

Two-Corner Hypothesis for Exchange Rate Regimes and its Relevance for Transition Economies

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ABSTRACT

This paper investigates the theoretical and empirical background of the hypothesis stating that the intermediate exchange rate regimes are no longer viable for the countries open to international capital flows. The empirical part of the paper is focused on a study of the transition economies of the CEE and the FSU with an application of a Markov chain model of exchange rate transition. The first transition matrix has been constructed on the basis of the official data. The de facto classification of exchange rate regimes has been obtained by 'k-mean cluster analysis' assigning each country-year point to particular cluster according to the values of absolute monthly exchange rate changes, volatility of these changes and absolute monthly volatility in foreign exchange reserves. Consequently, the second transition matrix based on the de facto classification has been constructed. It has been found that the two-corner hypothesis is supported by the official classification of exchange rate regimes adopted in the region, as it has turned out that fixed corner constitutes the absorbing state. However, this hypothesis is not supported by the actual data on exchange rate regimes for the sample countries. Furthermore it has been shown that practically all countries in the region classified as floaters are de facto situated among the countries with the intermediate or even fixed regimes.

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1 Introduction

The last decade was marked by large-scale international financial crises, which accentuated the importance of the sustainable exchange rate regimes in restraining scope of the destabilizing capital flows and fostering growth in the emerging market economies. These crises raised once more a scientific dispute between supporters of fixed and flexible exchange rate arrangements. Since the middle 1990-s the discussion has shifted towards a sustainability of the intermediate exchange rate regimes for countries open to the international capital flows. “Bipolar” or “two-corner solution” hypothesis argues that countries integrated into global financial markets should choose only the polar exchange rates¹.

An early version of the ‘hollowing of the middle’ hypothesis was suggested by Swoboda (1986) and was based on the argument that intermediate exchange rate regimes such as target zone and adjustable peg are not credible and frequently become inconsistent with conducted macroeconomic policies. The first scholars insisting that only a free float and hard exchange rate commitments (currency boards or monetary unions) are sustainable regimes were Eichengreen (1994, 1998) and Obstfeld and Rogoff (1995). Eichengreen (1994, pp. 4-5) even writes that “...contingent policy rules to hit explicit exchange rate targets will no longer be viable in the twenty-first century... Countries... will be forced to choose between floating rates on the one hand and monetary unification on the other.” While estimating the recent experience, Stanley Fischer (2001) argues that since 1994 each of the major international capital market-related crises has occurred in an environment of a fixed or pegged exchange rate regime.

However, this hypothesis is not unanimously supported. Paul Masson (2000) criticizes this approach as static, which takes the exchange rate regime as taken once and forever. He argues that intermediate solutions can be and are often the case for the countries, which want to deal with a high inflation or to increase the international competitiveness of their goods. Also the intermediate regimes can be chosen as a part of a regional integration strategy as in the Exchange Rate Mechanism (ERM) of the European Monetary System. Williamson (2000) questions the crises proofed characteristics of the corner regimes. He argues that even currency board can loose its confidence resulting in capital flight and currency crash. At the same time sharp depreciation under the free floating regime also represent possibility of the crash of corporate and public sectors with foreign exchange exposures.

While many authors claim intermediate exchange regimes are not viable in our highly integrated world, few of them suggest a theoretical rational for this paradigm. Furthermore, in spite of

¹ Among other frequently used names are “two poles”, “hollowing out” or “missing middle” hypothesis.

rather extensive body of literature on the exchange rate regimes for the transition economies, there have been no empirical investigations of relevance of two-corner hypothesis for these countries yet. Therefore, this paper will identify the theoretical and empirical issues connected with the two-corner hypothesis and show that this hypothesis has little if any empirical support in the transition economies of central and Eastern Europe (CEE) and former Soviet Union (FSU) countries. My research is based not only on official classifications of exchange rate regimes but also on the “deeds vs. words” methodology, determining an actual exchange rate regime by estimating behavior of some variables. In other words, I argue that the Holy Middle (interim solutions) will remain viable for the sample countries.

The paper is organized according to the following structure. In chapter 2 different theoretical rationales for two-corner hypothesis will be evaluated and empirical studies on this subject will be analyzed. Chapter 3 is focused on the exchange rate regimes in the transition economies and evaluation of hypothesis relevance to these regimes. In particular, the Markov chain model for exchange rate regime transition will be applied in order to find possible future distribution of regimes. The first stage of the analysis will employ the official IMF classification of exchange rate regimes, while the second one will apply the methodology developed by Levy-Yeyati and Sturzenegger (2000). A substantial part of this chapter is devoted to finding the three behavioral variables of exchange rate regimes and reclassifying every point in country-year space using k-mean cluster analysis. Chapter 4 briefly summarizes the policy implications for exchange rate regime choice by transition economies, while providing directions of their possible development and challenges they will encounter. The last chapter contains concluding remarks and suggestion for the necessary further research.

2.1 The Origins of the Two-Corner Hypothesis

Only in the post-war period was the concept of the most optimal exchange rate regime revised several times. As Carsten Hefeker (2000) points out, “preferences for exchange rate regimes appear to move in cycles”. Before the collapse of the Bretton Woods system it was argued that flexible exchange rates would isolate countries from an imported inflation. Later, after disappointment with the stabilizing effects of flexible exchange rates, the economic community started to consider fixed exchange rates as a way to import monetary stability. In the 1990-s, after the series of severe currency crises in countries, which followed de-facto some kind of intermediate exchange rate regime, it was proclaimed that only corner solutions were correct choices for countries opened to international capital flows.

Milton Friedman was one of the first scholars who indicated that intermediate exchange rates are worse than both corner solutions². He believed that an intermediate regime had a built in self-destructive element inducing speculation and, hence, undermining its own stability. He argued that under exchange rates held temporarily rigid but subject to change by government actions “...each exchange-rate change tends to become the occasion for a crisis.”³ Although it is rather strong and radical statement, its correctness was proved 40 years later by 1992-1993 ERM crises. After the East Asian crises Friedman continues to insist that “of the three possible exchange rate regimes for a developing country, either a truly fixed rate with no national central bank or a floating rate plus a national central bank is preferable to a pegged exchange rate”⁴.

Edwards (2000) further accentuates that from the historical perspective support for two-corner hypothesis is based not on the comparative merits of the two-corner system, but rather on the shortcomings of the intermediate system. In general, two opposite groups of scholars adhering to the two-corner hypothesis can be distinguished. Eichengreen (2000) argues that on the one side of the spectrum can be placed devoted free-market economists, insisting that only markets are able to be the right manager of exchange rate⁵ and, hence, there cannot be any conflicts between the exchange rate policy and monetary policy. They believe that the intermediate regimes only introduce unnecessary noise into the market mechanism. At the other end of the spectrum Eichengreen (2000, p.3) places the economists less confident of the efficiency of markets, which “worry that intermediate arrangements are fragile, conducive to crises, and prone to problems of multiple equilibrium”. Despite the varying reasons of their support for the two-corner hypothesis, all its adherents are common in their non-acceptance of the intermediate regimes. Stanley Fischer (2001, p.3) has suggested that exchange rate arrangements with the following characteristics should be excluded:

...exchange rate systems for countries open to international capital flows, in which government is viewed as being committed to defending a particular value of the exchange rate, or a narrow range of exchange rates, but has not made the institutional commitments that both constrain and enable monetary policy to be devoted to the sole goal of defending the parity. In essence, the excluded arrangements are fixed, adjustable peg, and narrow band exchange rate systems.

² “In short, the system of occasional changes in temporarily rigid exchange rates seems to me the worst of two worlds: it provides neither the stability of expectations that a genuinely rigid and stable exchange rate could provide in a world of unrestricted trade and willingness and ability to adjust the internal price structure to external conditions nor the continuous sensitivity of a flexible exchange rate.” (Friedman M. 1953, p.164).

³ Friedman M. 1953, p163.

⁴ Friedman M. (1998, p. 54)

⁵ As Hanke (1999, p.337) put it, “Although floating and fixed rates appear to be dissimilar, they are members of the same family. Both are free-market mechanisms for international payments”.

The choice between two corners should be defined by specific structural characteristics of a country, which include the degree of factual dollarization of the financial system, degree of labor market flexibility, the value of the pass-through coefficient and the country's inflationary history (Calvo, 1999). Among the merits of the fixed corner regimes the most frequently mentioned are credibility, transparency, low inflation and monetary and financial stability, as well as low and more stable interest rates. However, as Edwards (2000) stresses, the gain of credibility is not automatic, and additionally it needs fiscal solvency, strong banking system, substantial amount of foreign exchange reserves in the case of currency board, and delegating the lender of last resort function to some other foreign institution⁶. The benefits, expected by proponents of floating exchange rates, were summed up by Obstfeld M. (1995):

Floating rates would offset trend inflation differentials, smoothly accommodate equilibrium movements in real exchange rates, liberate monetary policy to pursue domestic goals, discourage rather than encourage destabilizing speculation, ease external constraints, and thereby discourage the proliferation of official controls on international trade and payments.

In the next subsection, a more detailed examination of the theoretical rationale behind the two-corner hypothesis will be provided.

2.2 Theoretical Justification for the Two-Corner Hypothesis

At the present time there is no generally accepted theory behind the two-corner hypothesis, which can provide indisputable arguments in its support. However, there is a number of studies which, on the one hand, show the drawbacks of the intermediate regimes or, on the other hand, present advantages of the corner regimes. Meanwhile, there are few works strongly defending sustainability of the different kinds of the intermediate regime and therefore weakening the two-corner hypothesis.

The principle of the “*Impossible Trinity*” is one of the main theoretical justifications of the hypothesis. This principle argues that a country cannot simultaneously have fixed exchange rate regime, monetary independence and openness to capital flows. As the last decade has been characterized by increased international capital mobility, involving both developed and developing countries, the only choice is between giving up on the exchange rate stability or the monetary independence.

However, the statement in support of the corner solutions is criticized by Jeffrey Frankel, Sergio Schmukler and Luis Servén (1999, 2000) arguing that nothing can prevent a country from

⁶ It may be a consortium of foreign banks, with which a contingent credit is contracted, a foreign country with which a monetary treaty has been signed, or a multilateral institution (Edwards, 2000, p.28).

having “half-stability and half-independence in monetary policy”⁷. They suggest a target zone of moderate width, a managed float “in which half of every fluctuation in demand for its currency is accommodated by intervention and half is allowed to be reflected in the exchange rate”⁸, or a peg with an escape clause contingent on exogenous shocks as examples of possible “interior solutions”. The weakness of these contrarguments is their concern about short-run perspective, while two-corner hypothesis predicts the long-run unsustainability of intermediate regimes.

The previous principle refers to all countries, while “*the original sin hypothesis*” suggested by Eichengreen and Hausmann (1999) deals exclusively with developing countries. These authors argue that a majority of developing countries cannot borrow abroad in their domestic currency or even borrow long-term domestically. This causes financial fragility, as all domestic investments will be subject to either a currency mismatch or a maturity mismatch. The original sin creates a dilemma for exchange rate policy. If a government tries to support the currency by increasing interest rates, it sooner or later will turn into a banking crisis due to maturity mismatches. If, on the other hand, a government will let the currency float, corporations, banks and public sector will suffer from currency mismatch. Eichengreen and Hausmann (1999) conclude that the only way out of this dilemma is dollarization, as in this case debt would be denominated in the same currency as cash flow.

Developing the previous argument, Wagner (2000, p.192) states that “pure floating and monetary union are the two regimes that cannot by construction be subject to speculative attack”. At the same he acknowledges that free floating is subject to large volatility that frequently is not based on fundamentals, but rather represents speculative bubbles and crashes. Therefore, the first best solution is monetary union, but as this is not always acceptable for political reasons, the second best solutions can be the regional monetary unions, currency boards and dollarization similarly to Eichengreen’s and Hausmann’s conclusion.

The most serious support for a two-corner hypothesis is provided by works demonstrating crucial drawbacks of the intermediate regime. Edwards (2000) questions the stabilizing effects of the adjustable pegs recently broadly applied as nominal anchor in disinflation programs⁹. He argues that in countries using this device the inflation tended to have a considerable degree of inertia. He found, for instance, that for the Chilean (1977-1982) and Mexican (1988-1994) exchange rate-based stabilization the degree of inflationary persistence did not change significantly, and remained very high after the

⁷ Frankel J. et al. (1999, p.6).

⁸ Frankel J. et al. (2000, p.69).

⁹ The recent exchange rate based stabilization programs include: Mexico (1987), Poland (1990), Uruguay (1990), Nicaragua (1991), Argentina (1991), Estonia (1992), Croatia (1993), Lithuania (1994), Brazil (1994), Russia (1995) and Bulgaria (1997). Four of them (Mexico, Brazil, Russia and recently Argentina) ended in currency crashes (Mussa et al. 2000).

implementation of the nominal exchange rate anchor program. Consequently, a fixed nominal exchange rate will result in a real exchange rate appreciation and, hence, in a decline in country's export competitiveness. Additionally he correctly mentions that pegged exchange rates would bring a costly adjustment process in the case of negative external shocks, with decline in economic activity and increase in unemployment. Nevertheless, the examples of successful implementation of the exchange rate based stabilization programs undermine his categorical argument.

Somewhat different theoretical rationale for the two-corner hypothesis is offered by Frankel J. et al. (1999, 2000) who, by introducing the notion of “*verifiability*”, state that intermediate exchange rate regimes are no longer viable¹⁰. The authors argue that when currency is pegged to a basket, the larger number of currencies in this basket, the harder it is for market participants to identify whether this regime is actually under operation. Also verifiability is complicated when the currency is allowed to fluctuate inside the wide band, or if there is crawling peg or crawling band. Frankel J. et al. (2000) conclude that if currency is not verifiable, then a country loses the credibility gain, which theoretically an anchored exchange rate regime should produce. On the other hand, the corner regimes may be easier to monitor and, therefore, they are more preferable for emerging markets. This position has some weaknesses. First of all, a conventional peg to a single currency is easily verifiable, but, nevertheless, it is one of the intermediate regimes, with all drawbacks characteristic to them. From the other side, flexible regime with inflation targeting, which belongs to corner solutions, would be difficult to verify, as changes in interest rate can be interpreted as attempts to defend a particular parity.

Another argument against intermediate exchange rate target can be formulated as “*the danger of unhedged dollar liabilities*”¹¹ implying underestimation of exchange rate risk by firms and banks resulting in possible bankruptcies and deterioration of economic activity due to speculative attacks. When the exchange rate in an emerging economy is pegged, market participants consider this peg as permanent. Given a lower dollar interest rate, there is large temptation to borrow in dollars and to lend the proceeds in the local currency or invest in local assets. This practice creates a very dangerous currency mismatch. The government, giving the implicit insurance against the risk of exchange rate changes, decreases the incentives to hedge the foreign exposures by private agents, which is the source of moral hazard. Burnside, Eichenbaum and Rebelo (1999) show in the theoretical model that it is optimal for banks to hedge exchange rate risks in the forward market, when there is no guarantees by the government. But when such a guarantee is provided, it is optimal for banks even to increase their

¹⁰ Verifiability is “the ability of a market participant to infer statistically from observed data that the exchange rate regime announced by the authority is in fact in operation” (Frankel J. and al., 1999, p.1)

¹¹ So called “fixed-exchange rate bubble”. See, for example, Blinder (1999, pp.55-57). This argument was analyzed also by Eichengreen and Hausmann (1999)

exchange rate exposure in a perspective of additional profits in case of no devaluation, and the banks will be bailed out by government in case of the exchange rate change. Unhedged dollar liabilities, together with a weak banking supervision are perceived by many scholars as the main reasons for the Asian crises.

One more justification for the corner solution is “*the political difficulty of exiting*” from the regime with the exchange rate target. Some authors argue¹² that the best time to exit the peg is when the currency is either under upward pressure or no pressure at all, as in this case the authorities’ degree of credibility will not be harmed. But it would be irrational from the point of view of a central banker, who had possibly put his reputation and political future on the sustaining of the peg, to change the parity or introduce more flexible regime. Therefore, governments facing reversal of capital inflow tend to wait too long before abandoning exchange rate targets, which leads to ‘lock in’ already unfavorable currency regime. Edwards (2000, p.12) gives examples of Chile and Poland as the cases of successful exits into the flexible exchange rates. Nevertheless, exits are mainly happening during crises due to the short-term horizons of decision-makers.

A more specific version of the same statement was elaborated with an application towards transition countries’ exchange rate regimes¹³. At the beginning of the transition most shocks have domestic origin and, hence, it is adequate to use peg as nominal anchor for macroeconomic policies. Later, when transition proceeds and domestic fundamentals improve, external shocks become prevailing, therefore, the exchange rate becomes optimal absorber of shocks and must be freed. Due to success in disinflation and a pegged exchange rate, a transition economy faces large capital inflow, which now is considered as one of the main predictors of currency or banking crises¹⁴. Hence, in the middle and long-run perspective the pegged exchange rate should be abandoned, which supports the two-corner hypothesis.

Cukierman et al. (1996) also analyze the shifts from pegged exchange rates, adopted at the beginning of stabilization program, to more flexible exchange rate regime, when the anti-inflation policy becomes credible and transparent¹⁵. For them, time and form of policy shift toward flexibility are mainly determined by transparency and changing policy objectives (from price stability to external competitiveness). However, the move to more flexible exchange rate regime does not go out of the

¹² For example, Alan Blinder (1999), Edwards (2000).

¹³ See on this topic Begg D. (1998), Begg D. and Wyplosz Ch. (1999).

¹⁴ This point is also supported by Frenkel (2000), who argues that important indicator of currency crash is the composition of inflow. He insists that higher the proportion of foreign direct investment, the smaller the probability of the crisis. For changing the composition of inflow and at the same time not restricting it, he proposes to introduce some penalty on short-term bank borrowing from abroad in the form of a non-interest-earning deposits with central bank.

¹⁵ Among the more flexible regimes they consider crawling peg and/or an exchange rate band.

scope of intermediate regimes, which illustrates the importance of intermediate regimes in stabilization and post-stabilization periods.

While these authors indicate a possible expediency of the intermediate regimes, Williamson (1999) strongly defends the crawling band system as preferable to free floating¹⁶. He argues that very weak links between the market exchange rate and fundamentals exist under floating regime and, therefore, government can manage their interrelations better than the market itself. He cites Rogoff (1996), who has documented the empirical evidence showing that exchange rates have no tendency to revert to the equilibrium, but rather follow a random walk. Acknowledging that bands normally do not have full credibility, he argues that “a band performs the function of crystallizing market expectations of where the equilibrium rate lies, and thus makes expectations stabilizing at the time horizons relevant for influencing market behavior” (Williamson, 1999, p.4). He considers a collapse of the crawling bands in Indonesia (1997) and Russia (1996-1999), rather as exceptions and argues that they can be explained by one common mistake of using crawling band system as a very hard nominal anchor, which led to overvaluation. It may be added that in cases cited there were many problems in other policies and it is doubtful if other exchange rate regimes could solve the problems. Williamson (2000) examines the feasibility of modifying the common intermediate regimes into some looser forms, which will not be so vulnerable to speculative attacks, but at the same time more conducive to sustaining competitiveness at an appropriate level. He argues that “it is the obligation to intervene at the edge of a conventional band, to prevent the market rate moving outside the band, which can trigger a crisis” (Williamson, 2000, p.25). Hence, he suggests three options to remedy this drawback: reference rates, soft margins and monitoring bands¹⁷. These variants of intermediate regimes are much less vulnerable to the crises and at the same time are flexible enough to prevent real appreciation.

The doubts about the correctness of the two-corner hypothesis are strengthened by the “*fear of floating*” phenomenon¹⁸. It states that many countries with officially declared floating exchange rates, in reality do not allow them to float freely but rather undertake some interest rate and intervention policy measures to affect their behavior. For example, in countries pursuing an inflation targeting approach to monetary policy any changes in the exchange rate are automatically taken into account as they affect expectation of the future inflation. Thus, in the case of depreciation it is expected to be

¹⁶ This system sometimes is called “BBC rule” – band, basket and crawl.

¹⁷ Under the reference rate or “fundamental equilibrium exchange rate” the authorities would have no obligations to defend it, but rather would be required to avoid conducting policies, which will push the market rate away from this reference rate. Under the soft margins the authorities can allow the exchange rate to move outside the band in the short run, while having the obligation to hold it within a band in the long run. Under the monitoring band it is forbidden to intervene inside the band, but it can be allowed to intervene outside the band without any obligation to defend a publicly announced margins.

¹⁸ See on this subject Calvo G, Reinhart C. (Nov. 2000); Reinhart C. (May 2000); Hausmann R., Panizza U., Stein E. (1999).

monetary tightening similar to the case of direct exchange rate targeting. Also, as shown by Hausmann et.al. (1999), in countries with large currency mismatches and high level of exchange rate pass-through, the authorities limit the exchange rate volatility. Hence, if many countries, which officially adopted floating exchange rate regime, actually follow some intermediate regime, then two-corner hypothesis will lose some empirical support. Besides, a majority of countries classified as pegged has frequently resorted to realignments¹⁹. This implies that a considerable part of fixed exchange rate regimes should also be classified as intermediate regimes.

Given a considerable lack of theoretical explanations for two-corner hypothesis, Jeffrey Frenkel (1999, p.9) argues that

... the rejection of the middle ground is then explained simply as a rejection of where most countries have been, with no reasonable expectation that the dreamed-of sanctuaries, monetary union or free floating, will in fact be any better. The grass is always greener on the other side of the parity. Many countries are fated to switch back and forth among various regimes, in an unending Markov process.

Now we will turn to the empirical side of the problem and consider how the theory of the missing middle is supported by an actual development of the exchange rate regimes.

2.3 Empirical Studies of the Two-Corner Hypothesis

Very little research, as already mentioned, has been directed to empirical investigation of the two-corner hypothesis. Even scholars who have conducted these studies have undertaken them mostly indirectly while dealing with other exchange rate problems. As the two-corner hypothesis relates to countries open to the capital flows, Fischer (2001) concentrates not only on the developed countries, but also on countries in the process of integration into the global capital markets. He has taken 22 advanced economies and 33 emerging market countries and considered the period from 1991 to 1999. Using simple comparison of distributions of exchange rate regimes in 1991 and 1999, he has found that the proportion of the intermediate regimes decreased substantially during the 1990-s (from 65% to 27%) and there was increase in hard pegs (from 5% to 25%) and also in floating regimes (from 29% to 47%). Among countries not included in the sample, he has also discovered the decrease in the intermediate regimes, but slightly less evident (from 60% to 37%). As a result of these findings he has concluded that “soft peg systems have not proved viable over any lengthy period, especially for countries integrated or integrating into the international capital markets” (Fischer, 2001, p.7). The weaknesses of Fisher’s analysis are, first of all, an inclusion of the managed floats into the floating

¹⁹ Klein and Marion (1997) found that the median duration of pegs among western countries is approximately 10 months.

group, when the two-corner hypothesis considers it as intermediate one and, secondly, reliance on the official IMF data which does not reflect the actual behavior of the exchange rates.

Exchange rate regimes reported in the International Financial Statistics are frequently far from observable performance for many countries. Some countries with declared a floating exchange rate hardly intervene in the foreign exchange markets or use interest rate as the instrument for smoothing exchange rate fluctuations. Others, which formally have a pegged exchange rate, periodically use devaluation in order to accommodate independent monetary policy. Hence, it is expedient to reclassify exchange rate regimes according to their real behavior before proceeding to empirical studies of the two-corner hypothesis. One of the influential works in this area is a paper written by Levy-Yeyati and Sturzenegger (1999). They have classified the exchange rate regimes according to the behavior of the following three variables: changes in the nominal exchange rate, the volatility of these changes, and the volatility of international reserves. They have selected these three variables as theoretically “fixed exchange rate regimes are associated with a high volatility of international reserves coupled with little volatility in the nominal exchange rate, and flexible regimes are characterized by a substantial volatility in nominal rates with relatively stable reserves” (Levy-Yeyati and Sturzenegger, 1999, p.3). They argue that the combined behavior of these three variables would be enough to determine the regime of each particular country at every time point.

Levy-Yeyati and Sturzenegger apply k-means cluster analysis methodology for exchange rate regime classification, using the data from all IMF-reporting countries over the period 1974-1999. Cluster analysis has the advantage over standard discriminant analysis in that it itself constructs the groups according to distances between the sample elements, not the declared types of regime. The researcher simply defines the number of groups and then the algorithm sorts the cases according to the characteristics of the above-mentioned variables. Levy-Yeyati and Sturzenegger’s results differ substantially from the IMF classification. They have found that the fraction of intermediate regimes was relatively stable during the last twenty years, which contradicted to the two-corner hypothesis prediction of disappearing of the intermediate regimes.

The previous authors have reported support for Calvo and Reinhart’s “*fear of floating*” hypothesis, according to which many officially floating countries intervene recurrently to stabilize their exchange rates and thus are more closely situated among intermediate or even fixed exchange rate regimes. Calvo and Reinhart (2000) by themselves have analyzed the behavior of exchange rates, foreign-exchange reserves, the monetary aggregates and interest rates in different exchange rate arrangements, in order to evaluate the coincidence of official and actual exchange rate regimes using monthly observations for 39 countries during the 1970-1999 period. They have found that most of the

cases, which pretend to be called floating exchange rates, actually behave like the non-credible pegs. The main reason for this phenomenon is a lack of credibility, which can be expressed through volatile interest rates and sovereign credit rating. Among other reasons stressed in their paper are pervasive liabilities' dollarization and high pass-through from exchange rate swings to inflation, which forces the authorities to stabilize the excessive volatility of exchange rates.

Amongst the other studies, it is worth mentioning the work of Hernandez and Montiel (2001) who have attempted to draw the picture of post-crises exchange rate regimes in five Asian countries²⁰. They have identified these countries' degree of commitment to the "soft peg" by using the observed volatility of financial variables, such as exchange rate, the stock of foreign exchange reserves and domestic interest rate (a methodology similar to the one developed by Calvo and Reinhart). They have found support for conventional wisdom that before the crisis all five countries actively defended exchange rate peg despite their official declaration of floating (except Thailand, which had fixed exchange rate regime). They have further showed that in the after-crises period all countries were continuing to manage their exchange rates while all of them "have moved along the exchange rate continuum, none of them have opted to jump to either of its extreme poles" (Hernandez L. and Montiel P.J., 2001, p.39). Their paper concludes that under current international conditions, the intermediate exchange rate regimes remain not only viable, but in some circumstances may even be desirable. The results of this paper are important from the point of view that the example of the East Asian countries was mostly cited as the empirical support for the two-corner hypothesis.

Empirical study of the advantages of the corner regimes was undertaken by Edwards (2000) based on examples of some emerging market economies. He has found, for example, that Argentina, despite the introduction of currency board arrangement in early 1991, was very sensitive to external shocks.²¹ Furthermore, Edwards shows that exchange rate risk did not disappear after the adoption of the currency board and domestic interest rates were relatively high and volatile. Besides, he points to significant overvaluation of the Argentinean peso and difficulties in bringing the fiscal accounts under control that undermined the expectations and the regime's degree of credibility. Considering the Panama's dollarization experience since 1904, Edwards has concluded that dollarization does not, on its own, assure fiscal solvency and prudence. Contrary to the conventional view that emerging countries do not have the appropriate institutions to conduct the effective monetary policy under a purely floating exchange rate, Edwards (2000, p.40) insists, taking Mexico as an example, that "in emerging

²⁰ They include Indonesia, Korea, Malaysia, Philippines and Thailand.

²¹ Especially to the Mexican "Tequila" crisis and the Russian and Brazilian currency crises accompanied by negative growth rates and resulted in high rate of unemployment (15 % during 1999-2000).

economies it is possible for the monetary authority to implement an effective and complex feed back rule, of an augmented-Taylor type".

2.4 Markov Chain Model of Exchange Rate Regimes Transition

One of the most influential empirical studies focused on investigation of the hypothesis of the disappearance of intermediate regimes has been done by Masson (2000)²². Masson perceives the exchange rate regime choice in terms of a likelihood of moving from one regime to another. He makes the assumption that the probability of being in one or another regime next period depends only on the current regime and tries to find possible directions of exchange rate regime transitions but not their causes.

Masson assumes that a Markov chain describes the stochastic process of the choice of exchange regime. He introduces the transition matrix $P = \{ p_{ij} \}$, in which a sum of the elements of every row is equal to unity. Here, p_{ij} is the probability of regime $s_t = j$ given $s_{t-1} = i$. Masson considers three types of regimes: fix, intermediate and float. Besides, he defines the notion of “absorbing state i” as a regime from which there is no probability to reach other regimes, or formally, if $p_{ii} = 1$ and all other elements of row ‘i’ are equal to zero. A “closed set of states C” is defined as a set that no state outside C can be reached from any state in C. Masson argues that the hollowing-out hypothesis would be correct if either fixed regimes or float regimes are absorbing states, or if they both compose a closed state. In this model the long-run distribution of the exchange rate regimes can be obtained as a limit $\pi = \lim_{n \rightarrow \infty} \pi_0 P^n$. He also argues that even if a trend toward polarization is not evident now in the actual regime distribution, this trend must be evident at the limiting distribution if the hypothesis is correct. Fixed exchange rates constitute the absorbing state if we have the following transition matrix:

		Probability of regime in period t		
Regime in period t-1		Fix	Intermediate	Float
Fix		1	0	0
Intermediate		p_{21}	p_{22}	p_{23}
Float		p_{31}	p_{32}	p_{33}

Fixed and floating exchange rates will compose a closed set if the transition matrix is as follows:

²² Detailed explanation is provided because of the further application of the model in my research.

Regime in period t-1	Probability of regime in period t		
	Fix	Intermediate	Float
Fix	p_{11}	0	$1 - p_{11}$
Intermediate	p_{21}	p_{22}	p_{23}
Float	$1 - p_{33}$	0	p_{33}

Due to the unreliability of the official IMF data concerning exchange rate regimes, Masson refers to two different data sources modifying the official classification, developed by Ghosh et al. (1997) and Levy Yeyati and Sturzenegger (1999). The Ghosh data set covers the period from 1960 till 1997 and describes a broad range of countries. Masson has re-grouped this classification in order to have only three types of regimes: hard pegs, floats and intermediate regimes. Masson includes in the hard peg group only countries with the currency board and announced pegs with almost no changes in parities. In the opposite pole are included only free floats. Countries with the other regimes constitute the intermediate group.

The transition matrix is constructed on the basis of 3453 observations and covers 24 years and 167 countries (Masson, 2000, p.10). It has been shown, as a result, that the transition matrix is irreducible, which means that all regimes can be reached from each state. Another interesting result is that each of these three regimes has turned out to be highly persistent with probability over 90% of not changing in the next year. Masson has derived the transition matrices for the periods 1974-1997, 1980-1997 and 1990-1997 and compared the actual distribution in 1997 with invariant distributions for these periods. No one of the distributions supports the hollowing out hypothesis, but there is some evidence that during the 1990-s there was some tendency of moving away from the center.

The second set of data applied in the paper considers three variables for classifying countries by exchange rate regimes: monthly percentage changes in the nominal exchange rate, the standard deviation of monthly percentage changes in the exchange rate and the volatility of reserves. The use of this data shows a smaller persistence of the exchange rate regimes and once more does not support the hollowing out hypothesis.

Further author considers 27 emerging market countries, which are highly integrated in world capital markets. The test of hollowing out hypothesis for this sample of countries is strongly rejected by the Levy Yeyati-Sturznegger data, but some variant of hollowing out, namely that fixed rates are an absorbing state, is proved by the Ghosh et al. data.

Therefore, Masson's study based on different sets of countries, various time periods and different methodology of exchange rate classification strongly rejects the hollowing out hypothesis. It

implies that intermediate regimes will continue to be an important part of actual exchange rate regimes. To conclude, we may argue that merits of polar regimes are in general overemphasized and drawbacks of intermediate solutions are overstated.

3.1 Markov Chain Model for Transition Economies of the CEE and the FSU. De Jure Data

In this chapter I will apply the methodology developed by P.Masson (2000) in order to test the following hypothesis using the data for exchange rate regimes in the CEE and FSU countries during 1990-2000. The data presented in Table 1 are *de jure* exchange rate regimes officially announced by these countries. Data for 1998-2000 were taken from the International Financial Statistics. However, data for the previous period were not published by the IMF and, hence, I used the paper by Halpern I., Wyplosz C. (2001) for the EU applicant countries and work of Cottarelli C. and Doyle P. (1999) for the rest countries.

In order to test the two-corner hypothesis all exchange rate arrangements given in Table 1 are reclassified into three groups: fixed, intermediate and floating and presented in Table 2. The first group containing the fix corner solutions will include countries with no separable legal tender and currency board (countries with numbers 1 and 2 in Table 1). Second group will comprise all intermediate regimes (numbers 3, 4, 5, 6, 7). I include the conventional pegs and managed floats into this group as these regimes, although being close to the corners, still have substantial drawbacks characteristic to the intermediate regimes. The last group will consist only of the independent floating (number 8).

Table 1. Exchange Rate Arrangements, Official Classification

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a.	3	8	8	8	8	8	8	8	8	8
Armenia	n.a.	n.a.	n.a.	n.a.	7	7	7	7	8	8	8
Azerbaijan	n.a.	n.a.	n.a.	n.a.	8	8	8	8	7	7	7
Belarus	n.a.	n.a.	n.a.	n.a.	7	3	4	7	7	7	7
Bulgaria	3	8	8	8	8	8	8	2	2	2	2
Croatia	n.a.	n.a.	8	8	3	3	3	3	4	7	7
Czech Republic	3	3	3	3	3	3	6	7	7	7	7
Estonia	n.a.	n.a.	2	2	2	2	2	2	2	2	2
Georgia	n.a.	n.a.	n.a.	7	7	7	7	7	8	8	8
Hungary	3	3	3	3	3	6	6	6	6	6	6
Kazakhstan	n.a.	n.a.	n.a.	n.a.	7	7	7	7	7	7	7
Kyrgyz Republic	n.a.	n.a.	n.a.	7	7	7	7	7	7	7	7
Latvia	n.a.	n.a.	8	8	3	3	3	3	3	3	3
Lithuania	n.a.	n.a.	8	8	2	2	2	2	2	2	2
Macedonia, FYR	n.a.	n.a.	7	7	3	3	3	3	3	3	3
Moldova	n.a.	n.a.	n.a.	n.a.	7	7	7	7	8	8	8
Poland	3	5	5	5	5	6	6	6	6	6	8
Romania	3	7	7	7	7	7	7	7	7	7	7
Russia	n.a.	n.a.	8	8	8	4	6	6	7	8	8
Slovak Republic	3	3	3	3	3	3	6	6	7	7	7
Slovenia	n.a.	n.a.	7	7	7	7	7	7	7	7	7
Tajikistan	n.a.	n.a.	n.a.	n.a.	n.a.	8	8	8	7	7	7
Turkmenistan	n.a.	n.a.	n.a.	n.a.	7	7	7	3	3	3	3
Ukraine	n.a.	n.a.	n.a.	7	8	8	4	4	4	7	7
Uzbekistan	n.a.	n.a.	n.a.	n.a.	7	7	7	7	7	7	7

Exchange rate regime description:

1. Dollarization, no separate legal tender.
2. Currency Board, currency fully backed by foreign exchange reserves.
3. Conventional Fixed Pegs, peg to another currency or currency basket within a band of at most $\pm 1\%$.
4. Horizontal Bands, pegs with bands larger than $\pm 1\%$.
5. Crawling Pegs, pegs with central parity periodically adjusted in fixed amounts at a fixed, pre-announced rate or in response to changes in selected quantitative indicators.
6. Crawling Bands, crawling pegs combined with bands of more than $\pm 1\%$.
7. Managed Float with No Pre-announced Exchange Rate Path, active intervention without pre-commitment to a pre-announced target or path for the exchange rate.
8. Independent Float, market-determined exchange rate and monetary policy independent of exchange rate policy.

Exchange rate regimes are given for the end of year.

Sources: International Financial Statistics, Halpern I., Wyplosz C. (2001), Cottarelli C., Doyle P. (1999).

Table 2. Modified Exchange Rate Arrangements

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a.	2	3	3	3	3	3	3	3	3	3
Armenia	n.a.	n.a.	n.a.	n.a.	2	2	2	2	3	3	3
Azerbaijan	n.a.	n.a.	n.a.	n.a.	3	3	3	3	2	2	2
Belarus	n.a.	n.a.	n.a.	n.a.	2	2	2	2	2	2	2
Bulgaria	2	3	3	3	3	3	3	1	1	1	1
Croatia	n.a.	n.a.	3	3	2	2	2	2	2	2	2
Czech Republic	2	2	2	2	2	2	2	2	2	2	2
Estonia	n.a.	n.a.	1	1	1	1	1	1	1	1	1
Georgia	n.a.	n.a.	n.a.	2	2	2	2	2	3	3	3
Hungary	2	2	2	2	2	2	2	2	2	2	2
Kazakhstan	n.a.	n.a.	n.a.	n.a.	2	2	2	2	2	2	2
Kyrgyz Republic	n.a.	n.a.	n.a.	2	2	2	2	2	2	2	2
Latvia	n.a.	n.a.	3	3	2	2	2	2	2	2	2
Lithuania	n.a.	n.a.	3	3	1	1	1	1	1	1	1
Macedonia, FYR	n.a.	n.a.	2	2	2	2	2	2	2	2	2
Moldova	n.a.	n.a.	n.a.	n.a.	2	2	2	2	3	3	3
Poland	2	2	2	2	2	2	2	2	2	2	3
Romania	2	2	2	2	2	2	2	2	2	2	2
Russia	n.a.	n.a.	3	3	3	2	2	2	2	3	3
Slovak Republic	2	2	2	2	2	2	2	2	2	2	2
Slovenia	n.a.	n.a.	2	2	2	2	2	2	2	2	2
Tajikistan	n.a.	n.a.	n.a.	n.a.	n.a.	3	3	3	2	2	2
Turkmenistan	n.a.	n.a.	n.a.	n.a.	2	2	2	2	2	2	2
Ukraine	n.a.	n.a.	n.a.	2	3	3	2	2	2	2	2
Uzbekistan	n.a.	n.a.	n.a.	n.a.	2	2	2	2	2	2	2

Exchange rate regime description:

1. Fixed group
2. Intermediate group
3. Floating group

The transition matrix is constructed on the basis of 218 observations covering an 11-year time-period for 25 countries. As some countries of the Central European region, and particularly from the FSU, had no national currency at the beginning of the 1990-s, the number of observations is smaller than it could potentially be (the missing observations are marked as n.a.). Of these 218 observations, 20 correspond to the fixed group, 153 to the intermediate group and 45 to the floating group.

The distribution of regimes by their type is presented in Table 3. It can be inferred from this table that the fix corner of exchange rate spectrum is still not particularly popular among transition countries of the CEE and the FSU, and has been increasing steadily from 0% in 1990 to 12% in 2000. Intermediate regimes, whose proportion fluctuates between 50% and 100%, represent the main type of the exchange rate policy for region. Floating rates, after substantial decrease in the middle of the 1990s, have increased in number during the last four years and now compose approximately quarter of all regimes.

Table 3. Distribution of the Exchange Rate Regimes in the Transition Economies

	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Fix	0	0	0	0	1	7	1	6	2	8	2	8	2	8	3	12	3	12	3	12	3	12
Int.	6	100	6	86	7	50	10	59	17	71	18	72	19	76	19	76	18	72	17	68	16	64
Fl.	0	0	1	14	6	43	6	35	5	21	5	20	4	16	3	12	4	16	5	20	6	24

Subsequently the transition matrix presented in Table 4 has been constructed based on the data of Table 2. It has turned out that for this sample the fixed rates constitutes the absorbing state - in our sample there are no exits from currency board to other regimes. The intermediate regime is very persistent, as diagonal element of transition matrix has value 0.9416, and it will take a long time to reduce the proportion of intermediate regimes, which is initially around 70 percent. As there is no possibility to go from the intermediate regime to fixed, and there is 6 % probability to go from intermediate to floating regime, the possible future development of regimes may have the following scenario: very slow transition from intermediate to floating regimes and at the same time slow transition from floating to fixed regimes. This is consistent with future enlargement of European Monetary Union, which demands a 2-year participation in ERM-II, which is flexible enough, and after that entering the Euro zone, which is fixed in our classification.

Table 4. Transition Matrix for Official Classification (1990-2000)

Regime in period t-1	Probability of regime in period t		
	Fix	Intermediate	Float
Fix	1.0000	0.0000	0.0000
Intermediate	0.0000	0.9416	0.0584
Float	0.0513	0.1538	0.7949

Table 5. Invariant Distribution and Current State

	Fix	Intermediate	Float
Regimes at the beginning of period for each country (initial distribution)	0.04	0.68	0.28
Regimes in 2000	0.12	0.64	0.24
Invariant distribution, 1990-2000	1.00	0.00	0.00

Limiting distribution, shown in Table 5, supports this suggestion. It implies that in the very long-run perspective all countries from our sample will end up with the fix regime (i.e. will be the members of the monetary union or will have currency board). The official data imply that the current

64% proportion of the intermediate regime will be reduced to 50 % in 25 years, to 37 % in 50 years, but still will have 20 % in 100 years.

In conclusion, we may state that Markov chain model of the exchange rate regime transition based on the official classification of the transition economies proves one variant of the two-corner hypothesis by implying that fixed regimes are absorbing state. However, this transition towards the fixed corner will take a very long time. In the next section we at first proceed to a reclassification of the official data that will reflect the actual behavior of the exchange rates and then we will again apply this new classification in the Markov chain model in order to check the two-corner hypothesis.

3.2 De Facto Exchange Rate Regimes of the Transition Economies

3.2.1 K-Mean Cluster Analysis Methodology

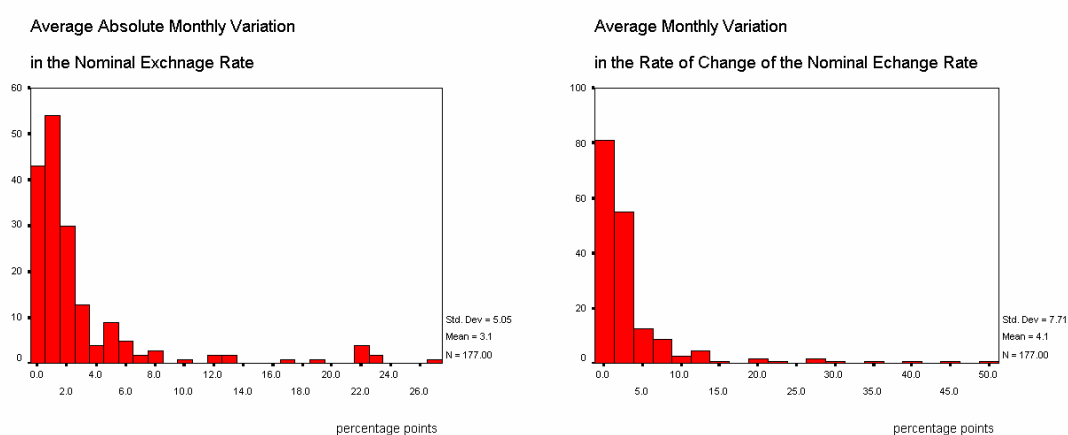
We will use the methodology developed by Levy-Yeyati and Sturzenegger (1999, 2001) in order to reclassify the exchange rate regimes prevailing during the last decade in the transition economies of the CEE and FSU. The classification of the exchange rate regimes will be based on a cluster analysis technique which will group countries according to the behavior of three variables: exchange rate volatility (σ_e), volatility of exchange rate changes ($\sigma_{\Delta e}$) and volatility of reserves (σ_r). We exclude as the variable interest rate volatility, which may give some additional information about the actual exchange rate regime, as some countries do not report the interest rate variable to the IMF and this will decrease substantially our sample, and also due to the fact that some studies²³ show that interest rate may have a similar behavior under the different regime.

Analysis will be provided for 22 countries, which report their financial data to the IMF and which are published at International Financial Statistics. The period of the analysis is 1990-2000. Our sample includes ten Central and Eastern European countries: Albania, Bulgaria, Croatia, the Czech Republic, Hungary, Macedonia, Poland, Romania, the Slovak Republic and Slovenia; three Baltic countries: Estonia, Latvia and Lithuania; and nine countries of the former Soviet Union: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia and Ukraine.

Following Levy-Yeyati and Sturzenegger, we will measure the exchange rate volatility (σ_e) as the average of the absolute monthly percentage changes in the nominal exchange rate during a calendar year. The volatility of exchange rate changes ($\sigma_{\Delta e}$) will be computed as the standard deviation of the monthly percentage changes in the exchange rate. The main problem for computing these variables is finding the appropriate currency of reference. In particular, I have used the following reference

currencies: US dollar for the countries of the former Soviet Union; among the Baltic states DEM and Euro for Estonia, US dollar for Lithuania and SDR for Latvia; DEM and Euro for all CEE countries. This method is not absolutely precise for countries stating their exchange rate regimes according to some currency basket (Hungary and Poland, for example); however, it has been used because it is difficult to follow the frequent changes in their composition, and additionally DEM have a substantial proportion in each basket. The summary of the data on these two variables is presented in Tables A1 and A2²⁴, and Figure 2. The charts leave out the upper 2 % tails of the histograms for a presentation purpose. The distribution of the first two variables is skewed to the left indicating on persistence of the small changes in the nominal exchange rate. The majority of the observations on exchange rate variables are concentrated in the range from 0 % to 4 %, with mode for monthly exchange rate changes placed between 1 % and 2 %.

Figure 1. Distribution of exchange rate variables

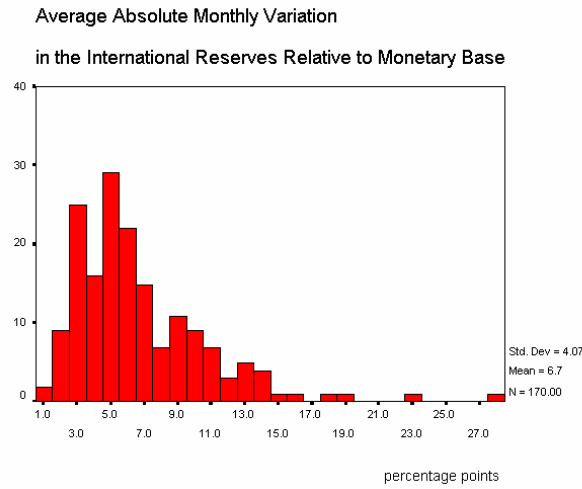


The volatility of reserves (σ_r) is found as the average of the absolute monthly change in the international reserves measured in dollars, relative to the monetary base in the previous month. In order to have the changes in reserves that reflect interventions in the foreign exchange markets, we have subtracted government deposits at the central bank from the central bank's net foreign assets. In practice these monthly changes in the international reserves have been calculated as the difference between line 11 from IFS and lines 16c and 16d, and result has been divided by line 14 lagged one month, all variables translated into dollars. The summary of the data is presented in Table A3 (see Appendix) and Figure 3. The histogram shows the average absolute monthly variation in the international reserves relative to monetary base. The curve for this variable is skewed less than for previous two variables, with mode corresponding to 5 % of a monetary base.

²³ See, for example, Darvas Z., Szapary G. (1999).

²⁴ See Appendix A.

Figure 2. Distribution of reserve variable



These three variables are computed on an annual basis, so actually each country-year case constitutes a point in the $(\sigma_e, \sigma_{\Delta e}, \sigma_r)$ space. Now we will use the cluster analysis to distribute all cases into four different groups: inconclusive, float, intermediate and fix. The classification characteristics of the clusters are identified in Table 6.

Table 6. Exchange rate regimes characteristics

	σ_e	$\sigma_{\Delta e}$	σ_r
Flexible	High	High	Low
Intermediate	Medium	Medium	Medium
Fixed	Low	Low	High
Inconclusive	Low	Low	Low

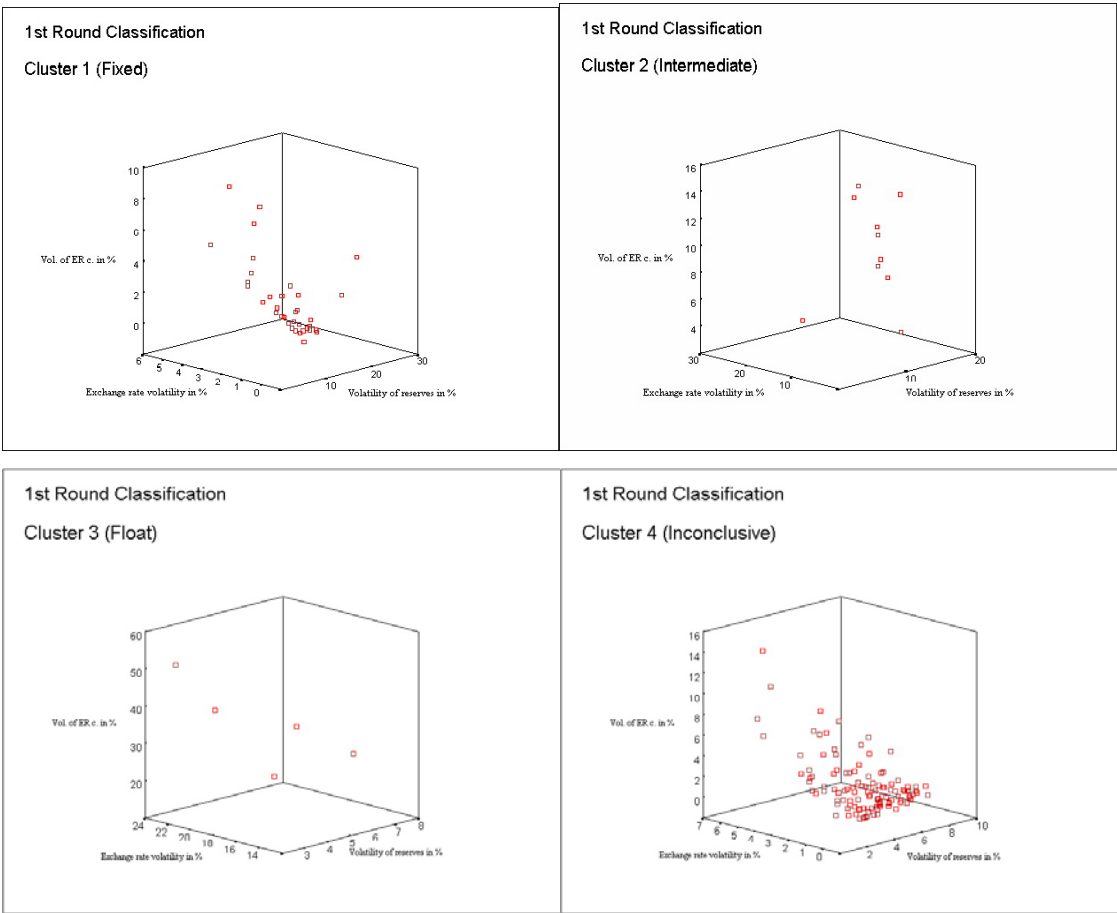
Source: Levy- Yeyati, Sturzenegger (2001)

In our space floats will be associated with comparatively low interventions (low variability of the foreign exchange reserves) and high volatility of the exchange rates. Observations with small values of the first two variables coupled with a substantial volatility in reserves will constitute the group of fixes. And finally, the intermediate regimes are predicted to have moderate to high volatility across all variables, which should reflect the exchange rate movements in spite of the active interventions in the currency markets. The countries, which exhibit little variability for all three variables, will be included in the inconclusive group.

3.2.1 Two-Round Classification Procedure

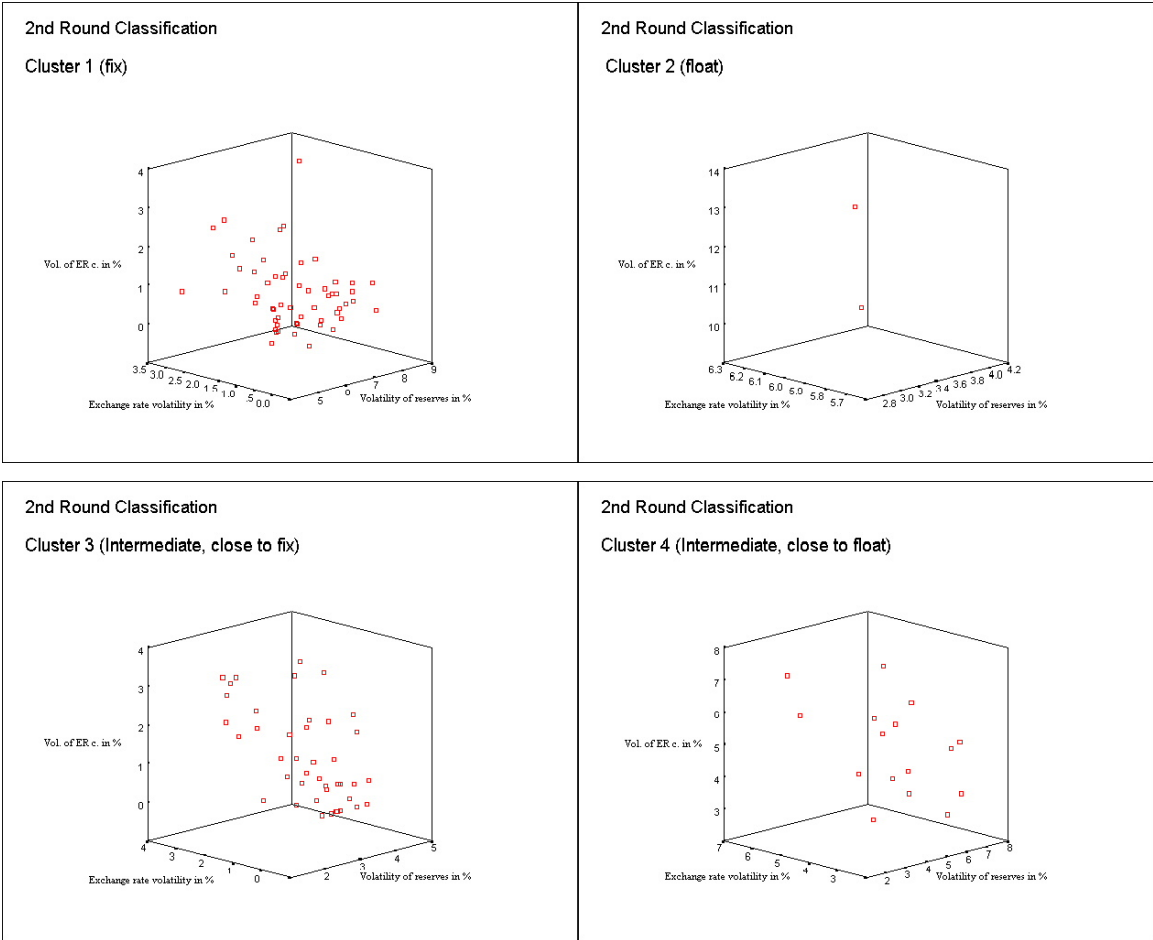
The classification procedure goes as follow. As k-mean cluster analyses uses the relative distance between points, it is crucial for data to be comparable for obtaining a relevant classification along all dimensions. Hence, first of all we eliminate the upper 2 % of the observations for each of three variables, which leave us with 167 country-year observations. After that we z-normalized remaining cases using their deviations from the mean divided by their standard deviation. Normalized data have been used to classify all cases into 4 clusters, which then have been assigned to the exchange rate regimes according to characteristics given in previous table. Following Levy-Yeyati and Sturzenegger (1999), we will call this first pass at the data the first round classification. The cases classified in the 1st round have comparatively high values of some variables indicating that they represent the observations of the exchange rate regimes under a substantial external pressure. For example, fixed group includes only the country-year points for which the average monthly volatility in the international reserves amounts minimum to 8.5 % of the monetary base and at the same time the median volatility of the exchange rate equals approximately to 1 %. While floating group includes cases with volatility of the exchange rate larger than 13.5 % accompanied with comparatively small changes in the international reserves. Figure 4 shows the scuttergrams for the resulting clusters.

Figure 3. 1st Round Classification



The 1st round classification assigns a high proportion of countries into the inconclusive cluster, similar to the results in Levy-Yeyati and Sturzenegger (1999). These cases represent country-year points, in which the dimension of the underlying shocks does not require large adjustment in either variable. Nevertheless, data in this category shows the relative volatility in all three variables, which allows us to redistribute further the data from this group into different exchange rate regimes, using the same methodology as in 1st round. We re-normalize the data for these 116 inconclusive cases and apply to them k-mean cluster analysis once more. We will call this procedure the second round classification, which results are presented in Figure 5.

Figure 4. 2nd Round Classification



Tables 7 and 8 show the upper and the lower bounds for each cluster as well as the median value for each variable. We have defined fixed exchange rates as a cluster with the relatively low nominal exchange rate volatility and the relatively high volatility in reserves. The two intermediate groups of the second round classification show the medium intervention in the foreign exchange market and the medium exchange rate volatility. Cluster 3 includes cases with the small exchange rate

variability and the medium reserve volatility, which indicates that this group is very close to the fixed regimes. In this group are placed observations with the *de jure* currency board, but which have the comparatively small changes in reserves. We have entitled Cluster 4 the intermediate, close to floating regimes as this cluster has the comparatively low volatility in reserves and the medium volatility in the exchange rate variables.

Table 7. 1st Round cluster boundaries

	Average monthly volatility in the exchange rate			Average monthly volatility in the change of the exchange rate			Average monthly volatility in international reserves relative to monetary base		
	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.
Cluster 1 Fixed (36)	0%	1.07%	4.91%	0%	1.49%	8.05%	8.48%	10.99%	27.95%
Cluster 2 Intermediate (10)	5.40%	7.90	22.49%	3.62%	10.59%	13.91%	3.43%	10.94%	18.05%
Cluster 3 Float (5)	13.49%	22.17	23.47%	20.50%	29.46%	49.84%	3.07%	4.99%	7.72%
Cluster 4 Inconclusive (116)	0%	0.98	6.23%	0%	1.05%	13.72%	1.22%	4.79%	8.33%

Table 8. 2nd Round cluster boundaries

	Average monthly volatility in the exchange rate			Average monthly volatility in the change of the exchange rate			Average monthly volatility in international reserves relative to monetary base		
	Min.	Median	Max.	Min.	Median	Max.	Min.	Median	Max.
Cluster 1 Fixed (56)	0%	0.79%	3.17%	0%	0.88%	3.80%	4.50%	5.76%	8.33%
Cluster 2. Float (2)	5.72%	5.97%	6.23%	9.69%	11.71%	13.72%	2.75%	3.37%	3.99%
Cluster 3 Intermediate, close to fix (42)	0%	1.00%	3.29%	0%	0.98%	3.27%	1.22%	3.13%	4.56%
Cluster 4 Intermediate, close to floating (16)	2.28%	3.88%	5.98%	3.03%	4.94%	7.08%	1.60%	5.63%	7.56%

3.2.1 THE CLASSIFICATION RESULTS AND NEW TRANSITION MATRIX

The results of the de facto classification (the first row for each country) and the official classification (the second row respectively) are presented in Table 9.

Table 9. Comparison of De Facto and De Jure Exchange Rate Regimes

Countries	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a. n.a.	n.a. n.a.	n.a. na.	n.a. n.a.	n.a. n.a.	Fix (1) Float	Int.(21) Float	Int.(22) Float	Int.(21) Float	Int.(21) Float	Int.(21) Float
Armenia	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. n.a.	Float(1) Int.	Fix (2) Int.	Fix (1) Int.	Fix (1) Int.	Fix (1) Float	Fix (1) Float	Fix (2) Float
Azerbaijan	n.a. n.a.	n.a. n.a.	n.a. n.a.	Int. (1) n.a.	n.a. Float	Fix (1) Float	Fix (2) Float	Fix (2) Float	Fix (2) Int.	Fix (2) Int.	Int.(21) Int.
Belarus	n.a. n.a.	n.a. n.a.	n.a. na.	n.a. n.a.	n.a. Int.	Fix (1) Int.	Fix (2) Int.	Float(2) Int.	Float(1) Int.	Fix (2) Int.	Int. (1) Int.
Bulgaria	n.a. Fix	n.a. Float	Int.(21) Float	Float(2) Float	Int. (1) Float	Int.(21) Float	Float(1) Float	n.a. Fix	Fix (2) Fix	Fix (2) Fix	Fix (2) Fix
Croatia	n.a. n.a.	n.a. n.a.	n.a. Float	Int. (1) Float	Fix (1) Int.	Fix (2) Int.	Int.(21) Int.	Int.(22) Int.	Fix (2) Int.	Fix (1) Int.	Fix (2) Int.
Czech Republic	n.a. Int.	n.a. Int.	n.a. Int.	Fix (2) Int.	Int.(21) Int.	Fix (2) Int.	Int.(21) Int.	Fix (2) Int.	Int.(21) Int.	Int.(21) Int.	Int.(21) Int.
Estonia	n.a. n.a.	n.a. n.a.	n.a. Fix	Fix (2) Fix	Int.(21) Fix	Int.(21) Fix	Int.(21) Fix	Fix (2) Fix	Fix (1) Fix	Fix (1) Fix	Fix (2) Fix
Georgia	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. Int.	n.a. Int.	Fix (1) Int.	Fix (2) Int.	Fix (2) Int.	Fix (1) Float	Int.(22) Float	Int.(21) Float
Hungary	Int.(21) Int.	Int.(21) Int.	Int.(21) Int.	Fix (2) Int.	Int.(21) Int.	Fix (1) Int.	Fix (2) Int.	Fix (2) Int.	Fix (2) Int.	Fix (2) Int.	Fix (2) Int.
Kazakhstan	n.a. N.a.	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. Int.	Fix (1) Int.	Int.(21) Int.	Fix (2) Int.	Fix (2) Int.	Fix (1) Int.	Fix (1) Int.
Kyrgyz Republic	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. Int.	n.a. Int.	Fix (2) Int.	Int.(22) Int.	Fix (2) Int.	Int.(22) Int.	Fix (1) Int.	Fix (2) Int.
Latvia	n.a. n.a.	n.a. n.a.	n.a. Float	Fix (1) Float	Int.(21) Int.	Int.(21) Int.	Int.(21) Int.	Int.(21) Int.	Fix (2) Int.	Int.(21) Int.	Int.(21) Int.
Lithuania	n.a. n.a.	n.a. n.a.	n.a. Float	Int. (1) Float	Fix (2) Fix	Int.(21) Fix	Fix (2) Fix	Int.(21) Fix	Int.(21) Fix	Fix (1) Fix	Int.(21) Fix
Macedonia, FYR	n.a. n.a.	n.a. n.a.	n.a. Int.	n.a. Int.	Fix (1) Int.	Fix (1) Int.	Int.(21) Int.	Fix (2) Int.	Fix (2) Int.	Fix (2) Int.	Fix (1) Int.
Moldova	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. n.a.	Fix (1) Int.	Fix (2) Int.	Int.(21) Int.	Fix (2) Int.	Int. (1) Float	Int.(22) Float	Fix (2) Float
Poland	Int.(21) Int.	Int.(22) Int.	Int.(21) Int.	Int.(21) Int.	Fix (2) Int.	Fix (1) Int.	Fix (2) Int.	Fix (2) Int.	Int.(22) Int.	Fix (2) Int.	Fix (2) Float
Romania	n.a. Int.	n.a. Int.	Int. (1) Int.	Int. (1) Int.	Int.(22) Int.	Int.(22) Int.	Fix (1) Int.	Int. (1) Int.	Int.(22) Int.	Int.(22) Int.	Int.(22) Int.
Russia	n.a. n.a.	n.a. n.a.	n.a. Float	n.a. Float	n.a. Float	Int.(22) Int.	Int.(21) Int.	Fix (2) Int.	Float(1) Int.	Int.(21) Float	Fix (2) Float
Slovak Republic	n.a. Int.	n.a. Int.	n.a. Int.	Fix (2) Int.	Fix (2) Int.	Fix (1) Int.	Fix (2) Int.	Fix (2) Int.	Fix (2) Int.	Fix (1) Int.	Int.(21) Int.
Slovenia	n.a. n.a.	n.a. n.a.	Fix (1) Int.	Fix (2) Int.	Fix (1) Int.	Fix (1) Int.	Fix (1) Int.	Fix (1) Int.	Fix (1) Int.	Fix (2) Int.	Fix (1) Int.
Ukraine	n.a. n.a.	n.a. n.a.	n.a. n.a.	n.a. Int.	Float(1) Float	Int.(22) Float	Fix (1) Int.	Int.(21) Int.	Int. (1) Int.	Int.(22) Int.	Int.(21) Int.

Note: In this table the following definitions were used:

Fix (1) – regimes that were selected in the fixed group in the 1st round;

Fix (2) – regimes that were selected in the fixed group in the 2nd round;

Int. (1) – regimes that were selected in the intermediate group in the 1st round;

Int. (21) – regimes that were selected into intermediate group in the 2nd round, which are closer to fixed regimes;

Int. (22) – regimes that were selected into intermediate group in the 2nd round, which are closer to floating regimes;

Float (1) – regimes that were selected in the float group in the 1st round;

Float (2) – regimes that were selected in the float group in the 2nd round;

Fix, Int., Float – regimes officially claimed by the countries.

The most honest country in our sample is Romania, for which the official and de facto classification coincides for all but one year. Hungary, which had pegged exchange rate until 1995 and after that accepted crawling band, is situated among the intermediate regime close to fix for the first

sub-period and then is classified as fixed which reflects the small size of crawl and substantial volatility in reserves. Slovenia, which claimed to have the managed float during the whole period, is permanently situated among fixers. Almost all cases of the official floating regime in reality is situated in the intermediate group and frequently even in the fix group, which supports the “fear of floating” hypothesis. The only exceptions are Bulgaria (1993, 1996) and Ukraine (1994) that floated in these years in both classifications. Worth noting is that Estonia (1994-1996) and Lithuania (1995, 1997, 1998.2000) are placed in the intermediate group while they actually had the currency board system in these years. This phenomenon is due to the low variability of reserves comparatively to other cases.

This new regime classification is further applied for a construction of the transition matrix. The new transition matrix is constructed on the basis of 167 country-year observations, of which 92 correspond to the fix group, 68 to the intermediate group and 7 to the floating group. This transition matrix gives a substantially different picture of the probabilities of switches from one regime to another. The fixed regime now is much less persistent with only a 65 % probability of remaining in the same state also next year. But now there is a 32 % probability of changing the exchange rate regime from the fixed to some kind of the intermediate regime. Persistence of the intermediate regime equals to approximately 60 %, but new result is that probability of switching to the fixed regime now equals approximately to 40 %, which differs completely from the results based on the official classification. Besides, the floating regime is less persistent, with probability of only 17 % of remaining in the same state and large probabilities of shifting to one of the two others regimes.

Table 10. Transition Matrix based on de facto classification (1990-2000)

Regime in period t-1	Probability of regime in period t		
	Fix	Intermediate	Float
Fix	0.6543	0.3210	0.0247
Intermediate	0.4035	0.5614	0.0351
Float	0.3333	0.5000	0.1667

Table 11. Invariant Distribution and Current State

	Fix	Intermediate	Float
Regimes at the beginning of period for each country (initial distribution)	0.55	0.36	0.09
Regimes in 2000	0.55	0.45	0
Invariant distribution, 1990-2000	0.54	0.43	0.03

The invariant distribution, presented in Table 11, now gives a completely different picture for the future exchange rate regimes in the region. In fact, limiting distribution is very similar to the distribution of the exchange rate regimes prevailing currently in the sample countries. The intermediate regimes compose 43 %, which is obviously far from zero. The most prevailing kind of regimes will remain fix with the proportion equal to 54%. The floating regime comprises only 3 %. Interestingly that already after 16 iterations transition matrix remains the same, which indicates much faster convergence to the limit distribution. These results are strongly inconsistent with the hollowing out hypothesis and completely contradict the statement that a distribution of the exchange rate regimes now is going to more flexible pole of the exchange rate spectrum.

4 Policy Implications for the Exchange Rate Regimes in the Transition Countries

The analysis of existing theoretical and empirical studies on the two-corner hypothesis and our investigation of the possible application of this hypothesis to the transition economies suggest that the diversity of the exchange rate arrangements in the region will not be limited to two regimes in the near future. The interior solutions would remain viable and, in many cases, advisable²⁵. The evolution of the exchange rate regimes will be guided, on the one side, by the gradual enlargement of the EU and widening of the euro zone, and on the other side, by further integration of the FSU countries into the world economy and international financial markets.

The historical development of the exchange rate regimes in the region underlines the fact that their choice is not static and has been frequently changed due to the shifts in the economic policy goals and external pressure. Common problems that were and remain on the policy agenda and to which resolving the exchange rate policy was directed, include fighting high inflation, especially at the beginning of the transition process; and sustaining the external competitiveness, as almost all countries are opened to the international trade.

It is difficult to describe the evolution of the exchange rate regimes in the region by some uniform pattern. Rather we may speak about some more or less common strategies that were used. The first strategy, in different interpretations employed by Poland, The Czech Republic, The Slovak Republic and Hungary, is characterized by gradual move towards greater exchange rate flexibility. This

²⁵ Mussa et al. (2000), for instance, argue that for many developing and transitional countries, which have limited connection with international financial markets pegged exchange rates remains advantageous to other regimes. Pegged exchange rates can be credible nominal anchor for monetary policy, as other anchors demand developed financial infrastructure and complex institutional requirements. They state that most transition countries were affected by recent crises only indirectly through movements in world commodity prices and trade flows. That is why the conclusion of hollowing of the middle can be applied only to the most advanced emerging economies and not to all developing countries.

move was accompanied by changes in monetary policy from the exchange rate anchor to adoption of direct inflation targeting frameworks (Czech Republic, Poland), or adoption of some combined strategies (elements of monetary and direct inflation targeting in The Slovak Republic). The second strategy includes adoption of currency board arrangement or conventional peg after the period of more or less managed float or directly at the beginning of the transition (Bulgaria, Estonia, Latvia, Lithuania, Macedonia and Turkmenistan). The third strategy, which can be distinguished, is adoption of the dirty or free float without any major changes in the regime. Among the followers of this strategy are Albania, Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Romania, Slovenia, Tajikistan and Uzbekistan. And the last group includes countries, which started transition with the floating exchange rate regimes, then in the middle of the 1990-s switched to peg or band and in the late 1990-s returned to floating (Belarus, Croatia, Russia and Ukraine)²⁶.

The above-described strategies show mainly the official intentions of authorities and frequently are far from the behavior of variables, which can be used for assessing the actual nominal exchange rate regime. Tables 11 and 12 indicate the prevalence of the fixed and close to fixed exchange rate regimes in the region. This finding supports the “fear of floating” proposition, as a majority of regimes claimed as floats has turned out to behave as fixed or close to fix regimes. Under actual “deeds vs. words” classification it is practically impossible to find some patterns in the evolution of the behavior of the exchange rates. One definite conclusion that can be drawn is that a few occasions of float happened in cases of large external pressure, when there were involuntary changes in the exchange rate regime or currency was just introduced (Armenia 94, Belarus 97-98, Bulgaria 93, 96, Russia 98, Ukraine 94).

For countries of the CEE, there is little doubt that after becoming members of the EU they will join the euro zone. Among the most frequently named advantages of this step are a reduction of the transaction costs, as more than half of their foreign trade is carried with the EU; lowering the interest rates and risk premiums. This process has three clearly defined stages: the EU accession, a minimum 2-year participation in the ERM II and then joining the euro zone. While before the accession countries are allowed to pursue any exchange rate regime, which best suits their needs, after it they are obliged to avoid excessive exchange rate fluctuations and competitive devaluations and to maintain the exchange rate within a $\pm 15\%$ band of ERM II²⁷. Besides, these countries are obliged to create and develop a market-oriented financial sector, provide full independence to their central banks and, most importantly, complete the liberalization of the capital accounts. In principle, ERM II can accept a wide range of the different exchange rate regimes, which have central parity to euro and can be sustained in

²⁶ See Table 1.

²⁷ In fact, there is no compulsion to enter the ERM II immediately after the accession to EU.

±15% band. For a long time currency board arrangement was considered as incompatible with ERM II, but recently the European Central Bank (ECB) agreed that currency board with euro as reference currency (Estonian type) can be one of the options on the road to the EMU.

One of the possible exchange rate regimes considered in political and scientific circles is unilateral euroisation²⁸, which belongs to the corner solutions. It is argued that euroisation will avoid the volatility of the floating exchange rates and contrary to pegged exchange rates will be invulnerable to speculative attacks. Besides, euroisation can cure the “original sin” characteristic for a majority of the transition countries. Additionally, it may help to resolve problem with increased capital inflows, real appreciation of the national currencies and resulting decline in the competitiveness. On the negative side of this option are loss of seigniorage and lender of last resort function as well as impossibility to eliminate fully the country risk. While this policy step can be beneficial in some cases from economic point of view, it is politically unacceptable by authorities of the EU, because the adoption of euro is considered as final stage of a structured convergence process within a multilateral framework.

One of the potential problems on the road to the EU and EMU membership is a trend real exchange rate appreciation, connected with Balassa-Samuelson effect²⁹. Application of the Balassa-Samuelson effect to the transition economies is mostly connected with their relative lower development compared, for example, with the EU countries, and real convergence, which has to take place during the process of integration. This effect can cause either inflation, that will be higher than is demanded under convergence criteria, or nominal exchange rate appreciation, which, if large enough, can be counter to the exchange rate stability criteria. Nevertheless, “the Balassa-Samuelson effect is an equilibrium phenomenon, not an undesirable transitory effect that ought to be counteracted through policy actions” (Halpern L. and Wyplosz C. 2001, p.11). Additional pressure on prices in the transition economies is connected with gradual privatization and subsequent liberalization of prices in traditionally state-owned spheres such as transport, telecommunications or public services. Hence, the suggestion to adjust the Maastricht criterion on inflation, defining the permissible inflation according to the average inflation rate of the euro zone³⁰, seems reasonable.

Evidently, the CEE countries that have not yet intended to join the EU will pursue some kind of the euro-based exchange rate target. Bosnia already has the currency board linked to the DEM (Euro). Since November 1999 the DEM has also been circulating as a parallel official currency in Montenegro.

²⁸ See on this matter Rostowski J. (1999), Nutti M. (2000), Bratkowski A. and Rostowski J. (2000), and Wojcik C. (2000) among others.

²⁹ See on this matter, Masson P. (1999), Szapary G. (2000), Halpern L. and Wyplosz C. (2001).

³⁰ See Szapary G. (2000).

The Euro is de facto domestic currency in Kosovo. These close links with the euro, place it in the center of these countries' exchange rate strategies, and the role of euro over time will only increase. The present development suggests that these countries will be situated somewhere in the corners.

For the countries of the FSU, the distinctive feature is their orientation to the USD in their exchange rate policy. It can be partly explained by the smaller share of their trade with the EU compared to the CEE countries and the absence of a strict political will directed to integration with the EU³¹. Another possible explanation of the dominant role of the USD for the FSU countries is the fact that raw materials comprise a substantial part of their export, which are traditionally priced in the USD in the world markets. All FSU countries chose a flexible exchange rate regime at the beginning of the transition. Stanley Fischer and Ratha Sahay (2000, p.7) name the following reasons for adopting a floating regime by these countries:

... the concern that real shocks would occur during the transition period, the view that the peg could not be maintained for long as the starting credibility of FSU countries was low, the lack of foreign exchange reserves to back a peg, and simply the inability to assess the rate at which the local currency should be pegged.

According to our investigation all FSU countries officially floated in 2000, but in fact followed some kind of pegged exchange rates.

Some studies look at the possibility for countries of the FSU to compose the Optimal Currency Area (OCA). Linda Goldberg (1999), for example, argues that the absence of a stabilizing fiscal federalist center, low labor mobility and not highly correlated shocks in the FSU countries mean that on balance these countries do not constitute the OCA and should have independent currencies with adjustable exchange rates. To my mind, the reasonable suggestion for a majority of the FSU countries is adoption of some modification of "BBC rule", which will support stability of the exchange rate, allow them to fight inflation, which is still high, and not harm the external competitiveness. The comparatively low integration into the international financial markets and still an undeveloped financial sector support this proposition.

5 Conclusions

The recent financial crises underlined the vulnerability of the soft intermediate exchange rate regimes and pushed the scientific world towards the view that only corners would be viable for countries opened to international capital flows. Still this commonly accepted wisdom has no unified theory,

³¹ Ukraine claims its desire to be a member of EU, but its conducted economic policies and political uncertainty rather distances it from this goal.

which can prove its truthfulness, but rather is based on different points indicating the drawbacks of the intermediate solutions. A thorough analysis of studies intended to find theoretical justification for the two-corner hypothesis allows us to identify the vulnerability to speculative attacks, creation of the implicit insurance against the risk of exchange rate changes and political difficulty of exiting from soft pegs, as the crucial drawbacks undermining the intermediate exchange rate regimes. Nevertheless, the potential benefits of using “the holy middle” in the course of stabilization programs balance the negative effects of the intermediate exchange rates and refine the question from the unsustainability of intermediate solutions to their costs and benefits as well as the timing of shifts along the exchange rate spectrum.

Empirical studies, either directly evaluating the two-corner hypothesis or indirectly dealing with it, mainly reject the disappearance of adjustable pegs, crawling bands and target zones as possible exchange rate arrangements, while indicating their decrease in number. One common feature of such studies is the fact that officially claimed exchange rate regimes seldom coincide with their market behavior. Most official floaters have strong fears of unpredictable market elements and, therefore, try to have a more than substantial stock of reserves and apply interventions on foreign exchange markets and interest rates in order to manage the exchange rate³². This fact further weakens the already inconvincible support for the two-corner hypothesis.

Our investigation of the exchange rate regimes in transition economies of the CEE and the FSU countries, based on k-mean cluster analysis, applied in the country-year space, draws a completely different picture to the official classification. Fix corner, which is the least popular exchange rate regime among the transition economies officially, prevails over all other regimes as a group under “deeds vs. words” classification, implying the strong support for “fear of floating” phenomenon. At the same time the intermediate regimes constitute approximately half of all regimes in both classifications. The freely floating exchange rate is actually dying out in the countries of the region, emerging only in the cases when a country is unable to defend a particular exchange rate target.

The official IMF classification and “deeds vs. words” classification have been used in this thesis for formal testing of the hollowing out hypothesis applying the Markov chain model of exchange rate transition developed by Masson (2000). The official classification supports one of the variations of the two-corner hypothesis: that fix corner is an absorbing state. This result implies that after very long transition all considered countries will be classified as having hard commitment to fix exchange rate.

³² As Eichengreen (2000, p. 19) put it: ‘Discomfort with the extremes drives economists like policy makers, back toward the middle, notwithstanding its instability’.

This result can be partly explained by the future enlargement of the EU and, hence, the adoption of the euro by the majority of the countries of the region, but practically the result is obtained due to the absence of exits from the currency board arrangements in our sample, which leads to gradual convergence to the fix corner. The “deeds vs. words” classification points to the stability of the current exchange rate regimes distribution, which implies the full specter of exchange rate regimes for the near future, skewed to the fix pole. Hence, our sample does not support the disappearance of the intermediate regimes.

The above-described research has some limitations. First of all, it is questionable if the Markov process can describe correctly the changes in exchange rate regimes adopted by different countries. It does not take into account the possibility of occurrence of some stochastic event, which may change completely the path of a regime, not depending on the current situation. A second limitation is connected with a mechanistic approach to the definition of actual exchange rate regime by use of the cluster analysis. The slightest difference in the cases coordinates in the country-year space may lead to different clusters membership, which can be illustrated by some observations for the Estonian and Lithuanian currency boards, that were classified as intermediate regimes. Additionally, the variables that have been used for cluster analysis can be slightly changed by introducing the variables connected with interest and inflation rates behavior, as well as some synthetic variables that accumulate the information about the exchange rate regime.

Nevertheless, despite the above-mentioned limitations this research can provide some important insights in the study of exchange rate regime development. Further research can be done on elaborating the theoretical model able to show the shifts in exchange rate regimes in response to the changes in fundamentals or external situation of a country.

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APPENDIX A

Table A1. Exchange rate volatility, in %

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a.	n.a.	16.823	2.249	2.230	1.905	2.273	5.977	1.697	1.921	1.031
Armenia	n.a.	n.a.	21.679	42.468	22.169	0.647	0.945	1.474	0.425	1.100	0.776
Azerbaijan	n.a.	n.a.	n.a.	7.876	75.813	1.635	0.635	0.466	0.139	1.014	0.349
Belarus	n.a.	n.a.	n.a.	n.a.	n.a.	1.068	2.546	6.227	23.467	3.174	12.880
Bulgaria	n.a.	n.a.	2.405	5.722	11.737	2.266	18.682	27.133	0.237	0.392	0.289
Croatia	n.a.	n.a.	n.a.	22.491	0.758	0.605	0.444	2.283	0.782	0.628	0.488
Czech Republic	n.a.	n.a.	n.a.	0.822	0.657	0.805	0.646	1.807	1.503	1.289	1.101
Estonia	n.a.	n.a.	0.369	0.234	0.276	0.255	0.394	0.419	0.253	0.361	0.259
Georgia	n.a.	n.a.	n.a.	n.a.	n.a.	1.187	0.398	0.386	2.750	5.135	0.970
Hungary	1.070	2.226	1.464	1.605	1.733	2.772	0.821	0.907	1.421	0.790	0.492
Kazakhstan	n.a.	n.a.	n.a.	n.a.	21.875	3.402	1.057	0.429	0.820	4.912	0.375
Kyrgyz Republic	n.a.	n.a.	n.a.	n.a.	5.563	1.170	3.589	1.372	4.752	4.748	1.018
Latvia	n.a.	n.a.	6.763	2.865	0.203	0.207	0.000	0.000	0.417	0.000	0.210
Lithuania	n.a.	n.a.	n.a.	7.540	0.234	0.000	0.000	0.000	0.000	0.000	0.000
Macedonia, FYR	n.a.	n.a.	n.a.	n.a.	1.509	1.011	0.388	2.260	0.342	0.277	0.302
Moldova	n.a.	n.a.	n.a.	n.a.	0.761	0.789	0.472	0.541	5.673	4.295	0.974
Poland	1.597	3.594	3.294	2.299	1.912	1.887	1.019	1.319	3.318	2.268	1.986
Romania	12.448	29.380	10.085	7.917	4.965	4.165	2.859	7.210	3.220	3.332	2.615
Russia	n.a.	n.a.	n.a.	n.a.	n.a.	4.772	1.521	0.581	13.491	2.466	0.901
Slovak Republic	n.a.	n.a.	n.a.	1.718	0.743	1.076	0.552	0.977	1.719	1.276	1.662
Slovenia	n.a.	n.a.	4.622	1.878	0.631	0.778	0.690	0.503	0.440	0.501	0.642
Ukraine	n.a.	n.a.	n.a.	28.750	23.100	4.789	1.608	0.624	5.399	3.429	1.031

Table A2. Volatility of exchange rate changes, in %

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a.	n.a.	44.111	2.559	2.602	2.263	3.191	7.080	2.423	1.881	1.379
Armenia	n.a.	n.a.	22.309	77.122	27.048	0.921	1.495	1.711	0.467	1.494	0.899
Azerbaijan	n.a.	n.a.	n.a.	7.925	91.757	3.543	0.458	0.127	0.195	1.561	0.137
Belarus	n.a.	n.a.	n.a.	n.a.	n.a.	3.176	2.494	9.690	49.838	0.764	5.523
Bulgaria	n.a.	n.a.	3.234	13.721	13.907	2.821	20.500	67.385	0.380	0.501	0.434
Croatia	n.a.	n.a.	n.a.	12.739	1.014	0.923	0.522	5.188	0.823	0.721	0.650
Czech Republic	n.a.	n.a.	n.a.	0.997	0.730	0.974	0.730	2.023	1.822	2.056	1.247
Estonia	n.a.	n.a.	0.583	0.305	0.357	0.329	0.587	0.640	0.318	0.454	0.386
Georgia	n.a.	n.a.	n.a.	n.a.	n.a.	1.679	0.664	0.503	6.684	7.010	1.560
Hungary	1.042	2.902	1.751	1.702	2.038	3.001	0.797	1.057	1.531	1.080	0.414
Kazakhstan	n.a.	n.a.	n.a.	n.a.	20.309	4.028	0.968	0.916	0.726	8.052	0.351
Kyrgyz Republic	n.a.	n.a.	n.a.	n.a.	7.925	1.397	4.257	1.898	5.608	4.770	1.005
Latvia	n.a.	n.a.	7.995	3.453	0.704	0.530	0.000	0.000	0.754	0.000	0.536
Lithuania	n.a.	n.a.	n.a.	9.487	0.555	0.000	0.000	0.000	0.000	0.000	0.000
Macedonia, FYR	n.a.	n.a.	n.a.	n.a.	2.348	1.317	0.502	3.797	0.447	0.337	0.484
Moldova	n.a.	n.a.	n.a.	n.a.	0.841	0.819	0.540	0.697	11.703	5.477	1.460
Poland	1.803	4.547	2.996	3.270	1.087	2.057	1.151	1.667	4.837	2.759	2.181
Romania	26.874	75.461	13.461	3.621	5.730	3.257	2.730	12.023	3.190	3.220	3.025
Russia	n.a.	n.a.	n.a.	n.a.	n.a.	6.309	0.679	0.311	29.457	2.879	1.784
Slovak Republic	n.a.	n.a.	n.a.	2.395	0.851	1.354	0.646	1.164	2.466	1.531	2.537
Slovenia	n.a.	n.a.	6.437	1.151	0.457	0.994	0.794	0.633	0.489	0.544	0.480
Ukraine	n.a.	n.a.	n.a.	40.819	35.622	5.052	2.107	0.984	9.448	4.201	2.021

Table A3. The volatility of reserves, in %

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Albania	n.a.	n.a.	n.a.	n.a.	n.a.	10.039	1.924	2.703	1.334	1.904	2.357
Armenia	n.a.	n.a.	n.a.	100.867	7.717	8.330	11.750	9.908	11.018	12.651	5.263
Azerbaijan	n.a.	n.a.	n.a.	12.495	3.285	27.950	4.977	4.549	6.326	5.728	3.756
Belarus	n.a.	n.a.	n.a.	n.a.	n.a.	10.969	5.101	3.989	3.075	4.787	3.430
Bulgaria	n.a.	n.a.	3.995	2.752	10.228	4.561	4.990	38.434	5.976	5.323	4.498
Croatia	n.a.	n.a.	n.a.	18.050	10.472	4.752	3.568	5.625	5.014	9.495	7.472
Czech Republic	n.a.	n.a.	n.a.	6.886	3.144	7.833	2.642	4.838	3.462	3.389	2.866
Estonia	n.a.	n.a.	38.374	5.070	2.197	2.756	3.117	5.527	13.308	12.273	6.735
Georgia	n.a.	n.a.	n.a.	n.a.	n.a.	22.752	7.091	6.775	10.308	6.243	4.476
Hungary	3.306	1.804	2.969	4.878	2.259	8.983	7.005	7.354	7.287	6.275	4.732
Kazakhstan	n.a.	n.a.	n.a.	n.a.	35.120	12.986	3.902	7.359	5.658	14.060	13.686
Kyrgyz Republic	n.a.	n.a.	n.a.	n.a.	n.a.	5.834	5.338	5.401	5.276	9.356	4.655
Latvia	n.a.	n.a.	n.a.	10.162	1.218	3.785	3.707	3.220	4.737	3.098	4.183
Lithuania	n.a.	n.a.	n.a.	11.310	5.171	3.972	5.321	2.967	3.141	9.483	2.694
Macedonia, FYR	n.a.	n.a.	n.a.	n.a.	11.118	9.411	3.158	7.784	6.136	8.011	9.868
Moldova	n.a.	n.a.	n.a.	n.a.	14.168	7.232	3.532	6.161	9.606	5.641	5.046
Poland	4.180	2.856	2.532	2.118	4.715	8.480	4.739	5.002	7.464	5.124	5.795
Romania	n.a.	9.422	15.854	14.476	7.400	6.166	9.373	10.580	3.048	7.560	5.903
Russia	n.a.	n.a.	n.a.	n.a.	n.a.	1.600	2.959	4.936	5.873	3.893	6.134
Slovak Republic	n.a.	n.a.	n.a.	6.421	7.057	9.298	4.789	6.158	6.547	8.891	2.164
Slovenia	n.a.	n.a.	19.497	6.436	12.820	9.300	11.392	12.859	11.124	6.988	10.371
Ukraine	n.a.	n.a.	n.a.	6.163	4.623	5.725	15.056	2.758	9.388	4.305	4.411