weights of the HICP will vary (as has been the case in recent years). Should the reference period for the MIC stretch from 2008 to 2009, the effect of the "drifting" weights of the HICP should be negligible. Even if the reference period is postponed until 2012 or so, the quantitative impact will probably be very small (no greater than 0.1 or 0.2 percentage points).
3. It is currently impossible to predict the impact on the CPI of the modified methodology for calculating "imputed rents" derived from the "acquisition approach".

Assuming that the difference between the CPI and the HICP during the reference period will be similar to that observed in recent years, we may suggest that 3% CPI inflation translates approximately to 2.75% HICP inflation, other things being equal. Should the MIC be located at 2.6% during the reference period (see *Section 4*), the CNB's point inflation target after 2005 (3% in terms of the y-o-y CPI) guides monetary policy slightly above the MIC. Considering the degree of uncertainty relating to the fluctuation of inflation (reflected by the ± 1 percentage point width of the inflation target band) the CNB target should thus satisfy the MIC with a probability of just under 50%.

Should the adoption of the euro be postponed (well) beyond 2010, the inflation target of 3% in terms of the CPI may become (almost) identical to the 3% target expressed in terms of the HICP. By that time, "imputed rents" are likely to have been included in the HICP and the HICP is therefore expected to increase accordingly (and to merge quantitatively with the CPI). If this takes place in all EU countries simultaneously (which is the very purpose of harmonising the price indexes) a corresponding increase in the MIC level itself can be expected. While this could have important implications for the quantitative definition of the ECB inflation target, such a modification of the methodology would not alter the above conclusion (about the approximate usefulness of the CNB's inflation target for meeting the MIC).

[63] Within this approach, the acquisition of apartments will be treated differently than the acquisition of houses. These types of acquisition will be weighted, but the weights are not known yet. Transfers of existing housing stock between households will not be considered net acquisitions. Any role of mortgage instruments in acquiring real estate will be disregarded (at the request of the ECB).

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Czech National Bank
Economic Research Department
Na Příkopě 28, 115 03 Praha 1
Czech Republic
phone: +420 2 244 12 321
fax: +420 2 244 14 278
http://www.cnb.cz
e-mail: research@cnb.cz