Exchange rate regimes and exchange market pressure in accession countries

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1. Introduction

The Central- and East-European countries (CEECs) have experienced big changes during the last decade. Starting from central planning eight CEECs – the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic and Slovenia – changed to a market economy and join the European Union in the spring of 2004[1]. It is to be expected that they will also join the Economic and Monetary Union (EMU) in the near future.

One of the selection criteria to judge whether is country is allowed to join the EMU is related to the stability of its exchange rate in the preceding period. According to the Maastricht criteria in order to be eligible the currency of the candidate country has to participate fully in the EMS. In the present context this means that the country has to join ERM II. Moreover the currency should not be subject to serious tensions within that system in the two preceding years that precede entry into the EMU.

In this respect the European Commission has already made it clear that some of the current exchange rate regimes in the CEECs are not acceptable (see European Commission, 2001). As a matter of fact the following regimes are not compatible with the so-called ERM II: crawling pegs, free floats or managed floats without a mutually agreed central rate and pegs to anchors other than the euro. This means that all CEECs except Estonia and Lithuania will have to modify their exchange rate arrangement when joining ERM II.

The Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia currently use exchange rate arrangements that can be defined as flexible. The change towards a less flexible exchange rate system constitutes a potential danger for these countries of increased susceptibility to currency crises. In the terminology of this paper they have to change their exchange rate regime from one classified as "extreme" (flexible exchange rates) to one classified as "intermediate" (fixed but adjustable exchange rates).

[1] Bulgaria and Romania will join the EU at a later time and are not further considered in this paper.

Economic theory has increasingly stressed the vulnerability to financial crises of so-called intermediate exchange rate arrangements. Intermediate exchange rate arrangements, such as e.g. conventional fixed pegs, fall between the two extreme exchange rate systems, viz. monetary union (irrevocably fixed exchange rate systems) on the one hand and floating exchange rates on the other hand. The reason for the high vulnerability of intermediate exchange rate systems is that they can never be made fully credible (as long as central banks care about domestic objectives) and that the central bank has an incentive to devalue once economic agents expect it to happen (see De Grauwe & Grimaldi, 2002).[2]

Increased capital mobility and capital import dependency further increase this vulnerability. In a world of high capital mobility the required increase in the domestic interest rate to counter a currency crisis becomes prohibitively high. In this respect it should be noted the CEECs have increasingly benefited from capital imports. Following the transition to a free market, capital inflows increased from $3.2 billion to $22.3 billion in 1990-1995. During the second half of the 1990s they averaged $23.2 billion per year, equivalent to 6.3 % of the CEECs' gross domestic product. These capital inflows make the candidate countries more vulnerable to sudden capital withdrawals. This concern has been voiced by a number of economists (see e.g. Buiter and Grafe, 2002). Several countries, such e.g. the Czech Republic in 1997, have already experienced rapid capital outflows on a smaller or bigger scale in the past (see Vanneste, Van Poeck & Veiner, 2003).

An important economic policy question therefore arises. Is it economically sensible to require the CEECs to change their current exchange rate arrangement and move to an intermediate exchange rate arrangement such as ERM II before they actually join the EMU? Would it not be better to let them enter EMU without passing this intermediate stadium?

One way to analyse this question is to look at the experience of the CEECs in the past. CEECs have used very different exchange rate regimes, ranging from currency board to independent floating. Most of them have also changed their regime in the course of the 1990s. What was the reason for their choice of an exchange rate system and why

[2] In developing countries financial instability seem to go hand in hand with flexible exchange rates, though. The reason may be that the extremely low credibility precludes the use of fixed exchange rates.

was it eventually changed? Has there been a general tendency for more flexibility in the CEECs exchange rate systems and why?

A second and more important question we want to answer is whether currency crises have been more frequent in the CEECs with intermediate systems as compared to the CEECs with flexible systems[3]. To answer this question we compute a measure of exchange market pressure (emp). The advantage of this measure is that it enables comparison of exchange market pressure in very different exchange rate regimes. We also compute the number of currency crises to which the CEECs have been subjected.

Although the sample of countries is too low to derive firm conclusions, the results deserve attention. The different countries in the sample have a lot in common. They all went through a difficult liberalisation process resulting in deep recession and high inflation. Further, they were subject to common external shocks, such as the Russian crisis. All this increases the probability that the differences in crisis experience are related to the exchange rate regime under which these countries operated.

[3] There are no examples of irrevocably fixed exchange rates or monetary union in the sample. Currency boards, although characterized by a lot of rigidity, cannot be considered as irrevocably fixed exchange rates as the experience of Argentina e.g. shows.

2. Financial crises and exchange rate regime

The turbulent times at the end of the 20th century have boosted discussions over the role of exchange rate regimes in supporting financial stability. In this section we briefly overview the main arguments in the widespread literature on this subject. We then investigate the CEECs' initial exchange rate regime choices and subsequent switches between 1990 and 2003.

Eichengreen and Hausmann (1999) discuss three hypotheses concerning the relationship between the exchange rate arrangement and financial fragility: (1) the moral hazard; (2) the original sin; and (3) the commitment hypothesis.

According to the moral hazard hypothesis the insurance against the exchange rate risk offered by fixed exchange rate arrangements prompts market participants to lend and borrow extensively. Mishkin (2001) develops a similar view that an exchange-rate peg by providing a more stable exchange rate might, lower the risk of foreign investors and thus encourage capital inflows. This theory concludes that floating exchange rate regimes better incite foreign and domestic investors to adequately take into account risks of excessive foreign lending.

The original sin hypothesis attributes the source of financial fragility to the concurrence of three factors: good economic prospects, openness to international capital flows and the impossibility to use the domestic currency to borrow abroad or long-term. This results in a situation where borrowers face currency or maturity mismatches which create risks in the event of a change in expectations.

Many central banks in the CEECs using managed floats actively exert interest rates and open market operations to keep exchange rate from high variability. Slovenia for example has announced a managed float system in 1992. However, the Slovenian central bank actively intervened in the exchange market to avoid a real appreciation of the crown. Coudert and Couharde (2003) conclude that Slovenia rather implemented

the crawling peg with the euro in the period considered. Constraints on capital mobility also have contributed to this policy.

The commitment problem hypothesis addresses the weaknesses of institutions. Institutions that fail to meet their commitments inevitably cause a financial crisis. Eichengreen and Hausmann (1999) point out that in the case of less developed financial infrastructure the markets need a lender of last resort. This lender of last resort can find the freedom provided by a flexible currency policy useful.

In conclusion the three hypotheses suggest that fixed exchange rate systems are more vulnerable to crisis. Flexible exchange rates offer greater financial stability and allow transition countries to reform their economies more smoothly. Masson (1999) adds that especially structural differences between the CEECs and the EU-countries make adjustable pegs vulnerable to speculative attacks. Flexible exchange rate regimes advocates also stress the need for CEECs to find an equilibrium exchange rate before joining the fixed EMU system.

However, the conclusions for designing the exchange rate regime may be less straightforward. Calvo and Reinhard (2000) find that countries who officially use a floating regime mostly do not so. In the "fear of float" they limit the exchange rate variability by using interest rates. Both exchange and interest rate volatility subsequently cause unstable asset prices. Darvas and Szapáry (2000) provide empirical evidence that pressure on the exchange rates and interest rates is not primarily influenced by the exchange rate regime itself. They claim that when there is a sudden shift in market sentiment, flexible regimes do not shield against attacks and when fundamentals are strong it makes sense to defend the currency in order to maintain stability.

3. Exchange rate regimes in the CEECs

Table 1 sketches the prevailing exchange rate regimes in the CEECs between 1990 and 2002 (end of year observations). In the beginning of 1990s most CEECs introduced intermediate exchange rate regimes e. g. conventional pegs or currency

boards. During the transition process however several countries among which the Czech Republic, Hungary and Poland moved to more flexible regimes (see also Corker et. al. 2000). Only the Baltic countries and Slovenia retained their original arrangement.

Table 1. Exchange rate regimes in the CEECs 1990-2003.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Czech Republic	3	3	3	3	3	3	4	7	7	7	7	7	7
Estonia	na	na	2	2	2	2	2	2	2	2	2	2	2
Hungary	3	3	3	3	3	6	6	6	6	6	6	6	6
Latvia	na	na	(8)	(8)	3	3	3	3	3	3	3	3	3
Lithuania	na	na	(8)	(8)	2	2	2	2	2	2	2	2	2
Poland	3	5	5	5	5	6	6	6	6	6	7	7	7
Slovak Republic	3	3	3	3	3	3	4	4	7	7	7	7	7
Slovenia	na	(7)	7	7	7	7	7	7	7	7	7	7	7

Note: End-year observations. Codes in parentheses refer to the periods when the newly-introduced national currencies have not yet assumed the status as the sole legal tender. The meanings of the codes are: na=not available, 1=currency union (no separate legal tender), 2=currency board arrangements, 3=conventionally fixed pegs (adjustable pegs, de facto pegs), 4=horizontal bands, 5=crawling pegs, 6=crawling bands, 7=managed floating without preannounced path for the exchange rate, 8=independent floating.
Source: von Hagen and Zhou (2002), IMF Annual Report on Exchange Rate Arrangements and Exchange Restrictions and authors observations for 2000 onwards.

Hungary started with a conventional fixed peg to a basket consisting of major currencies. Although capital account liberalization was not yet complete in 1990-1994 fixed peg was attacked on several occasions. Consequently the forint was devalued a number of times. The possibilities of speculators increased when Hungary joined the OECD and the authorities lifted several aspects of capital controls. The main concern in the eyes of investors was fiscal policy, although the early 90s were also characterized by banking sector problems. The situation developed into a mini-crisis in 1995. The stabilization package of March 1995 contained important structural reforms, a steep devaluation of the forint (9 %) and the subsequent introduction of a crawling band regime, as reflected in Table 1 by the switch from 3 to 6. From then on Hungary operated under a crawling band of ±2.25% relative to a basket consisting of the ECU and the US dollar.

The Hungarian economy and exchange rate came under strong pressure in 1998 when fiscal concerns after the elections and the Russian crisis coincided. The official reserves initially fell, but the National Bank of Hungary responded by raising interest rates by 100 basis points, which helped to calm the foreign exchange markets. The Russian and to a lesser extent the Asian crisis also led to a decline in stock market prices, but on the whole the country weathered the crisis rather easily. From the beginning of the 21st century the forint has faced mostly appreciating pressures. In 2001 the national bank widened the fluctuation band to ±15% and carried out repeated interventions in the foreign exchange markets.

Quite a similar path was chosen by the Czech Republic and Poland. Both countries moved from a conventional peg to a managed floating regime. For *Poland* the development has been relatively gradual. In 1991 the Polish national bank introduced a crawling peg/band. The original fluctuation band ±2.5% was widened several times till ±15% in 1999. In 2000 a free float was announced. This corresponds in table 1 with the gradual move from 3 to 7.

With the separation of the Czech-Slovak Federation the new *Czech Republic* introduced its own currency and fixed the exchange rate to a currency basket. In the early transformation years there were no appreciation or depreciation pressures. The Czech Republic was also the first CEEC that attained an A-rating from Standard&Poors rating agency (see appendix IV). The favourable economic climate attracted short-term foreign capital. To counterbalance this speculative inflow the koruna's fluctuation band was widened to ±7.5% in 1996.

The critical time arrived in May 1997 when, after publication of new weak economic data, the koruna came under pressure from domestic and foreign investors resulting in skyrocketing sales of Czech crowns and purchases of foreign exchange assets. At the end of the month the Czech National Bank cancelled the existing exchange rate regime and introduced a managed float. The regime switch and the introduction of a stabilization program alleviated the situation and the crisis was successfully overcome. The appreciation trend since 2001 outweighs the devaluation during the 1997 crisis.

The monetary authorities of the *Slovak Republic* introduced a fixed exchange rate from 1993 and defended it effectively till the Russian crisis. The first serious pressure on the Slovak crown was experienced five days after the first attack on the Czech crown in May 1997. In reaction to the contagion the Slovak central bank raised interest rates and reserve requirements. The central bank was able to maintain the peg, though interest rates remained high for a long time. The attack was not successful mainly due to the relatively low level of foreign capital inflow in the past. The Slovak Republic was rather closed and the capital market liberalisation was still limited.

The country had to give up its currency peg in 1998 after the outbreak of the Russian crisis. The new Slovak government voted in the September 1998 elections realised the costs and distorting effects of the wrongly positioned exchange rate. After the introduction of the floating regime the Slovak crown devalued by 17% and the country's external balance improved significantly.

Slovenia has always concentrated its economic policy on stability rather than on transformation. The monetary authorities introduced a managed floating exchange rate system in 1993 (see table 1). Despite the announced float the central bank has actively managed the exchange rate to ensure its stability and smoothly devalued it to keep the country's competitiveness. To impede capital inflows motivated by the high interest rates, restrictions on capital movement were put in place. In general the Slovenian "crisis avoidance" policy proved to be successful. Slovenia did not experience spill-over effects from the Asian and Russian crisis and preserved its A rating throughout the period (see appendix IV).

As Slovenia has to implement free capital movement on its course to EU-accession it remains to be seen if this liberalisation will harm the exchange rate stability. Capital restrictions are considered to be the main recipe for the successful Slovenian exchange rate policy until now.

The Baltic countries form a quite homogenous group of strong peggers. They all use tightly fixed exchange rate regimes and have been able to manage it till today. *Latvia*'s independent monetary policy started in 1993 by introducing its national currency. Since 1994 Latvia successfully maintained the conventionally fixed peg at 0.8 Lats per SDR.

Estonia started its money reform already in 1992. It introduced a currency board system in which the Estonian crown was pegged to the German mark. The central bank changed the peg in 1999 as a result of the introduction of the euro. *Lithuania* followed Estonia's path in 1994. Since then, the litas has been pegged to the US dollar at four litas per US dollar. Discussions on abolishing the arrangement have been frequent in the past but the volatile international environment lessened them considerably. In February 2002 the Lithuanian litas was repegged to the euro at the European Central Bank's official dollar rate.

The 1990s emerging market crises except the Russian crisis did not considerably influence the Baltic economies. The Asian crises generated only short-lived speculative pressure in 1997 in Estonia about the sustainability of the currency board. However the Baltics heavily suffered from the Russian crisis in 1998 mainly through the international trade channel. In August and September 1999 the Bank of Latvia accomplished several interventions in the foreign exchange market. The crisis mainly hit the stock market due to more pessimistic expectations of foreign investors in emerging markets. Lithuania suffered more than its two northern neighbours from contagion of the 1998 Russian crisis. Out of the three Baltic countries the Lithuanian economy was obviously the most exposed to Russia and its share of developed economies in foreign trade the lowest. The crisis caused some capital outflow and increasing interest rates. Due to the strong political commitment the currency board arrangement survived the tension.

The currency board systems and the conventional peg helped to provide stability in the Baltics. However the fixed exchange rate resulted in considerable appreciation of the currencies. The worsened competitive position is reflected in high current account deficits. On the other hand the reliability of exchange rate arrangement and the high level of liberalisation have made these countries attractive to foreign investors. As a result foreign direct investment dominates the capital inflows and covers a big part of current account deficit.

Summing up, the general pattern characterising the CEECs is that they mainly started with fixed regimes. Fixing the exchange rate helped to bring down their worrying hyperinflation. However, after the stabilisation, the CEECs have opted for more

flexible regimes that leave more manoeuvrability for domestic monetary and fiscal policy.

4. Exchange market pressure and financial crises in the CEECs

In this section we investigate in a more formal way to what extent exchange rate regimes in the CEECs have been subject to tensions between 1990 and 2003. To this purpose we compute a quarterly based measure of exchange market pressure (emp) for each of the CEECs. We also count the number of currency crises to which the CEECs have been subject. A crisis quarter is defined as one in which the value of emp takes an exceptionally high value.

The notion of exchange market pressure was introduced by Girton and Roper (1977). They started from the insight that excess demand or supply on the foreign exchange market can result in a change in the price of foreign exchange as well as in a change in the level of foreign reserves. The interesting feature of the concept is that is applicable to all exchange rate systems and to different degrees of exchange rate management. We use the extended version which includes the change in the interest rate differential, in addition to reserve and nominal exchange rate changes (see Eichengreen et al. (1995)). As a matter of fact, interest rates have been frequently changed in CEECs to alleviate exchange market pressure (see section 2). We also take into account the different volatility of the components by using variance smoothing weights. The weights on the intervention and interest rate terms are the ratio of the standard error of the percentage change of the exchange rate over the standard error of the percentage change of reserves and the interest rate differential respectively. Exchange market pressure is thus defined as:

$$(1)\quad emp_{ERW} = e - \frac{\sigma_e}{\sigma_{\hat{r}}} \cdot \hat{r} + \frac{\sigma_e}{\sigma_{\left(i_s - i_s^*\right)}} \cdot \left(i_s - i_s^*\right)$$

where:

e rate of depreciation of domestic currency;

$\hat{r}$ proportional increase in domestic international reserves;

$i_s - i_s^*$ interest rate differential;

$\sigma_e, \sigma_{\hat{r}}, \sigma_{(i_s - i_s^*)}$ Standard error of the variables respectively.

In the spirit of the emp-measure one might to also include changes in capital controls. The empirical research testing the effectiveness of capital controls often relies on data from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. However, this source does not measure the intensity of controls and only reports on capital outflows. In the case of CEECs it is especially hard to connect increased capital controls with increased speculative pressure on their currencies. The eight EU joiners have achieved almost full alignment with the aquis' requirements on free capital movement. Hence during the last decade there has been almost a constant trend of liberalisation of capital flows. For these various reasons we do not include capital controls in our emp-measure calculations.

The data are derived from IMF International Financial Statistics (Appendix I). Changes in domestic exchange rate are computed relative to the German mark using the fixed Euro conversion rate after 1999. The main reason lays in the fact that all CEECs have used the German mark as single peg or as one of the reference currencies in the basket. We also use Germany as anchor to compute the changes in the short term interest rate differential. We drop the possibility of intervention by foreign authorities, which is quite realistic for the CEECs. So only the unilateral intervention measure is used.

The appendix III gives a detailed view of the emp-measure[4] for each CEEC during the last 12 years. Appendix II presents an overview of the different components used to compute emp-measures.

Table 2 reports the average emp-measure computed for each of the exchange rate regimes that occurred in the CEECs. We also compute the number of crisis quarters.

[4] We computed several emp-measures for CEECs starting with the classical Girton-Roper and ending with Eichengreen et. al. measure. All measures are highly correlated as shown in appendix V for a selection of the CEECs (the Czech Republic, Hungary, Latvia and Poland). We also experimented with principal components version of exchange market pressure for these same countries. The factor scores are properly signed for Poland, so the first principal component can be regarded as an overall index of exchange market pressure. However, for the Czech Republic, Hungary and Latvia one of the factor scores is wrongly signed (see appendix VI).

A crisis quarter is said to occur when the emp-measure exceeds the mean value by 1.5 standard deviation. However the general picture and conclusions are not significantly altered by using weaker (1 standard deviation) or stronger (2 standard deviations) definitions of crises. We also show the averages over all countries and quarters for intermediate exchange rate regimes and floating regimes.

Table 2. Exchange rate regime and emp-measure in CEECs.

	Observa-tions	Average emp-measure	Standard deviation	Number of "crisis" quaters[1]	Insidence of "crisis" quaters[1]
Currency board arrangements	79	-2.12	5.04	1	1%
Conventionally fixed pegs	71	-1.06	6.99	7	8%
Horizontal bands	14	-0.18	5.31	1	7%
Crawling pegs	16	1.51	6.99	4	25%
Crawling bands	53	-2.92	8.17	2	4%
Total intermediate regimes	*233*	*-1.61*	*6.98*	*15*	*8%*
Managed floating	95	-1.12	5.64	4	4%
Total floating regimes	*95*	*-1.12*	*5.64*	*4*	*4%*
Results of one-way ANOVA to test the means between intermediate and floating systems					
F-statistic		*0.373*			
Significance of the F		*0.542*			

[1] *The "crisis" periods occur when the time series exceeds the sample mean by 1.5 standard deviation.*

On average financial exchange market pressure was lower when the CEECs operated under intermediate regimes as compared to floating regimes – -1.6 and -1.1 respectively. This conclusion should however be put in perspective. The analysis of variance shows that the exchange rate regime does not influence the average emp-measure considerably as the F-statistic is small and insignificant.

Still intermediate regimes are clearly more prone to crises than floating regimes, when judged by the proportion of crisis quarters. The incidence of crisis quarters is 1.5 times longer in intermediate regimes when compared to floating exchange rate regimes.

Table 3. Exchange rate regime and emp-measure by countries.

		Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Slovak Republic	Slovenia
Currency board arrangements	(a)		43			36			
	(b)		-0.30			-4.29			
	(c)		1.18			6.78			
	(d)		0			1			
Conventionally fixed pegs	(a)	11		20	37			3	
	(b)	-4.38		3.23	-2.70			2.64	
	(c)	4.10		8.09	6.18			0.86	
	(d)	0		5	2			0	
Horizontal bands	(a)	5						9	
	(b)	-0.43						-0.05	
	(c)	1.39						6.69	
	(d)	0						1	
Crawling pegs	(a)						16		
	(b)						1.51		
	(c)						10.81		
	(d)						4		
Crawling bands	(a)			33			20		
	(b)			-0.71			-6.57		
	(c)			8.17			6.90		
	(d)			2			0		
Total intermediate regimes	*(a)*	*16*	*43*	*53*	*37*	*36*	*36*	*12*	-
	(b)	*-2.40*	*-0.30*	*1.26*	*-2.70*	*-4.29*	*-2.53*	*1.30*	
	(c)	*3.91*	*1.18*	*8.29*	*6.18*	*6.78*	*9.62*	*5.84*	
	(d)	*0*	*0*	*7*	*2*	*1*	*4*	*1*	
Managed floating	(a)	24					12	18	41
	(b)	-1.73					-1.70	-2.11	-0.16
	(c)	7.91					4.86	6.40	3.63
	(d)	2					0	1	1
Total floating regimes	*(a)*	*24*	-	-	-	-	*12*	*18*	*41*
	(b)	*-1.73*					*-1.70*	*-2.11*	*-0.16*
	(c)	*7.91*					*4.86*	*6.40*	*3.63*
	(d)	*2*					*0*	*1*	*1*

(a) observations
(b) average emp-measure
(c) standard deviation
(d) number of crisis quarters

The picture stays broadly unchanged looking at the single country experiences in table 3, although the intermediate systems show a lot of variability between different countries. Estonia and Lithuania e. g. implemented similar currency board

arrangements, but their average emp-measure and standard deviation differ noticeably. Slovenia's "crisis prevention" policy also occurs clearly.

5. Conclusions

In this paper we computed a measure of exchange market pressure for the various CEECs. We found that average exchange market pressure in CEECs was marginally smaller in countries and periods characterized by an intermediate exchange rate system as compared to those characterized as a floating regime. Yet, the proportion of crisis quarters is significantly larger in the first regime. If this finding is robust it would cast serious doubts on the European Commission's requirement that the CEECs enter ERM II (an intermediate exchange rate system), and participate in this system without serious tensions on the exchange rate, as a qualification for entry into EMU. In subsequent research we therefore enlarge the data set to a larger number of transition economies, and explore exchange market pressure using a data panel. The exchange rate arrangement then enters the equation as a RHS-variable together with macroeconomic variables that have been shown to "explain" crises such as differential money growth rates, budget deficits and current account deficits (see Pentecost, Hooydonk, Van Poeck (2001)).

Nevertheless a few qualifications are at order. First, as De Grauwe & Grimaldi (2002) have argued the probability of a currency crisis in a fixed exchange rate regime may be lower when participation in that regime without devaluation is a condition for entry into EMU. This is because in that case the cost of devaluation increases. Since this is known to the market it is likely to affect the expectations of speculators in a positive way.

Second, the rules of ERM II allow for fluctuation margins around the official parity of 15%. This introduces a lot of exchange rate flexibility into the fixed exchange rate regime. Whether this flexibility suffices to absorb exchange market pressure will of

course depend on the extent of the future crises. In this respect it is also not very clear what is meant by ‘the currency not being subject to serious tensions’.

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Appendix I – Data sources

e – the rate of depreciation of domestic currency; percentage change of exchange rates vis-à-vis Deutsche mark calculated on the basis of IMF International Financial Statistics line ae;

$\hat{r}$ – the proportional change in domestic international reserves; change in the level of reserves divided by money base of previous period – IMF International Statistics financing of the balance of payments (line 79dad), for Poland the change in net foreign assets (line 11-line16c) were used; the whole was deflated by inherited money base (IFS line 14);

$i_s - i_s^*$ – change in the short term interest rate differential with Germany – IMF International Statistics money market rates (line 60b) for Czech Republic, Estonia, Latvia, Lithuania, Poland, Slovak Republic and Slovenia, Treasury bill rates (line 60c) for Hungary were used.

Appendix II - Components of exchange market pressure

Figure 1. Index of nominal exchange rate (national currency per euro (before 1999 ECU)) 1993, Q1=100.

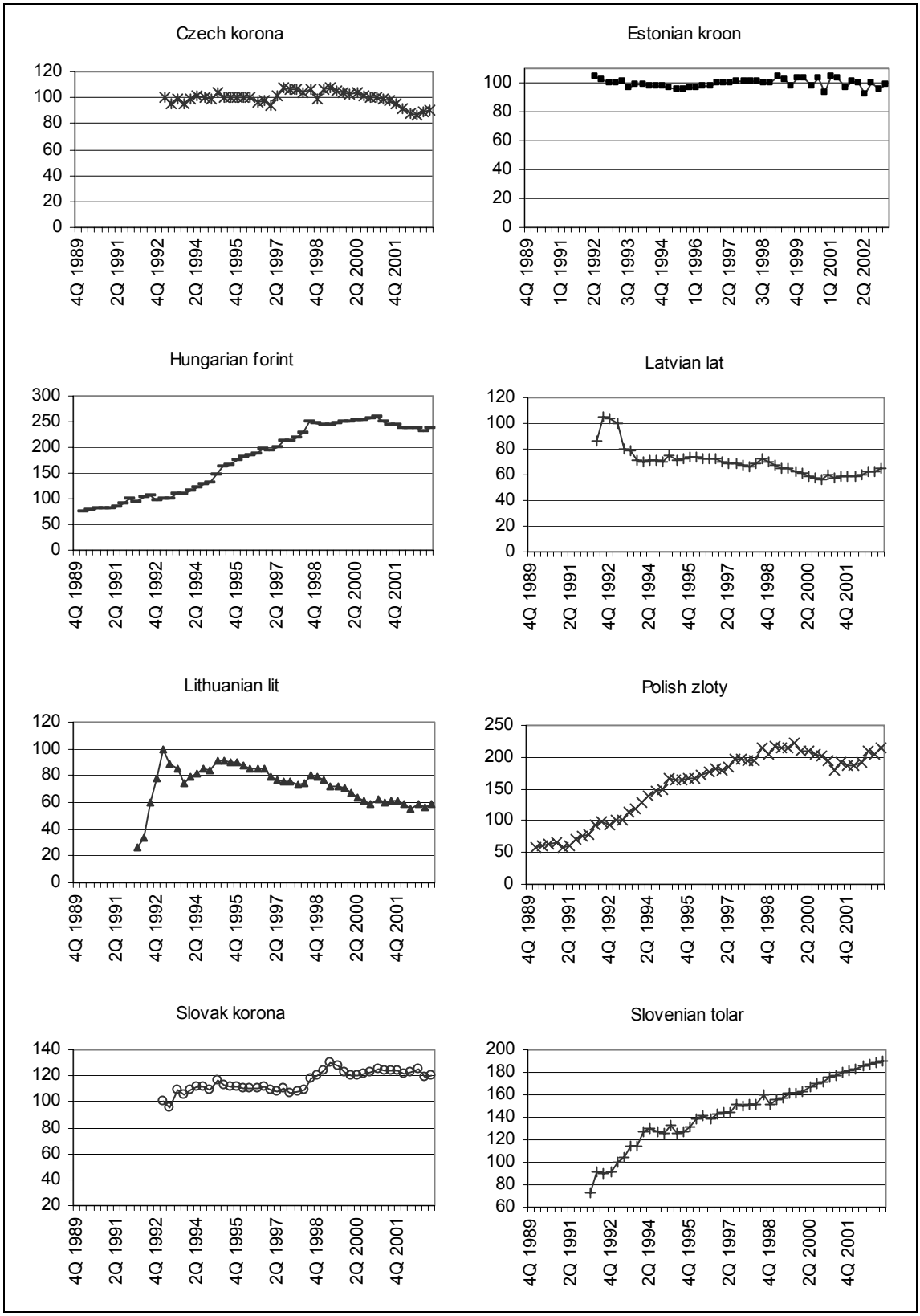


Figure 2. Short term interest rate.

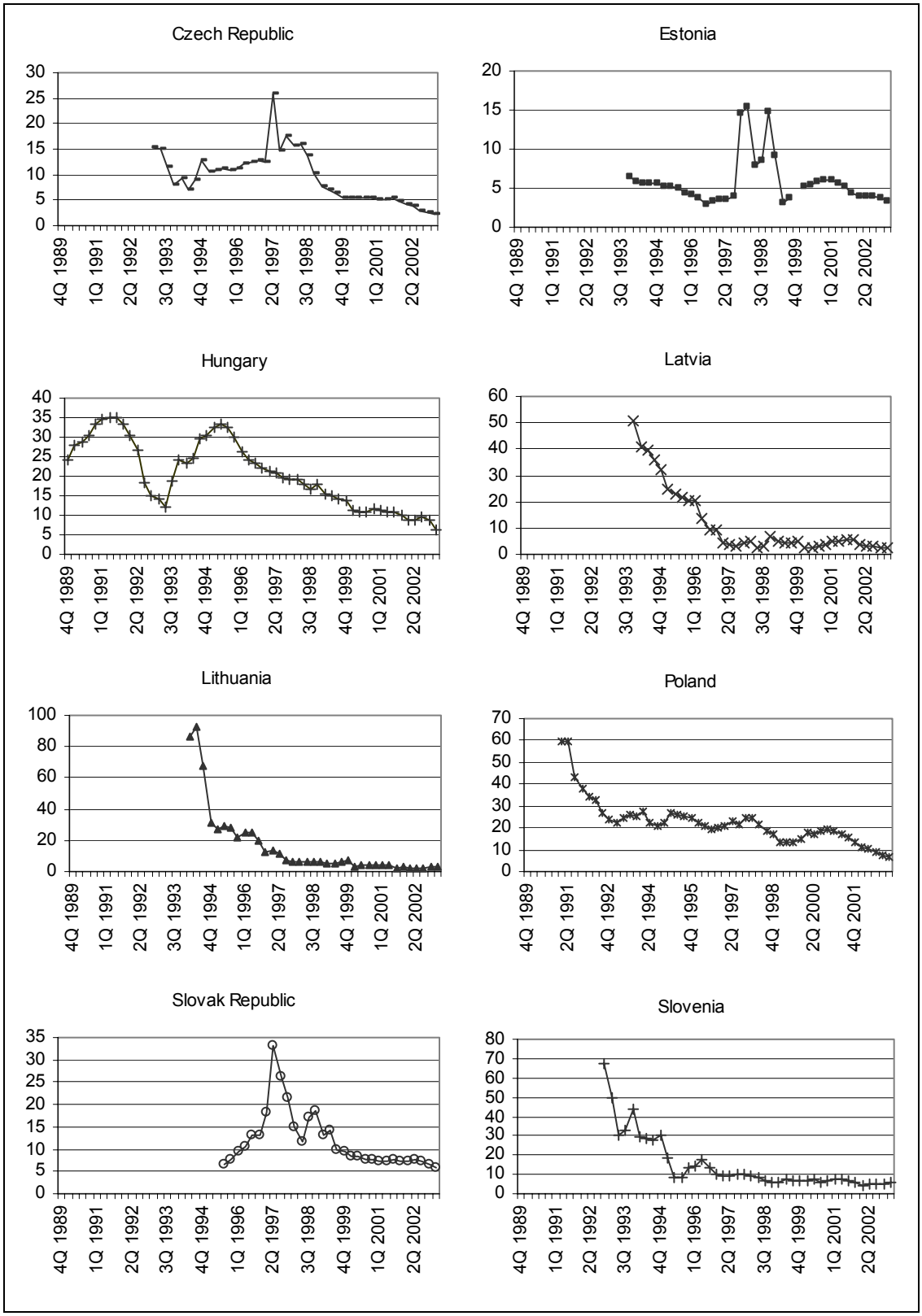
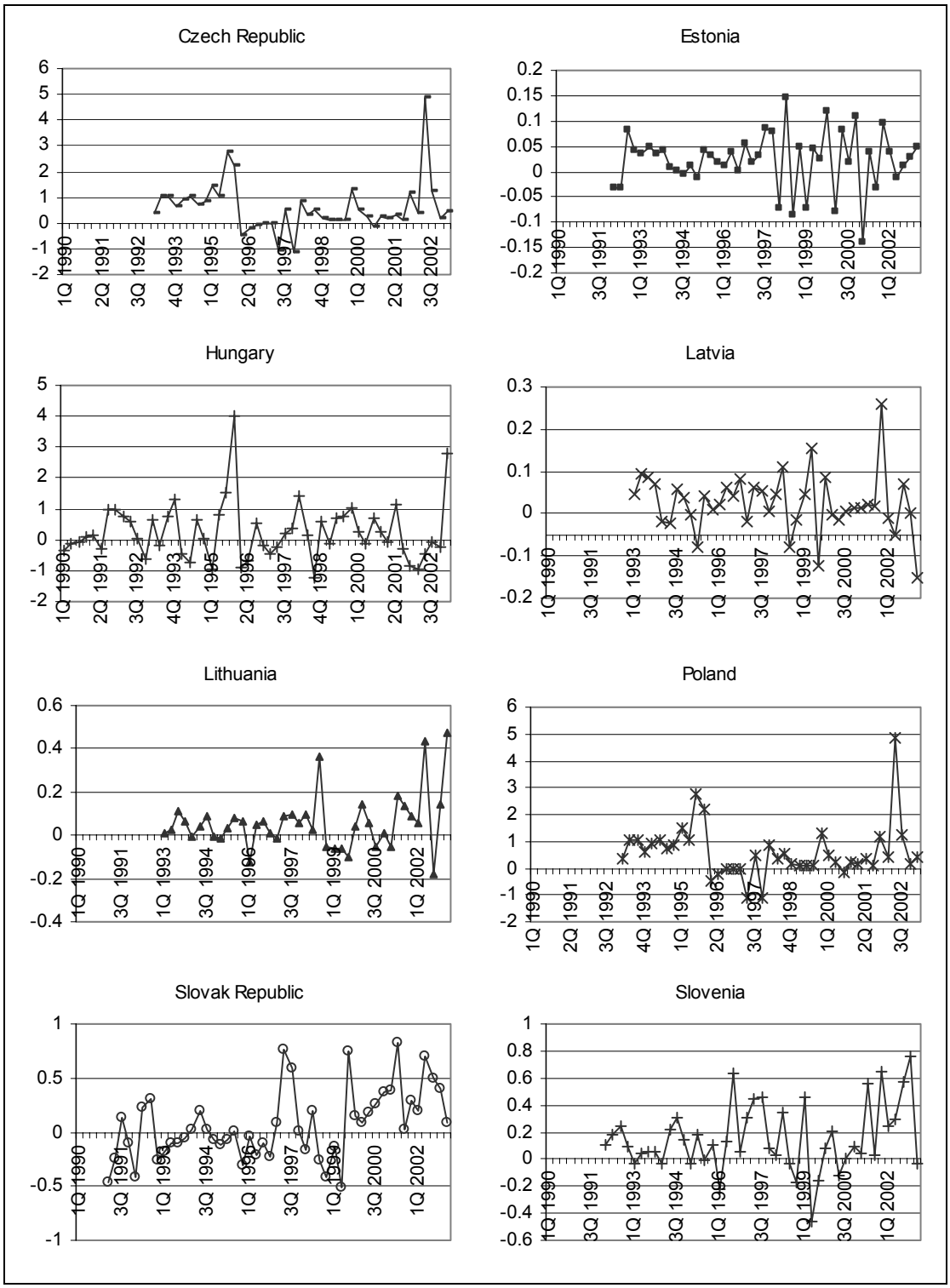


Figure 3. Change in the international reserves, in milliards of the US dollars.



Appendix III

Figure 4. Exchange market pressure in the Czech Republic.

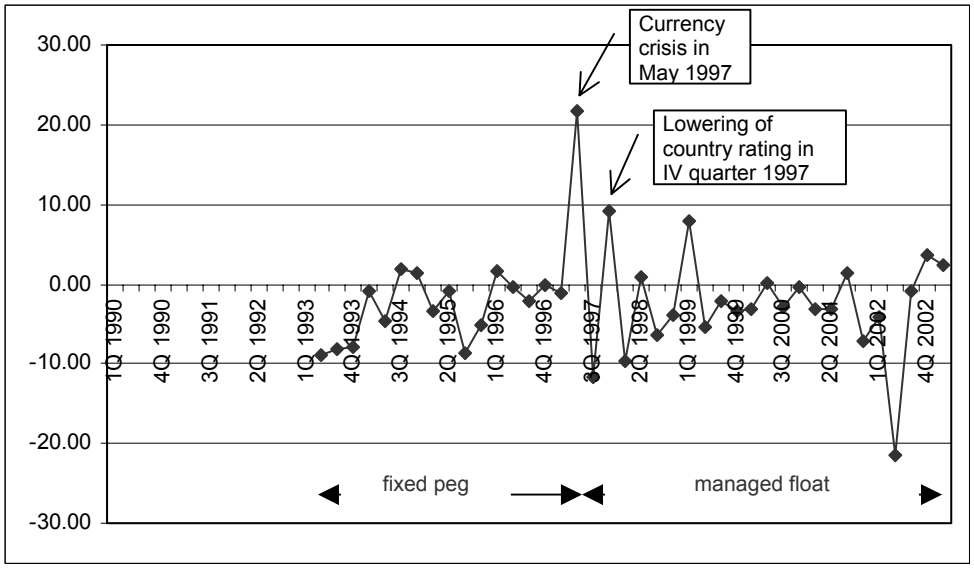


Figure 5. Exchange market pressure in Hungary.

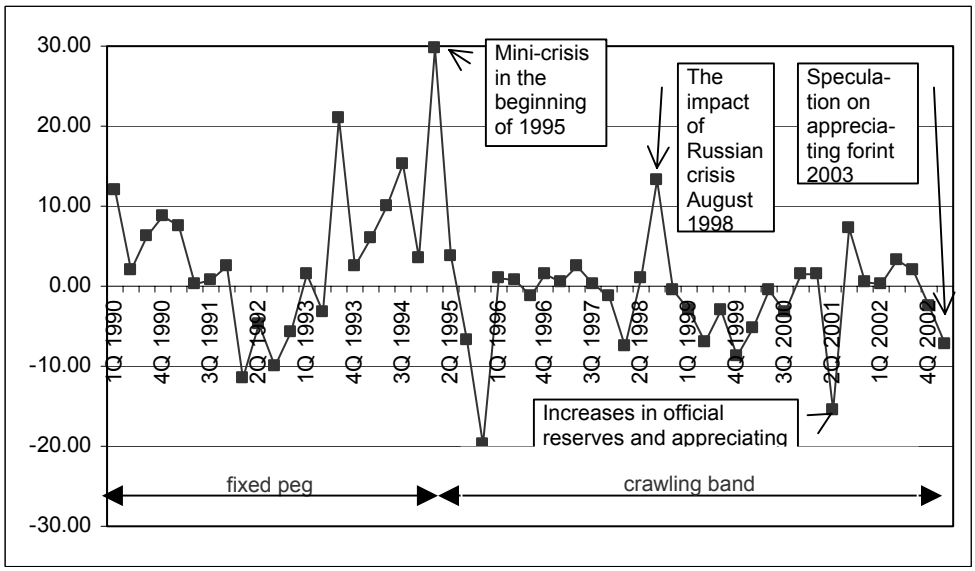


Figure 6. Exchange market pressure in Poland.

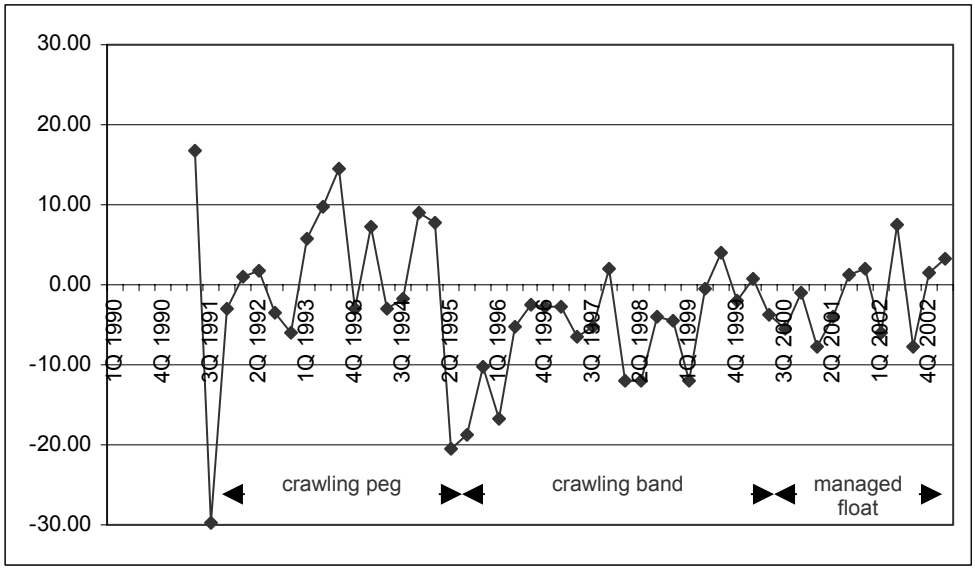


Figure 7. Exchange market pressure in Slovak Republic.

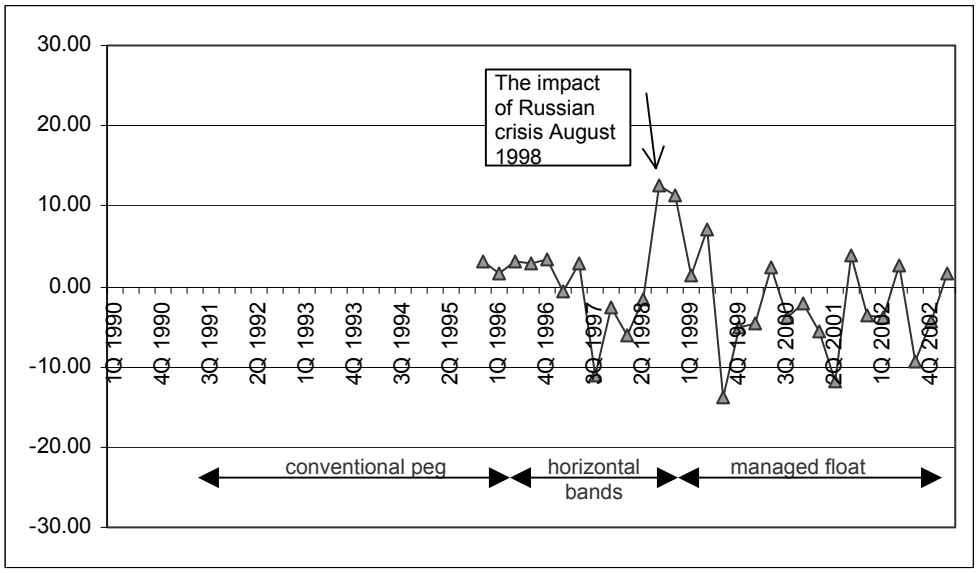


Figure 8. Exchange market pressure in Slovenia.

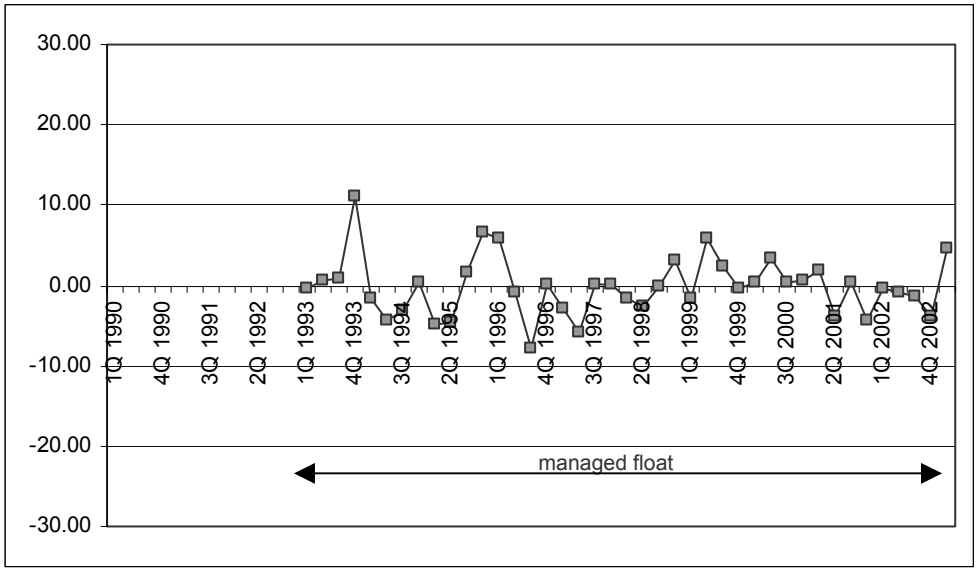


Figure 9. Exchange market pressure in Estonia.

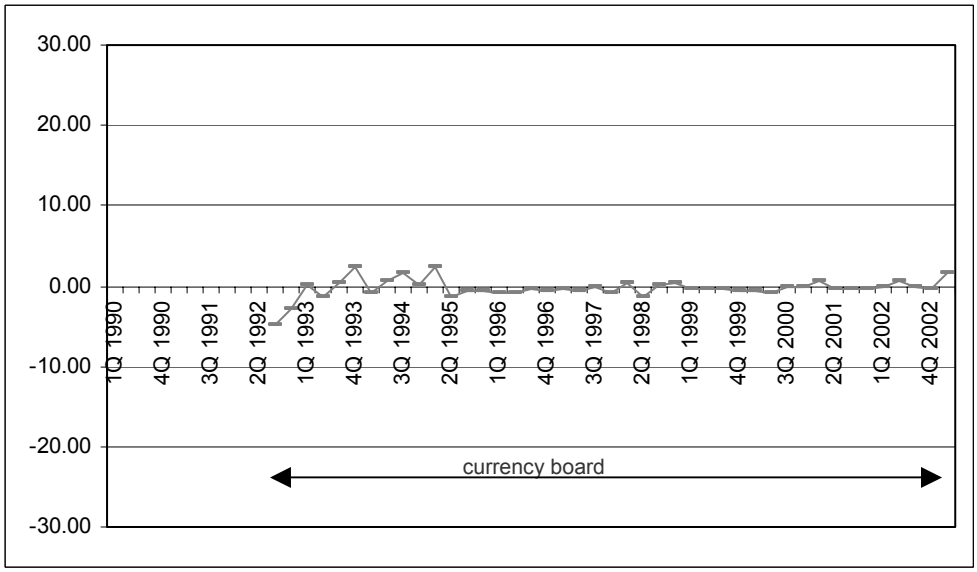


Figure 10. Exchange market pressure in Latvia.

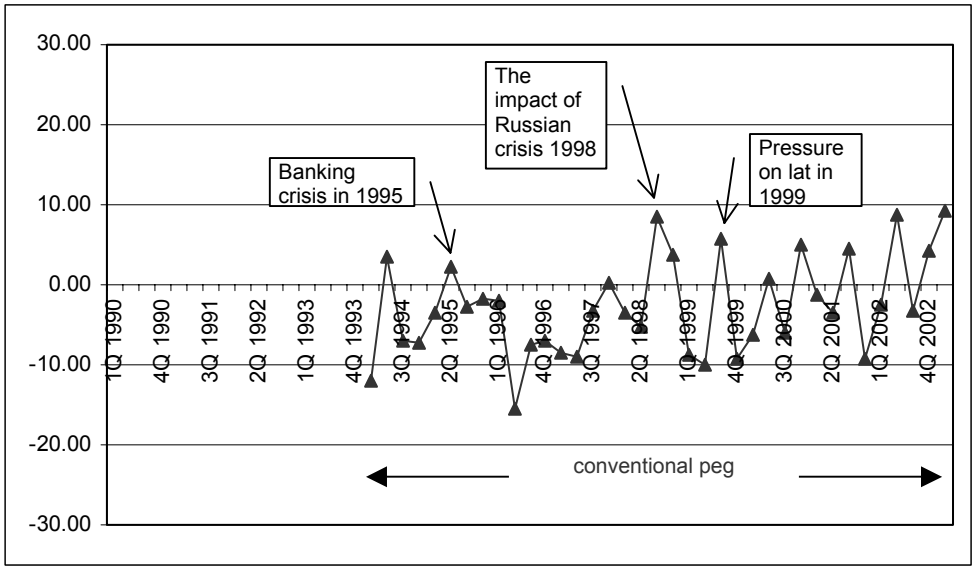
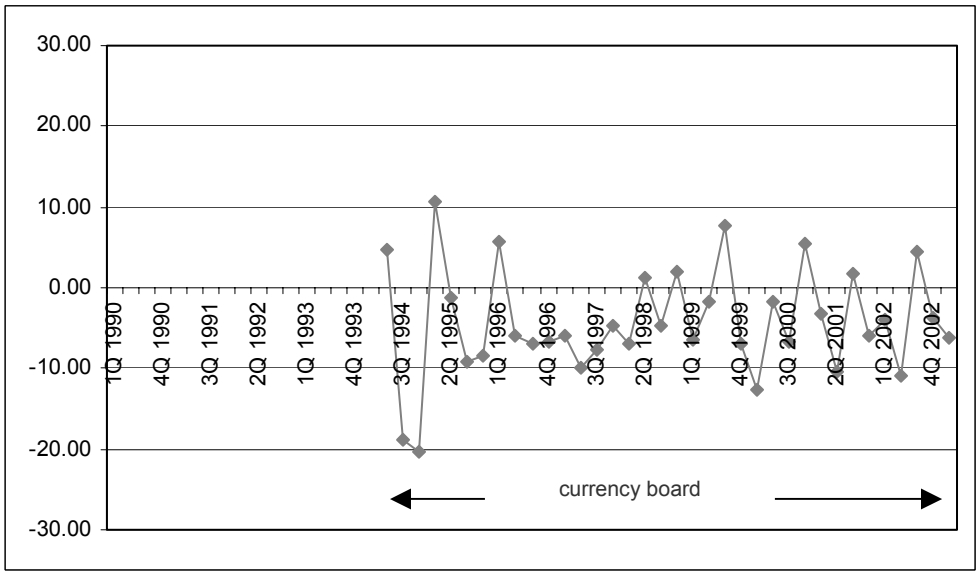


Figure 11. Exchange market pressure in Lithuania.



Appendix IV - Long term credit ratings

		1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Czech Republic	(a)	Baa3	Baa2	Baa1	Baa1	Baa1	Baa1	Baa1	Baa1	Baa1	A1	A1
	(b)	BBB	BBB+	A	A	A	A-	A-	A-	A-	A-	A-
Estonia	(a)					Baa1	Baa1	Baa1	Baa1	Baa1	A1	A1
	(b)					BBB+	BBB+	BBB+	BBB+	A-	A-	A-
Hungary	(a)	Ba1	Ba1	Ba1	Baa3	Baa3	Baa2	Baa1	A3	A3	A1	A1
	(b)	BB+	BB+	BB+	BBB-	BBB-	BBB	BBB	A-	A-	A-	A-
Latvia	(a)					Baa2	Baa2	Baa2	Baa2	Baa2	A2	A2
	(b)					BBB	BBB	BBB	BBB	BBB	BBB+	BBB+
Lithuania	(a)				Ba2	Ba1	Ba1	Ba1	Ba1	Ba1	Baa1	A3
	(b)					BBB-	BBB-	BBB-	BBB-	BBB-	BBB	BBB+
Poland	(a)			Baa3	Baa3	Baa3	Baa3	Baa1	Baa1	Baa1	A2	A2
	(b)			BB	BBB-	BBB-	BBB-	BBB	BBB+	BBB+	BBB+	BBB+
Slovak Republic	(a)			Baa3	Baa3	Baa3	Ba1	Ba1	Ba1	Baa3	A3	A3
	(b)		BB-	BB+	BBB-	BBB-	BB+	BB+	BB+	BBB-	BBB	BBB
Slovenia	(a)				A3	A3	A3	A3	A2	A2	Aa3	Aa3
	(b)				A	A	A	A	A	A	A	A+

(a) Moody's long term credit rating

A – obligations are considered upper-medium grade and are subject to low credit risk; **Baa** – obligations are subject to moderate credit risk. They are considered medium-grade and as such may possess certain speculative characteristics; **Ba** – obligations are judged to have speculative elements and are subject to substantial credit risk;

The modifier 1 indicates that the obligation ranks in the higher end of its generic rating category; the modifier 2 indicates a mid-range ranking; and the modifier 3 indicates a ranking in the lower end of that generic rating category.

(b) Standard and Poor's long term credit rating

A – an obligor has strong capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories; **BBB** – an obligor has adequate capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments; **BB** – an obligor is regarded as having significant speculative characteristics but is less vulnerable in the near term than other lower-rated obligors. However, it faces major ongoing uncertainties and exposure to adverse business, financial, or economic conditions which could lead to the obligor's inadequate capacity to meet its financial commitments. Plus (+) or minus (-) shows relative standing within the major rating categories.

Source: Moody's and Standard & Poor's.

Appendix V - Correlation coefficients between various emp-measures

Czech Republic

	Simple Girton and Roper	Smoothed Girton and Roper	Extended emp-measure	Variance smoothed emp-measure
Simple Girton and Roper	1	0.901	0.980	0.793
Smoothed Girton and Roper	0.901	1	0.892	0.880
Extended emp-measure	0.980	0.892	1	0.880
Variance smoothed emp-measure	0.793	0.880	0.880	1

Hungary

	Simple Girton and Roper	Smoothed Girton and Roper	Extended emp-measure	Variance smoothed emp-measure
Simple Girton and Roper	1	0.868	0.991	0.684
Smoothed Girton and Roper	0.868	1	0.870	0.832
Extended emp-measure	0.991	0.870	1	0.762
Variance smoothed emp-measure	0.684	0.832	0.762	1

Latvia

	Simple Girton and Roper	Smoothed Girton and Roper	Extended emp-measure	Variance smoothed emp-measure
Simple Girton and Roper	1	0.941	0.969	0.799
Smoothed Girton and Roper	0.941	1	0.909	0.843
Extended emp-measure	0.969	0.909	1	0.904
Variance smoothed emp-measure	0.799	0.843	0.904	1

Poland

	Simple Girton and Roper	Smoothed Girton and Roper	Extended emp-measure	Variance smoothed emp-measure
Simple Girton and Roper	1	0.917	0.964	0.672
Smoothed Girton and Roper	0.917	1	0.868	0.708
Extended emp-measure	0.964	0.868	1	0.824
Variance smoothed emp-measure	0.672	0.708	0.824	1

Appendix VI - Principal components analysis

	First principal component – correlation coefficients – factor scores						Number of observa-tions
	Eigenvalue	% variance	ê	$\Delta(i_m-i^*_m)$	ř	Correct signs	
Czech Republic	1.405	46.8	0.709 0.504	-0.633 -0.450	0.709 0.505	N	40 (IIQ 1993-IQ 2003)
Hungary	1.159	38.6	-0.736 -0.635	0.762 0.657	0.191 0.165	N	53 (IQ 1990-IQ 2003)
Latvia	1.261	42.0	0.794 0.630	0.102 0.081	0.787 0.624	N	37 (IQ 1994-IQ 2003)
Poland	1.329	44.3	0.840 0.632	0.344 0.259	-0.711 -0.535	Y	47 (IIQ 1991-IVQ 2002)

Note:
ê the rate of depreciation of domestic currency
$\Delta(i_m-i^*_m)$ change in the short term interest rate differential with Germany
ř the proportional change in domestic international reserves
Data: see appendix I

The factor scores are properly signed for Poland, se the first principal component can be regarded as an overall index of exchange market pressure.