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# Importing Low Inflation via Pegged Exchange Rates, Currency Boards and Monetary Unions

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# IMPORTING LOW INFLATION VIA PEGGED EXCHANGE RATES, CURRENCY BOARDS AND MONETARY UNIONS

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# I. Introduction

Much of the literature in monetary economics discusses how to create credible institutions which would stabilise inflation expectations at low levels, prevent the creation of a political business cycle etc. (see e.g. Persson and Tabellini, 1993). In reality, however, it may prove difficult for some countries to gain credibility quickly through domestic institutional arrangements. After all, any independent central bank can be subject to political pressure in practice, any law on the central bank can be changed and the conservative central banker (Rogoff, 1985) replaced, the incentive contract for central banker (Walsh, 1995) may not be eventually enforced etc. For institutional arrangements to be effective in giving credibility to monetary policy, the legal and political institutions must themselves be credible.

In some countries, though, this may not be the case - for example at the beginning of economic transition from central planning to democracy when the political culture is not fully established. At the same time, reputation cannot work as a source of credibility in transition countries, as these have no history of independent central banking. The lack of reputation and political credibility may also constitute a problem in some emerging economies with a non-democratic past and/or high-inflationary history.

Therefore, many transition and emerging market economies have used a different approach to resolving the credibility problem – importing low inflation from abroad via a fixed exchange rate. This approach, however, is not without drawbacks. Obstfeld (1994; 1996a,b) has demonstrated that under some circumstances it can give rise to self-fulfilling currency crises. To avoid this danger, the exchange rate peg has to be designed in a very credible way that greatly reduces the possibility of a flexible monetary policy response to shocks. Indeed, the current trend in exchange rate regimes favours the two corner solutions – either a fully flexible exchange rate, or a rigidly fixed exchange rate ("hard peg") that is close to a de-facto monetary union (i.e. currency boards or dollarization/euroization). Dornbusch and Giavazzi (1998), for example, have suggested that the Central European countries should adopt currency boards to resolve their credibility problem. And currently, as the EU-accession date approaches, many argue for a fast eurozone entry, too.

However, creating a monetary union, or something that closely resembles it, is not without costs. The traditional optimum-currency-area literature has put much emphasis on the problem of stabilising asymmetric shocks which becomes more painful when the exchange rate is fixed and there in no sufficient factor mobility between countries. The lack of flexibility is thus both an advantage of hard pegs, and at the same time one of their greatest drawbacks. Which of these two aspects dominates depends on the circumstances, for example on each country's credibility deficit and its degree of integration with the reference currency area.

In other words, the credibility-import considerations must be combined with the optimum-currency-area considerations to find out which exchange rate regime appears to be the most suitable one. So far, this has not been so common in the literature, probably because the optimum currency area theory used to be predominantly applied to study the monetary integration between EU countries, which have mostly managed to solve their credibility problems in monetary policy by domestic institutional arrangements (perhaps with some exceptions). The aim of this paper is to partly make up for this deficit. The strategy is to use the basic Obstfeld (1996a) model of self-fulfilling currency crises and introduce a simple optimum-currency-area aspect into it. Section II reviews very briefly the basic Obstfeld model. In section III, I introduce foreign supply-side shocks, study its implications and show how the degree of integration between economies affects the outcome. Section IV discusses

consequences of the theory for present and future monetary policy in the Czech Republic, and section V concludes.

## II. Obstfeld Model and Its Implications

I will start with a simple model of the dynamic inconsistency in monetary policy. The model is based on three equations:

$$y_t = y^* + (\pi_t - \pi_t^E) - z_t \quad (1),$$

$$\Lambda_t = \chi \pi_t^2 + [y_t - y^{**}]^2 \quad (2),$$

$$k \equiv y^{**} - y^* > 0 \quad (3).$$

where $y$ denotes (a natural logarithm of) GDP, $y^*$ the long-run equilibrium level of GDP, $y^{**}$ is the optimal level of output, $\pi$ the rate of inflation, $\pi^E$ the expected inflation, $z$ is a white-noise supply-side shock (a positive $z$ means an adverse shock), and $\chi$ is the weight put on inflation in the central bank's loss function.

Equation (1) is a short-run expectations-augmented Phillips curve. It says that the deviations of GDP from its long-run equilibrium can be caused by inflationary (or deflationary) surprises. For simplicity, and without much loss of generality, I assume that the slope of short-run supply curve is equal to one. The GDP is also influenced by supply-side shocks. Equation (2) represents the one-period loss function of the central bank, where $\chi$ is the weight put on inflation and $y^{**}$ is the optimal level of output. In other words, the central bank takes into account the costs associated with current inflation and the cost of output's deviations from its optimum. Equation (3) is the standard assumption of the dynamic inconsistency literature (Kydland and Prescott, 1977; Barro and Gordon, 1983a,b). It defines a measure of the inflationary bias, or credibility deficit, stemming from the fact that the optimal output targeted by the central bank exceeds the equilibrium level of output.

It is easy to show that in this setting the central bank's reaction function is given by (see e.g. Obstfeld and Rogoff, 1996; Čihák and Holub, 1999)

$$\pi_t = \frac{\pi_t^E + k + z_t}{1 + \chi} \quad (4),$$

which means that the model has a unique (Nash) equilibrium at

$$\pi_t^E = \frac{k}{\chi} \quad (5).$$

This shows an inflationary bias of the central bank, as the average inflation rate is above zero. An optimal institutional setting of the monetary policy would have to assure that the central bank's policy rule is

$$\pi_t = \frac{z_t}{1 + \chi} \quad (6),$$

as this eliminates the inflationary bias, and at the same time preserves optimal responses to supply-side shocks.

I will assume in this essay that the home country is not able to solve its inflationary bias by domestic institutional arrangements, e.g. by appointing a conservative central banker (see Rogoff, 1985) or by signing an optimal central bank contract (see Walsh, 1995), but the central bank has a limited capacity to commit itself to a pegged exchange rate.[1] If it does so, its loss function modifies to (see Obstfeld, 1996a,b).

$$\begin{aligned}\widetilde{\Lambda}_t = \Lambda_t + C; \quad C &= \bar{c} \quad \text{if devaluation} \\ &= \underline{c} \quad \text{if revaluation} \\ &= 0 \quad \text{otherwise}\end{aligned} \qquad (7),$$

where $\Lambda_t$ is the standard loss function defined in (2), and $C$ represents the central bank's cost of breaking its exchange rate commitment, which is equal to $\bar{c}$ for a devaluation and $\underline{c}$ for a revaluation.

Following the standard textbook approach, I will assume for the moment that the foreign country to which the exchange rate is pegged maintains zero inflation. Furthermore, I will assume that the relative purchasing power parity holds perfectly, which means that the exchange rate can be sustained only if the domestic inflation is exactly equal to the foreign one, which is zero.[2] As a result, we can rewrite (7) as

$$\begin{aligned}\widetilde{\Lambda}_t = \Lambda_t + C(\pi_t); \quad C(\pi_t) &= \bar{c} \Leftrightarrow \pi_t > 0 \\ &= \underline{c} \Leftrightarrow \pi_t < 0 \\ &= 0 \Leftrightarrow \pi_t = 0\end{aligned} \qquad (8).$$

If the central bank maintains the exchange rate peg, the value of its loss function reaches

$$\Lambda_t^{fix} = \left[k + \pi_t^E + z_t\right]^2 \qquad (9).$$

On the other hand, if the central bank decides to realign the exchange rate, it chooses the rate of inflation in line with equation (4). As a result, the value of its loss function is

$$\widetilde{\Lambda}_t^{float} = \Lambda_t^{float} + C(\pi_t); \qquad \Lambda_t^{float} = \frac{\chi}{1+\chi}\left[k + \pi_t^E + z_t\right]^2 \qquad (10).$$

Clearly, the rational strategy for the central bank is to devalue if there is an adverse supply-side shock strong enough to cause

$$\Lambda_t^{fix} - \Lambda_t^{float} > \bar{c} \;\Leftrightarrow\; \frac{1}{1+\chi}\left[k + \pi_t^E + z_t\right]^2 > \bar{c} \qquad (11).$$

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[1] Frankel (1995), for example, assumes that the central bank cannot directly commit to the policy rule of equation (6), but can commit to a range of operational rules, for example to a pegged exchange rate, money supply rule, inflation targeting rule, nominal GDP rule etc.

[2] Arguably, the assumption that the relative PPP holds perfectly is a big simplification that does not correspond to the empirical experience, at least for the short-run horizon. But it is a standard assumption in this model, and I thus decided to keep it. Perhaps we could also interpret this assumption more loosely as follows: by fixing the exchange rate, the country gives up the chance to *systematically* influence its inflation rate, which is then *primarily* affected by foreign inflation.

From (11), we can find out the critical level of supply-side shock $z_t$, above which the central bank devalues as

$$\bar{z}_t = \sqrt{\bar{c}(1+\chi)} - k - \pi_t^E \qquad (12).$$

Similarly, a revaluation is carried out if there is a favourable supply-side shock strong enough to cause

$$\Lambda_t^{fix} - \Lambda_t^{float} > \underline{c} \;\Leftrightarrow\; \frac{1}{1+\chi}\left[k + \pi_t^E + z_t\right]^2 > \underline{c} \qquad (13),$$

or in other words, if $z_t$ is below[3]

$$\underline{z}_t = -\sqrt{\underline{c}(1+\chi)} - k - \pi_t^E \qquad (14).$$

In this setting, the rational expectation of inflation before the supply-side shock is realised is given by

$$E(\pi_t) = E\{\pi_t / z_t < \underline{z}_t\}P\{z_t < \underline{z}_t\} + E\{\pi_t / z_t > \bar{z}_t\}P\{z_t > \bar{z}_t\} \qquad (15),$$

where $E$ denotes mathematical expectations and $P$ is probability. The rational expectation of inflation is thus a function of the critical levels of supply-side shock $\bar{z}_t$ and $\underline{z}_t$, which themselves depend on the level of inflation expected by the economic agents ($\pi^E$). If we assume that people's expectations are formed rationally, i.e. that in equilibrium

$$\pi_t^E = E(\pi_t) \qquad (16),$$

there is a two-way relationship between expectations and the critical levels of supply-side shocks. This can potentially lead to multiple equilibria and self-fulfilling currency crises.

Obstfeld (1996a) demonstrates this fact using an assumption that the supply-side shocks are uniformly distributed on a closed interval, let's say [-Z;Z].[4] He shows that the "expectations schedule"[5] may have the shape illustrated in Figure 1. In this case, there are three rational-expectations equilibria. The equilibrium number 1 corresponds to the inflationary, full-discretionary outcome of equation (5). In this equilibrium, the economic agents expect the central bank to devaluate regardless of the level of supply-side shock, and the central bank confirms these expectations as it does not want to impose on the economy the high costs of an economic recession. On the other hand, the point 3 in Figure 1 is a low-inflation equilibrium that demonstrates the potential benefits of using a pegged exchange rate to import anti-inflationary credibility from abroad. At the same time, however, it demonstrates its disadvantages. As we can see, the expected inflation in this equilibrium can be

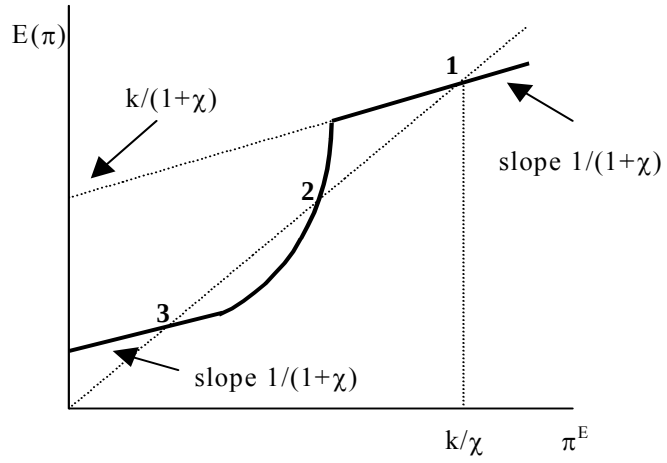
[3] Note that for the central bank to desire a revaluation, the argument in the square bracket of inequality (13) needs to be negative. This leads to the negative sign in front of the square root function in equation (14).

[4] Obstfeld (1996b) illustrates the same multiple equilibria problem using a "tent-shaped" density function $g(z_t) = \left(Z - |z_t|\right)/Z^2$ for $z_t \in [-Z;Z]$.

[5] This expectations schedule is a counterpart of the reaction function in the basic dynamic inconsistency model. It is not a "true" reaction function, however, as it does not show what the central bank *in fact* does in every state of the world. Instead, it shows what the central bank *is expected* to do before the state of the world is revealed, depending on the level of inflation expected by the economic agents.

substantially lower than in equilibrium number 1, but is still above zero. Consequently, in most "normal periods", i.e. when supply-side shocks are relatively small and the central bank maintains the exchange rate peg, the economy operates under its potential, as the actual inflation is below the expected one (see Obstfeld, 1996a,b). This, of course, may erode political support for the pegged exchange rate. Finally, there is also an unstable equilibrium 2, which I am not going to discuss in detail here.

**Figure 1: The Expectations Schedule**




The possibility of multiple equilibria arises in this setting only if at $\pi_t^E = k/\chi$ (i.e. at the point corresponding to full-discretionary equilibrium), the exchange rate commitment has no practical value, as $-Z > \bar{z}_t > \underline{z}_t$ (i.e. a devaluation always takes place). Therefore, the multiple equilibria can be eliminated if the country satisfies the condition

$$\sqrt{\bar{c}(1+\chi)} - \frac{1+\chi}{\chi}k > -Z$$

*(17).*

This means that a self-fulfilling currency crisis is the less likely to occur:

(i) the higher is $\bar{c}$;

(ii) the lower is *k*;

(iii) the higher is $\chi$;

(iv) the higher is *Z*.

The results (ii) and (iii) are very intuitive, but their value for policy-making is rather limited. The problem of self-fulfilling currency crisis is eliminated if the central bank has a high anti-inflationary credibility, and its temptation to devalue the currency is low. Unfortunately, this only says that importing low inflation via a pegged exchange rate is least problematic in those cases when it is least needed, as the country has managed to institute low-inflationary environment by domestic arrangements. It can thus hardly serve as a policy guide how to import low inflation from abroad in those circumstances when domestic institutions are not perceived as credible.

The result (iv) is neither very intuitive, nor useful for policy purposes. Intuitively, we would expect that in a country with high variability of supply-side shocks (i.e. with high Z), the exchange rate realignments are more likely to take place. However, this is indeed true if we are speaking about devaluations or revaluations that are caused by actual shocks. In our case, however, we are analysing purely self-fulfilling (or "sunspot") currency crises that are not justified by macroeconomic fundamentals but by more-or-less random changes in market expectations. A high volatility of supply-side shocks reduces the danger of self-fulfilling crises because it is then possible that a strongly positive shock will occur which will enable the central bank to sustain the exchange rate peg even with high-inflationary expectations ($\pi_t^E = k/\chi$) with some positive probability. As a result, the mathematical expectations of the inflation will be below $\pi_t^E = k/\chi$, meaning that this point is not an equilibrium. It is clear, however, that trying to eliminate the multiple equilibria by increasing the variability of real shocks is not a choice for the policy makers, as it would (if possible at all) reduce social welfare.

We are thus left with the result (i), which is both intuitive and useful for policy making. It says that a stronger political commitment to the exchange rate peg reduces the possibility of self-fulfilling currency crises. What are its policy implications for the institutions-designing phase of the game? Formally, it adds another constraint to the optimisation problem of the policy makers. Before Obstfeld (1994; 1996a,b) pointed out to the possibility of multiple equilibria, the optimal institutional choice was thought of as a solution to the maximisation problem

$$\underset{\bar{c},\underline{c}}{Max}\, E(\Lambda_t) = E\left(\chi \pi_t^{\,2} + \left[y_t - y^{**}\right]^2\right) \qquad (18),$$

subject to constraints (1), (12), (14), (15), (16).[6] Obstfeld's theoretical message means that the policy-makers should consider constraint (17), as well. Otherwise, it is a pure gamble to rely on an exchange rate peg, as we cannot (due to the multiple equilibria problem) assign a probability distribution to its survival.[7]

As far as the practical policy-making is concerned, however, we can question whether the central bank is really able to recognise perfectly the range of exchange rate commitments that are sufficient to prevent the self-fulfilling crises, and then choose from this range the arrangement which maximises the expected social utility. After all, the quantitative results of the model depend on its structure and timing of events, on the exact distribution and nature of shocks, on the perceptions of market participants about the credibility of exchange rate commitments and so on, which may all be sources of substantial uncertainty for policy makers. As a result, the message of the Obstfeld model for practical purposes is usually being interpreted as an argument for corner (or "polar") exchange rate solutions. The central bank should either make a fixed exchange rate regime extremely credible, or it should rather avoid using it to import low inflation at all.[8,9] This is indeed the trend that has been observed in the

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[6] An important example of the literature on optimal escape clauses in monetary policy is Lohmann (1992).

[7] In the dynamic inconsistency model of exchange rate pegs, though, the worst possible outcome that is achieved when the country devalues is the full-discretionary equilibrium. As a result, even if there is a danger a self-fulfilling currency crises, it may be beneficial to peg the exchange rate as long as its perceived probability of survival is not zero. In practice, however, currency crises seem to be associated with high real costs and systemic risks, that may far exceed the potential social losses associated with the discretionary equilibrium.

[8] This opinion is clearly expressed, for example, in the final report of the International Financial Institution Advisory Commission, established by the US Congress and chaired by A. Meltzer. The report says: "The Commission recommends that countries avoid pegged or adjustable rate systems. The IMF should use its policy

reality of recent years, as Figure 2 illustrates (see Fischer, 2001). While many countries have recently moved to a greater exchange rate flexibility, some other emerging and transition economies have adopted "currency boards" (or dollarized/euroized their economies).[10,11] On the contrary, the number of countries with intermediate exchange rate regimes has declined significantly.

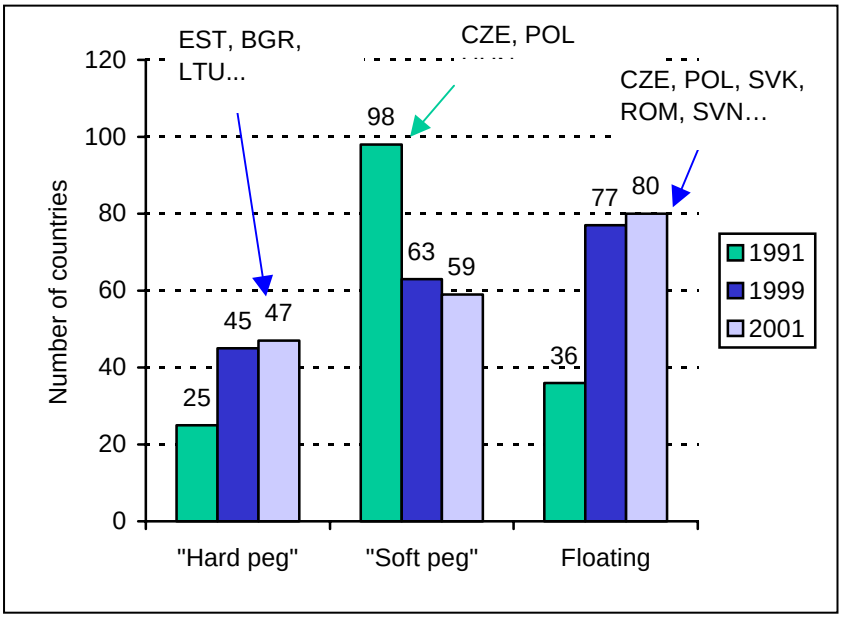


**Figure 2: The "Bipolar" View in Practice**

*Source: IMF; Fischer (2001)*

The currency boards (or dollarization/euroization) have also become increasingly popular among some theoretical economists. For example, Dornbusch and Giavazzi (1998) have suggested that adopting currency boards would be the best monetary arrangement for transition economies of Central and Eastern Europe to solve their credibility problems and lack of competence for running independent monetary policies.

What is the fundamental difference between a currency board and a standard fixed exchange rate? Hanke and Schuler (1994), for example, define a currency board as "a monetary institution that issues notes and coins (and, in some cases, deposits) fully backed by a foreign "reserve" currency and fully convertible into the reserve currency at a fixed rate and

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consultations to recommend either firmly fixed rates (currency board, dollarization) or fluctuating rates. Neither fixed nor fluctuating rates are appropriate for all countries or all times. Experience shows, however, that mixed systems such as pegged rates or fixed-but-adjustable rates increase the risk and severity of crises."

[9] One reservation has to be made at this point, though. The above conclusions relate only to those cases when an exchange rate peg is used to import credibility and low inflation from abroad. There may be situations, however, when the exchange rate is pegged between countries with credible monetary policies for some other reasons (stabilising the conditions for foreign trade, reducing exchange rate risks etc.). In these circumstances, the problem of self-fulfilling currency crises may be less relevant (see results (ii) and (iii) above), and non-polar exchange rate regimes may thus still be applicable.

[10] The following text draws on a collaborated work with M. Čihák (see Čihák, Holub, 2000).

[11] Estonia, Lithuania and Bulgaria etc. are examples in Central and Eastern Europe, Argentina used to be a Latin American case.

on demand." While this (quite a standard) definition captures the main "visible" features of a currency board, it says relatively little about its essence. Even with a standard exchange rate peg, the central bank commits itself to a fixed exchange rate between the domestic currency and the reserve currency, and usually maintains full convertibility, too. Moreover, many central banks that maintain exchange rate pegs are also close to the 100 % coverage of the domestic monetary base by foreign exchange reserves. It is a common misunderstanding to say that normal central banks are not strong enough to defend exchange rate pegs, as their foreign exchange reserves are negligible compared to private international capital flows, while currency boards are able to defend the fixed exchange rate because their currencies are fully covered by foreign exchange reserves.[12]

As has been illustrated by Obstfeld and Rogoff (1995, 1996), many of the central banks that faced currency crises in early-1990s had sufficient foreign exchange reserves to buy out the whole monetary base. In Table 1, I reproduce their evidence, and add data on the emerging and transition economies that were hit by currency turmoil in the second half of 1990s. As we can see, in most cases the ratio of foreign exchange reserves to the monetary base exceeded 100 % or was just marginally below this level before the crises broke out, the only exceptions being Italy in 1992 and Russia in 1998. True, we may object against the Obstfeld and Rogoff's argument that normal central banks – unlike theoretically pure currency boards – have other liabilities besides the monetary base that can serve for some economic agents (banks, government etc.) as secondary reserves.[13] It is thus probably better to compare the foreign exchange reserves of central banks with their total liabilities (except their own capital), and not just with the monetary base. Nevertheless, even this ratio exceeded 80 % in many countries (see Table 1). We can thus conclude, that the financial strength of these central banks to defend their currencies was relatively large, in many cases of the same order as the strength of currency boards.

[12] At this point, we should note that even with a currency board, the foreign exchange reserves do not cover the total money supply, but the monetary base only. The total money supply thus can exceed the foreign exchange reserves several times, depending on the size of money multiplier. For example in 1998, the ratio of foreign exchange reserves to broad money (M2) reached 52 % in Estonia, 31 % in Argentina and 27 % in Hong Kong. To compare, in the Czech Republic the corresponding figure was 33 %.

[13] Obstfeld and Rogoff (1995, 1996) used the data from the International Financial Statistics published by the IMF. The definition of monetary base in this publication is broader than the narrow definition used by the Czech National Bank. It thus includes, for example, the liabilities of the Czech National Bank to the commercial banks resulting from reverse repo-operations. These liabilities serve as a major source of secondary liquidity reserves to the commercial banks in the Czech Republic. The Obstfeld and Rogoff's figures thus in fact take an important part of the secondary liquidity reserves into account.

**Table 1: FX Reserves (in % of monetary base and total CB's liabilities)**

| Country | Year | RE/MB | RE/TL | Country | Year | RE/MB | RE/TL |
|---|---|---|---|---|---|---|---|
| Finland | 1992 | 95 | 79 | Czech Rep. | 1997 | 108 | 84 |
| France | 1992 | 116 | 80 | Philippines | 1997 | 120 | 55 |
| Italy | 1992 | 46 | 45 | Indonesia | 1997 | 162 | 82 |
| Ireland | 1992 | 147 | 94 | South Korea | 1997 | 110 | 46 |
| Norway | 1992 | 214 | 65 | Malaysia | 1997 | 100 | 76 |
| Portugal | 1992 | 137 | 96 | Thailand | 1997 | 215 | 119 |
| Spain | 1992 | 87 | 86 | Greece | 1997 | 127 | 44 |
| Sweden | 1992 | 112 | 54 | Brazil | 1998 | 92 | 35 |
| UK | 1992 | 109 | 63 | Russia | 1998 | 61 | 41 |
| Mexico | 1994 | 159 | 88 | Slovak Rep. | 1998 | 123 | 83 |

*Source: International Monetary Fund, own computations*

*Note: The data relate to the beginning of each year; RE = FX reserves; MB = monetary base (currency + bank reserves, as defined in the IMF's International Financial Statistics); TL = monetary base, foreign liabilities, liabilities to commercial banks and the government.*

In spite of this, most central banks eventually gave up their fight for the currency, often long before their foreign exchange reserves have been exhausted. A typical example is the Czech National Bank in May 1997 which held USD 11.5 bn. of reserves at that time, but decided to float the currency having spent just USD 1.5 bn. (and even this was criticised by some analysts and politicians as "wasted money").

Why was this the case? In answering this question, we can come back to the Obstfeld model. The reason for early abandoning of the exchange rate pegs by most central banks is the fact that, in addition to the exchange rate target (and price stability goal), they follow also other goals. These include the economic growth (which is the case in Obstfeld model), low volatility of interest rates, or stability of the banking sector. Should a central bank decide to fight for the currency to the bitter ends, it would have to cease functioning as a lender of the last resort to commercial banks and buy back a substantial portion of its monetary base in exchange for foreign reserves. This would, in theory, mean a decline of the money supply towards zero, which would have devastating real effects: a jump-up in nominal interest rates, deflation, deep economic recession and liquidity crisis of the financial sector. These costs are so high that even a strongly politically independent central bank cannot afford impose them on the economy. This fact, however, leads to the danger of self-fulfilling currency crises. The economic agents know that the central bank will always devalue if there is a currency crisis which may itself give them an incentive to speculate against the currency, and thus cause the crisis. On the other hand, if everybody believes that the exchange rate will be maintained, no crises happens.

What is the fundamental difference with a currency board? Even in this monetary policy regime, a speculative attack on the currency may take place, and its consequences are equally

hard as under a radical defence of a standard exchange rate peg.[14] The key difference, however, consists in the fact that a currency board does not bear any responsibility for the above consequences. Its role is not to serve as a lender of the last resort and regulator of commercial banks, and it can thus be hardly criticised for a banking crisis. Similarly, a currency board is by definition forbidden to run an independent monetary policy - it even does not have people to do that. Therefore, it cannot be blamed for a deflation and economic recession. Moreover, it is relatively difficult (though not impossible) to make changes to the exchange rate under a currency board, as it typically requires a decision from by the parliament and not just an independent decision of the monetary authority. From this point of view, a currency board is a self-destructing commitment to the fixed exchange rate (or a "poison pill", to use the terminology of Dornbusch and Giavazzi, 1998), which is its fundamental difference from a standard exchange rate peg. Interpreting this conclusion from the perspective of Obstfeld model, a currency board is an institutional setting that makes the costs of realignments $\bar{c}$ and $\underline{c}$ extremely high. The reason for doing this is to eliminate the danger of self-fulfilling currency crises. The experience of 1997-98 suggests that it may really work in practice, at least partially.[15]

For all of the above, I will assume from now on that the government in principle faces a zero-one choice: it can either make an extreme exchange rate commitment, that is close to a monetary union (which an orthodox currency board is), or give up any effort to import low inflation from abroad. What is the right choice in this situation? In fact, this question is an extreme example of the discretion vs. commitment debate in monetary policy. While a currency board is an extreme exchange rate commitment[16], free floating gives much room for discretion in monetary policy (if there is no "home-made" commitment, which I have assumed away in this paper). If we have an explicit loss function of the society – which we do in the dynamic inconsistency model – we can make a judgement on this debate by comparing the expected values of this loss function under alternative arrangements.

If the country has a floating exchange rate, the expected value of its loss function is

$$E\left(\Lambda_t^{float}\right) = E\left\{\chi\left(\frac{k}{\chi}+\frac{z_t}{1+\chi}\right)^2+\left(-k-\frac{\chi}{1+\chi}z_t\right)^2\right\} = \frac{1+\chi}{\chi}k^2+\frac{\chi}{1+\chi}\sigma^2\left(z_t\right) \qquad (19),$$

where $\sigma^2(z_t)$ denotes the variance of supply-side shocks. The first term on the right-hand side of equation (19) is the cost for the society that is in equilibrium associated with the inflationary bias, while the second term captures the (optimised) welfare cost of supply-side shocks.

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[14] The recent problems of Argentina illustrate this.

[15] No currency board was attacked and/or abandoned during this period. However, there were still speculations that the domestic currencies could be devaluated in Hong Kong and Argentina. In Hong Kong, though, it was partly supported by political considerations (unification with China) that can be thought of as an exogenous shock to the credibility of Hong Kong's authorities. In Argentina, on the other hand, the currency board was made less credible by the fact that it serves as a lender of the last resort, and it this thus not a pure currency board (see Hanke, Schuler, 1994). The problems that hit Argentina in 2001-02, however, clearly showed that introducing a currency board is in itself not a guarantee that the country avoids crises, especially if the fiscal policy is not disciplined enough to make the currency board fully credible.

[16] Two even more extreme exchange rate commitments are a full dollarization (eurization etc.) and a monetary union. In this essay, however, I will treat them together with an orthodox currency board as a group of de-facto irrevocable exchange rate commitments. It is, of course, true that a currency board can always be abandoned (after all, the same applies to dollarization and currency unions, too), but in the dynamic inconsistency model it is sufficient to assume that such a change cannot be quick enough to create nominal illusion and boost output.

If, on the other hand, the country adopts a hard peg that does not allow it to realign even when the worst possible supply-side shocks take place, the expected value of the loss function becomes

$$E\left(\Lambda_t^{fix}\right) = E\left\{\left(-k - z_t\right)^2\right\} = k^2 + \sigma^2\left(z_t\right) \qquad (20).$$

From a simple comparison of equations (19) and (20), it is easy to see that adopting a hard peg reduces the costs associated with the inflationary bias, but at the same time increases the costs of supply side shocks. There is thus a trade-off, which forms the core of the discretion-versus-rules debate.

Choosing a hard peg is preferred to having a flexible exchange rate only if

$$\frac{1+\chi}{\chi}k^2 + \frac{\chi}{1+\chi}\sigma^2\left(z_t\right) \geq k^2 + \sigma^2\left(z_t\right) \;\Leftrightarrow\; k^2 \geq \frac{\chi}{1+\chi}\sigma^2\left(z_t\right) \qquad (21),$$

We can thus conclude that a currency board, dollarization, or monetary union is the more likely to be preferable for a country:

(i) the higher is the inflationary bias $k$;

(ii) the lower is the variability of supply side shocks $\sigma^2(z_t)$;

(iii) the lower is the parameter $\chi$.

The first two results are easy to interpret: a high inflationary bias increases the desire of a country to import low inflation abroad, while having a low variability of supply-side shocks makes it less costly in terms of foregone discretion. The last result is a bit more difficult to explain. A low inflation-aversion $\chi$ increases the magnitude of inflationary bias, which speaks in favour of a fixed exchange rate and against discretion. On the other hand, a low $\chi$ also reduces the "unit" social costs of the inflationary bias and makes it also more desirable to respond to supply-side shocks by inflationary surprises, which speaks in favour of a floating exchange rate. The first factor, however, dominates in equilibrium, making a fixed exchange rate more advantageous when $\chi$ is low.

## III. An Extended Model with Non-Zero Foreign Inflation

To enrich the model with optimum-currency-area considerations, I will now modify one of its simplifying assumptions. Namely, I will cease to assume that the foreign country maintains zero inflation in all circumstances. Instead, this country will be allowed to respond to its own supply-side shocks with non-zero inflation. A convenient assumption is that the foreign country has managed to develop an optimal institutional framework for its monetary policy, meaning that its inflation follows an exact analogue to equation (6), i.e.

$$\pi_t^f = \frac{z_t^f}{1+\chi^f}; \quad \chi^f = \chi; \quad \sigma^2\left(z_t^f\right) = \sigma^2\left(z_t\right) \qquad (22),$$

where $\pi^f$ denotes foreign inflation and $z^f$ foreign supply-side shocks. In (22), I further assume that the inflation aversion $\chi$ is the same abroad as in the home country, and that foreign supply-side shocks have the same variance as the domestic ones. This greatly simplifies the algebra, but at the same time artificially removes some potentially important sources of asymmetry between countries. Therefore, I show in Appendix I what happens when the simplifying assumptions are relaxed.

Under these new assumptions the equation (9) of section II, which expresses the value of domestic country's loss function when a fixed exchange rate is maintained, modifies to

$$\Lambda_t^{fix} = \frac{\chi}{1+\chi}\left(z_t^f\right)^2 + \left[k + \pi_t^E + \left(z_t - \frac{z_t^f}{1+\chi}\right)\right]^2 = \frac{1}{1+\chi}\left(z_t^f\right)^2 + \left[k + \pi_t^E + z_t\right]^2 - 2\frac{z_t^f}{1+\chi}\left[k + \pi_t^E + z_t\right] \quad (23).$$

If we compare (23) and (10), we can easily derive modified critical levels of the domestic supply-side shock that triggers a devaluation or revaluation of the exchange rate. The equation (12) modifies to

$$\bar{z}_t - z_t^f = \sqrt{\bar{c}(1+\chi)} - k - \pi_t^E \quad (24),$$

while equation (14) becomes

$$\underline{z}_t - z_t^f = -\sqrt{\underline{c}(1+\chi)} - k - \pi_t^E \quad (25).$$

In other words, it is now not the domestic supply-side shock on its own, but rather its difference from the foreign shock that matters for the decision whether to maintain a pegged exchange rate or not. The intuition behind this result is very simple: the optimal response to foreign shock is already reflected in the actions of foreign monetary authority, and the domestic central bank replicates this response by keeping the exchange rate fixed. If the domestic shock is equal to the foreign one, there is thus no desire to realign the exchange rate (besides that stemming from the inflationary bias itself).

Of course, the danger of self-fulfilling currency crises carries on to this extended version of the Obstfeld model, and the recommendation that countries should avoid intermediate exchange rate regimes thus remains valid.[17] But the range of factors that influence the choice between floating and a hard peg broadens. The expected value of the loss function under floating is still given by equation (19), but its expected value under a fixed exchange rate (i.e. equation (20) of section II) modifies to

$$E\left(\Lambda_t^{fix}\right) = k^2 + \sigma^2\left(z_t\right) + \frac{1}{1+\chi}\sigma^2\left(z_t^f\right) - \frac{2}{1+\chi}\mathrm{cov}\left(z_t, z_t^f\right) \quad (26),$$

[17] To show this, it is enough to assume that the difference between $z$ and $z^f$ is uniformly distributed on the interval [-Z;Z], and than proceed along the lines of Appendix I. The qualitative results then could be again illustrated by Figure 1. Alternatively, we could assume a tent-shaped distribution for this difference in supply side shocks (which seems to be more realistic) and then follow Obstfeld (1996b). We could also ask how the correlation between $z$ and $z^f$ (which represents a condensed measure of the countries' integration in this model) affects the possibility of self-fulfilling currency crises. It is realistic to expect that when the correlation is high, it reduces the dispersion of the difference between $z$ and $z^f$, i.e. it lowers $Z$. As was shown in section II, this paradoxically makes it more likely that a self-fulfilling crisis can take place (even though it reduces the probability of fundamentally justified realignments). In the logic of the present model, a smaller integration makes it possible that a strongly positive asymmetric shock will happen which will enable the central bank to sustain the exchange rate peg even when inflationary expectations are high with some positive probability, and the full-discretionary outcome is thus not an equilibrium (see section II).

where $\sigma^2(z^f)$denotes the variance of foreign supply-side shocks and $cov(z,z^f)$ is the covariance between domestic and foreign supply-side shocks. A rigidly fixed exchange rate is thus preferred to floating if

$$\frac{1}{\chi}k^2 \geq \frac{1}{1+\chi}\sigma^2(z_t)+\frac{1}{1+\chi}\sigma^2(z_t^f)-\frac{2}{1+\chi}\mathrm{cov}(z_t, z_t^f) \qquad (27).$$

Using the assumption that the variance of foreign shocks is the same as that of domestic shocks, we can rewrite this as

$$k^2 \geq \frac{2\chi}{1+\chi}\sigma^2(z_t)\left[1-\rho(z_t, z_t^f)\right] \qquad (28),$$

where $\rho(z,z^f)$ is the correlation coefficient between $z$ and $z^f$. This correlation coefficient represents a condensed measure of the degree of integration between economies in the present model.

From (28), we can conclude that a currency board, dollarization, or monetary union is the more likely to be advantageous for a country:

(i) the higher is the inflationary bias $k$;

(ii) the lower is the variability of supply side shocks $\sigma^2(z_t)$;

(iii) the lower is the parameter $\chi$;

(iv) the higher is the degree of integration measured by $\rho(z,z^f)$.

The first three results need no special comment as they are the same as in section II. The last one, however, is the key result of this section. It says that an increasing integration between economies, here condensed in the correlation of their supply-side shocks, increases the desirability of a hard peg between these economies, as it reduces the cost of foregone discretion in monetary policy. This alone is not an innovative outcome, as it only replicates one of the central conclusions of the optimum-currency-area literature. Nevertheless, in this paper I demonstrated how this literature can be extended in a very simple model framework to allow for credibility considerations, which may be important when a country with low credibility of its monetary policy decides to introduce a currency board, dollarize its economy or join a monetary union.[18]

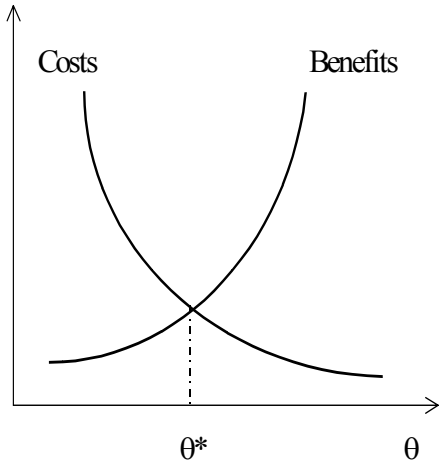
We can give a simple graphical interpretation. The traditional optimum currency area theory (see Mundell, 1961; McKinnon, 1963) is summarised in a textbook fashion in Figure 3a). The costs of a monetary unification, which result primarily from reduced discretion in monetary policy, are a decreasing function of the degree of integration $\theta$. On the other hand, the benefits are an increasing function of the degree of integration. These benefits include, inter alia, an elimination of exchange rate risk and reduction in transaction costs. It is optimal for a country to join the monetary union if the degree of integration exceeds the critical level $\theta^*$.

---

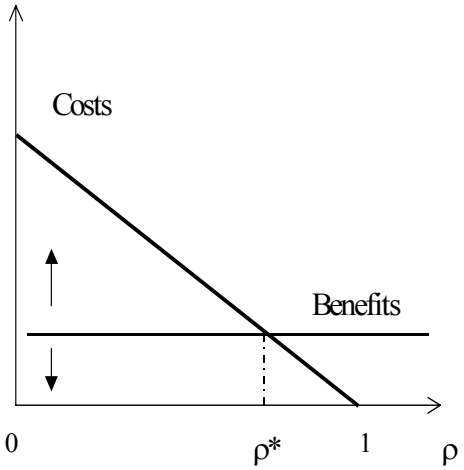
[18] Frankel (1995), for example, discusses both credibility and the degree of integration in a single paper, but does not put these in a unified model setting. He just models increasing integration by arbitrarily putting a larger weight on the exchange rate stabilisation objective in the central bank's loss function. Ricci (1997) presents a very interesting and complex model in which the optimality of a currency area depends on many factors including the correlation of real shocks between countries and the differences in their inflationary biases.

**Figure 3: Optimum Currency Areas**

a) traditional approach



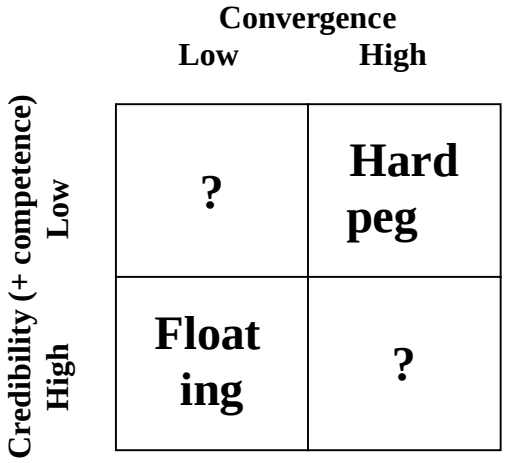

b) the present model




The present paper, however, ignores all the traditional benefits of currency integration, and instead concentrates on another potential benefit: the import of credibility from abroad that overcomes the inflationary bias (*k*). This benefit is independent of the degree of integration, which is why the benefits are plotted as a horizontal line in Figure 3b). Again, it is optimal for a country to join a monetary union if the degree of integration exceeds the critical level $\rho^*$. But it is realistic to think that the credibility deficit is not the same across countries and time periods, which means that the line showing the benefits of a currency integration may shift up and down, changing the critical level of integration $\rho^*$.

An alternative (a little bit more schematic, but also quite illustrative) graphical presentation of the problem is shown in Figure 4. It is a simple matrix that is divided into four regions according to the degree of economic convergence (low/high) and credibility (+competence) of the central bank (low/high). In the upper-right region the convergence is high and credibility low, meaning that the costs of a hard peg are small and the potential benefits very large, and the hard peg is thus clearly a good option. On the other hand, in the lower-left region the costs of a hard peg are high due to a low degree of convergence, while the benefits are low due to a high level of central bank's credibility, leading to a floating exchange rate as a natural choice. In the remaining two regions, the decision is not so easy. In the upper-left region both the costs and benefits of a hard peg are high, in the lower-right region both of these are low. This means that to find out whether a hard peg is a good idea, a more thorough analysis is needed for these two regions in order to determine if the benefits exceed costs or not.

**Figure 4: Optimum Currency Areas – an alternative illustration**




The above analysis may be used to respond to the arguments of Dornbusch and Giavazzi (1998), who advocated an adoption of currency boards in Central European countries to resolve their low credibility problem.[19] The choice of an appropriate exchange rate regime is not as simple as Dornbusch and Giavazzi (1998) suggested, because the economic transition means in its nature an effort to move from the upper-left indecisive region of Figure 4 to the lower-right indecisive region. At the beginning of economic transition, the post-communist countries were typically only weakly integrated with advanced market economies. The potential costs of fixing the exchange rate were thus relatively high. In spite of this, however, many of these countries chose to peg the exchange rate. The reason is that they needed to import stability and anti-inflationary credibility from abroad. The potential benefits were extremely large, especially in the very early stage of transition. As time passed on, however, many transition countries made substantial progress both in integrating with the West and gaining more credibility – which Dornbusch and Giavazzi (1998) seem to ignore in their argument. Both the costs and benefits of a fixed exchange rate thus fell down, giving rise to a dilemma how to go on with the exchange rate regimes. Moreover, as the countries proceeded with the balance-of-payments liberalisation they became more vulnerable to currency crises, which was clearly demonstrated by the Czech experience, for example. As a result, the intermediate exchange rate regimes, such as pegged but adjustable exchange rates or crawling bands, became more risky, which further amplified the above dilemma.

In such a situation, it is not easy to decide whether to radically strengthen the exchange rate commitment or move to managed floating. It depends on the (perceived) speed of two processes mentioned above, i.e. the convergence process and the gain in credibility. If the former one was faster, it should not be surprising to see the countries maintain and even strengthen their exchange rate commitments. If the latter one proceeded at higher pace, it should be no surprise to see the countries move to floating. Indeed, there are examples in both directions. Estonia, Bulgaria and Lithuania, for example, have introduced and maintained currency boards (even though not orthodox ones), while the Czech Republic, Slovakia and

[19] In addition, Dornbusch and Giavazzi (1998) have argued that central banks in post-communist countries have low policy competence. I abstract from this factor in the basic model of this section which assumes perfect competence of the central bank in discerning the supply-side shocks and setting the optimal inflation rate. In Appendix II, I show how policy errors of the central bank under discretion can make a fixed exchange rate more attractive, which lends support to the argument of Dornbusch and Giavazzi (1998).

Poland, for example, have moved to floating exchange rates. A priori, we cannot judge any of these as irrational choices, the judgement must be based on empirical measures of convergence and credibility. In the next section, I discuss such empirical measures for the Czech Republic.

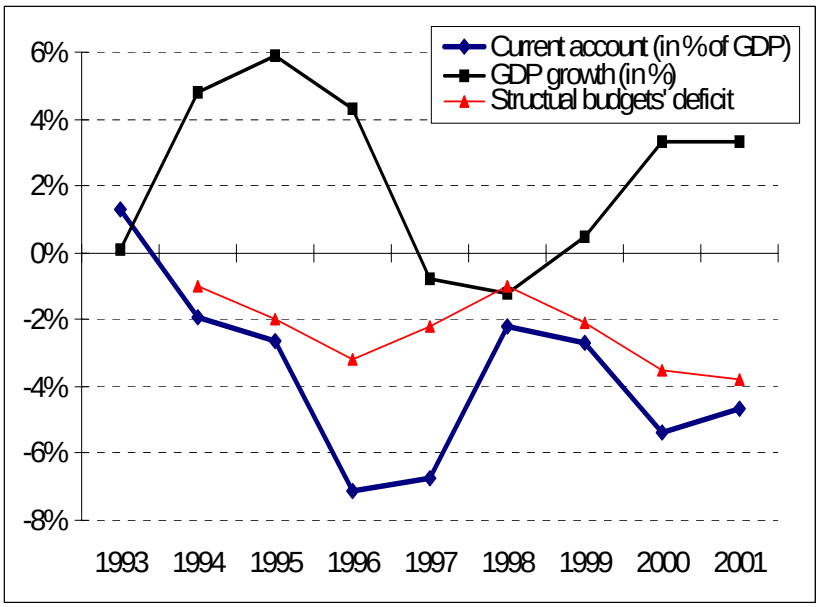
# IV. A Discussion for the Czech Republic

## IV. 1 Monetary Policy Credibility and Competence in the Czech Republic

Until February 1996, the Czech Republic used a pegged exchange rate regime. The inflation was moving between 8 % and 11 % since early 1994 (meaning one of the lowest inflation rates among the transition economies at that time), with a modest declining tendency. The Czech National Bank, though, was constantly missing its money-supply targets due to fast inflows of foreign short-term capital. The wage growth far exceeded productivity growth, real exchange rate was appreciating fast and the domestic demand growth (at around 8 % in 1995-96) was also excessive, partly due to an expansive fiscal policy and the high wage growth. The economy got clearly overheated, which led to a mounting current account deficit that reached almost 8 % of GDP in 1996 (Figure 5).

The CNB responded by widening the exchange rate's fluctuation band in February 1996 and by a set of restrictive monetary policy measures in the second half of 1996. These measures, however, proved to be insufficient. In May 1997, the Czech Republic experienced a currency turmoil that forced the CNB to float the exchange rate and intensify its restrictions. In addition, fiscal restrictions were introduced in the spring of 1997. As a result, a period of a painful stabilisation followed in 1997-99, marked by a drop in GDP (see Figure 5) and rising unemployment, but also by falling inflation and current account deficit. The years 2000-02 then saw a revival in economic growth again, but this time without re-emergence of any serious macroeconomic imbalances (apart from the fiscal problems – see below).

**Figure 5: GDP Growth, Current Account Balance and Public Budgets**

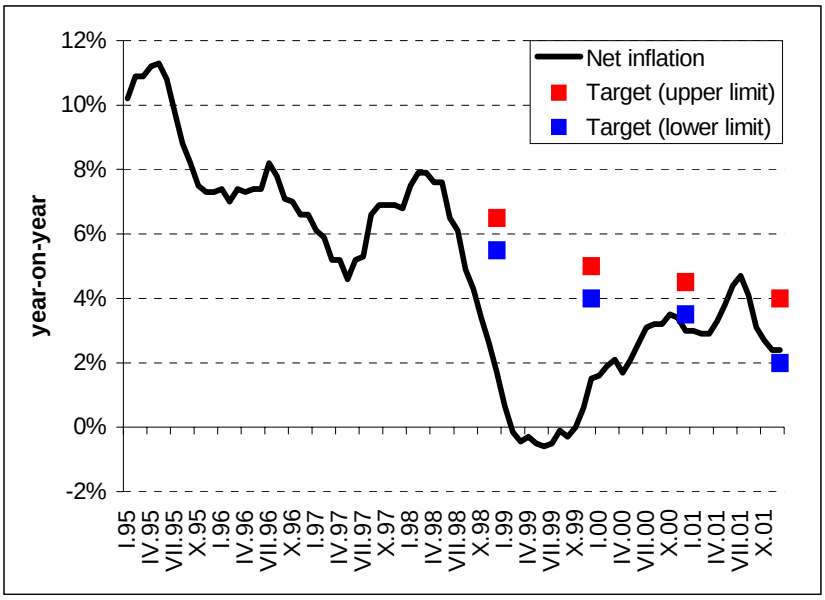



*Source: Czech Statistical Office, CNB; Bezděk, Matalík (2000)*

Since 1998, the Czech National Bank introduced inflation targeting as its monetary policy strategy. Figure 6 compares its targets with the actual developments of net inflation

(CPI-inflation adjusted for price deregulations and changes in indirect taxes), which was the target indicator in 1998-2001. As we can see, the CNB undershot its targets in all three years since the adoption of inflation targeting, even though in 2000 by a relatively small margin only. Only in 2001, when the CNB already decided to switch towards targeting the headline inflation from 2002, did it manage to reach the target. The CNB was therefore criticised for being too hawkish in the first years of inflation targeting. At present, the Czech inflation again finds itself well below the CNB's target corridor (even though it is largely due to exogenous factors). Combined with the relatively modest inflation rates throughout the whole transition, the price stability during the communist era and the stability of Czechoslovak crown between the world wars, this makes me believe that the CNB does not suffer from a lack of anti-inflationary credibility, and thus feels no acute need to import it from abroad.

**Figure 6: Net Inflation – the Targets vs. Reality**




*Source: Czech Statistical Office*

On the other hand, the sharp business cycle (see Figure 5) combined with the consistent undershooting of the inflation targets may be used as an argument for low policy competence of the CNB, which would imply that the autonomy in monetary policy may be harmful rather than stabilising in the Czech reality, making a case for a fast unilateral of official euroization of the Czech economy.

This argument, though, ignores the reasons behind the sharp business cycle, the role of fiscal policy, the external shocks to inflation etc.[20] I view as the primary reason of the painful stabilisation period a substantial overheating of the economy that took place in 1994-96, and a sub-optimal mix of policies that was subsequently used to stabilise it. The overheating occurred during a period of fixed exchange rate regime, which made the situation worse by attracting short-term capital inflows rather than preventing it. There is thus no reason to think

[20] I do not want to discuss the external shocks to inflation here, even though these have been very important. In 1998-99, for example, the undershooting of inflation targets could be largely attributed to a drop in world oil prices and in food prices (see e.g. CNB, Inflation Report, January 2000). In 2000, on the other hand, the adverse oil price shock brought the net inflation closer to the target than it would have otherwise been. In 2002, it is low import and food prices, combined with a strong exchange rate, that are responsible for the target undershooting.

that such an overheating could not take place under a currency board or euroization of the economy as well. In such a case, it would either require a stabilising action from the fiscal policy side, or a deflationary adjustment. The fiscal policy in the Czech Republic, though, was rather pro-cyclical in the past. In Figure 5, I have plotted an estimate of the structural public budgets' deficit.[21] As we can see, the fiscal policy became expansionary in 1995-96, contributing to the economic overheating. The monetary policy started to respond in mid-1996 by restrictive measures, but these were ineffective in reducing the current account deficit quickly, as they contributed to a short-run appreciation of the exchange rate, which had a negative impact on the trade balance. A fiscal restriction would have been much more appropriate at that time, but it was not implemented due to longer recognition lags and political cycle considerations (1996 was an election year). The fiscal policy was tightened only in 1997 and further in 1998, when the Czech economy had already entered an economic recession.

It should be thus clear that one cannot put all the blame for the developments in the second half of the 1990s on monetary policy. True, one may for example argue (see e.g. Čihák and Holub, 2001) that from the ex-post view the CNB should have lowered the interest rates faster in 1998 than it actually did, responding more aggressively to the fiscal restrictions and appreciating exchange rate.[22] Such a move could have probably made the recession shorter and the undershooting of inflation targets smaller. But this ex-post assessment does not automatically mean that the resulting pattern of adjustment was harsher than it would have been without an independent monetary policy, i.e. during deflationary adjustment under a hard peg.

I thus believe that the Czech experience in the second half of 1990s cannot be used as a clear argument against having an independent monetary policy.[23] It simply shows that the monetary policy must be well mixed with fiscal policy to reduce the costs of stabilisation. If the fiscal policy is pro-cyclical and does not respond flexibly to the macroeconomic needs, serious problems may emerge. But this would be even more true with a currency board regime or euroization, under which the fiscal policy remains the only stabilisation policy tool. At present, the Czech fiscal policy is not ready to assume such a role.[24] There are serious structural problems in public finance, combined with an expansive fiscal policy spending the privatisation revenues, that will cause the structural budget deficits to widen further to about 7 % of GDP in 2002-03. This means that in the coming years a substantial fiscal consolidation will be needed. Unless the circumstances are really favourable, the fiscal policy will be a source of demand shocks rather than a stabilising element. The unresolved fiscal problems thus constitute a strong argument for having an independent monetary policy at the moment.

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[21] I have borrowed this estimate from Bezděk and Matalík (2000). The structural deficit is adjusted for privatisation revenues and subsidies to the transformation institutions, i.e. for one-off operations that do not have direct implications for aggregate demand in the economy. This adjustment reflects the special features of a transition economy such as the Czech Republic.

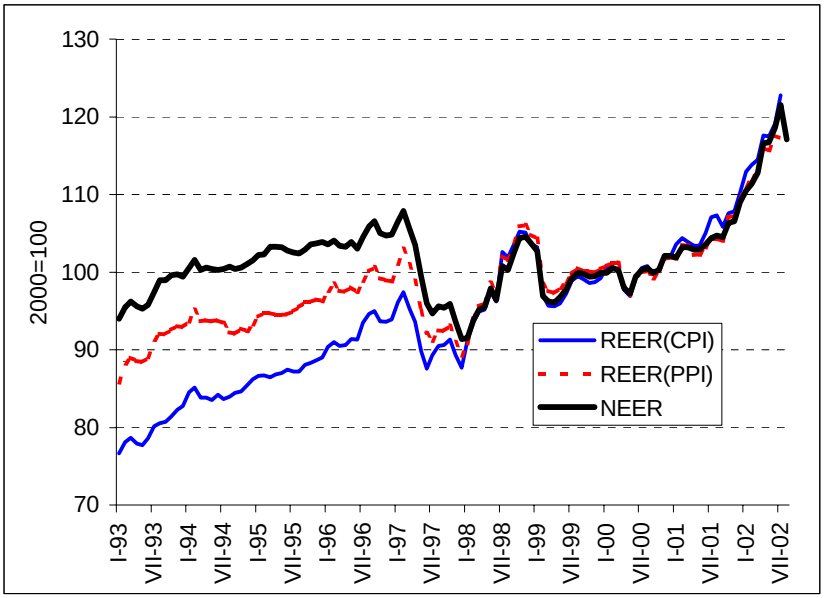
[22] For this view, see e.g. IMF: "Czech Republic: Staff Report for the 2000 Article IV Consultation," August 2000. However, as the IMF also pointed out, fears prevailed in 1998 that the emerging market crises might undermine stability of the CZK and lead to quick reversals in capital flows. These concerns may serve as an ex-ante explanation of why the interest rate cuts were slower in 1998 than is now perhaps viewed as optimal.

[23] Moreover, I believe that the past policy (ex-post) errors can be largely attributed to the uncertainty about transmission mechanisms of monetary policy. If transmission mechanisms in the Czech Republic differ from those in the EU, it is another source of asymmetry – in addition to those that I discuss in sub-section IV.2 – that supports the arguments against euroizing quickly. This point was stressed e.g. by Janáčková (1998).

[24] As Fischer (2001) pointed out, "fiscal policy can play a counter-cyclical role provided the fiscal situation is strong enough in normal times for fiscal easing during a recession not to raise any questions about the long-term fiscal sustainability."

It is also true, however, that the recent developments strengthened the arguments of the people favouring a fast eurozone accession. Since late 2001, there has been a sharp appreciation both in the nominal and real effective exchange rate of the CZK (see Figure 7). Even though there are good reasons for a long-run real appreciation trend, its recent speed (10-15 % y/y in real terms) seems to be by far excessive. The CNB has called this development "a bubble" and responded quite actively with a set of measures (an agreement with the government to convert its FX revenues through the CNB's FX reserves; direct FX interventions in the market; interest rate cuts etc.). If the CNB's judgement is correct, which I believe it is, it shows that the exchange rate may be a source of serious shocks for the economy, rather than a shock-absorber. This makes a case for a fast euroisation. At present, though, we still do not have sufficient evidence how much the strong crown actually hurt the economy.

**Figure 7: Nominal and Real Effective Exchange Rate of the CZK**




*Source: Czech National Bank*

In any case, the recent exchange rate developments also constitute a strong argument for a fast fiscal consolidation at least on three grounds: (i) If we believe it is good to adopt euro fast to avoid exchange rate volatility, it is necessary to fix the fiscal situation to be able to enter (Maastricht criteria and the Growth and Stability Pact) and to survive the entry smoothly. (ii) The current exchange rate bubble was originally initiated by the expectations of high privatisation inflows which the government would want to spend – it was thus connected to the fiscal expansion, at least indirectly. (iii) To the extent that the expansive fiscal policy puts an upward pressure on the interest rates (which, however, are very low at present), it also pushes the exchange rate to the strong side.

### IV.2. Czech Republic's Degree of Integration with the EU

In the model analysis of section III, the only measure of integration between economies was the correlation of their supply-side shocks. In reality, however, the sources of potential shocks are likely to be very diverse, and we can hardly measure their cross-country correlations. Therefore, it is difficult to find a universal, comprehensive measure of the degree

of integration among countries in practice. We thus have to rely on a range of indirect indicators.

Cincibuch and Vávra (2000) provide some of these indicators for the Czech Republic. Among the factors that speak in favour of a fast monetary integration with the EU, they point out to a substantially increased correlation between the Czech and German business cycles over the last years, increasing share of the EU on Czech exports and growing share of intra-industry trade with the EU. Among the factors that speak in the opposite direction they stress the existing tight links of the Czech Republic with the CEFTA countries and strong wage shocks coming from the labour market. In the following text, I reproduce some of their arguments and present a few other indicators, trying to infer their implications for the optimal exchange rate regime before our E(M)U-accession.

Probably the most frequently used measures of the degree of integration are the territorial and commodity structure of foreign trade, together with the economic openness. From this point of view, the Czech Republic has achieved a substantial progress in its convergence to the EU. As shown in Figure 8, the EU now accounts roughly for 70 % of total Czech exports.[25] The importance of these developments is underlined by the Czech Republic's large degree of economic openness, the total exports of goods and services reaching more than 70 % of GDP.

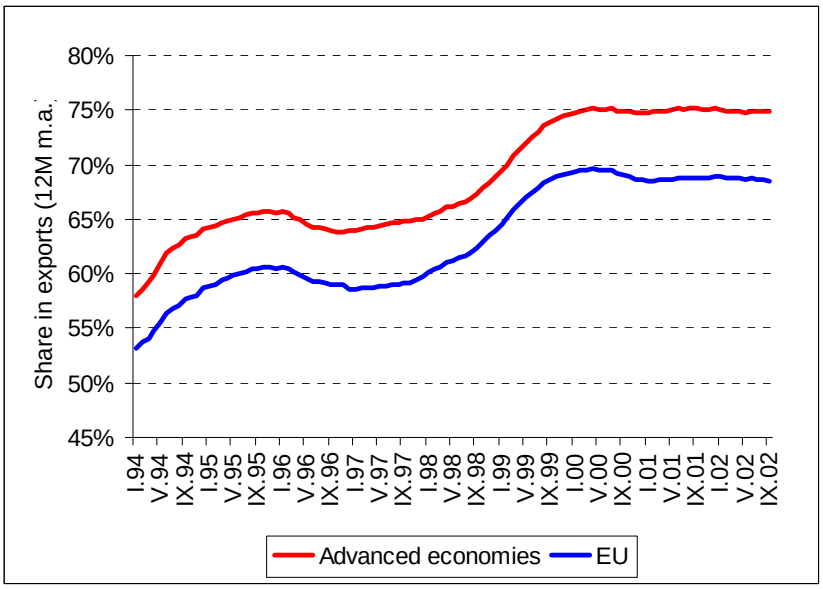



**Figure 8: Trade Convergence to the EU**

*Source: Czech Statistical Office*

Moreover, favourable changes have been observed in the commodity structure of foreign trade, too. The share of higher-value-added products (i.e. machinery, transport equipment, industrial consumer goods) is growing steadily, and has already reached 60 %. This should lead to an increasing synchronisation of the Czech business cycle with the EU (see Cincibuch and Vávra, 2000) and reduced probability of asymmetric shocks. In the recent years, though, the Czech business cycle has not been synchronised with the EU (Figure 9),

[25] In Hungary, the EU's share slightly exceeds 75 %, in Poland 70 % and in Slovakia 60 %.

which may be an argument against a fast eurozone entry (if one does not believe that the Czech cycle is generated by the monetary policy and/or the exchange rate fluctuations).

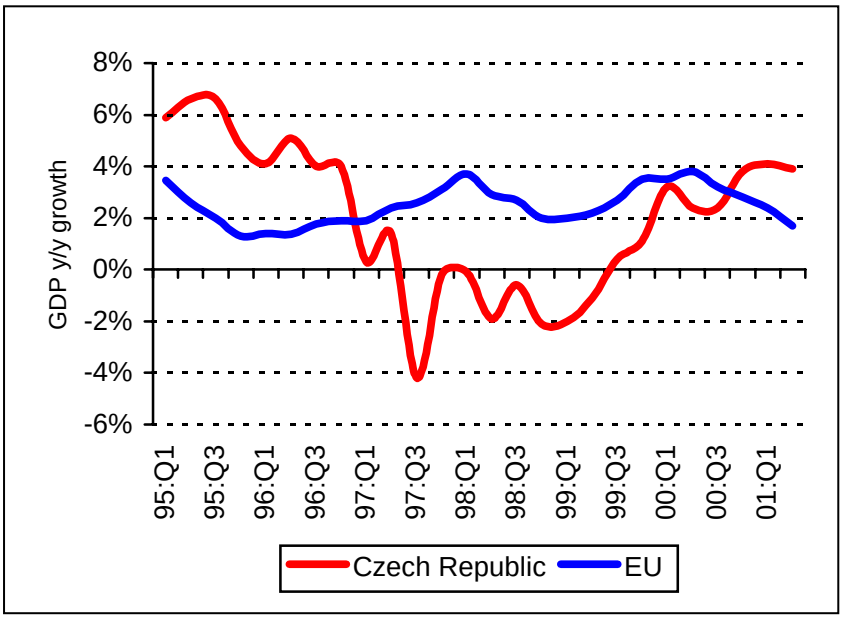


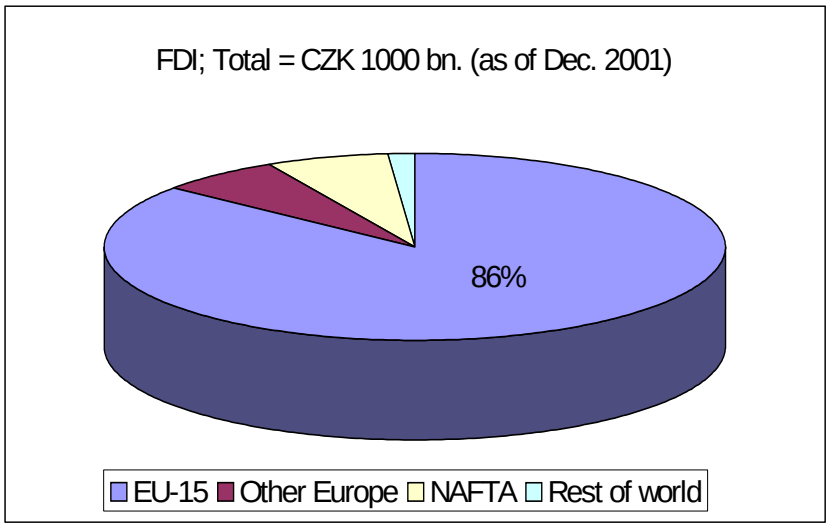

**Figure 9: Cyclical Convergence with the EU**

*Source: Czech Statistical Office*

The trade convergence is being facilitated by an increasing integration with the EU in the ownership area. The inflow of foreign direct investment to the Czech Republic has accelerated substantially in the last three years. As a result, more and more Czech companies become members of international conglomerates, and should thus be subjected to the same kinds of external shocks as their foreign parents and sisters. Given the fact that the EU accounts for 85 % of all FDIs in the Czech Republic (see Figure 10 below), this considerably reduces the danger of asymmetric shocks between the EU and Czech Republic.

On the other hand, there are also some reasons to believe that the current degree of Czech Republic's integration with the EU is not sufficient to justify an effort to join the monetary union quickly. One of them is related to the problem of real and nominal convergence to the advanced EU countries. As shown in Figure 11, the Czech real GDP measured in purchasing power parity (PPP) reaches just about 60 % of the EU average (and is even much less measured by current exchange rate). While this is the second highest level among all Central and Eastern European applicants to the EU (behind Slovenia), it is still well below even the least advanced EU-countries. The process of real EU-convergence, that will hopefully take place in the future, will probably have different speeds in different economic sectors and geographic regions, which may be viewed as a kind of asymmetric supply-side shocks in relation to the EU. The process of real convergence will thus create challenges for the stabilisation policies that a common EMU monetary policy could not reflect.

**Figure 10: "Ownership Convergence" with the EU**

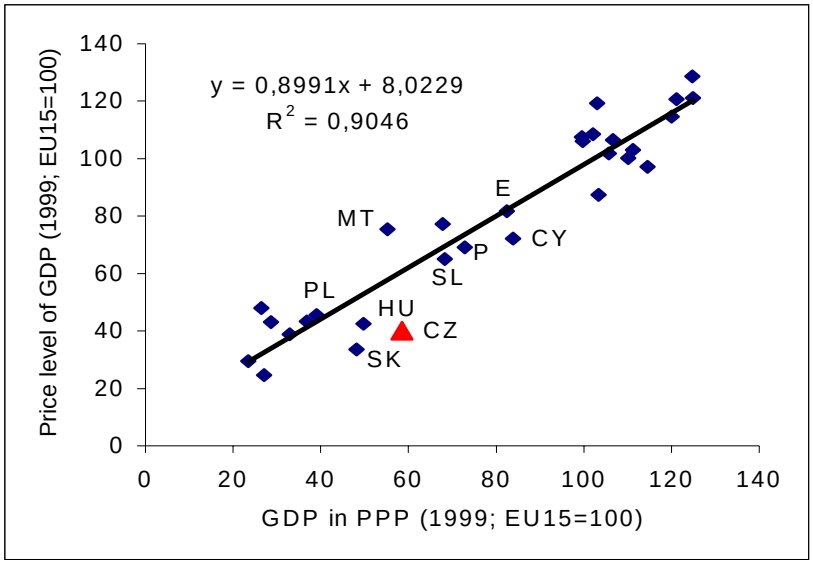



*Source: Czech National Bank, own computations*

The real convergence problem is related to the price convergence problem. At present, the average Czech price level reaches just about 40 % of the EU average. Partly, this can be attributed to the low GDP level in the Czech Republic, as the cross-country comparisons confirm there is a strong empirical correlation between the real GDP and price levels in individual countries (see Figure 11). Nevertheless, the GDP-price level relationship cannot explain the low Czech price level fully, as the Czech Republic lies far below the regression line in Figure 11 (by more than 15 % points), having one the largest negative residuals. There is no clear consensus on why this is the case (for some alternative explanations see e.g. Holub, Čihák, 2000; Čihák, Holub, 2001), but there seems to be a consensus that the nominal convergence will be an important part of our overall economic convergence to the EU. The average Czech price level thus should be growing over time, which is equivalent to a long-run real exchange rate appreciation. This, of course, will mean a challenge for stabilisation policies that may be taken into account only if the Czech Republic performs its own independent monetary policy.[26] In addition, the timing of this expected real exchange rate appreciation is a big source of uncertainty, which could seriously undermine the credibility of any exchange rate peg.

[26] Frankel (1995), for example, writes: "A country experiencing sustained rapid productivity growth will eventually have to allow its currency to appreciate in real terms. The implication for the choice of monetary regime is that, if a country hopes seriously to maintain an inflation rate no higher than that of its major trading partners, fixing the exchange rate cannot be a permanent policy; eventually there will have to be an upward revaluation."

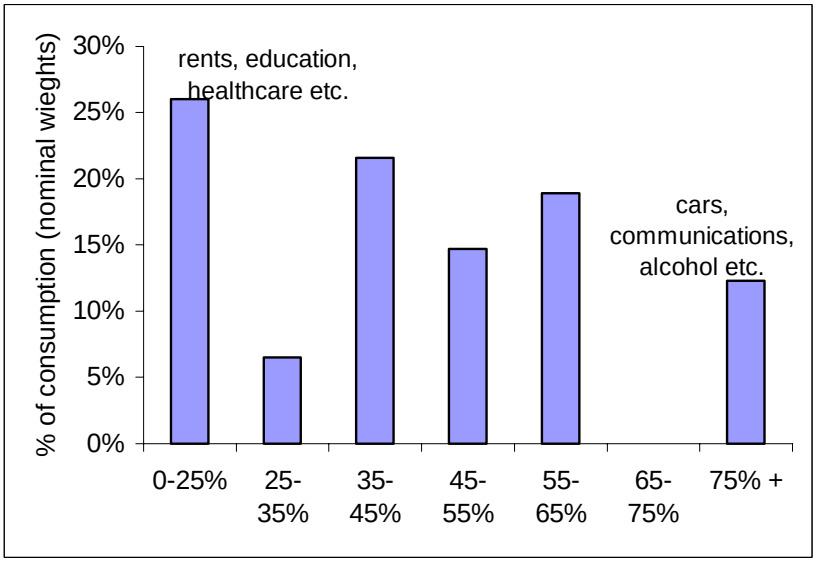
**Figure 11: Real and Nominal Convergence**




*Source: OECD; own computations*

Moreover, as stressed in Holub, Čihák (2000), the core of the price convergence problem consists not so much in the low average price level itself, but rather in the high dispersion of individual prices around this low average (see Figure 12). This means that the system of Czech relative prices differs substantially from that in advanced EU economies. As the Czech Republic converges to the EU, these relative price differences should be gradually reduced. This means that the price growth will have different speeds for each commodity group, which can be loosely interpreted as structural supply-side shocks. Moreover, if the prices are downward-sticky, the relative price adjustment will push on higher inflation in the Czech Republic (by 2 - 4 % points – see Holub, Čihák, 2000) which will be yet another challenge for the Czech monetary policy.

**Figure 12: Distribution of Czech Prices Compared to Germany (1999)**




*Source: Czech Statistical Office, own computations*

Finally, the Czech economy showed significant supply-side weaknesses in the recent past due to institutional and structural problems. The "institutional convergence" can thus be thought of as another issue that may contribute to asymmetric developments between the Czech Republic and the EU, and reduce credibility of any exchange rate peg. But in this respect, the Czech Republic has made substantial progress. Perhaps the most striking example is the banks reform, which was de facto finished in 2001 with a sale of the last large state-owned bank to a foreign strategic partner. Nowadays, foreigner control more than 70 % of Czech bank equity and 95 % of bank assets. The foreign owners are expected to financially stabilise the banks, improve their efficiency and, perhaps most importantly, to supply the much needed know-how in modern banking. As a result, it may be hoped that the Czech banks do not constitute a threat to the Czech macroeconomic stability in the foreseeable future, and that their behaviour might become more standard, perhaps helping increase the symmetry of monetary transmission with the advanced countries.

To sum up, I believe that there are both pros and cons for a fast euroisation. There seems to be no urgent need to import credibility of monetary policy from abroad. As a result, it is unwise to think of any other possibility than the official eurozone entry. But an official EMU membership remains an indisputable medium-run target. The only issue is thus its timing. And as the cost-benefit analysis gives no clear answer to this, we find ourselves in a situation when the politics take over the economics in the decision-making. The crucial prerequisite for the timing will most probably be the pace of fiscal consolidation. Due to that, it seems unrealistic at present that the Czech Republic could join the EMU before 2007-08. The positive side of this is that in this time horizon, the main risks of monetary integration can be further reduced by the on-going convergence process. In the meantime, the Czech National Bank should continue to carry out its independent monetary policy of inflation targeting and managed floating of the exchange rate. The ERM2 entry should take place just two years before the expected eurozone entry, as this exchange rate regime belongs to the soft peg category which I criticised in section II.

# V. Summary and Conclusions

In this paper, I discussed how emerging and transition countries can try to reduce their credibility deficit by importing low inflation from abroad via fixed exchange rates. Using the standard Obstfeld model of exchange rate pegs I demonstrated the danger of self-fulfilling currency crises. This danger explains why the economists and politicians currently favour the corner (polar) exchange rate solutions: either floating or very rigidly fixed exchange rates. I discussed the essence of currency boards as "self-destructing commitments" that can eliminate the danger of self-fulfilling crises. I also showed that a currency board or dollarization/euroization is more advantageous for a country if its inflationary bias (or, loosely speaking, its credibility deficit) is high and the variability of supply-side shocks is low. This is a standard result in the rules-versus-discretion debate.

In section III, I demonstrated how the decision whether to adopt a rigidly fixed exchange rate or not depends on the degree of country's integration with the foreign economy, the currency of which is used as an exchange rate anchor. I showed that increasing correlation between the shocks in both regions can reduce the costs of their monetary integration. This is a standard result of the optimum currency area literature. In the present paper, however, it was derived in a very simple model that integrates the optimum-currency-area considerations with the rules-versus-discretion debate.

In an appendix, I also show the impact of another asymmetries between countries. These include differences in the variability of foreign and domestic supply-side shocks and

differences in the inflation aversions of countries. If the correlation of shocks is not perfect, it may be desirable to have some asymmetries in the other areas, too. In particular, it may be wise to fix the exchange rate to the currency of a country that suffers from smaller supply-side shocks and has higher inflation aversion than the domestic country does. These conclusions seem to run against the common wisdom that reducing the degree of asymmetries in every parameter is always good for monetary unification.

Finally, I used the model analysis to argue with the recommendations of Dornbuch and Giavazzi (1998) that the CEE countries should adopt currency boards to resolve their credibility problem. In my opinion, these authors ignore the fact that both the credibility of post-communist countries and their integration with the West tend to increase over time. In such a situation it is not easy to give a universal recommendation on the appropriate exchange rate regime for all post-communist economies. For those countries that have achieved a substantial progress in building credibility and expertise of their monetary policies, and at the same time still face many challenges in their convergence to the advanced EU countries, it may be perfectly rational to have independent monetary policies with floating exchange rates before their official E(M)U-accession. I argued, that the Czech Republic belongs to such countries. It is true that our integration with the EU is relatively large when measured by the degree of economic openness and structure of foreign trade. On the other hand, there are other indicators showing that our economic transition and convergence to the EU is still far from being completed. In this situation, it would not be wise to speed up the monetary integration with the EU artificially. On the other hand, if we join the EMU around the year 2007-08, which seems to be a realistic scenario at present given the existing political constraints, it may be hoped that the major convergence risks will have been reduced by that time. Before the EMU accession, the CNB should continue to carry out its independent monetary policy of inflation targeting and managed floating of the exchange rate. The ERM2 period should be kept down to the minimum of two years, as this exchange rate regime belongs to the unpopular and dangerous category of soft pegs.

# Appendix I: Additional Sources of Asymmetry Between Countries

In equation (22), I assumed that countries do not differ in the variability of their supply-side shocks and their inflation aversions. In practice, however, such differences may be important. In this appendix, I analyse how the model of section III changes if either of these two assumptions is relaxed.

1) Differences in the variability of shocks

I will assume that the variability of foreign shocks is given by

$$\sigma^2\left(z_t^f\right)=(1+\lambda)\sigma^2\left(z_t\right);\quad \lambda\geq -1$$

*(AI-1)*.

If $\lambda$ is below zero, it means that the foreign country is hit by less volatile supply-side shocks than the home country, and vice versa. All other assumptions remain the same as in section III.

We can use (AI-1) to rewrite equation (26) as

$$E\left(\Lambda_t^{fix}\right)=k^2+\frac{2+\chi+\lambda}{1+\chi}\sigma^2\left(z_t\right)-\frac{2}{1+\chi}\sigma^2\left(z_t^f\right)\sqrt{(1+\lambda)}\rho\left(z_t,z_t^f\right) \qquad \textit{(AI-2)}.$$

It is thus preferred for the home country to have a rigidly fixed exchange rate in this setting if

$$k^2\geq\frac{\chi}{1+\chi}\sigma^2\left(z_t\right)\left[2+\lambda-2\sqrt{(1+\lambda)}\rho\left(z_t,z_t^f\right)\right]$$

*(AI-3)*.

The second term in the square bracket on the right-hand side is directly increasing with $\lambda$. If the correlation between the domestic and foreign supply-side shocks is negative, the last term in increasing in $\lambda$, too, meaning that the argument of the square bracket is smallest for $\lambda$=*-1*. For a non-negative correlation of supply-side shocks, the last term in the square bracket is decreasing in $\lambda$. We can find the optimal value of $\lambda$ by differentiating the right-hand side of (AI-3) with respect to $\lambda$. We get the first-order condition

$$1-\frac{1}{\sqrt{(1+\lambda)}}\rho\left(z_t,z_t^f\right)=0\quad\Leftrightarrow\quad\lambda=\rho^2\left(z_t,z_t^f\right)-1 \qquad \textit{(AI-4)}.$$

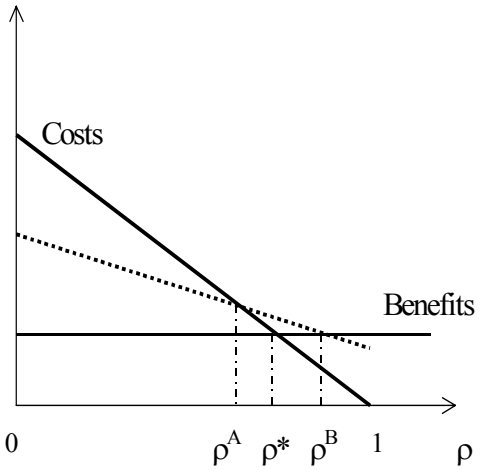
If the positive correlation of supply-side shocks is perfect, it is most convenient if the foreign country also has the same variability of supply-side shocks as the home one. Otherwise, the responses to supply-side shocks that are imported from abroad are not optimal for the home country, despite the perfect correlation of shocks. On the other hand, if the correlation is zero, the home country wants the foreign shocks to be as small as possible (i.e. $\lambda$ close to –1). The foreign central bank's responses to supply-side shocks are a nuisance for the home country, and it thus wants these responses to be minimal (the same logic explains why it wants $\lambda$=*-1* if the correlation of shocks is negative). In the general case when the correlation coefficient is between zero and one, the home country prefers $\lambda$ to be above minus one, but below zero. In other words, if the possibility of asymmetric shocks cannot be fully

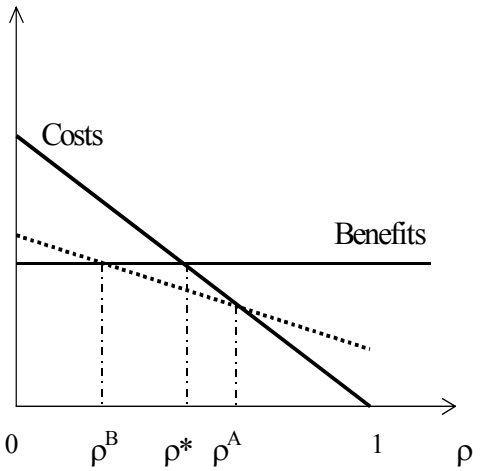
avoided, the home country would ideally want to peg its currency to a country that is more stable in terms of its supply-side shocks.

One can also give a simple graphical interpretation of the above findings (see Figure AI-1). If $\lambda<0$, the intercept of the costs line in Figure 3b) shifts downward and the whole curve becomes flatter (see equation AI-2). Moreover, with $\lambda<0$ the costs of a hard peg can never decline to zero for $\rho=1$. As a result, these costs go down for lower correlations of shocks and up for higher correlations of shocks. Only for one level of correlation (denoted $\rho^A$ in Figure AI-1) the costs stay the same. We can thus clearly see that if the correlation is below some level (i.e. below $\rho^A$ in the case of Figure AI-1; but in general if it is below 1) it is better for a country if the variability of foreign shocks is smaller than the variability of domestic shocks.

**Figure AI-1: Additional Sources of Asymmetry – a graphical illustration**

**a)** **b)**



We may also ask if for a given level of asymmetry in the variability of shocks (i.e. for a given $\lambda<0$), the minimum correlation of shocks required for a hard peg is smaller or greater than for perfect symmetry in the variability of shocks. The answer to this question is not clear, however, as is depends on the exact situation. In particular, if $\rho^A<\rho^*$ as in Figure AI-1a), the minimum required correlation of shocks goes up to $\rho^B>\rho^*$. On the other hand, if $\rho^A>\rho^*$, the break-even point for the correlation of shocks goes down to $\rho^B<\rho^*$ as in Figure AI-1b).

2) Differences in the inflation aversion

Now I will assume that the two countries differ in their inflation aversion, denoting the foreign inflation aversion by $\chi^f$. Again, I keep all the other assumptions of section III (including the equal variability of shocks). It is not difficult to show that in this setting equation (26) modifies to

$$E\left(\Lambda_t^{fix}\right)=k^2+\sigma^2\left(z_t\right)\left[\frac{1+\chi}{\left(1+\chi^f\right)^2}-\frac{2}{1+\chi^f}\rho\left(z_t,z_t^f\right)+1\right] \qquad \textit{(AI-5)}.$$

It is preferable for the home country to have a fixed exchange rate if

$$k^2\geq\chi\sigma^2\left(z_t\right)\left[\frac{1+\chi}{\left(1+\chi^f\right)^2}-\frac{2}{1+\chi^f}\rho\left(z_t,z_t^f\right)+\frac{1}{1+\chi}\right] \qquad \textit{(AI-6)}.$$

If the correlation of supply-side shocks between the two countries is negative, the term in the square bracket on the right-hand side is decreasing in $\chi^f$, which means that you would ideally like $\chi^f\to\infty$. If the correlation is non-negative, we can find the optimal level of foreign inflation aversion by differentiating the argument of the square bracket with respect to $\chi^f$ and setting this derivative equal to zero. This leads to the first-order condition

$$\frac{1+\chi}{1+\chi^f}=\rho\left(z_t,z_t^f\right)\ \Leftrightarrow\ \chi^f=\frac{1+\chi}{\rho\left(z_t,z_t^f\right)}-1 \qquad \textit{(AI-7)}.$$

This means that for a perfect positive correlation of supply-side shocks the home country welcomes if the foreign country has the same inflation aversion, because in this situation the foreign central bank's policy actions are optimal for you. On the other hand, if the correlation is zero, the home country wants $\chi^f\to\infty$. The logic is the same as in the previous case of differing shock variances. The foreign central bank's responses to shocks represent a nuisance for the home country if shocks are non-correlated. The home country thus wants these responses to be minimal, which is achieved if the foreign central bank does not care about output but only about stabilising inflation at its zero target. For the general case when the correlation of shocks is between zero and one, the home country prefers $\chi^f$ somewhere above $\chi$. This means that it welcomes if the foreign country is more inflation-averse.

The graphical illustration of this situation is the same as in Figure AI-1 above.

The following general lesson can be drawn from this appendix. When there exist asymmetric shocks, the home country may prefer to have some asymmetry in other parameters of the economies as well, that would lead to smaller responses of the foreign central bank to supply-side shocks compared to the optimal responses of the domestic central

bank. The desired asymmetries include a lower variability of foreign shocks and a higher inflation aversion abroad.[27] These conclusions seem to run against the common wisdom that reducing the degree of asymmetries in every single parameter is good for monetary unions in any situation.

In practice, it is quite realistic to assume that the advanced countries, whose currencies are the most serious candidates to become nominal anchors for the currencies of less developed countries, are hit by smaller supply-side shocks on average. This is because their labour markets are more stabilised, productivity growth is more balanced and their dependence on raw-materials and agricultural production (i.e. the industries with most volatile production and prices) may be relatively weaker than in the emerging and transition countries. Also, it is realistic to expect that these countries have a relatively high degree of inflation aversion. This increases their attractiveness as exchange rate anchors for the currencies of emerging economies.

[27] Another source of asymmetry could be a difference in the slopes of domestic and foreign supply curves. This factor was not explicitly taken into account in this paper for computational simplicity. If the slope of the foreign supply curve $\beta$ was in general different from unity (i.e. the assumed slope of the domestic supply curve), it would be optimal for the foreign country to follow a policy given by $\pi_t^f = \frac{\beta}{\beta^2 + \chi} z_t^f$ (see e.g. Frankel, 1995; Obstfeld, 1996b). This means that a change in $\beta$ may have similar impacts as a change in $\chi$ (but the responsiveness to supply-side shocks is not a monotonic function of $\beta$, and depends on its relationship to $\chi$).

# Appendix II: Policy Errors

In this appendix, I relax the assumption that the domestic central bank makes no policy errors under discretion. I will model these errors by introducing a white-noise shock to the central bank's reaction function of equation (4). In particular, I will assume that under discretion the central bank sets inflation to

$$\pi_t = \frac{\pi_t^E + k + z_t}{1+\chi} + \varepsilon_t \qquad \textit{(AII-1).}$$

As a result, the expected value of central bank's loss function under floating modifies from equation (19) to

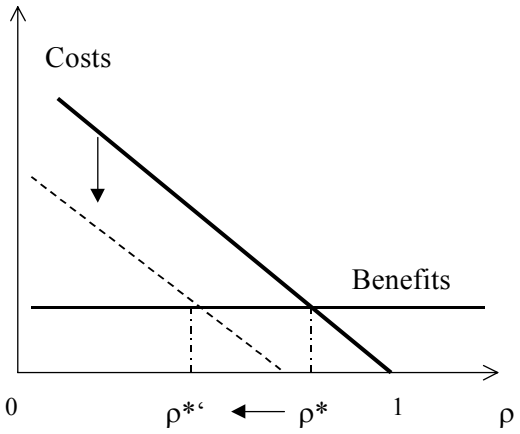
$$E\left(\Lambda_t^{float}\right) = \frac{1+\chi}{\chi}k^2 + \frac{\chi}{1+\chi}\sigma^2(z_t) + (1+\chi)\sigma^2(\varepsilon_t) \qquad \textit{(AII-2).}$$

The inequality (28) then changes to

$$k^2 \geq \frac{2\chi}{1+\chi}\sigma^2(z_t)\left[1-\rho\left(z_t, z_t^f\right)\right] - (1+\chi)\chi\sigma^2(\varepsilon_t) \qquad \textit{(AII-3).}$$

The central bank's errors thus make fixing the exchange rate more attractive, as the discretionary policy under floating makes the economy subject to undesirable policy shocks. This effect is the stronger the larger is the inflation aversion $\chi$. In the graphical interpretation of Figure 2b), the policy errors shift the costs of foregone discretion downwards, reducing the critical level of integration that is needed for a monetary integration to be optimal (see Figure AII-1).

**Figure AII-1: Policy Errors and the Costs of Monetary Unification**



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