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INFLATION AND EXCHANGE RATE REGIMES IN  
TRANSITION ECONOMIES

**Currency Board Arrangement as a Special Case**

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**Tiivistelmä**

Kun suunnitelmatalous äkillisesti murtui noin kymmenen vuotta sitten, ja siirtymä (transitio) kohti markkinataloutta alkoi, aiemmin säädeltyjen hintojen vapauttaminen aiheutti aluksi korkean, jopa hyperinflaation siirtymätalouksissa. Tämän tutkimuksen tarkoituksena oli selvittää valuuttakurssiregiimin ja inflaation välistä suhdetta transition aikana konstruoimalla inflaatiota selittävä ekonometrinen malli. Aineisto koostui 25 siirtymätaloudesta, joille oli havaintoja vuositason ajanjaksolta 1991 – 1998. Aineisto on koottu pääasiassa EBRD:n (Euroopan jälleenrakennus- ja kehityspankki) ja IMF:n (Kansainvälinen valuuttarahasto) julkaisuista.

Aiempi kirjallisuus antaa valuuttakurssiregiimin ja inflaation välisestä suhteesta ristiriitaisen kuvan. Siirtymätalouksien kohdalla vallitseva näkemys on ollut, että valuuttakurssiregiimin rooli on inflaation vakauttamisessa toissijainen; tärkeintä on säilyttää tiukka rahapolitiikka ja hallittu finanssipolitiikka. Kuitenkin talusteorioiden ja tutkimuksen pohjana olevat Ghoshin ja muiden (1997, 1998, 1999) tutkimukset ehdottavat, että valuuttakurssin sitominen rajoittaa rahapolitiikkaa (discipline effect) ja läpinäkyvänä järjestelmänä tuo talouteen luottamusta (credibility effect) ja täten alentaa inflaatiota. Lisäksi teoriassa valuuttakatejärjestelmä korostaa molempia mainittuja etuja, ja siten vakauttaa hintojen nousua vielä tavallista kiinteän kurssin järjestelmää enemmän. Tutkimushypoteesini oli teorian mukainen.

Mallittamisessa käytettiin paneeliestimointia, jossa aikasarja lyheni vuosiin 1992 – 1997 aineiston kattavuuden säilyttämiseksi. Valuuttakurssiregiimit jaettiin neljään luokkaan, joista kukin muodosti oman dummy-muuttujansa: valuuttakatejärjestelmä, muu kiinteän kurssin järjestelmä, hallittu kellunta ja vapaasti kelluva valuuttakurssi. Kontrollimuuttujia oli aluksi mukana kuusi (poislukien viiveet). Estimointimenetelmänä oli edetä yleisestä kohti yksinkertaisempaa mallia talusteorian asettamisessa rajoissa.

Estimointitulosten mukaan valuuttakurssiregiimi ei ole tilastollisesti robusti muuttuja. Erityisesti rahan tarjonnan kasvun ja talouden vapauttamisindeksin ollessa mukana mallissa, valuuttakurssiregiimit menettävät tilastollisen merkittävyytensä. Osittain tulokset kuitenkin tukevat käsitystä, että kiinteä valuuttakurssi hillitsee rahan tarjonnan kasvua ja näin alentaa inflaatiota. Aineisto ei antanut tälle ilmiölle tukeaa valuuttakatejärjestelmän kohdalla. Sen sijaan valuuttakatejärjestelmän havaittiin korreloivan varsin selkeästi talouden avoimuuden kanssa ja tätä kautta vaikuttavan alhaisemman inflaatiotason saavuttamiseen. Kuitenkin, erityisesti valuuttakatemaiden toistaiseksi vähäinen määrä rajoittaa johtopäätösten tekemistä.

**Avainsanat:** valuuttakurssiregiimi, valuuttakatejärjestelmä, inflaatio, siirtymätalous, inflaatioon vaikuttavat tekijät

**Exchange Rate Regimes and Inflation in Transition Economies. Currency Board Arrangement as a Special Case. Kauppila, Tarja. Economics. University of Jyväskylä. Spring 2001. 58 pages, 6 appendices.**

**Abstract**

This paper makes an empirical examination of the relationship between exchange rate regimes and inflation using panel data from 25 transition economies. Exchange rate regimes are divided in currency boards, conventional pegs and flexible exchange rates (managed floats and free floats). The main emphasis is on currency boards in comparison to other pegs. The data used in this study is collected from variety of different sources, main sources being EBRD's (European Bank of Reconstruction and Development) Transition Reports, IMF's (International Monetary Fund) surveys and a number of scholarly articles.

To carry out the econometric analysis, the cross-section and time series data for all 25 countries for six years, 1992-1997, is pooled. The analysis applied follows the general-to-specific methodology.

The results suggest that in all, exchange rate regimes do not count for highly significant fraction of inflation performance in transition countries. To a certain extent our findings support previous empirical evidence and theoretical hypothesis that inflation is lower under conventional pegs (through lower monetary growth rates; discipline effect) and still lower under currency board arrangement. However, exchange rate regimes were not robust to the inclusion of a set of other determinants of inflation, mainly monetary growth and liberalization index. Currency boards did not affect inflation significantly even when money supply growth was excluded. Instead we found a strong correlation between currency board arrangements and liberalization index. This would suggest that currency board countries have been successful in stabilizing inflation, not because of the system itself but because they have followed liberal economic policies, and this liberality or openness itself has imposed discipline to the economy. However, the limited amount of currency board observations enables only very cautious conclusions.

**Key words:** exchange rate regime, currency board, inflation, transition economies, determinants of inflation

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## **Abbreviations:**

<b>BGL</b>	<b>Bulgarian lev</b>
<b>CEE</b>	<b>Central and Eastern Europe</b>
<b>CPI</b>	<b>Consumer Price Index</b>
<b>DEM</b>	<b>Deutsche mark</b>
<b>EBRD</b>	<b>European Bank for Reconstruction and Development</b>
<b>EEK</b>	<b>Estonian kroon</b>
<b>FSU</b>	<b>Former Soviet Union</b>
<b>GDP</b>	<b>Gross Domestic Product</b>
<b>IMF</b>	<b>International Monetary Fund</b>
<b>LTL</b>	<b>Lithuanian litas</b>
<b>SDR</b>	<b>Special Drawing Rights</b>
<b>USD</b>	<b>U.S. dollar</b>

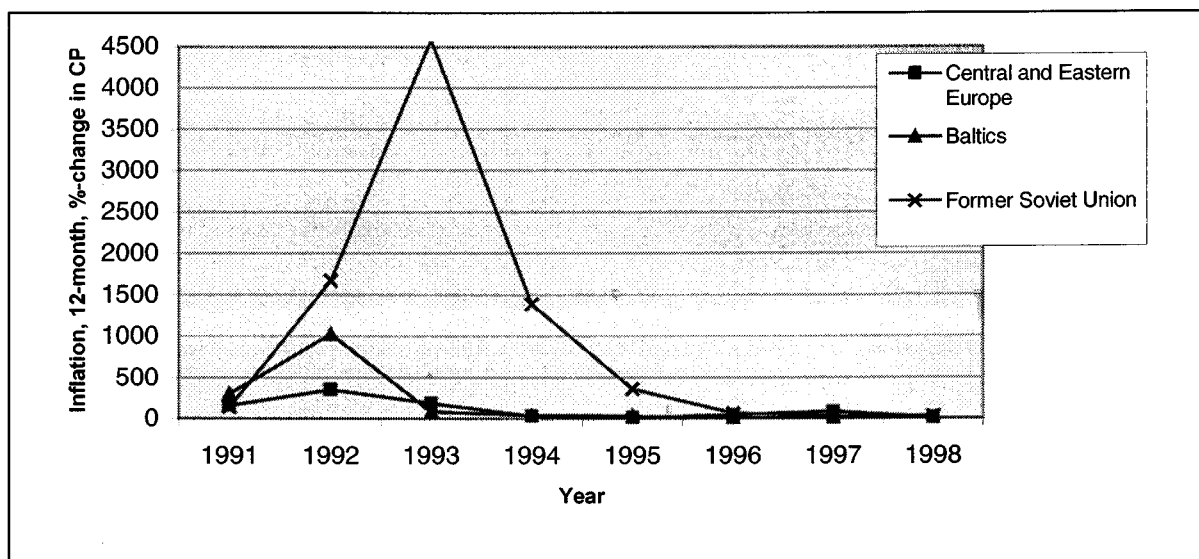
# 1 INTRODUCTION

*"Stability might not be everything, but without stability, everything is nothing."*

-Karl Schiller-<sup>1</sup>

The sudden collapse of socialism in the Central and Eastern Europe in the years after 1989 created a rare natural laboratory for comparative economics. Approximately ten years after the initial reforms it is already possible to draw some lessons of the determinants of macroeconomic performance in a road from centrally planned toward market economy.

Even though it was well known that inflationary pressures were repressed in the old system, the fact that inflation jumped to over thousand percent a year in every former Soviet Union (FSU) country was a surprise for many. Some Central and Eastern European countries managed to lower inflation figures to double-digits already until the end of 1992, when in Baltic countries, Russia and other FSU countries inflation was still hiking.



**FIGURE 1 Inflation performance in transition economies in 1991 – 1998**

<sup>1</sup> Karl Schiller was the West German Social Democrat's economics minister between 1966 and 1972. (Quoted in Hanke 2000, 51.)

If inflation surged extremely fast, it also was stabilized remarkably fast in many countries despite the fact that when the economic transition process began there was little experience of how to manage it. Thus, those responsible for reforms had to make decisions on how to proceed before any evidence was available. In the beginning of transition also the question which exchange rate regime to choose was 'hot'. Many Central and Eastern European countries<sup>2</sup> initially pegged their currency, Estonia adopted a currency board arrangement (extreme case of a fixed exchange rate system) in 1992, and Lithuania followed Estonia's example in 1994. All the other transition countries chose first a more flexible regime.

The focus of this study is on the relationship between exchange rate regime and inflation in transition economies, which here consist of ten Central and Eastern European countries, the Baltic countries, Russia and other successor states of the former Soviet Union. During the last decade, as data has accumulated, many quantitative analyses of the transition experience have been done for instance by the European Bank for Reconstruction and Development (EBRD) in its annual Transition reports since 1994, De Melo, Denizer and Gelb (1997), Fischer, Sahay and Vegh (1996) and Wolf (1999) among others.

Still, empirical findings from transition countries so far are rather scarce mostly because of lack of large enough sample sizes. Concerning the relationship between regime choice and inflation there are essentially two views. First, especially in terms of transition countries rather common opinion among economists is that the regime choice itself plays only minor role in stabilizing inflation. Wyplosz (1999) among others argues that most important thing is to keep the monetary policy tight and fiscal policy under control and both pegged and flexible exchange rate regimes can work as means for these goals.

On the other hand, Fischer and others (1996), examining the early experience of transition countries find that fixed exchange rates are associated with lower inflation. This is consistent with findings that are not limited to transition countries. Perhaps the most comprehensive study of this issue is done by Ghosh, Gulde, Ostry and Wolf (1997), who using a pooled data of over 130 countries for thirty years, find that under fixed exchange rate arrangements inflation has been lower and less volatile than under more flexible regimes. Moreover, there has been a lot of enthusiasm and debate of currency board arrangements as a tool for

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<sup>2</sup> Croatia, the Czech Republic, Hungary, Macedonia, Poland and the Slovak Republic.

stabilizing, and Ghosh, Gulde and Wolf (1998 and 1999) report results in favor of currency boards.

So does it matter which nominal exchange rate regime the country chooses? Since the collapse of the Bretton Woods system<sup>3</sup> - when more flexible exchange rate arrangements gained momentum - not many questions in international economics have aroused as much discussion and debate as the choice of the nominal exchange rate regime.<sup>4</sup> Better understanding of the linkages between nominal exchange rate regime and inflation performance seems to be needed, because until now no consensus has emerged. In theoretical level this relationship is difficult to establish because of many different links between them.

The aim of this study is to examine the influence of the exchange rate regime on inflation performance in 25 transition economies during time period 1991 – 1998. In order to isolate the independent effects of exchange rate regimes on inflation, an econometric analysis of determinants of inflation will be conducted. However, some factors do complicate this kind of analysis. For example, the transition countries started their serious stabilization programs at different times, which complicates comparisons over a given time period. Moreover, shortcomings in data availability and quality are remarkable and differ across countries and across time.

This paper attempts to go beyond previous work mainly in that respect that exchange rate regimes are divided in three: besides fixed and flexible exchange rate regimes, currency board arrangement is introduced as an own regime. The main emphasis is on currency boards in comparison to other pegs, and focus is on transition countries. Moreover, the fact that capital markets have opened and capital mobility substantially increased during the past decade also in transition context is attempted to take into account. The hypothesis is that exchange rate pegging provides lower inflation and that currency boards are even more effective in bringing price stability.

The paper is organized as follows. Section 2 defines the basic concepts used and constructs a theoretical framework of the relationship between the exchange rate regimes and inflation.

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<sup>3</sup> Under the Bretton Woods system all countries were required to maintain some kind of currency peg.

<sup>4</sup> The literature that explores the theory of exchange rate regimes and discusses the choice of the regime is active. For recent discussion see among others Obstfeld and Rogoff (1995), Frankel (1999),



Section 3 reviews previous empirical evidence of the issue. Section 4 first presents and summarizes the data on the experience of inflation in 25 transition countries, and after that discusses the econometric estimation, empirical results and their robustness. Section 5 summarizes the findings and provides some concluding remarks.

## 2 THEORETICAL BACKGROUND: A BRIEF OVERVIEW

### 2.1 Concepts and the Context

#### 2.1.1 Defining Basic Concepts

To start with definition, *the exchange rate* is the price of foreign currency in terms of domestic currency. In other words exchange rate is the relative price of two monies. *Exchange rate regime* means those rules and principles according to which the exchange rates are determined. Every country has to maintain its external balance in the long run. There are two main alternatives to do that: floating exchange rate and fixed exchange rate.

When a country has a regime of *floating exchange rates*, the demand and supply of currency in the exchange rate market determines the equilibrium value of the exchange rate without any restrictions given for this rate. Thus the exchange rate is market determined and the devaluation or revaluation of the domestic currency eliminates the deficit or surplus of the balance of payment. The condition for pure floating exchange rate regime is that there is no exchange rate target in the economy. To refer to a less rigid category of floating exchange rates (for example managed floats), we will use term 'flexible'.

*Fixed exchange rate* refers to any system in which a monetary authority is committed to defend the exchange rate parity by selling or buying foreign reserves at this given fixed rate. For covering the difference between demand and supply of foreign currencies, the monetary authority needs to have a sufficient amount of foreign reserves. The distinction between fixed and pegged exchange rates is often confusing. In this study terms 'fixed' and 'pegged' will be used as synonyms. Moreover, we assume that when the exchange rate is pegged or fixed, it is tied to some 'hard' currency, which is likely to exhibit monetary discipline.

*Currency board arrangement (CBA)* is essentially an extension - a rigid form - of a fixed exchange rate regime. It has four basic principles: 1) domestic currency is pegged at fixed rate

to the anchor currency<sup>5</sup>, 2) domestic currency is completely convertible and fully backed by foreign reserves, 3) central bank is not allowed to finance fiscal deficits or act as a lender of last resort to banks and 4) the arrangement is based on law.

Thus, currency board is an institution that issues notes and coins that are completely convertible into the reserve currency at any time. It holds foreign reserves equal to at least 100 percent of the board's notes and coins in circulation. Currency board does not work as lender of last resort to commercial banks as a central bank may do, and the commitment to a fixed exchange rate is binding and based on law. Thus, in theory a currency board has no independent, discretionary monetary policy. Its power includes only the issuing of notes and coins and the exchange of them into the reserve currency. A currency board as the issuer of money also receives seigniorage<sup>6</sup> income, because the reserves held by the currency board can be deposited to earn interest, and the notes and coins issued by a currency board are naturally not interest bearing.

To continue with definitions, inflation refers to average growth in prices in time, and *disinflation* is a decline in the rate of increase in prices. As an example of disinflation, between 1992 and 1995 the annual rate of increase in the consumer price index (CPI) in Russia dropped from 2506 per cent to 129 percent<sup>7</sup>. Disinflation is important to distinct from deflation, which refers to fall in prices and is thus opposite to inflation.

During last decades starting from Milton Friedman's position against activist monetary policy, there has emerged a consensus that inflation reduction and price stability should be the main objective of monetary policy. What have led to this consensus leaves beyond this study and we will simply assume that price stability is the primary goal of monetary policy.

### **2.1.2 Background for Hiking Inflation in Transition Countries**

Focus of this paper will be on countries of Eastern Europe and countries that were part of the former Soviet Union. More precisely, the focus is on transition economies, where *economic*

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<sup>5</sup>Most countries that have adopted a currency board, have tied their currency to the US dollar or the Deutsche mark. In principle the domestic currency could be pegged to a currency basket, but in practice this has not happened.

<sup>6</sup> Here seigniorage means the profit made by a government in issuing currency.

<sup>7</sup> See Table 2 in section 4.1.2.

*transition* refers to abandoning central planning as the principal mode of organizing the economy and moving to private ownership based market economy.<sup>8</sup>

The transition can be said to have begun in 1989, when the Berlin Wall was opened and when Poland started its stabilization program on January 1990 (Fischer and others 1996). Major elements of transition that have generally been emphasized are macroeconomic stabilization, price and market liberalization, privatizing state enterprises and redefining the role of state (see e.g. EBRD Transition Reports). Given the goal of moving to a market economy, the key objectives of transition have been to raise economic efficiency and to promote growth.

Transition countries inherited from the socialist era a structure of relative prices that was very different than in market economies around the world. Under command economy prices did not reflect scarcities. Instead scarce goods were rationed and prices were fixed and usually set below market-clearing levels. This led to accumulation of money – that could not be spent on rationed goods – in savings deposits, pension funds, labor funds and so on. These cumulated forced savings are called a *monetary overhang*. Monetary overhang, excess demand of rationed goods, created repressed (hidden) inflation instead of open inflation.

Thus, because some administratively set prices were higher and some lower than in the market-based equilibrium, the transition countries first had to liberalize the state-controlled prices. When prices were liberalized, they were rapid to move upward but sticky to move downward. Thus, relative prices were needed to adjust through inflation. However, even though price liberalization caused initial burst in inflation, there is evidence (see e.g. Fischer, Sahay and Vegh 1996, Cottarelli, Griffiths and Moghadam 1998) that in the long run liberalization helps in reducing inflation.

Reasons for experienced high inflation in the beginning of transition were except price liberalization also for example budget deficits and their inflationary financing often by printing money. An external factor creating inflation was foreign trade that turned toward

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<sup>8</sup> According to Wolf (1999) some studies may include in transition economies also countries in East Asia (Cambodia, China, Lao P.D.R., Mongolia and Vietnam), but as the East Asia group differs in starting years of transition and in the feature that these economies have started economical but not political transformation, they can be excluded. Sometimes the net of transition economies includes also countries in Africa and Latin America. Even though they implemented some form of central planning at some time, the impact of socialism was quite limited. (Wolf 1999.)

western markets thus helping the relative prices to converge to market determined level. At the same time inflation became caused more by increasing costs as former cheap energy prices increased. Non-oil-producing transition economies experienced significant increases in the prices of energy imports (Wolf 1999, 12).

For the former Soviet Union countries an additional inflationary impulse was the decision to first maintain a common ruble area<sup>9</sup>. After the collapse of Soviet regime in 1991 the Baltic countries very soon introduced own currencies, while the others continued under the ruble area until July 1993<sup>10</sup> when Russia abandoned it by announcing the demonetization of pre-1993 rubles. The ruble area arrangement was ineffective, lax credit policy and lack of monetary instruments made it hard to implement plausible monetary policy between the period after the Soviet collapse until the abandoning of the ruble area. The end of ruble zone, however, did not immediately lead to stable monetary policy due to remaining inflationary facts. But it became gradually understood that inflation is harmful to investments and production. (Cottarelli and Doyle 1999, 23-24.)

In all, the context for disinflation was still quite favorable, because inflation had not persisted for long time and backward indexation was limited. Only six of 25 transition economies ever used backward-looking indexation. (Cottarelli and Doyle 1999, 6.)

### **2.1.3 Demand for Money Function as a Mirror**

We introduce a demand for money function to work as our framework in analyzing monetary policy under different exchange rate regimes and also as a framework in interpreting results of empirical work. The results naturally do not depend on the chosen function. This methodology follows mainly Ghosh and others (1997).

Demand for money function has its roots in the Quantity Theory of Money, which dates back several hundreds years, but was given a new lease of life mainly by Milton Friedman in mid

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<sup>9</sup> The stage when ruble was floating, and the Central Bank of Russia (CBR) was the only national bank that could issue cash is known as the ruble area period. However, all national banks could create credits and in fact they had a strong incentive to do that because part of the inflationary costs of doing so were shared with other republics as well. (Cottarelli and Doyle 1999).

<sup>10</sup> However, countries such as Georgia and Ukraine introduced national currency already before July 1993, and Tajikistan delayed the adoption of an own national currency and used the ruble until May

20<sup>th</sup> century. The Quantity Theory treats money as an independent variable implying that inflation is caused by increase in money supply by the authorities.

The Quantity Theory equation is usually written in following way:

$$(1) \quad M/P = Y/V,$$

where M is the nominal amount of money, P is the price level, Y is the real income and V is the velocity of money (the number of times each period a unit of money is in a transaction). The left hand side can be interpreted as the supply of real money. Accordingly, right hand side is the demand for real money. Demand increases when the real income increases, or the increase in demand can be reflected as a decrease in the velocity of money. The more people want to hold money, the bigger is the amount of money the economy needs to function. If applied to Keynes' idea that the real money demand depends on real income and interest rates ( $M/P = L(Y, i)$ ), the velocity of money measures exactly the effect interest rate level has on the real money demand. The higher the nominal interest rates are the less people hold cash money and thus, the velocity of money increases.

In fact, the Quantity Theory assumes that 1) the demand for real money is constant in the long run, 2) the change in money supply causes the change in inflation (causality goes this way) and 3) prices are completely flexible. In reality the changes in real variables (like real income and real interest rate) can change the demand for real money, but they are usually considered to be slow. Therefore the change in the money supply is considered more easily to be shown as changes in other nominal variables like in prices and wages. In reality also prices are often rigid in short run and are not able to adjust to changes in the money supply. As a consequence, in the short run there might be no relationship between the growth of money supply and inflation.

Changing the order of variables and transforming the function into logarithmic form gives:

$$(2) \quad \text{Log}(MV/P) = \text{log}(Y)$$

$$\rightarrow \log M + \log V - \log P = \log Y$$

$$\rightarrow \log P = \log M + \log V - \log Y$$

and taking the first order difference gives an expression for inflation.

$$(3) \quad \pi = \Delta p = \Delta m - \Delta y + \Delta v$$

where small letters mean logarithms (for example  $p = \log(P)$ ). According to this function, inflation decreases when growth of money supply or growth of velocity of money decrease or when growth of real output increases. So this function will be our framework when examining the possibilities and effects of monetary policy under fixed exchange rates and moreover under a currency board arrangement.

## 2.2 Exchange Rate Pegging as an Anti-inflationary Tool

There are basically four different strategies to reduce and control inflation: exchange rate pegging, 2) monetary targeting, 3) inflation targeting, and 4) 'heterodox way' to stabilize without any certain nominal anchor. Thus, to explore relationship between exchange rate regimes and inflation may be a biased way to look at the issue, because exchange rate is only one of a few possibilities a country can choose as a target for stabilization (see e.g. Mundell 1997). This leads us to ask whether some target is more credible and clearer nominal anchor to tight monetary policy and fiscal discipline than other targets (Mussa and others 2000, 23).

So in general, if a country gives up a fixed exchange rate as a nominal anchor, some alternative anchor is needed to stabilize inflation. Most often, mainly in more developed countries, the anchor is inflation target (and independent central bank). In transition economies the choice has, however, mainly been between money (or credit) target and exchange rate target. In Eastern Europe, Baltics, Russia and the other countries of former Soviet Union the IMF (International Monetary Fund) supported programs have typically involved a binding credit target, when the exchange rate regime has been flexible. Even though credit target is not exactly a nominal monetary anchor, the credit expansion has, however, been a main factor determining money growth in these countries. (Citrin and

Zettermeyer 1995.) Thus, we may say that the division of exchange rates into fixed (pegged) and floating (flexible) is to a certain extent consistent with the division into exchange rate pegging and monetary targeting.

In this study we focus on exchange rate pegging and on the question, does the rigidity of the peg matter. Therefore our theoretical framework is limited to features of exchange rate pegging as a strategy to control inflation. We will look separately at conventional pegs and currency boards as means to reduce and control inflation. Next we will also examine possible effects of capital mobility.

### **2.2.1 Fixed Exchange Rate as a Nominal Anchor**

Pegging the exchange rate at fixed value to some 'hard' currency has mainly two advantages: 1) the constraint that the fixed exchange rate imposes on monetary policy (*discipline in terms of money supply growth*), and 2) the simplicity and transparency of a fixed exchange rate system (*credibility in terms of money demand growth*) (see e.g. Calvo and Vegh 1994, Edwards 1993, Obstfeld and Rogoff 1995).

#### **Discipline**

To start with the discipline effect, the argument is that fixing the exchange rate limits independent monetary policy and thus limits the possibility to inflate in order to get short-run real effects. Exchange rate peg provides one way to solve the time inconsistency problem of monetary policy, originally introduced by Barro and Gordon (1983). Their main idea is that in a discretionary regime monetary authority is able to create an inflationary bias to the economy by printing more money in order to achieve expansion of economic activity (to raise economic output and to avoid unemployment) in the short-run. However, assuming rational expectations, when people understand the policymaker's incentives, they adjust their price and wage expectations accordingly, and inflation surprises cannot arise systematically. Therefore the country may end up with higher inflation but without any better output performance.

According to Barro and Gordon (1983) enforced commitments (formal rules) can eliminate the whole potential to create surprise inflation. Thus, if the commitment to the peg is strong enough, the peg as a nominal anchor can prevent the time inconsistency problem. Strong or



hard peg implies that monetary policy becomes endogenous and thus, is no more an instrument of a central bank. Money supply becomes equal to the country's overall balance of payments surplus or deficit, and the system works automatically. With a strong commitment, monetary authorities cannot produce expansionary monetary policy and by that way cause inflation.

Thus, fixing the exchange rate would lead to more discipline in terms of money supply growth. But in order to create fiscal and monetary discipline, a fixed exchange rate system needs *credibility* (see also Obstfeld and Rogoff 1995).

### **Credibility**

How clear and easily understood the nominal anchor is, is important in creating credibility of the monetary policy. Exchange rate peg is easy to understand by the public. If we assume that economic agents have rational expectations and that it is commonly expected that the main objective of monetary policy is to maintain the exchange rate parity, then fixed exchange rate regime creates credibility through transparency. If the economic actors expect inflation to be low they set their wages and prices based on that expectation, and the outcome is a lower level of inflation. (Edwards 1993 and Obstfeld and Rogoff 1995.) As Edwards (1993) notes, this however implies that in general a fixed exchange rate regime creates fiscal and monetary discipline in countries, which already have a reputation for stability. Thus, paradoxically, a fixed exchange rate regime suits best for countries that need it the least.

Theoretically, fixing the exchange rate discourages causing inflation also because inflation would then lead to an appreciation of the real exchange rate and thus reduce the competitiveness of the country's exports.

### **2.2.2 Currency Board as a Tighter Monetary Rule**

Concerning monetary *discipline* under currency board the restrictions for independent monetary policy are stronger than under conventional fixed pegs.

As discussed above, according to Barro and Gordon (1983) enforced commitments can eliminate the time inconsistency problem. Under currency board the commitment to the peg is strong (based on law). Currency board also effectively ties the hands of monetary authorities,

which implies that the central bank cannot devalue, hold government debt or act as lender of last resort. A loss of foreign reserves is matched by a contraction in money supply, and automatic tightening of monetary conditions will occur. Thus, as an enforced commitment that denies independent monetary policy currency board can eliminate the time inconsistency problem, the potential to create surprise inflation (see e.g. Ghosh and others 1999, Korhonen 1999).

In terms of *credibility* effect, from administrative and operational point of view a currency board is as a monetary policy solution rather simple to implement and also to maintain. The system is easily understood and monitored by general public and thus, it works as a signal of credibility of policymakers, which again is likely to make inflation expectations more realistic. Moreover, the fact that currency board is based on rules, explicit restrictions, and that the abolition of the regime is considerably more difficult (for example in Estonia parliamentary approval is needed) presumably creates confidence<sup>11</sup>. Exchange rate is fixed by law, which implies that it is less prone to policy reversals than conventional pegs. Hence, the institutional settings of currency board give it more credibility compared with conventional peg.

However, also laws can be changed, so legal restrictions alone do not bring credibility. And also, the fact that a currency board rules out important central bank functions may cause other problems for the economy, even though it by doing this creates discipline. Therefore, for example Williamson (1995, 15) notes that a currency board requires sound banking system not to be so vulnerable to crises or to let the government to finance its deficit through commercial banks. In many transition countries private sector is however lacking money, so most countries that have chosen currency board attempt to maintain as balanced budget as possible. So on the other hand a currency board cannot work alone; it requires fiscal discipline already as a precondition. (Williamson 1995, 15.)<sup>12</sup>

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<sup>11</sup> The higher the (political) costs of exiting the currency board the higher the likelihood that it will not be exited and the lower the expected inflation and thus also actual inflation (Ghosh and others 1999, 12-13).

<sup>12</sup> See among others Williamson (1995) and Balino and others (1997) for more detailed discussion of the pros and cons of currency board arrangements. See Roubini (1998) for critical view of currency boards.

### **BOX 1 Currency board's comeback**

Currency board arrangement is not a new phenomenon<sup>13</sup>. In the history of economics there are several examples of the use of the system. The most well known are perhaps the cases of Hong Kong and Singapore, but most common the arrangement was in colonial states in the end of 19th century and in the beginning of the 20th century. The first currency board was established in Mauritius in 1849. Altogether, currency board was adopted in about 70 British colonials. After the colonial states got their independence, also currency boards disappeared for few decades.

Again currency board appeared in 1980's, but this time not to facilitate monetary relations between a dominant and a dependent economy. Instead it has been applied for example to cut the hyperinflation (like in Argentina and Bulgaria), to transform from socialism to market-oriented economy (like in Estonia and Lithuania) and to stabilize the infrastructure in the aftermath of the war (Bosnia). The similarities between historical and modern currency boards are limited. Historical currency boards worked under different circumstances, as a part of the colonial system and in a world of lower capital mobility and pegged exchange rates.

The modern currency boards are in practice usually not 'pure' arrangements. More than that they are combinations of currency board and traditional central banking. (Korhonen 1999.)

Only three of the 25 transition economies of Eastern Europe and former Soviet Union have chosen currency board arrangement: Estonia, Lithuania and Bulgaria. In each of them currency board is established in institutional frameworks encompassing on existing central bank, which retains many traditional central bank functions. The currency board operations, however, are separated from the rest of the central bank. In all three countries the central bank is reorganized into an Issue Department and a separate Banking Department. Although in Bulgaria there is also a third department, the Banking Supervision Department. The Issue Department is the heart of the currency board.

Estonia, Lithuania and Bulgaria (and actually all existing currency boards) have pegged their exchange rates to a single currency, Estonia and Bulgaria to the Deutsche mark and Lithuania to the U.S. dollar. More details of these three currency boards are shown in Table 1<sup>14</sup>.

<sup>13</sup> For historical analysis and descriptions, see for example Schuler (1992) and Williamson (1995).

<sup>14</sup> See also Appendix 1 for more background information of currency boards in Estonia, Lithuania and Bulgaria.

**TABLE 1 Some facts of currency boards in Estonia, Lithuania and Bulgaria**

	<b>Estonia</b>	<b>Lithuania</b>	<b>Bulgaria</b>
<b>Date established</b>	June 1992	April 1994	July 1997
<b>Administrative and supervising agency</b>	Bank of Estonia (BOE)	Bank of Lithuania (BOL)	Bulgarian National Bank (BNB)
<b>Previous exchange rate regime</b>	Ruble standard	Ruble standard and interim coupon (talonas)	Floating exchange rate
<b>Reserve currency</b>	Deutsche mark/Euro	U.S. dollar	Deutsche mark/Euro
<b>Exchange rate</b>	DEM 1 = EEK 8	USD 1 = LTL 4	DEM 1 = 1000 BGL
<b>Access to convertibility</b>	In principle general public; in practice only banks	Commercial banks	General public
<b>Coverage of backing</b>	100 % of monetary base	100 % of currency and BOL's liquid liabilities	100 % of Issue Department liabilities
<b>Power to change rules</b>	The BOE has right to revalue; devaluation need an act of Parliament	BOL in consultation with the government	Parliamentary approval needed
<b>Last-resort facilities</b>	By the BOE; emergency situations; limited to foreign exchange in excess of backing requirement	By the BOL; emergency situations; limited to foreign exchange in excess of backing requirement	Eliminated; exception credit from the Banking Department to deal with banking sector weaknesses

Sources: Camard (1996), Cottarelli and Doyle (1999), Miller (1999), Sörg and Vensel (2000)

### 2.2.3 Role of Capital Mobility and Expectations

In theoretical level, if we make an assumption that capital is fully mobile and domestic and foreign currency assets are seen as perfect substitutes, the domestic interest rate should equal the foreign interest rate plus the expected depreciation of the domestic currency (in other words, the *uncovered interest rate parity* condition holds). Under this assumption, expansion of money supply would have no effect under fixed exchange rates, because the domestic interest rate is tied to the foreign interest rate. This means that when domestic interest rates fall, new money flows immediately out of the country and causes balance of payments deficit. This can be written as:

$$(4) \quad i = i^* + dS/S$$

Now, under fixed exchange rate, the exchange rate is expected to stay constant. Thus, the expected depreciation of the domestic currency ( $dS/S$ ) is equal to zero. This also means that, under fixed exchange rate, the nominal interest rate of an open economy must always be equal to the world interest rate ( $i=i^*$ ). If it were lower, no one would hold domestic currency denominated assets. According to this, for example in Estonia, interest rate should equal that of Germany, because the Estonian kroon is pegged to the Deutsche mark at fixed rate  $1DEM = 8EEK$ .

However, to go further and probably closer to the real world, also people's expectations may have an effect on the domestic interest rate. According to Hansson and Sachs (1994, 9-10), domestic interest rate is equal to foreign interest rate ( $i = i^*$ ) if people have full confidence in exchange rate stability. The less people trust in exchange rate stability the higher the domestic interest rate in relation to foreign one. Thus, if people in Estonia fully believe that the exchange rate  $1DEM = 8EEK$  remains stable, then interest rates in Estonia and Germany should be equal.

### 3 EARLIER EMPIRICAL EVIDENCE IN COMPARISON

This section will discuss the existing evidence on the relationship between exchange rate regimes and inflation performance. Cross-country studies analyzing the determinants of inflation in transition context have gained momentum rather recently when larger samples in terms of countries and years have become available<sup>15</sup>. The earlier evidence was based on descriptive analyses of individual countries' experiences, but in country-specific studies the independent effects of the exchange rate regime on the macroeconomic performance were found difficult to capture<sup>16</sup>.

There are a few empirical cross-country studies giving evidence that in general (not specifically in transition countries) lower inflation is achieved under pegged exchange rate regimes compared to flexible ones. However, in the light of previous empirical evidence, the choice of the exchange rate regime, fixed or flexible, currency board or not, seems not to be exogenous and not to determine inflation as such. It is difficult to assign a causal role of the exchange rate regime, which is mainly one part of the macroeconomic strategy rather than the solution by itself. Moreover, empirical studies have to face many methodological limitations – such as regime classification – that may make results biased (see section 3.3).

In terms of transition countries the role of different exchange rate regimes is unclear. In fact, many studies seem to come to a conclusion that it is not possible to make generalizations. To quote Edwards and Savastano:

...since the early 1990's it has become customary to end every study on exchange rates in developing countries by stressing that both fixed and flexible exchange rates can work in those economies, provided that policy makers show a sufficiently strong commitment to macroeconomic stability. (Edwards and Savastano (1999, 12.)

The empirical review is not limited to transition countries for two reasons: First, there does

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<sup>15</sup> For general reviews of macroeconomic developments in transition countries see for example Cottarelli and Doyle (1999), Fischer and Sahay (2000), Ghosh (1997), Valdivieso (1998) and Wyplosz (1999). For panel data study of non-monetary factors of inflation see Cottarelli, Griffiths and Moghadam (1998).

<sup>16</sup> This does not mean that cross-country studies would be free of difficulties in trying to capture the

not exist any systematical comprehensive study that would have focused on exchange rate regimes and inflation in transition context, and second, the underlying assumption is that transition countries are not different.

### **3.1 Inflation Analysis Concerning Transition Economies**

Although initial shocks causing inflation were common, and although in general inflation stabilization has been one of the major successes of the transition process, stabilization paths and outcomes have substantially differed across transition countries. Moreover, the role of different exchange rate regimes remains unclear. The view that exchange rate anchors have played an important role in disinflation is supported by individual country studies and also by cross-country evidence, but the opposite view, arguing that the choice of the exchange rate regime makes little difference by itself, gets support as well.

A currency board is in many individual country studies seen as a success in fighting against inflation. In Estonia the inflation rate has fallen considerably since 1992 when the currency board was adopted, and for example Sörg and Vensel (2000) credit the currency board for this success. Also in Bulgaria, after introducing the currency board in 1997 inflation stabilized very quickly to 13 percent by mid 1998 and still lower by end 1998. Thus, also Bulgarian experience has been seen to give evidence of the potential of a currency board to work as a successful stabilization device (see e.g. Miller 1999).

Moreover, Estonia and Latvia, which are similar in many respects<sup>17</sup>, have provided a useful pair of countries for a comparison of the effects of different exchange rate regimes. Among others Saavalainen (1995), Citrin and Zettermeyer (1995) and Hansson (1995) have systematically compared the early experience of Baltic stabilization. When Estonia already in 1992 adopted a currency board, Latvia chose first a flexible exchange rate arrangement and opted for a strong independent central bank. Latvia, however, pegged its currency to the SDR (Special Drawing Rights) in practice in 1994 and also officially in 1997. The initial disinflation paths were very similar in Estonia and Latvia. Thus, already the early experience

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independent effect of exchange rate regimes on macroeconomic performance.

<sup>17</sup> For example in terms of location, size, factor endowments and external relations with Russia and other FSU countries (Citrin and Zettermeyer 1995).

let authors conclude that Latvian experience confirms that inflation can be effectively stabilized also under a money-based stabilization. However, the track record for making any strong conclusions was noted to be still too short.

Also a few pooled cross-country and time-series studies have examined the determinants of inflation in transition economies, but none of them has focused on examining exactly the role of exchange rate regime. Those studies that have taken the exchange rate regime into account have divided regimes into two: pegged and flexible.

Instead, there is a growing consensus that inflation has been highly monetary phenomenon during the transition, and that monetary financing of fiscal and quasi-fiscal deficits has been an essential reason for money supply growth (see among others De Melo, Denizer and Gelb 1997 and Hernandez-Cata 1999). Moreover, the relationship between economic liberalization and inflation has been emphasized in many studies. De Melo and others (1997), studying years 1989-1994, suggest that the most critical factor of successful stabilization is the extent of economic liberalization<sup>18</sup> - even though its first impact is a surge in inflation. (see also Fischer, Sahay and Vegh 1996, Cottarelli, Griffiths and Moghadam 1998).

Wolf (1999) went further in examining the nexus between transition strategy choice, initial conditions and outcomes. He studied time period 1989-1995 dividing countries into *radical*, *gradual* and *lagging* reformers depending on their speed to liberalize economy. He found that radical reformers experienced substantially lower inflation than gradual ones, and gradual reformers, in turn, lower inflation than 'laggards'.

Of econometric analyses, which have taken the exchange rate regime or exchange rate anchor explicitly for one independent variable among others, Fischer, Sahay and Vegh (1996)<sup>19</sup> find that fixed exchange rates - exchange rate pegs, including a crawling peg - are associated with lower inflation. They, however, examined the early experience of transition countries using a panel data for a rather short period 1992-1994. Differently to many other studies, they reasonably excluded years 1989-1991 referring on the fact that macroeconomic policy, in the

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<sup>18</sup> Meaning not only price liberalization but a weighted average of liberalization in internal markets, external markets and privat-sector entry (De Melo and others 1997).

<sup>19</sup> The study by Fischer and others (1996) focuses on the relationship between stabilization and growth, but first it conducts an econometric analysis of the main short-run determinants of both inflation and growth.



sense it is understood in market economies, did not exist especially in the former Soviet Union countries before 1992. Furthermore, they note that in particular it is difficult to define the different exchange rate regimes during the pre-reform period.

Thus, even though also Wolf (1999) finds fixed exchange rates<sup>20</sup> to be associated with lower inflation, this finding is not that convincing, because years under study are from 1989 to 1995. Moreover, Wolf also reports that the dummies both for pure exchange-rate-based stabilization and for pure money-based stabilization are associated with higher inflation than those yielded by hybrid stabilization. This suggests that exchange rate regime itself is not the subject matter, and comes close to Wyplosz' (1999, 26) argument that the choice of an exchange rate regime is always a matter of tradeoffs and rather irrelevant by itself. According to Wyplosz (1999) what instead matters, are the constraints the exchange rate regime imposes on monetary policy. It is not so important which form of monetary target is adopted as long as it is adhered to.

An econometric analysis made by Hernandez-Cata (1999) focuses on price liberalization, money growth and inflation in transition economies<sup>21</sup> for years 1990-1996. Thus, it also includes years 1990-1991, which may be problematic. The study finds the coefficient of the fixed exchange rate dummy unstable and insignificantly different from zero. However, exchange rate regime is found to have an influence on the rate of money expansion - which the study finds to be the fundamental determinant of inflation - and thus indirectly on inflation (discipline effect).

Cottarelli and Doyle (1999) instead explore disinflation in transition countries during years 1993-1997. The study reviews policies implemented by transition countries, and the point of view is to examine from different angles how these policies participated in stabilizing inflation<sup>22</sup>. According to authors the role of monetary policy is not clear. Only few countries chose officially fixed exchange rate regime for a nominal anchor, especially after year 1993. Most countries officially adopted floating currency, but many of them however unofficially pegged the currency at least for some times. Both 'floaters' and 'peggers' tried to create more credibility to the currency by increasing the independence of central bank and by taking part

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<sup>20</sup> Wolf (1999) divides regimes to pegs and floats but does not specify how the classes are formed.

<sup>21</sup> The data set includes also Mongolia.

<sup>22</sup> So Cottarelli and Doyle (1999) do not conduct any econometric analysis.

to IMF's programs. The study finds that those who pegged their currency for a whole time, stabilized inflation faster but also remained in modest level of inflation despite tight fiscal discipline.

### 3.2 Role of Exchange Rate Regime in General

According to a few recent and rather large panel data studies, which have examined the link between the exchange rate regime and inflation performance, there first seems to be a continuum from hard peg (currency board) to float and respectively from lower to higher inflation. But closer look raises important questions such as the problem of causality, regime classification and absence of capital controls.

A broad and comprehensive study, 136 countries over time period 1960-1990, by Ghosh and others (1997) covers nine regime-types, but classifies them to three categories: pegged (both soft and hard pegs), intermediate and floating.<sup>23</sup> Moreover, their regime classification is a combination of *de jure* (official) and *de facto* (real) classifications. The authors use terms 'discipline effect' to reflect lower growth rate of money supply and 'credibility (or confidence) effect' to reflect faster money demand growth. When money supply growth is included as an own variable, the dummy for exchange rate regime captures the 'credibility effect'.

The main finding of the study is, that countries with pegged exchange rates experience significantly lower and less variable inflation rates than countries with intermediate or floating exchange rate regimes. Inflation is in average 5 percentage points lower for pegs than for floats, and when controlling money growth, difference falls to 1.8 percentage points. This reflects greater significance of discipline effect (tight monetary policy) than confidence effect (higher demand on domestic currency). Coefficients for intermediate exchange regimes were statistically insignificant.

The authors checked if their results are subject to simultaneity bias, in other words, if the

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<sup>23</sup> The pegged regime includes single currency pegs, SDR pegs, other published pegs and secret basket pegs. The intermediate group includes cooperative systems, unclassified floats and floats within a pre-determined range. The float group includes floats without a pre-determined range and pure floats.

chosen level of inflation leads to the choice of the exchange rate regime. Controlling for the endogenous regime choice, however, did not unravel their results. Also the robustness of results across subsets was tested. The main results were found robust with the exception of the subset of countries without capital controls, when there was no significant difference in inflation performance between pegged, intermediate and floating exchange rate regimes. The authors suggest that the absence of capital controls itself imposes discipline and hence, the nominal exchange rate regime makes little further difference.

Two more recent studies, made by Ghosh, Gulde and Wolf (1998) and Ghosh, Gulde, Ostry and Wolf (1999), extend the time period to mid 1990's and consider currency board as a separate regime. These studies report similar results that inflation has been lower under pegged exchange rate regimes than under floating ones and moreover that the rigidity of the peg matters. Currency boards faced even lower inflation than other pegs mainly due to a confidence effect.<sup>24</sup>

Ghosh and others (1998) compare inflation performance of currency board countries to those with other pegs. Countries with at least 50 percent cover requirement are classified as currency boards. The data set consists of all IMF member countries and covers the time period 1970 – 1996. On average inflation is found four percentage points lower under currency boards compared to other pegs. When controlling for money growth, difference falls to 3.4 percentage points and thus, the confidence effect captures bigger part of the better performance of currency boards.

Ghosh and others (1999) extend the estimations to cover all three regimes: currency boards, other pegs and floating regimes. The time period under study is from 1961 to 1997, but most of the analysis is done for the period 1975 - 1997. The study comes to a conclusion that countries with currency boards experience lower inflation compared to both floating regimes and simple pegs. Relative to floats inflation is 7.0 percent lower under currency boards and 4.8 percent lower under other pegs. When controlling for money growth, figures are 3.3 percent and 1.4 percent respectively. Moreover, when comparing currency boards with

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(Ghosh and others 1997, 5.)

<sup>24</sup> According to Ghosh and others (1998) also Kwan and Lui (1996) find that the currency board reduces inflation, but they compare currency board to a flexible exchange rate regime thus excluding other pegs.

other pegs, currency boards perform better with major part of difference<sup>25</sup> stemming from greater confidence effects rather than greater monetary discipline.

The adoption of a currency board remained to be associated with lower inflation in both later studies also when controlling for the endogenous regime choice. But again, the results were not robust for the subset of countries without capital controls. In the study by Ghosh and others (1998) currency boards did *not* result in lower but higher inflation than other pegs, and Ghosh and others (1999) found inflation to be very similar under every regime in the absence of capital controls.

### **3.2 Challenges in Regime Classification**

The results reported above are subject to many biases due to methodological problems concerning especially the regime classification. This brings us back to the critical aspect toward fixed versus floating dichotomy. The possible differences between the official and the real exchange rate regime will be examined in more detail, as well as the importance of how fine the classification is.

#### **3.2.1 *De jure* versus *De facto***

First, in practice most of empirical studies classify exchange rate regimes according to the countries' official description of their exchange rate arrangement rather than following the actual degree of flexibility of their nominal exchange rates. In real world, however, the difference between official and real regime can be remarkable. For instance, a big part of official nominal regimes that in empirical studies are classified as flexible are in fact strongly regulated

In principle, there exist two alternatives for regime classification: *de jure* and *de facto*. *De jure* –classification means nominal exchange rate regime the central bank announces. *De facto* –classification is based on the observed behavior of the exchange rate. The advantage of *de facto* –classification is that it captures the real behavior paying attention to the characteristics

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<sup>25</sup> 1.9 percentage points out of 2.2 percentage points.

of the system rather than to what they are called. However, *de facto* –classification may lose the main idea of regime choice: how committed the central bank is to intervene and depress its monetary policy under foreign currency markets. *De jure* –classification takes this official commitment into account but fails to observe how it is applied in reality. (Ghosh and others 1997.)

In the study made by Ghosh and others 1997 (see previous section) countries that frequently changed the exchange rate parity, but officially maintained the peg, did not receive the full anti-inflationary benefits. Especially the confidence effect was considerably lower in these countries. According to authors this gives evidence that both the *de jure* commitment and the *de facto* behavior matter.

However, the more recent study by Ghosh and others (1999) addressed this issue by restricting to countries with lowest realized nominal exchange rate variability. According to them, if primarily the *de facto* behavior matters, the official regime should be less significant. Also by including the variability of the nominal exchange rate as an explanatory variable, the same phenomenon could be tested. In both cases, the coefficients for currency boards and other pegs remained almost unchanged and significant, too. According to authors this suggests that the “formal exchange rate regime matters for inflation above and beyond the effects of low nominal variability”. (Ghosh and others 1999, 19.)

### **3.2.2 Fineness of Classification**

Second, studies always have to combine a number of regimes – usually those reported in IMF sources – into a couple of broad regime types. In most empirical studies exchange rate regimes have been divided in fixed (or pegged) and flexible. ‘Fixed’ has typically referred to pegged-but-adjustable, often including for example crawling pegs. ‘Flexible’ refers to pure floats, managed floats and so on. Thus, what is in literature called flexible exchange rate regimes includes in reality a whole variety of different regimes. Moreover, there is no clear boarder between these two broad categories, and this can lead to significant differences in classifying the same regime in different studies.

So in reality there is a continuum of flexibility between them and because purely floating exchange rates hardly exist. For instance, Mundell (1997, 42) classifies the spectrum of

exchange rate arrangements according to their degree of flexibility as follows (discretion of monetary policy in parenthesis): 1) clean float (independent), 2) dirty float (independent), 3) sliding-gliding parity or tablita<sup>26</sup> (independent), 4) pegged rates (independent), 5) fixed exchange rates (adaptive or automatic), 6) currency board (adaptive or automatic) and 7) monetary union (automatic).

For comparison, Edwards and Savastano (1999) classify alternative exchange rate regimes to free float, dirty float, floating within a band, sliding band, crawling band, crawling peg, fixed-but-adjustable exchange rate, currency board and full 'dollarization'. Thus, the simple fixed (pegged) - floating (flexible) division based on officially announced exchange rate regime of a country can make empirical results biased and ignore essential points.

The study by Ghosh and others (1997) tested the robustness of results for finer regime classification as well. The test revealed that the lowest inflation is observed for countries on cooperative systems, which belong to intermediate group and not to pegged regime. Moreover, the finer classification shows that inflation is in fact lower under pure floats than under single currency pegs. Thus, the poor performance of dirty floats causes the positive correlation between regime flexibility and inflation. These findings suggest that this relationship is not that simple and monotonic, and we may lose important details in combining regimes to a couple of regime types.

Moreover, Edwards and Savastano (1999) mention still two other problems concerning regime classification. First, in most empirical works regimes that have been in use for a very short time are treated in the same way than regimes that countries chose already a long time ago. This means that the duration of an exchange rate regime is not taken into account. Moreover, it is usually implicitly assumed that all the changes in regime were voluntary, which is according to authors unlikely the case. (Edwards and Savastano 1999, 16.)

And second shortcoming in fixed versus flexible dichotomy is a so-called survival bias. It means that countries that initially adopted a pegged exchange rate arrangement but could not sustain it are then classified as having a flexible regime. The problem is that high inflation rates due to exchange rate collapses are attributed to flexible regimes. (Edwards and Savastano

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<sup>26</sup>Tablita means such a variant in which the nominal exchange rate will be adjusted by a preannounced

1999, 12-13.)

To summarize, the empirical evidence of the relationship between exchange rate regimes and inflation is mixed and does not give any clear picture especially in the case of transition countries. However, in general the evidence suggests that pegs – both hard and soft pegs – are successful in controlling inflation and especially in stabilizing from high to moderate inflation rates. Moreover, in comparison to conventional pegs currency boards tend to exhibit lower inflation mostly due to a credibility effect, which is consistent with theory. In general these results were found non-robust when controlling capital mobility. Furthermore, choices in regime classification were found problematic.

Concerning transition countries, individual country studies suggest that pegs and especially hard pegs have been successful in stabilizing inflation. Panel data studies give evidence that monetary growth, liberalization and budget deficits are factors behind inflation, but the evidence of the role of exchange rate regime is mixed. In fact, only few studies have taken the regime choice into account and also they have divided regimes only into pegged and flexible.

## **4 Does the Regime Choice Matter in Transition Context? - An Econometric Look**

### **4.1 Descriptive View to Inflation and Exchange Rate Regimes**

This chapter examines patterns of inflation and exchange rate regimes for 25 economies in transition in Central and Eastern Europe (Albania, Bulgaria, Croatia, Macedonia, Poland, Romania, Slovak Republic, Czech Republic, Hungary and Slovenia), the Baltic countries (Estonia, Latvia and Lithuania), Russia and other former Soviet Union countries (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, the Kyrgyz Republic, Moldova, Tajikistan, Turkmenistan, Ukraine and Uzbekistan). Annual data set covers time period 1991-1998. Thus, altogether there are 200 observation units (25 countries \* 8 years) in the data set.

Before proceeding with any empirical research it is, however, worth reminding of the data weaknesses and the problems in regime classification.

#### **4.1.1 Data and Its Limitations**

The data used in this study is collected from variety of different sources, main sources being EBRD's (European Bank of Reconstruction and Development) Transition Reports, IMF's (International Monetary Fund) surveys and a number of scholarly articles.

Data availability and quality differ across countries and in time, but especially the early years of transition are problematic due to poorly equipped statistical agencies and conceptual and measurement differences. That is even more the case in former Soviet Union countries, where transition in greater extent started a couple of years later than in Central and Eastern European countries. Conceptual differences refer to the fact that before the transition process relative prices did not reflect the scarcity of goods and were very different from world prices. The measurement problem in terms of inflation refers to the phenomenon that price increases under controlled price regime may have been "disguised as quality improvements and inflation in the black markets simply ignored" and as a consequence "inflation during the



transition may have been overestimated". (Fischer and others 1996.) Moreover, the fact that much of the economy in transition countries is based on other means of exchange than money<sup>27</sup> is likely to complicate interpreting present data.

Due to data availability and quality problems the data set used in estimation in this study shrank in size from the initially intended. However, this is the only systematically collected data available, and because data shortcomings treat transition countries rather equally, it is possible to use this data in regression analysis. Still it is worth emphasizing that the biases in the data may be large and may have an effect on some of the reported results, which is important to keep in mind when interpreting results. Some individual data shortcomings will be told in more detail in their contexts.

#### **4.1.2 From Surging Inflation to Different Paths of Stabilization**

Inflation has been very high in transition countries. But the significant reduction in inflation constitutes one of the key achievements of transition economies. The common advice to post-communist countries was to do stabilization fast, because inflation management was seen as an essential starting point for restructuring in macro and micro level and as a precondition to growth<sup>28</sup>. On the other hand, in transition context inflation was also welcomed, because it eliminated debts taken under planned economy regime and because it gave enterprises easier access to credit (see among others Fischer and others 1996 and Ghosh 1997).

Table 2 shows the twelve-month inflation rates in transition countries for the period 1991-1998. The peak in inflation was usually recorded at the start of the transition process – during 1992-1994 in FSU countries and a couple of years earlier in CEE countries - when prices were freed and often also trade controls were lifted. These one-time price jumps were common eliminating the hidden inflation, monetary overhang, from previous years under command economy<sup>29</sup>.

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<sup>27</sup> A good example of that is Russia, where reliance on barter trade has accounted for significant deal of all transactions, although now monetisation seems to increase.

<sup>28</sup> See, for instance, Fischer and others (1996) for the proposition that low inflation is a necessary, but not sufficient, condition for growth.

<sup>29</sup> See section 2.1.2 for background for surging inflation.

**TABLE 2 Inflation rates** (end-year percentage change in consumer prices)

	Year	1991	1992	1993	1994	1995	1996	1997	1998
<b>Baltic countries</b>	Estonia	304	954	36	42	29	15	12	8
	Latvia	262	959	35	26	23	13	7	5
	Lithuania	345	1161	189	45	36	13	8	4
	<i>Average</i>	<i>304</i>	<i>1025</i>	<i>87</i>	<i>38</i>	<i>29</i>	<i>14</i>	<i>9</i>	<i>6</i>
<b>Central and Eastern Europe</b>	Albania	104	237	31	16	6	17	42	10
	Bulgaria	339	79	64	122	33	311	578	10
	Croatia	250	938	1149	-3	4	3	4	6
	Macedonia	230	1925	230	55	9	-1	3	1
	Poland	60	44	38	29	22	18	13	10
	Romania	223	199	296	62	28	57	151	45
	Slovak Republic	58	9	25	12	7	5	6	9
	Slovenia	247	93	23	20	9	9	9	7
	Czech Republic	52	13	18	10	8	9	10	9
	Hungary	32	22	21	21	28	20	18	14
	<i>Average</i>	<i>160</i>	<i>356</i>	<i>190</i>	<i>34</i>	<i>15</i>	<i>45</i>	<i>83</i>	<i>12</i>
<b>Former Soviet Union</b>	Armenia	25	131	1394	188	32	6	22	3
	Azerbaijan	126	135	124	178	84	6	0	4
	Belarus	93	1559	1996	1960	244	39	63	60
	Georgia	131	131	138	6474	57	14	7	5
	Kazakhstan	137	2984	2169	1160	60	29	11	9
	Kyrgyz Republic	170	1259	1363	96	32	35	15	12
	Moldova	151	2198	837	116	24	15	11	30
	Russia	161	2506	840	204	129	22	11	150
	Tajikistan	204	132	234	1	133	1	164	10
	Turkmenistan	155	644	9750	1328	1262	446	22	28
	Ukraine	161	2730	10155	401	182	40	10	22
	Uzbekistan	169	910	885	1281	117	64	50	33
<i>Average</i>	<i>140</i>	<i>1672</i>	<i>4585</i>	<i>1391</i>	<i>363</i>	<i>63</i>	<i>32</i>	<i>31</i>	

NOTES: Shaded cells refer to years under regional tension.

In 1998, the average inflation rate for the CEE countries was about 12 percent, compared with

about 45 percent in 1996 and nearly 360 percent in 1992<sup>30</sup>. The Baltic states experienced single-digit inflation in 1998, compared with about one thousand percent in 1992. In the other FSU countries the average inflation rate was highest in 1993, being in excess of 4500 percent, declining rapidly to about 30 percent in 1997 and 1998.

Shaded cells in Table 2 mean that during that year the country has been affected by military conflict. It can be seen that after successfully weathering a period of regional tension, these countries – Croatia, Macedonia, Armenia, Azerbaijan, Georgia and Tajikistan – have substantially reduced their inflation rates. In fact, all of them faced nearly single-digit annual inflation in 1998.

Also a few relapses into high inflation have happened after initially successful stabilization, mainly in Bulgaria, Romania, Belarus, Tajikistan and Russia. Bulgaria had two failed stabilization efforts and its inflation rose to very high levels in 1996 and 1997 before it introduced a currency board and succeeded to stabilize to single-digits.

Tajikistan is a peculiar case, because it had very low inflation in 1994 (one percent year-on-year) even though its inflation rate was over seven thousand in the previous year and over two thousand in the following year. Reason for the very low inflation in 1994 was shortage of cash rather than any disinflation policy. In fact Tajikistan introduced its own currency just in May 1995 and its first stabilization program soon after that. (Gürgen and others 1999, 23-25.)

Many former Soviet regime countries delayed the start of stabilization but by 1995 all except Turkmenistan had started the program. Russian first ‘successful’ stabilization led to a huge collapse of ruble in August 1998<sup>31</sup> and a new surge in inflation. In Romania and Belarus (and also in Turkmenistan, Ukraine and Uzbekistan) delays in launching comprehensive reforms have rendered price stability and continued high inflation.<sup>32</sup>

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<sup>30</sup> The scale is wide in 1992: in Slovak Republic the inflation is as low as 9 percent, while in Macedonia the annual end-period rate is nearly 2000 percent reflecting a period of civil unrest.

<sup>31</sup> Ruble devaluated from 6 to 21 ruble per dollar in few weeks and that meant end to ruble corridor that had for years since 1995 been the basis of Russia’s monetary policy. Causes for that will not be examined in more detail here, but for example according to Rutland (1999) stabilization was first built in rather shaky foundations, since it was accompanied by the dollarization and demonetization of much of the economy.

<sup>32</sup> See Appendix 5 for stabilization dates and developments in inflation performance.

In all, it seems that once the stabilization package was undertaken, inflation typically fell very rapidly. However, after achieving moderate inflation level further disinflation has often been slow. From the table it can be seen that achieving single-digit inflation rates has in fact been even more difficult for early reformers such as Hungary and Poland that had moderate inflation level already before the end of 1992 than for some late reformers such as Armenia, Azerbaijan, Kazakhstan and Georgia.

#### **4.1.3 Choice of Exchange Rate Regimes**

Table 3 introduces the *de jure* -classification of exchange rate regimes in transition economies based on IMF's classification system<sup>33</sup>, except currency boards, which has been added as an own category. This existing exchange rate regime classification has a number of shortcomings, which are well recognized, and therefore the IMF has developed a new classification scheme for regimes<sup>34</sup>. New classification is, however, in early phase and still developing and thus the old classification scheme, which is available for all years under study, will be used here<sup>35</sup>. However, it is worth reminding that data description and estimation results are conditional to this classification.

Transition countries adopted a variety of different exchange rate regimes in the beginning of transition, and in the case of former Soviet Union countries when introducing own national currencies. Most Central and Eastern European countries first introduced some kind of pegged exchange rate regime (Croatia, the Czech Republic, Hungary, Macedonia, Poland and the Slovak Republic)<sup>36</sup>. Estonia immediately adopted a currency board arrangement and was of former Soviet Union countries in the beginning the only one that fixed its exchange rate. All the others chose first a more flexible regime.

The Central Asian states (Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan) after the introduction of domestic currencies, first maintained rather complex multiple exchange rate systems. More recently they have moved toward more flexible, unified

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<sup>33</sup> See Appendix 3 for IMF's definitions of different regimes.

<sup>34</sup> The last major review of the classification was made in 1982 (IMF 1999, 28).

<sup>35</sup> See Appendix 4 for new IMF exchange rate classification system and an example of it for transition economies in 1997.

<sup>36</sup> The beginning refers to beginning of transition in each country. So it does not need to refer to the year 1991, which is the first year in our sample.

and market determined exchange rates (Gürgen and others 1999, 42).

Lack of foreign reserves<sup>37</sup>, low initial credibility and uncertainty about the rate at which to peg the currency were often the reasons for not to adopt a peg. However, many formally flexible regimes in practice (de facto) heavily managed or informally pegged their currency to some hard currency such as the US dollar or the Deutsche mark./ For example Latvia officially pegged its currency to the SDR in 1997, but *de facto* the Bank of Latvia has pegged the lats to the SDR already since 1994 (Saavalainen 1995, 3). Also in the Central Asian states informal pegs have been in use.

...the Central Asian states adopted, more or less, discretionary monetary frameworks that were, in essence, informal inflation targeting regimes. All countries adopted floating exchange rates, although the central banks frequently intervened to limit movements in the exchange rate (managed float), and some even, at times, adopted an informal peg. (Gürgen and others 1999, 42.)

As discussed, these differences between official and real exchange regimes create difficulties in classifying exchange rate regimes and in considering the effects of different regimes on macroeconomic performance (see sections 2.2.3 and 3.3).

The initial regime choice was often modified when transition proceeded. Of previous flexible regime countries Latvia adopted (officially) a peg and Lithuania and Bulgaria introduced currency boards. In contrast, Albania, Czech Republic, Slovak Republic, Hungary and Poland<sup>38</sup> moved to more flexible regimes.

By 1998 many countries had, however, moved from pegs to more flexible regimes. In 1998 only four countries (Estonia, Lithuania, Bulgaria and Latvia) had formally a fixed exchange rate regime and in fact, three of them had a currency board. Reason for this phenomenon has been explained by the dangers of pegs in the context of high capital mobility and possible currency speculations, when huge and sudden net capital flows may turn around<sup>39</sup>.

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<sup>37</sup> For example in Russia external shocks (like the collapse of Council for Mutual Economic Assistance (CMEA) trade system) led to a remarkable capital flight in 1991.

<sup>38</sup> Poland had fixed exchange rate in 1990.

<sup>39</sup> See among others Edwards and Savastano (1999), Frankel (1999) and Larrain and Velasco (1999).

TABLE 3 Exchange rate regimes in transition economies

	Year	1991	1992	1993	1994	1995	1996	1997	1998
<b>Baltic Countries</b>	Estonia	Ruble	Cba	Cba	Cba	Cba	Cba	Cba	Cba
	Latvia	Ruble	Free Float	Free Float	Free Float	Managed Float	Managed Float	Pegged*	Pegged*
	Lithuania	Ruble	Free Float	Free Float	Cba	Cba	Cba	Cba	Cba
<b>Central and Eastern Europe</b>	Albania	Pegged*	Free Float	Free Float	Free Float	Free Float	Free Float	Free Float	Free Float
	Bulgaria	Free Float	Free Float	Free Float	Free Float	Free Float	Free Float	Cba	Cba
	Croatia	...	...	Free Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
	Macedonia	...	...	Free Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
	Poland	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
	Romania	Managed Float	Free Float	Free Float	Free Float	Free Float	Free Float	Free Float	Managed Float
	Slovak Republic	Pegged!	Pegged!	Pegged*	Pegged*	Pegged*	Pegged*	Pegged*	Float
	Slovenia	...	...	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
	Czech Republic	Pegged!	Pegged!	Pegged*	Pegged*	Pegged*	Pegged*	Managed Float	Managed Float
	Hungary	Pegged*	Pegged*	Pegged*	Pegged*	Managed Float	Managed Float	Managed Float	Managed Float
	<b>Former Soviet Union</b>	Armenia	Ruble	Ruble area	Free Float	Free Float	Free Float	Free Float	Free Float
Azerbaijan		Ruble	Ruble area	Ruble area	Free Float	Free Float	Free Float	Free Float	Free Float
Belarus		Ruble	Ruble area	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
Georgia		Ruble	Ruble area	Free Float	Managed Float	Managed Float	Managed Float	Managed Float	Managed Float
Kazakhstan		Ruble	Ruble area	Free Float	Free Float	Free Float	Free Float	Managed Float	Managed Float
Kyrgyz Republic		Ruble	Ruble area	Free Float	Free Float	Managed Float	Managed Float	Managed Float	Managed Float
Moldova		Ruble	Ruble area	Free Float	Free Float	Free Float	Free Float	Free Float	Free Float
Russia		Ruble	Free Float	Free Float	Free Float	Managed Float	Managed Float	Managed Float	Managed Float
Tajikistan		Ruble	Ruble	Ruble	Ruble	Free Float	Free Float	Free Float	Managed Float
Turkmenistan		Ruble	Ruble	Managed Float	Pegged	Managed Float	Managed Float	Managed Float	Managed Float
Ukraine		Ruble	Free Float	Free Float	Free Float	Managed Float	Managed Float	Managed Float	Managed Float
Uzbekistan		Ruble	...	...	...	Managed Float	Managed Float	Managed Float	Managed Float

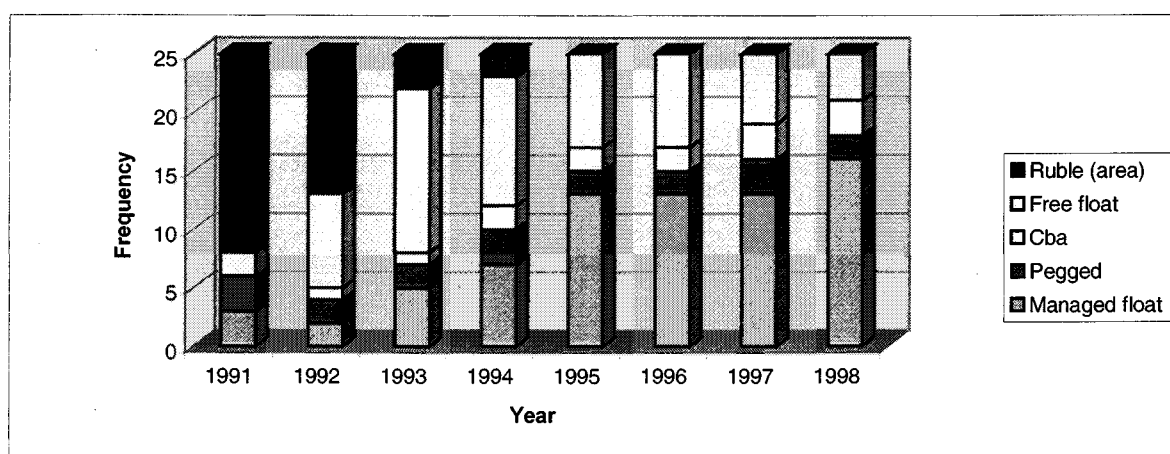
NOTES: \*Pegged exchange rate vis-à-vis a currency composite, † Czechoslovakia

Shaded cells in the table address years under stabilization program.

Sources: IMF (1995): World economic and financial surveys: Issues in International Exchange and Payments Systems, IMF (1999): Exchange Rate Arrangements and Currency Convertibility, Developments and Issues. For year 1998 data from IMF (1998): International Financial Statistics Yearbook.

Figure 2 summarizes the use of different exchange rate regimes in transition countries during 1991-1998. From the figure it can be seen that the relative amount of managed floats has increased while the relative amount of free floats has decreased during transition. Quite big part of this phenomenon is related to former Soviet Union countries, which initially when introducing their own national currencies let them float independently but later switched to managed floats.

The absolute frequency of conventional pegs and currency boards is nearly the same. Geographically their appearance differs so that pegs have mainly been adopted in Central and Eastern Europe, while Baltic countries count the currency board experience, only Bulgaria being an exception in 1997 and 1998.



**FIGURE 2** Frequency of different exchange rate regimes in transition economies

#### 4.1.4 Relationship between Inflation and Exchange Rate Policies

In interest of this study is how the inflation is related to different exchange rate regimes. To shed some light to this question, Table 4 shows median inflation rates calculated for currency boards, conventional pegs, managed floats and independent floats. Median inflation rates are used instead of average inflation rates in order to avoid bias due to high inflation rates especially in the early phase of transition.

The lowest median inflation of each year is shaded, and as the table shows, conventional fixed pegs seem to perform better than currency boards in terms of lower inflation. There also does not appear to be any big difference in median inflation rates between managed floats and currency boards. Free floats, instead, provide higher inflation rates than other regimes except for the year 1998, when median inflation for free floats is lower than for managed floats and for currency boards. In 1998 exchange rate was freely floating only in three countries: Albania, Armenia and Azerbaijan.

**TABLE 4 Median inflation rates for each exchange rate regime in 1991 – 1998**

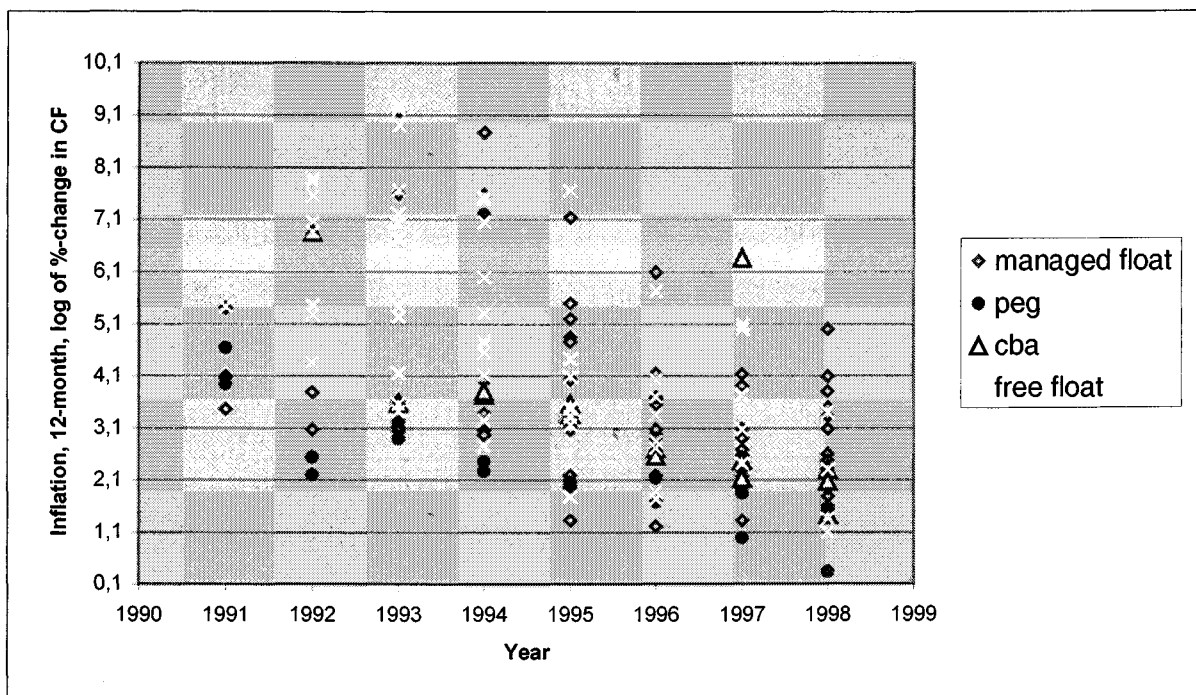
	<b>Managed</b>		<b>Cba (14)</b>	<b>Free</b>
	<b>float (72)</b>	<b>Pegged (19)</b>		<b>float (61)</b>
<b>1991</b>	60,4	58,3	-	284,5
<b>1992</b>	33,0	10,9	-	1060,0
<b>1993</b>	37,6	21,7	36,0	838,5
<b>1994</b>	29,4	11,7	43,5	121,9
<b>1995</b>	31,9	7,6	32,3	32,4
<b>1996</b>	19,8	7,0	14,1	23,0
<b>1997</b>	11,3	6,4	12,0	32,0
<b>1998</b>	11,1	3,0	8,0	7,0

NOTES: Number of observations is in parenthesis and shaded cells address lowest median inflation rates.

Another way to avoid the possible bias due to high inflation figures is to take natural logarithms of inflation rates<sup>40</sup>. By contrast to the picture arising out of the comparison by using median inflation rates, average natural logarithmic inflation rates suggest lower inflation for currency boards if compared with managed floats. Otherwise, the order of exchange rate arrangements in terms of inflation performance does not change remarkably. Conventional pegs give the lowest inflation rates every year except in 1994 when currency boards provide a somewhat lower inflation than pegs. An explanation for this is Turkmenistan (with its 1328 percent inflation rate in 1994), which according to this classification had a fixed exchange rate in 1994; it adopted a peg in 1994, but switched to managed float already the next year.



Figure 3 finally shows the relationship between (logarithmic) inflation and exchange rate regimes separately for each year across the whole time period under study. Again it can be seen that in average conventional pegs provide the lowest inflation rates. There is one outlier among pegs for the year 1994, the Turkmenistan. The high observation of currency board in 1997 belongs again to Bulgaria, which introduced a currency board in high inflation conditions in July that year. In following estimations, currency board observation for Bulgaria in 1997 will be dropped, because it was in use under half of the year.

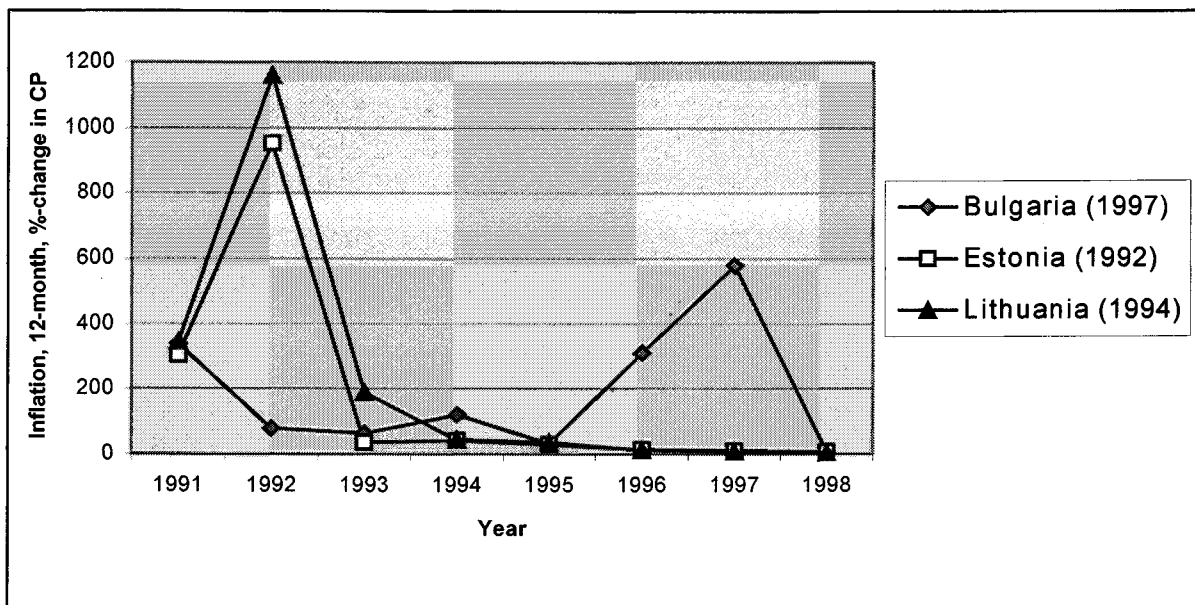


**FIGURE 3 Inflation rates (in logarithms) for each exchange rate regime in 1991 – 1998**

The inflation performance of currency boards is illustrated separately in Figure 4. In Estonia the inflation rate has fallen considerably since 1992 when the currency board was adopted. Also in Bulgaria, after introducing the currency board in 1997 inflation stabilized very quickly to 13 percent by mid 1998 and still lower by end 1998. Thus, Estonian and Bulgarian experiences give evidence of the potential of a currency board to work as a successful stabilization device.

<sup>40</sup> See, for instance, Fischer and others (1996).

In Lithuania, inflation was already moderate when adopting the currency board and thus, currency board did not need to work that much as a device for stabilizing hyperinflation but more to provide inflation to remain stable. Under currency board inflation has reduced to single-digits also in Lithuania.



NOTES: Years in parenthesis note year when currency board was adopted.

**FIGURE 4 Inflation performance in currency board countries**

## 4.2 Inflation Estimation

What light can an econometric model shed on the question of the role of exchange rate regimes in inflation performance? First of all, in individual country studies it is difficult to distinct the independent effect of the regime choice. Second, comparisons done in previous section can look at only the simple relationship between these two variables, thus, ignoring other potential factors that can have an effect on inflation.

Thus, in order to isolate the possible independent effects of exchange rate regimes on inflation, an econometric analysis of determinants of inflation is reasonable. Following subsections examine first the choice of variables, the model and the method before turning to

estimation, results and their robustness.

#### 4.2.1 Model Specification

Basing on the above reviewed theoretical framework and empirical findings, explanatory variables for inflation were searched from three categories: macroeconomic policies, structural reforms and initial conditions.

As the dependent variable, we have annual inflation ( $\pi$ ), which is measured as end-year percentage change in consumer prices. In general, it is more common to use average annual inflation measures when comparing the evolution of inflation over time. However, following the approach taken by Fischer and others (1996), if the focus is on the developments within a certain period of time or on the response to policy variables within a certain time period, end-period measures may express more information.

In estimations inflation is converted into natural logarithmic form in order to decrease very high inflation rates, which were remarkable in transition context. The natural logarithmic transformation changes large growth rates substantially but has much less influence on small growth rates.<sup>41</sup> Therefore it is useful in reducing the importance of hyperinflation observations in the regressions. Here we draw on the example of Fischer and others (1996) and De Melo and others (1997) that used this same transformation for inflation rates in transition countries.

Exchange rate regimes, money supply growth and fiscal deficit were considered as explaining macroeconomic policies. The independent variables in our interest, exchange rate regimes, are as above divided in four categories: currency boards (**Cba**), other pegs (**Peg**), managed floats (**Mf**) and independent floats. Exchange rate regimes will be estimated as dummy-variables in such a way that value for dummy is 1 when the wanted regime is in use, and 0 in other case. For example, the value for Cba-dummy is 1 for currency boards, and 0 for other regimes.

Drawing on Fisher and others (1996), the year 1991 is excluded from estimation except when using lagged values from that year.

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<sup>41</sup> To diminish the role of outliers, we also tested alternative scaled measure,  $\pi/(1+\pi)$ , for the growth rates. But according to coordinate/correlation diagrams this form seemed to be falsifiable, because it scaled figures between 0 and 1.

...that macroeconomic policy as commonly understood in market economies simply did not exist in more than half the countries before 1992, especially in the former SU and Albania. In particular, it is difficult to define the exchange rate regime as either fixed or flexible during the pre-reform period. (Fisher and others 1996.)

Basing on the demand for money function above, the broad money growth (end-year percentage change in broad money:  $\Delta m^{42}$ ) will be used as an independent variable. Similarly to inflation rates, broad money growth is re-scaled into natural logarithmic form due to high monetary growth outliers and in order to retain the relationship between inflation and monetary growth linear.

Fiscal balance is often used as a proxy for monetary growth due to the fact that in transition context, budget deficits have often been financed by printing money. But this does not imply that they are perfect substitutes<sup>43</sup>. The study made by Wolf (1999) gives evidence that both money supply and fiscal deficit can be significant in explaining inflation performance. Thus, in general model we use fiscal balance (general government balance in percentages of GDP: **Bal**) as an explanatory variable as well.

Explanatory variables initially also include the change in GDP as a macroeconomic control variable (percentage change in real terms:  $\Delta gdp$ ).

As a proxy to the extent of structural reforms, we use a liberalization index developed by De Melo and others (1997). In order to capture also the degree of the openness of countries, we use a composite liberalization index (**LI**) instead of mere price liberalization index<sup>44</sup>. It combines three components of liberalization: internal markets (I), external markets (E) and

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<sup>42</sup> Percentage change in broad money ( $(M(t) - M(t-1)) / M(t-1)$ ) is approximately same as  $\Delta \log M$  and thus  $\Delta m$ .

<sup>43</sup> Fiscal deficits can be financed not only by printing money but also for instance by selling assets, by borrowing from abroad or by issuing domestic bonds. Moreover, one problem in data of fiscal deficits is that it may not include so-called quasi-fiscal deficits, which are caused for example by soft loans to the private sector or by deficits in extra-budgetary accounts (Pirttilä 2000, 14).

<sup>44</sup> Another reason for using the composite index is that all countries except Turkmenistan achieved the same level of price liberalization by 1995, and only slight variation appears during following years even though no country has fully liberalized prices. For more detailed definition of the liberalization index and for table of liberalization index and separately price liberalization index for each year and country see Appendix 3.

private-sector entry (P). I and E represent liberalization through introduction of competitive, flexible-price markets, and P represents liberalization through changing ownership of fixed assets<sup>45</sup>.

In addition to these variables, we control the effect of regional tensions by a variable (**RT**), which classifies the ‘degree’ of conflict using a scale 0; 0,25; 0,5; 1. However, consistent data for regional tension was available only until 1996. To keep year 1997 with in estimation, data of conflicts was attempted to collect from different sources. Regional tension was found to have appeared only in Tajikistan in 1997. Tajikistan signed a peace agreement in mid 1997 (Gürgen and others 1999) and thus, the degree of regional tension was chosen to be 0,25, the same as in 1996.

Moreover, there are systematic differences in the date of stabilization between FSU and CEE countries and also in their inherited conditions<sup>46</sup>. In order to take these into account in a general model, a dummy-variable (**FSU**) is used. The value for dummy is 1 for former Soviet Union countries and 0 otherwise.

Thus, the general model, initial specification selected for estimation is of the following type:

$$(6) \quad \pi = \alpha + \beta_1 Cba + \beta_2 Peg + \beta_3 Mf + \beta_4 Dm + \beta_5 Dm(-1) + \beta_6 Dgdp + \beta_7 Dgdp(-1) + \beta_8 Dbal + \beta_9 Dbal(-1) + \beta_{10} LI + \beta_{11} LI(-1) + \beta_{12} RT + \beta_{13} FSU$$

in which the  $\beta$ :s are functions of the structural parameters of the model and  $\alpha$  is the constant. Minus ones in parentheses mean one-year lags of the variables. Lagged values are used in order to take into account possible inertia in the effects of variables. Inflation and money growth rates are used in logarithmic form without any separate notion.

#### 4.2.2 Analyzing Panel Data

To carry out the econometric analysis, the cross-section and time series data for all 25

<sup>45</sup> One might also ask why we do not use the change in liberalization. Reason is again the attempt to at least partially capture also the level of openness of the country.

<sup>46</sup> FSU countries, for example, experienced larger trade shocks when the CMEA collapsed. Moreover, they probably inherited more distorted economies than many CEE countries, which had introduced some market elements already during previous decades.

countries for six years, 1992-1997, was pooled. Before turning to an analysis of the interactions between exchange rate regimes and inflation, features of panel data and alternative econometric methods for analyzing it will be briefly discussed.

Panel data allows exploring problems that cannot be examined only by cross sectional or time series data. The advantage of the panel data is that there are a lot of observations included, which implies that degrees of freedom increase and the multicollinearity between independent variables decreases, especially when compared to simple time series data. Panel data also increases the robustness of estimates.

There are two dimensions in panel data: time dimension:  $t = 1, \dots, T$  and individual dimension  $n = 1, \dots, N$ . Altogether the amount of observations is  $N * T$ . The general form of linear panel data model, which includes only exogenous variables, is:

$$(7) \quad y_{it} = \alpha_i + \beta' X_{it} + \varepsilon_{it},$$

in which

$X_{it}$  includes  $K$  independent variables excluding the constant term,  
 $\alpha_i$  expresses the individual effect for each cross sectional unit and  
 $\varepsilon$  is an error term.

Panel data analyses are more oriented toward cross-section than time-series analyses. The most commonly used models for panel data are fixed effects model (covariance model) and random effects model (error components model), which are basically extensions of the classical regression model. To put it short, the fixed effect approach takes  $\alpha_i$  to be a group specific constant term. The random effect considers  $\alpha_i$  as a group specific disturbance.

Fixed effects model may be viewed as applying only to those cross-sectional units that are included in the study and not other ones outside the sample. In the case of transition countries, the sample of 25 countries is more or less the full set of countries in transition<sup>47</sup>. If the sampled cross-sectional units were taken from a large population, random effects approach

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<sup>47</sup> See section 2.1.2.

could fit better, because it might be appropriate to view individual constant terms as randomly distributed across cross-sectional units.

Thus, in this study, the fixed effects model could be appropriate, but because our model already includes dummy-variables (for exchange rate regimes, regional tension and for FSU countries), the classical regression model, with a common intercept, is defensible and will primarily be used. Fixed effects together with dummy-variables are likely to make regressors become collinear.

The assumptions that are usually made in normal linear regression model may not be valid when analyzing panel data. For example, the error term estimated for panel data may include both heteroscedasticity, which is typical for cross sectional data, and autocorrelation, which is usually a problem of time series data. Therefore different econometric techniques are usually needed. However, our each cross-section contains only maximum 6 observations, so it is hardly useful to consider possible problems of autocorrelation. To treat heteroscedasticity, we use White heteroscedasticity-consistent estimates of the standard errors. They provide correct estimates of the coefficient covariances in the presence of heteroscedasticity of unknown form. This variance estimator is robust to general heteroscedasticity within each cross-section, but it still leaves the possibility of contemporaneous correlation across cross-sections. (Greene 1997.)

Thus, the above selected model specification is estimated as a classical regression model with common intercept. Based on previous experience the expectation was that inflation is higher the larger the fiscal deficit, the higher the monetary growth and the lower the degree of liberalization. Inflation was also expected to be higher during military conflicts and also in the former SU countries due to their later start of stabilization. Concerning exchange rate regimes, expectation was a subject of controversy, but more towards expecting that inflation is lower under fixed exchange rate regime and still lower under a currency board arrangement.

The analysis applied here follows the general-to-specific methodology. Thus, first we include all the explanatory variables discussed above and examine this general model. We continue by simplifying the structure to achieve the best parsimonious specification. In the order of simplification, we will not strictly follow the statistical significance, as a primary measure, but also some prior choice will be used with the help of theory and previous evidence.

### 4.2.3 Regression Analysis and Results

The above selected general model specification was estimated both with (fixed effects approach) and without individual dummies for cross-section units (countries). The coefficients on exchange rate dummies are all insignificant in both cases. Only monetary growth and lagged fiscal balance appear statistically significant in both models as can be seen from Table 5 (see first and second columns). Output growth is significant in pooled model but not in the fixed effects model

**TABLE 5 Regression results for inflation**

	(1) OLS	(2) OLS Fe	(3)	(4)
Constant	-0,035 (-0,038)	individual	5,111 (18,733***)	3,938 (14,230***)
War	-0,812 (-1,022)	-0,815 (-0,746)		3,310 (4,526***)
FSU	-0,296 (-1,670*)			1,401 (4,427***)
Currency board	0,085 (0,227)	-0,808 (-1,455)	-1,628 (-3,338***)	-1,856 (-3,576***)
Peg	-0,168 (-0,664)	-0,513 (-1,480)	-2,578 (-5,535***)	-1,604 (-3,560***)
Managed float	-0,122 (-0,696)	-0,016 (-0,039)	-1,455 (-3,922***)	-1,051 (-3,015***)
Monetary growth at t	1,078 (8,733***)	0,937 (7,202***)		
Monetary growth at (t-1)	-0,024 (-0,245)	0,085 (0,758)		
GDP growth at t	-0,037 (-2,349**)	-0,018 (-1,013)		
GDP growth at (t-1)	-0,009 (-0,697)	0,002 (0,142)		
Fiscal balance/GDP at t	0,015 (0,688)	-0,027 (-0,746)		
Fiscal balance/GDP at (t-1)	-0,027 (-3,230***)	-0,045 (-3,337***)		
Liberalization at t	-0,715 (-0,585)	-1,631 (-1,101)		
Liberalization at (t-1)	0,174 (0,171)	-0,192 (-0,187)		
Number of obs.	110	110	129	129
R-squared	0,863	0,922	0,200	0,374
Adjusted R-squared	0,845	0,886	0,181	0,349

NOTES: The numbers in parenthesis are t-statistics based on White Heteroscedasticity-Consistent standard errors. One, two and three asterisks denote significance at the 10, 5 and 1 percent levels respectively.

The third column reports a regression of the inflation rate only on the exchange rate regimes. Pegs are associated with lowest inflation rates, and currency boards and managed floats also provide significantly lower inflation than countries with floating exchange rate regimes. However, there is only a slight difference between currency boards and managed floats themselves. Including only the regimes yields  $R^2$  of 0,200. Thus, exchange rate regimes seem



not to be able to account for a significant fraction of the differences in inflation performance in transition economies.

Including the regional tension variable and a dummy for former SU countries increases the explanatory power to 0,374 (see fourth column). Both added variables are statistically and economically significant; inflation is higher under regional tension and in former SU countries. As a consequence of this inclusion, the order of exchange rate regimes changes so that currency boards provide now the lowest inflation before pegs and managed floats, respectively. Thus, controlling the fact that currency board countries, Estonia and Lithuania (as FSU countries), started their stabilization a couple of years later compared to countries with pegs (pegs belong mainly to CEE countries), gives support to our hypothesis.

We proceeded from general to parsimonious model first eliminating all lags and then omitting the output growth. Output growth was dropped, because the output data may be seriously biased. It is likely that output figures were under communist legacy often exaggerated, but during the transition may in contrary be underreported due to unknown extent of the second economy (black markets)<sup>48</sup>. Also according to EBRD (Transition report 1999, 288) the data for percentage change in real GDP can “lack precision due to large shifts in relative prices, the failure to account for quality improvements and the substantial size and change in the informal sector. Moreover, in some countries monetary authorities have started to incorporate the informal sector in their estimates of GDP”.

Furthermore, the causality of the relationship between inflation and economic growth is difficult to establish. Referring to empirical evidence there is a strong negative correlation between inflation and growth for the transition countries (see Fischer and others 1996). There the commonly accepted view is that low inflation is a necessary, although maybe not sufficient, condition for growth. This suggests that inflation determines growth more than growth determines inflation. In any case, the output growth is not an exogenous variable and hence, it will be dropped from estimation<sup>49</sup>.

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<sup>48</sup> There exists a variety of estimates of second economy activity but they vary widely both between countries and between sources (de Melo and others 1996, 19). See Fischer and others (1996) for more details of data caveats in terms of output figures.

<sup>49</sup> To use instrumental variables to avoid endogeneity was tried, but it lead to near singular matrix suggesting strong collinearity between explanatory variables.

**TABLE 6 Further regression results for inflation**

	(1)	(2)	(3)
Constant	0,501 (0,554)	9,252 (14,730***)	0,112 (0,154)
War	-0,436 (-0,555)	2,572 (3,258***)	
FSU	-0,211 (-1,086)	-0,175 (-0,638)	
Currency board	0,411 (0,823)	0,618 (1,236)	
Peg	-0,175 (-0,692)	-0,796 (-2,485**)	
Managed float	-0,241 (-1,369)	-0,506 (-1,675*)	
Monetary growth at t	1,141 (11,767****)		1,190 (13,969****)
Fiscal balance/GDP at t	-0,028 (-1,532)	-0,000 (-0,020)	
Liberalization at t	-1,718 (-2,255**)	-7,150 (-9,065****)	-1,530 (-2,727****)
Number of obs.	121	129	133
R-squared	0,833	0,649	0,848
Adjusted R-squared	0,821	0,628	0,845

NOTES: The numbers in parenthesis are t-statistics based on White Heteroscedasticity-Consistent standard errors. One, two and three asterisks denote significance at the 10, 5 and 1 percent levels respectively.

Table 6 relates inflation to received potential determinants of inflation. In addition to dummy-variables these include liberalization index, fiscal balance and broad money growth. As expected, lower monetary growth, better (positive) fiscal balance and higher degree of liberalization are associated with lower inflation. Perhaps more unexpected is that controlling for these variables leads to completely insignificant effects of exchange rate regimes. This would suggest that regimes operate primarily through the additional determinants, especially through monetary growth (discipline effect), and that the confidence effect is not that important. In fact, also correlation diagrams<sup>50</sup> show that exchange rate regimes correlate with inflation in the same way as they correlate with monetary growth rates. Moreover, the coefficients for FSU dummy and for regional tension change from positive to negative and become insignificant, suggesting that other included variables capture their effects.

To examine the possible discipline effect of exchange rate the column 2 relates inflation to all other factors except monetary growth. Most radical changes are that the explanatory power, R-squared, drops to 0,654, and the coefficient for fiscal balance becomes completely insignificant. Liberalization index, instead, gains a lot more significance, while the FSU

<sup>50</sup> See the Appendix 6 for correlation diagrams between inflation and independent variables and for correlations between dependent variables themselves.

dummy maintains negative sign. This implies that mainly the liberalization index captures the effects of initial conditions attempted to capture by FSU dummy variable.

When excluding monetary growth in order to capture the discipline effect, the dummy for pegs becomes statistically significant implying lower inflation under pegs due to increased monetary discipline. Currency boards, however, are not statistically significant.

In fact, referring to Hansson (1995), the use of broad money as an explanatory variable can be criticized, because the demand for money has not been stable during transition. Real money demand was likely to grow sharply when stabilization gained credibility and thus, separating out the shifts in money supply and money demand would be needed. However, when dropping all other explanatory variables except money supply growth and liberalization index, we can see that only these two variables explain nearly 85 percent of the inflation variation (see last column in table 6).

To proceed in this way – both from simple to general and from general to simple – can be criticized as not very orthodox method, but for the purpose of this study it can be justified, because it reveals something quite important about (multi)collinearity, relationships between explanatory variables. Especially when including liberalization index into estimation, the coefficients for currency boards and for pegs change very differently (compare columns 2 and 4). Currency boards lose their statistical significance and the coefficient changes from negative to positive.<sup>51</sup>

Also correlation diagrams<sup>52</sup> show strong relationship between exchange rate regimes and liberalization so that there is a continuum from ‘very liberal’ currency board countries to ‘less liberal’ independent floaters. In our sample, currency board countries include now only Estonia and Lithuania. As already mentioned, Estonia is today the most liberal trade regime in the former Soviet Union. Also Lithuania has strongly liberalized and the liberalization index (LI) is 0,89 for all years since 1994 when it adopted a currency board. This would suggest that the liberalization index already captures the effect of currency boards.

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<sup>51</sup> This is to some extent consistent with the finding by Cottarelli, Griffiths and Moghadam (1998), who found that for the sample consisting of transition economies and when including the price liberalization index into estimation, exchange rate regime becomes insignificant.

<sup>52</sup> See the Appendix 6 for correlation diagrams between inflation and independent variables and for correlations between dependent variables themselves.

However, the issue is more complicated, because there is also a continuum in time in such a way that pegs were relatively more present in earlier part of our sample and currency boards in later part (see Figure 2 in section 4.1.3). And moreover, the question of causality is open; does the adoption of currency board impose liberalization or is a liberal country more likely to adopt a currency board.

The robustness of results is tested in two different ways: 1) are the results robust for controlling spillover effects of regime changes, and 2) do the results hold for country sub-groups.

**TABLE 7 Regression results when first year after regime change excluded**

	(1)	(2)	(3)
Constant	4,090 (16,430***)	-0,067 (-0,072)	8,271 (10,805***)
War	3,400 (4,295***)	-0,618 (-0,743)	2,561 (3,070***)
FSU	1,080 (3,584***)	-0,066 (-0,315)	-0,055 (-0,182)
Currency board	-2,150 (-5,549***)	-0,062 (-0,160)	0,046 (0,084)
Peg	-1,786 (-6,316***)	0,100 (0,354)	-0,867 (-2,656***)
Managed float	-1,431 (-4,523***)	-0,274 (-1,358)	-0,811 (-2,638***)
Monetary growth at t		1,164 (10,462***)	
Fiscal balance/GDP at t		-0,035 (-1,814*)	-0,011 (-0,516)
Liberalization at t		-1,199 (-1,497)	-5,870 (-5,801***)
Number of obs.	110	105	110
R-squared	0,480	0,830	0,643
Adjusted R-squared	0,455	0,816	0,618

NOTES: The numbers in parenthesis are t-statistics based on White Heteroscedasticity-Consistent standard errors. One, two and three asterisks denote significance at the 10, 5 and 1 percent levels respectively.

First, for example in Estonia, the currency board was introduced under hiking inflation in order to cut this high inflation. Thus, in annual data set the first year (1992) inflation rate is very high but currency board cannot be blamed for that. To avoid these kind of potential biases, results are re-computed for an alternative data set excluding the first year after adopting a new exchange rate regime. This modification excludes also the 'outlier peg', which belonged to Turkmenistan.

Modification does not alter the main result that monetary growth is the most robust and most significant explanatory variables, and exchange rate regimes are statistically insignificant after including the monetary growth and liberalization index (see Table 7). When including only the regimes, regional tension variable and FSU dummy into estimation, all the coefficients get stronger and the explanatory power is remarkably better than in our first estimation modification ( $R^2$  from 0,374 to 0,480).

Moreover, the strong positive correlation between liberalization and currency boards remains valid. Experimenting with monetary growth and liberalization index suggests that the effect of lower inflation under pegs is primarily related to greater monetary discipline. Instead, currency boards seem not to have created that much monetary discipline but instead operated through liberalization in lowering inflation.

**TABLE 8 Regression results for inflation in the subgroup of CEE and Baltic countries**

	Original modification	First year after regime change excluded
Constant	4,377 (15,918***)	4,226 (15, 560***)
War	1,917 (1,841*)	2,098 (1,949*)
FSU	0,527 (1,058)	0,799 (1,193)
Currency board	-1,421 (-2,103**)	-2,004 (-2,913***)
Peg	-2,242 (-7,030***)	-1,922 (-6,318***)
Managed float	-1,676 (-5,415***)	-1,598 (-5,064***)
Number of obs.	73	64
R-squared	0,488	0,542
Adjusted R-squared	0,450	0,503

NOTES: The numbers in parenthesis are t-statistics based on White Heteroscedasticity-Consistent standard errors. One, two and three asterisks denote significance at the 10, 5 and 1 percent levels respectively.

Second, we checked whether the results hold in a country subset (see Table 8). Because pegs and currency boards have been adopted only in Central and Eastern Europe and Baltic countries – with one exception, Turkmenistan - the sub-sample consisting of CEE and Baltic countries includes all types of exchange rate regimes. Thus, the estimation for this group of countries was run, but including only regimes, regional tension and FSU dummy. An attempt to include monetary growth variable into estimation causes near singular matrix implying high collinearity between regressors.

Picture changes slightly; the dummy for FSU countries (meaning now Baltic states) is not significant, and pegs provide now the lowest inflation. In fact, also managed floats perform better than currency boards. However, when excluding the first year after each regime change currency boards gain more significance and also provide the lowest inflation. Both of these model specifications yield  $R^2$  of about 0,50.

In all, to a certain extent the evidence supports the hypothesis that inflation is lower under fixed exchange rate regime and still lower under currency board arrangement. However, it seems that exchange rate regimes affect inflation mainly through other variables: monetary growth and liberalization. These two variables are robust to inclusion of other regressors, while the regimes lose their significance when these two variables are with in estimation. Exchange rate regimes themselves seem not to be able to account for a significant fraction of the differences in inflation performance

Thus, openness - as measured by the degree of liberalization - itself seems to impose policy discipline. Liberalization does not lose its significance when including other determinants, which suggests that it has some credibility effect that is reflected as lower velocity growth of money<sup>53</sup> in comprehensively liberalized economies. Moreover, the estimations support the widely accepted view that inflation has been a highly monetary phenomenon during transition. Monetary growth is without doubt the most robust explanatory variable across all estimation modifications.

The results were found robust for spillover effects of regime changes and for a sub-group of Baltic and CEE countries.

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<sup>53</sup> See for example Wolf (1999).

## 5 CONCLUSION

Twenty-five countries began the transition from command economy to market-oriented economy at roughly the same time. Their initial conditions were different, they chose different strategies and their outcomes differ as well. From this point of view transition economies offer a possibility to explore also the relevance of the exchange rate regime for macroeconomic performance.

The question of this study was whether the choice of exchange rate regime has played any role in determining inflation outcomes in transition countries. In the early phase of the transition the choice of exchange rate regime was much debated and countries chose very wide spectrum of different regimes. Almost the whole continuum from strictly fixed rates to purely floating rates have been in use. In this study exchange rate regimes were divided in currency boards, conventional pegs and flexible exchange rates (managed floats and free floats). Only three countries in our sample – Estonia, Lithuania and Bulgaria – have used currency board, and Bulgaria dropped out of our econometric analysis, because it adopted the system just in the second half of 1997.

Inflation stabilization has in fact been one of the major successes of the transition process, but the evidence of this study over years 1991 – 1998 (in econometric analysis 1992 – 1997) suggests that exchange rate regime has not been a major determinant of this success. Consistently with previous empirical evidence, inflation was found to have been highly monetary phenomenon during this time period. Monetary growth was the most robust explanatory variable across all estimation modifications. Thus, strict monetary policy seems to be the primary factor in determining inflation. However, the seemingly clear relationship between broad money growth and inflation may be partly misleading, because also the real money demand has not always been constant during transition period.

To a certain extent our findings also support our hypothesis that inflation is lower under conventional pegs (through lower monetary growth rates; discipline effect) and still lower under currency board arrangement. However, exchange rate regimes were not robust to the inclusion of a set of other determinants of inflation, mainly monetary growth and liberalization index. Currency boards did not affect inflation significantly even when money

supply growth was excluded. Instead we found a strong correlation between currency board arrangements and liberalization index. This would suggest that currency board countries have been successful in stabilizing inflation, not because of the system itself but because they have followed liberal economic policies, and this liberality or openness itself has imposed discipline to the economy.

Liberalization, credibility and currency board seemed to be closely related in our sample. Our currency board countries consisted only of Estonia and Lithuania. Estonia is today the most liberal trade regime in the former Soviet Union. Moreover, Estonian authorities are strongly committed to conservative economic policy and market-base economy, thus implying credibility. However, credibility usually attracts capital inflows, and the (external) liberality of the country enables country to receive them. Capital inflows obviously stimulate growth, but they are also likely to cause upward pressure on inflation. Thus, paradoxically credibility may increase and not decrease inflation.

Capital inflows are in fact one suggested explanation for continuing moderate inflation<sup>54</sup>, a topic that has aroused a lot of debate and discussion during last years. On the other hand, if capital flows are complete, and if people have full confidence in exchange rate stability, expansion of money supply should have *no* effect. So it should not cause inflation. This assumption is, however, quite strict to apply to the real world.

It seems that the success in reaching low and stable inflation does not lie in such factors as the choice of exchange rate regime. Similarly to our results, the recent study by IMF (2001, 116-144) did not find statistically significant relationship between (de jure) pegged exchange rate regimes and inflation. Moreover, being consistent with our findings, the study gives evidence for a negative long-run relationship between openness and inflation. Although after including the fiscal deficit, measured as a ratio of government deficit to narrow money, for an explanatory variable also this relationship became insignificant (IMF 2001, 125-126), and the analysis suggests that the influence of openness and exchange rate regimes is indirect and occurs largely through fiscal policy. Thus, instead of using directly the money supply growth as an independent variable, it would be worth testing also our model by using this deficit to narrow money –ratio.

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<sup>54</sup> Generally defined as inflation, which is above industrialized countries' standards but below 30



In all, even though a clear consensus of the influence of exchange rate regime on inflation was found, it would not say what overall is the best regime. In reality we always should take, for instance, the costs of disinflation into account and look at the welfare effects as well. A good example of this is Russia, which after in a sense successful stabilization suddenly found itself in a deep crisis in 1998, when ruble devaluated nearly to a quarter of its previous value in just few weeks. Thus, any potential benefits of lower inflation should be weighed against potential costs for example in terms of lower output growth. In the limits of this paper these themes could not be discussed.

Moreover, it may even be asked, does it make sense transition countries to aim for developed countries' inflation rates. Transition countries may still need inflation tax<sup>55</sup> due to limited tax collection and other sources of budget revenue. Moreover, many prices are still administratively set (heat, communal services, and fuel), predicting future relative price adjustments.<sup>56</sup>

This paper focused on the connection between inflation performance and chosen exchange rate regimes in transition economies. Undoubtedly, there are many extension possibilities. For example it would be interesting to analyze this issue by using instead of chronological time stabilization time, first year being the year in which the stabilization program was implemented<sup>57</sup>. As mentioned before, one interesting experiment could be to use the ratio of government deficit to narrow money as an explanatory variable.

After a few years it is also more plausible to examine the behavior of currency boards, when it is possible to take also Bulgaria and Bosnia into account<sup>58</sup>. In this study the limited amount of currency board observations enables only very cautious conclusions.

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percent annually.

<sup>55</sup> Inflation tax refers to capital losses by moneyholders due to inflation. When the rate of inflation equals the growth rate of nominal money, inflation tax revenue is equal to seigniorage revenue.

<sup>56</sup> See Ghosh 1997.

<sup>57</sup> Fischer and others (1996) looked at the data from transition countries by computing the profiles in stabilization time in order to eliminate systematic difference in the date the stabilization was started in CEE countries, in Baltics and in other FSU countries. See also Pirttilä (2000).

<sup>58</sup> Today currency board is still in use in Estonia, Lithuania, Bulgaria and since 1997 also in Bosnia.

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## APPENDICES

### **Appendix 1: Framework for Currency Boards in Estonia, Lithuania and Bulgaria**

Estonia was the first of former Soviet Union countries that relinquished the ruble and founded its own currency, the kroon. When the three Baltic States regained their independence from the Soviet Union in August 1991, they for a while continued to use the rapidly depreciating Soviet ruble that led to high inflation and political pressures to introduce a national currency. Confidence in the inflationary ruble was lost and dollarization ratio was high when Estonia - lacking an experience in monetary management and believing that policy credibility is essential to succeed in stabilization - adopted a currency board arrangement in June 1992 (see e.g. Korhonen 1999 and Sörg and Vensel 2000). The Estonian kroon was pegged to the Deutsche mark at 8 kroons to one mark, and on 31 December 1998, by a technical conversion at 15,6466 kroons to 1 Euro, which is equivalent to  $1DEM = 8EEK$ . So the original exchange rate still exists. The currency in circulation and also the deposits of commercial banks are at least 100 % backed with gold and foreign reserves in Eesti Pank (the Bank of Estonia).

Lithuania facing the same situation as Estonia firstly introduced as own currency talonas in October 1992 (at par value with Russian ruble). The country initially implemented rather loose monetary policy, which delayed stabilization. In June 1993 a new currency, the litas, was introduced and in April 1994 the authorities adopted a currency board. The litas was tied to the U.S. dollar at a rate of  $1USD = 4LTL$ . (Baliño and Enoch 1997, 7.) Inflation had been reduced to rather low level by interventions already by mid 1993 (Ghosh et al 1999, 37) and thus Lithuania did not introduce a currency board in response to severe macroeconomic imbalance. Instead, the authorities had a desire to solve the time inconsistency problem of the monetary policy. A currency board was known to remove the incentive and even more, the opportunity to use the central bank to finance the fiscal deficits and thus cause inflation. Another reason was obviously the success of Estonian currency board. (Korhonen 1999, 29.)

In Estonia tight fiscal policies, foreign trade liberalization and extensive privatization have supported the currency board arrangement. In fact, Estonia is today the most liberal trade regime in the former Soviet Union and Estonian authorities are strongly committed to conservative economic policy and market-base economy. Despite major challenges in recent



years (like Russian crisis in 1998), the confidence in the currency board arrangement has remained firm (see e.g. Sörg and Vensel 2000). Also Lithuania is characterized by the high liberalization<sup>1</sup>. But by contrast to Estonia, in Lithuania, support for the currency board arrangement is less strong and the country has several times discussed about possible exit strategy. Estonian and Lithuanian currency boards differ also in a sense that the Estonian law allows only parliament to devalue, whereas in Lithuania this power has been given to the Bank of Lithuania together with a consultation with the government. (see among others Camard 1996.)

Bulgaria introduced a currency board in mid 1997 in order to bring stability after facing at least two failed traditional stabilization programs and a severe banking crisis. Before that currency board had been rather strongly resisted due to lack of necessary preconditions; Bulgaria had large domestic debt, severe banking system problems and lack of foreign reserves. In 1996 and early 1997 the country experienced a financial and political crisis and inflation surged to hyperinflationary levels peaking in February 1997, when monthly inflation was 240%. (Gulde 1999 and Miller 1999, 12.)

A visible and credible departure from past policies seemed essential and hyperinflation, bank closures and return to political stability gave momentum to accept and adopt a currency board in July 1997. Bulgarian currency, the lev, was tied to the Deutsche mark at rate of 1000 lev for one mark. Bulgarian National Bank (BNB) was reorganized into Issue Department, Banking Department and Banking Supervision Department. All liabilities of the Issue Department – notes and coins, commercial bank reserves, non-governmental and governmental deposits and Banking Department deposits - are covered by foreign reserves and gold. (Miller 1999.) Thus, the Bulgarian system is sometimes referred to as quasi-currency board. The presence of government deposits and Banking Department deposits on the liability side of the balance sheet is not typical for currency board. Bulgaria also maintains some monetary policy operations, like reserve requirements. Also the strengthening of the banking supervision has been essential support for the implementation of the currency board.

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<sup>1</sup> Since 1994 Estonia has abolished all limits on capital movements and foreign exchange accounts. Lithuania has full current account and high capital account convertibility. (Hansson 1995.)

## Appendix 2: Panel Data Studies of Exchange Rate Regimes and Inflation

<b>Study</b>	Ghosh, Gulde, Ostry and Wolf (1995): Does the nominal exchange rate regime matter?	Ghosh, Gulde and Wolf (1998): Currency boards: the ultimate fix?	Ghosh, Gulde and Wolf (1999): Currency boards: More than a quick fix?
<b>Inflation comparison</b>	Compares inflation performance of countries with pegged exchange rates to those with floats	Compares inflation performance of countries with Cbas to those with other pegs	Compares inflation performance of countries with Cbas to those with simple pegs and floating regimes.
<b>Data set</b>	136 countries, period 1960-1990	All IMF members covering the period 1970-1996	All IMF members, period 1961-1997, but much of the analysis done for the period 1975-1997
<b>Regime classification</b>	Combination of <i>de jure</i> and <i>de facto</i> classifications; three categories: pegged, intermediate and floating	Categories: pegged, float, currency board. Countries with at least 50% cover requirement are classified as currency boards.	Categories: pegged, float, currency board.
<b>Average inflation rates per year</b>	8.4 % pegged 11.6 % intermediate 15.2 % float	5.6 % currency board 19 % pegged 48.3 % float	5.6 % currency board 22.3 % pegged 43.1 % float
<b>Results</b>	Inflation 5 percentage points lower for pegs than for floats. When controlling money growth, difference falls to 1.8 percentage points. Coefficients for intermediates statistically insignificant.	Inflation 4 percentage points lower under currency boards compared to other pegs. When controlling for money growth, difference falls to 3.4 percentage points.	Relative to floats inflation 7 % lower under Cbas and 4.8 % lower under other pegs. When controlling for money growth, inflation 3.3 % lower under Cbas and 1.4 % lower under other pegs.
<b>Robustness</b>	The main result was found robust when controlling the regime choice endogeneity.	The main result was found robust when controlling the regime choice endogeneity.	The main result robust to various specifications and to possible simultaneity bias.
<b>Things worth mentioning</b>	*Alternative definitions for pegs → both the <i>de jure</i> and the <i>de facto</i> matter. *Finer regime classification → inflation lowest for cooperative arrangements; inflation lower for pure than dirty floats *Results robust across subsets except countries without capital controls	*Anti-inflationary benefit of currency boards relative to other pegs arises more from the confidence than discipline effect. *Results robust across subsets except countries without capital controls	*The formal exchange rate regime seems to matter for inflation above and beyond the effects of low nominal variability

### Appendix 3: Definitions and Sources of Variables

**Inflation** - End-year percentage change in consumer prices.

Source: *EBRD (European Bank of Reconstruction and Development): Transition Report 1996 and 1999 and Update 1999*

**Monetary growth** - End-year percentage change in broad money. The data for broad money growth<sup>2</sup> was missing for several countries in 1991 and for some countries also for the year 1992<sup>3</sup>.

Source: *EBRD: Transition Report 1996 and 1999 and Update 1999*

**Growth** - Annual percentage change in real, officially measured GDP.

Source: *EBRD: Transition Report 1996 and 1999 and Update 1999*

**Fiscal balance** - General government balance in percentage of GDP. Figures were missing for year 1991 for Latvia, Bulgaria, Croatia and Macedonia.

Source: *EBRD: Transition Report 1996 and 1999 and Update 1999*

**Regional tension** – Countries that have experienced major and persistent internal conflicts or conflict-related blockades.

**Liberalization** - Liberalization is measured by an index of economic liberalization constructed initially by de Melo, Denizer and Gelb (1997). An annual liberalization index (LI) is calculated for each country for each year over the period 1991-1997 (index is available for years 1989-1997). The index ranges from 0 to 1, where 1 indicates that the country's situation is comparable to that prevailing on average in the advanced economies, and 0 represents conditions before reform in a centrally planned economy with dominant state ownership of means of production. The LI is the weighted average of 0-to-1 rankings of liberalization in the following three areas:

I – *internal markets*: liberalization of domestic prices and abolition of state trading

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<sup>2</sup> According to source (EBRD: Transition Report 1999, 288) broad money comprises base money (Central bank reserve money and currency in circulation) and quasi-money (sight and demand deposits of the banking system). In some countries where foreign exchange deposits are a large proportion of demand deposits, broad money also includes deposits in foreign currency. EBRD has taken data from IMF country reports, International financial statistics and monetary authorities.

<sup>3</sup> For year 1992 the data for broad money growth is missing for Croatia, Macedonia, Slovak Republic, Armenia, Azerbaijan, Turkmenistan and Ukraine.

monopolies (weight 0.3);

E – *external markets*: currency convertibility and liberalization of the foreign trade regime including elimination of export controls and taxes as well as substitution for low to moderate import duties for import quotas and high import tariffs (weight 0.3);

P – *private-sector entry*: privatization of small-scale and large-scale enterprises and banking reform (weight 0.4).

Source: *De Melo, Martha, Cevdet Denizer and Alan Gelb (1997): From Plan to Market: Patterns of Transition.*  
Source for liberalization index updated to 1997: *International Monetary Fund (2000): World economic and financial surveys: World Economic Outlook, October 2000, Focus on Transition Economies.*

### Liberalization index

	1991	1992	1993	1994	1995	1996	1997
<b>Baltic countries</b>							
Estonia	0,32	0,64	0,81	0,89	0,93	0,93	0,93
Latvia	0,29	0,51	0,67	0,81	0,81	0,85	0,89
Lithuania	0,33	0,55	0,78	0,89	0,89	0,89	0,89
<b>Central and Eastern Europe</b>							
Albania	0,24	0,66	0,70	0,70	0,74	0,74	0,78
Bulgaria	0,62	0,66	0,66	0,64	0,58	0,65	0,79
Croatia	0,62	0,72	0,79	0,82	0,85	0,85	0,85
Macedonia	0,65	0,68	0,78	0,78	0,78	0,82	0,82
Poland	0,72	0,82	0,82	0,86	0,89	0,89	0,89
Romania	0,36	0,45	0,58	0,68	0,71	0,72	0,75
Slovak Republic	0,79	0,86	0,83	0,83	0,86	0,86	0,86
Slovenia	0,71	0,78	0,82	0,82	0,85	0,87	0,89
Czech Republic	0,79	0,86	0,90	0,90	0,93	0,93	0,93
Hungary	0,74	0,78	0,82	0,86	0,90	0,90	0,93
<b>Former Soviet Union</b>							
Armenia	0,13	0,39	0,42	0,42	0,49	0,72	0,72
Azerbaijan	0,04	0,25	0,31	0,35	0,44	0,55	0,62
Belarus	0,10	0,20	0,33	0,36	0,48	0,48	0,51
Georgia	0,22	0,32	0,35	0,39	0,49	0,69	0,72
Kazakhstan	0,04	0,33	0,60	0,76	0,82	0,86	0,86
Kyrgyz Republic	0,14	0,35	0,35	0,39	0,61	0,72	0,75
Moldova	0,10	0,38	0,51	0,55	0,68	0,75	0,75
Russia	0,10	0,49	0,59	0,66	0,77	0,80	0,83
Tajikistan	0,11	0,20	0,26	0,30	0,39	0,42	0,45
Turkmenistan	0,04	0,13	0,16	0,22	0,22	0,32	0,36
Ukraine	0,10	0,23	0,13	0,26	0,51	0,59	0,65
Uzbekistan	0,04	0,26	0,30	0,43	0,58	0,57	0,57

**Price liberalization** - Index is initially developed by de Melo, Denizer and Gelb (1996) for years 1990-1993. For years 1994-1997 IMF has updated the index with the help of price liberalization index available in EBRD Transition Report. For year 1998 I counted the index at the same way.<sup>4</sup>

### Price liberalization index

	1991	1992	1993	1994	1995	1996	1997	1998
<b>Baltic countries</b>								
Estonia	0,42	0,75	0,75	0,75	0,71	0,71	0,71	0,71
Latvia	0,42	0,67	0,75	0,75	0,71	0,71	0,71	0,71
Lithuania	0,42	0,67	0,75	0,75	0,71	0,71	0,71	0,71
<b>Central and Eastern Europe</b>								
Albania	0,17	0,75	0,75	0,75	0,71	0,71	0,71	0,71
Bulgaria	0,75	0,75	0,75	0,75	0,71	0,47	0,71	0,71
Croatia	0,58	0,67	0,75	0,75	0,71	0,71	0,71	0,71
Macedonia	0,58	0,67	0,75	0,75	0,71	0,71	0,71	0,71
Poland	0,58	0,75	0,75	0,75	0,71	0,71	0,71	0,76
Romania	0,42	0,42	0,58	0,75	0,71	0,71	0,71	0,71
Slovak Republic	0,75	0,75	0,75	0,75	0,71	0,71	0,71	0,71
Slovenia	0,75	0,75	0,75	0,75	0,71	0,71	0,71	0,71
Czech Republic	0,75	0,75	0,75	0,75	0,71	0,71	0,71	0,71
Hungary	0,75	0,75	0,75	0,75	0,71	0,71	0,76	0,76
<b>Former Soviet Union</b>								
Armenia	0,17	0,42	0,5	0,75	0,71	0,71	0,71	0,71
Azerbaijan	0	0,42	0,58	0,75	0,71	0,71	0,71	0,71
Belarus	0,08	0,17	0,25	0,5	0,71	0,71	0,71	0,47
Georgia	0,25	0,42	0,5	0,5	0,71	0,71	0,71	0,71
Kazakhstan	0,08	0,42	0,42	0,5	0,71	0,71	0,71	0,71
Kyrgyz Republic	0	0,25	0,5	0,75	0,71	0,71	0,71	0,71
Moldova	0,08	0,42	0,58	0,75	0,71	0,71	0,71	0,71
Russia	0,08	0,5	0,58	0,75	0,71	0,71	0,71	0,65
Tajikistan	0,08	0,33	0,42	0,75	0,71	0,71	0,65	0,71
Turkmenistan	0	0,17	0,25	0,5	0,47	0,47	0,47	0,47
Ukraine	0,08	0,25	0,17	0,5	0,71	0,71	0,71	0,71
Uzbekistan	0	0,33	0,33	0,75	0,71	0,71	0,65	0,47

<sup>4</sup> The EBRD indicators, which are published annually in the EBRD Transition Report for all transition economies, range from 1 to 4+, where de Melo et al (1997) use the range from 0 to 1. IMF has rescaled the EBRD indicators so that a value of 4+ represents a value of 1 and a EBRD's value of 1 represents a value of 0.

## **Nominal exchange rate regimes**

*Currency board arrangement:* A monetary regime based on an implicit legislative commitment to exchange domestic currency for a specified foreign currency at fixed exchange rate, combined with restrictions on the issuing authority to ensure the fulfillment of its legal obligation. This implies that domestic currency be issued only against foreign exchange and that new issues are fully backed by foreign assets, eliminating traditional central bank functions such as monetary control and the lender of last resort and leaving little scope for discretionary monetary policy; some flexibility may still be afforded depending on how strict the rules of the boards are established.

*Peg, single currency:* The country pegs to a major currency (such as US dollar) with infrequent adjustment of the parity.

*Peg, currency composite:* A weighted composite is formed from the currencies of major trading of financial partners. Currency weights are generally country-specific and reflect the geographical distribution of trade, services, or capital flows. They can also be standardized, such as those of the SDR.

*Managed float:* The central bank quotes and supports the rate but varies it frequently. Indicators for adjusting the rate are broadly judgmental, including, for example, the balance of payments position, international reserves, or parallel market developments, and adjustments may not be automatic.

*Independent (free) float:* Rates are market-determined, with any intervention aimed at the moderating rate of change, rather than at establishing a level for the rate.

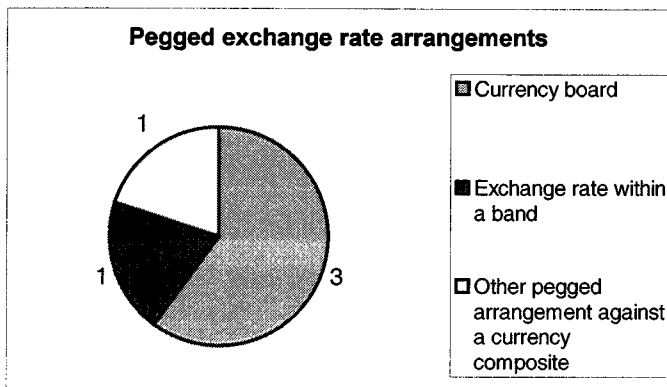
Source: IMF classification except for currency board; *IMF (1999): World economic and financial surveys: Exchange Rate Arrangements and Currency Convertibility, Developments and Issues. p. 24.*

Source for currency boards: A number of scholarly articles, e.g. *Wyplosz, Charles (1999): Ten Years of Transformation. Macroeconomic Lessons. Graduate Institute of international Studies, Geneva and CEPR.*

Definition of currency board is from IMF's new classification system, IMF (1999), p. 36.

## Appendix 4: IMF's New Regime Classification System

Source: International Monetary Fund (1999, 30, 36-37)

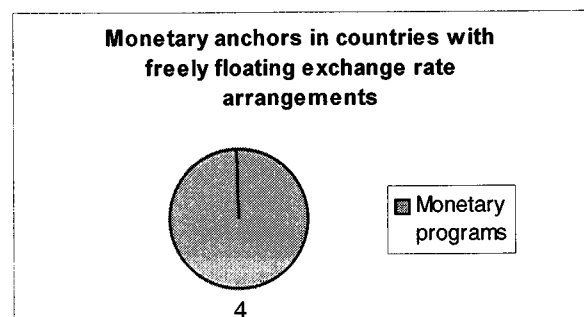
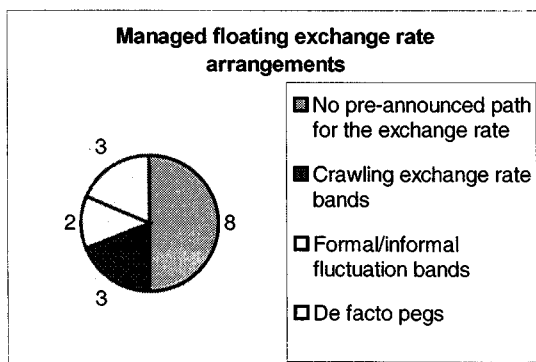


The adoption of the new classification scheme would mean a move from the long-standing *de jure* –classification toward actual *de facto* exchange rate arrangements. The new system would also present the countries' exchange rate regimes against alternative monetary policies by using both

criteria: monetary policy framework and exchange rate regime. This would make the role of countries' exchange rate arrangements as part of their monetary policies more transparent than it is nowadays. (IMF 1999, 35-36.)

The IMF's new classification system ranks exchange rate regimes basing on the degree of flexibility of the arrangement. It distinguishes between following categories: exchange arrangements with no separate legal tender, currency board arrangements, other conventional fixed peg arrangements, pegged exchange rates within bands, crawling pegs, exchange rates within crawling bands, managed floating with no pre-announced path for the exchange rate and independent floating. Moreover, the new classification presents exchange rate regimes against alternative monetary policy frameworks in order to capture the role of the exchange rate in broad economic policy. Monetary policy frameworks are classified to exchange rate anchor, monetary aggregate anchor, inflation-targeting framework, IMF-supported or other monetary program and other frameworks.

Expanded IMF classification of exchange rate arrangements for transition economies as of December 31, 1997 are presented here.



## Appendix 5 : Some Descriptive Tables

### Inflation characteristics for different regions (twelve-month end year inflation)

Year	1991	1992	1993	1994	1995	1996	1997	1998
<b>Baltic countries</b>								
Min	262	954	35	26	23	13	7	4
Median	304	959	36	42	29	13	8	5
Max	345	1161	189	45	36	15	12	8
Average	304	1025	87	38	29	14	9	6
<b>Central and Eastern Europe</b>								
Min	32	9	18	-3	4	-1	3	1
Median	164	86	35	21	9	13	12	10
Max	339	1925	1149	122	33	311	578	45
Average	160	356	190	34	15	45	83	12
<b>Former Soviet Union</b>								
Min	25	644	837	1	24	6	0	3
Median	153	1380	2083	1221	101	32	13	17
Max	204	2984	10896	6474	2133	446	164	150
Average	140	1672	4585	1391	363	63	32	31

### Inflation characteristics across exchange rate regimes for years 1991-1998

	Managed floats	Pegged	Cba	Free floats
Min	-3,00	1,40	4,20	0,40
Max	9750,00	1328,00	954,00	10896,00
Mean	337,20	88,40	127,90	906,60
Median	21,70	9,10	22,00	116,00
Std deviation	1,64	1,52	1,56	2,08

### Frequencies of exchange rate regimes separately for CEE and FSU countries in 1991-1998

	Managed floats	Pegged	Cba	Free floats
Central and Eastern Europe	35	16	2	23
Baltic countries	2	2	12	5
Former Soviet Union	35	1	0	33
Sum total	72	19	14	61



**Transition Economies: Stabilization Programs and Inflation Performance, 1989-1998**

	<b>Stabilization program date</b>	<b>Pre-program inflation<sup>5</sup></b>	<b>Exchange rate regime adopted</b>	<b>Year(s) in which inflation peaked</b>	<b>Peak inflation</b>	<b>Inflation at third year after starting the program</b>	<b>Inflation in 1998<sup>6</sup></b>	<b>Exchange rate regime in 1998<sup>7</sup></b>
<b>Baltic countries</b>								
Estonia	June 1992	1086	Currency board	1992	947	29	8	Currency board
Latvia	June 1992	818	Floating; Fixed to SDR since Feb 1994	1992	1162	23	5	Fixed
Lithuania	June 1992	709	Floating; Currency board since Apr 1994	1992	1162	36	4	Currency board
<b>Central and Eastern Europe</b>								
Albania	August 1992	293	Floating	1992	237	6	10	Floating
Bulgaria	1st Feb 1991 2nd Jul 1997	245	Floating; Currency board since Jul 1997	1997	579	1994: 122 1998: 10	10	Currency board
Croatia	October 1993	1903	Fixed	1989	2585	3	6	Managed float
Macedonia	January 1994	248	Fixed	1992	1780	3	1	Pegged de facto
Poland	January 1990	1096	Fixed	1989	640	38	10	Crawling peg
Romania	October 1993	314	Managed float	1993	295	57	45	Managed float
Slovak Republic	January 1991	46	Fixed	1991	58	12	9	Broad band peg
Slovenia	February 1992	288	Managed float	1991	247	9	7	Managed float
Czech Republic	January 1991	46	Fixed	1991	52	10	9	Managed float
Hungary	March 1990	26	Fixed	1990	35	21	14	Crawling peg

Main source: Fisher and Sahay, 2000.

<sup>5</sup> Pre-program inflation is inflation in the twelve months previous to the month of the stabilization program.

<sup>6</sup> See Table 1.

<sup>7</sup> From Transition Report 1999 (EBRD).

(Table continues)

	Stabilization program date	Pre-program inflation <sup>8</sup>	Exchange rate regime adopted	Year(s) in which inflation peaked	Peak inflation	Inflation at third year after starting the program	Inflation in 1998 <sup>9</sup>	Exchange rate regime in 1998 <sup>10</sup>
<b>Former Soviet Union</b>			Jan 1992-Jul 1993 ruble area					
Armenia	December 1994	1885	Managed float	1993	10896	22	3	Managed float
Azerbaijan	January 1995	1651	Floating	1994	1787	4	4	Managed float
Belarus	November 1994	2180	Managed float	1993	1997	63	60	Managed float
Georgia	September 1994	56476	Managed float	1993	7486	7	5	Floating
Kazakhstan	January 1994	2315	Managed float	1992	2961	11	9	Managed float
Kyrgyz Republic	May 1993	934	Managed float	1992	958	35	12	Managed float
Moldova	September 1993	1090	Floating; 1995 managed float	1992	2198	15	30	Floating
Russia	April 1995	218	Broad band peg	1992	2510	1997: 11 1998: 150	150	Broad band crawling peg; since Aug 1998 managed float
Tajikistan	February 1995	73	Floating	1993	7344	10	10	Managed float
Turkmenistan	Not started	-	Not applicable	1993	9743	-	28	?
Ukraine	November 1994	645	Managed float	1993	10155	10	22	Broad band peg
Uzbekistan	November 1994	1555	Managed float; multiple exchange rates	1994	1281	50	33	Managed float

Main source: Fisher and Sahay, 2000.

<sup>8</sup> Pre-program inflation is inflation in the twelve months previous to the month of the stabilization program.

<sup>9</sup> See Table 1.

Table above lists the 25 countries in economic transition and shows for each country the year in which inflation peaked and how the stabilization developed in time during 1989-1998. Inflation rates at third year after starting the stabilization program and at last year (1998) are shown in the table. Accordingly, exchange rate regimes adopted when starting the stabilization and at last year are listed. The main data source for this table is a study made by Fischer and Sahay (2000). However, the last column, which lists the exchange rate regimes in 1998, relies on data from EBRD's Transition report (1999).

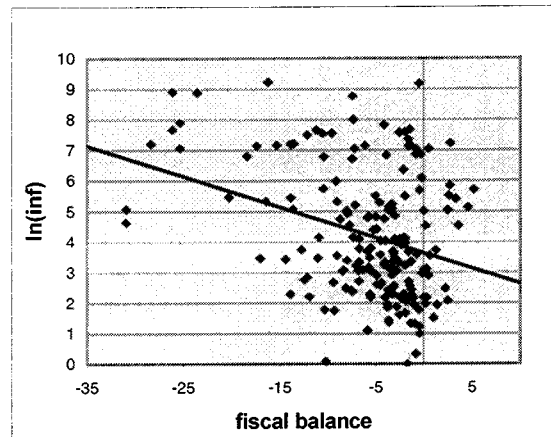
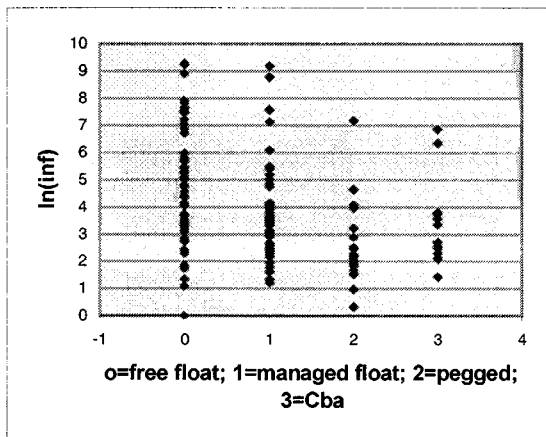
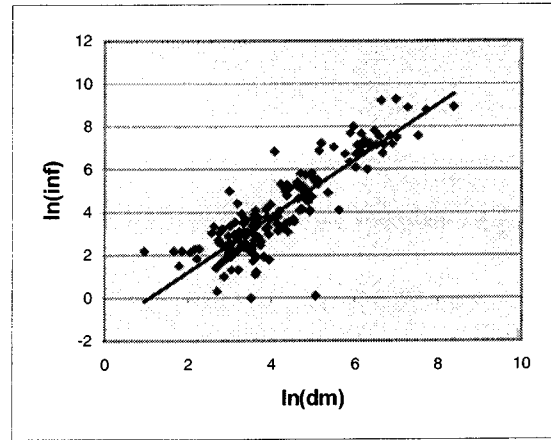
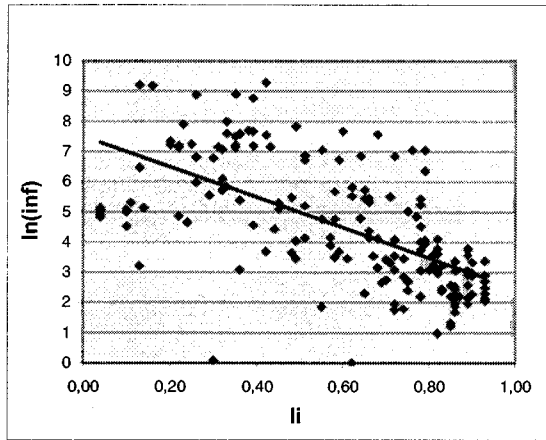
**Average inflation rates (in logarithms) across exchange rate regimes**

	<b>Managed float</b>	<b>Pegged</b>	<b>Cba</b>	<b>Free float</b>
<b>1991</b>	4,33	4,22	-	5,63
<b>1992</b>	3,43	2,37	-	6,54
<b>1993</b>	5,32	3,06	3,58	6,45
<b>1994</b>	4,96	3,97	3,77	5,24
<b>1995</b>	3,87	2,02	3,47	3,93
<b>1996</b>	3,23	1,92	2,64	3,25
<b>1997</b>	2,63	1,60	3,66	3,87
<b>1998</b>	2,78	0,93	1,94	2,04

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<sup>10</sup> From Transition Report 1999 (EBRD).

## Appendix 6: Correlation Diagrams Between Dependent and Main Independent Variables



NOTES: **Ln(inf)** refers to logarithm of 12-month inflation, **li** is liberalization index, **ln(dm)** means logarithm of 12-month monetary growth and **cba** is currency board arrangement.

