Does the Exchange Rate Regime affect Macroeconomic Performance? Evidence from Transition Economies *

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Abstract

To examine whether the exchange rate regime in place has any impact on inflation and growth performance in transition economies, the study develops an empirical framework that addresses some of the main problems plaguing empirical work in this strand of the literature, namely the *Lucas critique, endogeneity of the exchange rate regime*, and *the sample selection problem.* Empirical results demonstrate that exchange rate regime does make a difference for inflation performance. The findings indicate that transition countries with intermediate arrangements may achieve lower inflation if they were to adopt a fixed regime. The results also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation. Furthermore, an interesting empirical finding worth highlighting is that an *unanticipated float*—a situation describing a country where fundamentals suggest it is likely to adopt another regime, but it adopts a floating regime—results in lower inflation. Based our results, however, it is not possible to make any inference about particular exchange rate regime being superior to another in terms of growth performance. Nonetheless, empirical findings underscore that policy variables—and also other variables influencing economic activity—do have different effects on growth under different exchange rate arrangements.

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* The findings and conclusions of the paper are those of the authors. They do not necessarily represent the views of the World Bank, its Executive Directors, or the countries they represent.

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1. Introduction

The issue of the appropriateness of exchange rate arrangements has returned to the forefront as a result of the recent crises in Asia, Russia, Brazil, and more recently economic developments in Argentina. More precisely, the debate over fixed and flexible exchange regimes has once again taken center stage. Some claimed that the first round of this debate was won by those advocating flexible regimes: all crisis episodes took place in countries which had adopted a variety of mechanisms for pegging more or less closely to the dollar.[1] Fixed exchange rates, soft pegs in particular, were blamed for the recent financial meltdowns.[2] The advocates of fixed exchange regime, however, have asserted that there are bad fixes and good fixes: a good fix is, for example, *full dollarization* [Calvo (1999), Hanke and Schuller (1999)]. Clearly, this controversy, which has raged in the economic literature for more than a century, continues unabated.

An important recent development in the debate over most appropriate best exchange rate arrangement is the recognition that the choice of the exchange rate regime for developing countries is different from that of developed countries.[3] Developing countries are often beset by a lack of credibility and limited access to international markets; they are beset by more pronounced adverse effects of exchange rate volatility on trade, high liability dollarization, and higher passthrough from the exchange rate to inflation. Consequently, *benign neglect* of the exchange rate is not a feasible option for developing countries.

Admittedly, empirical corroboration of the arguments set forth in the literature has been the least explored part of this debate. Contrary to the large number of theoretical and conceptual discussions, relatively few studies have made an attempt to investigate empirically the link

[1] See Calvo (1999) for a more detailed discussion of this issue.
[2] See, for instance, Goldstein (1999).

between macroeconomic performance and the exchange rate regime. This is, perhaps, because such an empirical investigation is fraught with difficulties, including the problem concerning the classification of the exchange regime. [4]

In spite of the growing interest over the link between the exchange rate regime and macroeconomic performance, the burgeoning empirical literature on transition economies has paid little attention to this issue.[5] It has largely focused on recovery and growth as well as price liberalization and inflation.[6] Some of the existing studies made an attempt to incorporate only the effect of the adoption of a fixed exchange rate regime on inflation and growth with mainly two objectives in mind: (i) to capture favorable confidence effects of nominal exchange rate anchors on velocity; and (ii) to account for the output costs of stabilization associated with the adoption of a particular nominal anchor, namely the exchange rate. Nevertheless, none of the studies made an attempt to investigate explicitly the links between the nominal exchange rate regime and macroeconomic performance.

This paper aims to fill this void by investigating empirically the link between the exchange rate regime and macroeconomic performance in transition economies.[7] To this end, we develop an empirical framework that addresses some of the main problems plaguing empirical work in this strand of the literature, namely the *Lucas critique, endogeneity of the exchange rate regime,*

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[3] Calvo (1999) and Calvo and Reinhart (2000a, 2000b)

[4] See, for instance, Ghosh et al (1997), Baxter and Stockman (1989), and Edwards and Savastano (1999) for a review of problems encountered by empirical studies in this literature.

[5] Studies by Dornbusch (1994) and by Sachs (1996) are among the few papers focusing on the macroeconomic implications of the exchange rate regime and on the choice of the exchange rate in the transition countries. More recently, series of papers—presented at an Association for Comparative Economic Studies panel entitled "*Exchange Rate Policies in Transition*", in Chicago, January 4, 1998—made an attempt to explore issues related to exchange rate regime in the countries in Transition. Majority of the papers were descriptive in their nature and made no attempt to empirically investigate the macroeconomic implications of the exchange rate regime in transition economies.

[6] See, for instance, Berg et al. (1999), Hernandez-Cata (1999), Christoffersen and Doyle (1998), Fischer et al. (1998, 2000), and Havrylyshyn et al. (1998).

[7] This study will not explore issues related to monetary and exchange rate policy encountered by countries negotiating EU accession—Czech Republic, Estonia, Hungary, Poland, and Slovenia. See Corker et al (2000) and Masson (1999) for a detailed discussion of these issues.

and the sample selection problem.[8] More specifically, we utilize a *switching regression model* which is estimated using a *two-step Heckman procedure*. First, we estimate the equation for the choice of the exchange rate regime by using ordered probit. Second, we utilize a switching regression technique to investigate whether the exchange rate regime has a bearing on inflation and growth performance in transition economies.

When tackling this controversial topic in the context of transition economies, however, two issues emerge. First, it is important to make a distinction between the appropriateness of the exchange rate arrangements in the earlier phase of the transition process—money vs. exchange rate based stabilization debate—and the appropriateness of the exchange rate arrangements (in the aftermath of the stabilization) for long-run economic management. Second, one needs to clarify whether the same economic principles of exchange rate policy apply both to market economies and transition economies. Put differently, *are transition economies so unique that what characterizes market economies or developing countries has little relevance to them?*

The first issue, though beyond the scope of this investigation, will be discussed briefly by looking at some stylized facts about the performance of transition countries that adopted different anchors in their stabilization programs.[9] In the case of the second issue, the paper, while conceding that transition economies have distinct features—such as extreme forms of central planning which meant price controls, chronic excess demand, and forced saving—compared to other developing countries, will proceed under the assumption that the fundamental tenets of exchange rate policy apply to any and all types economies [Guitián (1994) and

[8] The Lucas critique states that when there is a policy switch the coefficients associated with policy variables should change. This is because the way in which expectations are formed—the relationship of expectations to past information—changes when the behavior of forecasted variables changes. The sample selection problem arises from the fact that countries do not choose their exchange rate regimes randomly. Instead, their choice hinges on a set of fundamentals, which, in turn, affects macroeconomic outcomes such as inflation and growth. Consequently, the use of standard econometric techniques such as OLS or 2SLS will produce biased results stemming from the correlation between the regime choice and the error term in either the inflation or growth equation.

Dornbusch (1994)].[10] The investigation, however, will attempt to make the necessary modifications to account for the distinct characteristics of transition economies, where possible.

The principal conclusions that emerge from our study are:

1. Transition economies that: (i) have lower budget deficits; (ii) are more open (i.e. have a higher ratio of exports plus imports to GDP); and (iii) made more progress in private sector entry and internal markets tend to adopt more stringent exchange rate regimes. While the results suggest that those which have made more progress in opening to external markets and with a reserves to monetary base ratio above 1.34 opt for more flexible exchange rate arrangements.
2. The exchange rate regime does make a difference for inflation performance. The findings imply that countries with intermediate arrangements may achieve lower inflation if they were to adopt a fixed regime. The results also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation since their fundamentals may be inappropriate for an intermediate regime. However, when a country with an intermediate regime switches to a floating regime, it experiences higher inflation.
3. The results also suggest that the case of an *unanticipated float*—a situation describing a country where fundamentals make it likely to adopt another regime, but it adopts a floating regime—results in lower inflation.
4. Based our empirical results, however, it is not possible to make any inference about a particular exchange rate regime being superior to the other in terms of growth performance. Nonetheless, empirical findings suggest that policy variables—and also other variables

[9] In Appendix 1, we try to highlight some stylized facts from the stabilization performance of transition countries under different anchors.

[10] This conjecture, however, does not imply that the working of a particular exchange rate policy or arrangement is independent of the characteristic of the economy in which it is being pursued.

influencing economic activity—do have a different impact on growth under different exchange rate arrangements.

The remainder of the paper is organized as follows. Section 2 discusses the overall trend in the evolution of the exchange rate regimes both in general and in the context of transition economies in the 1990s. Section 3 provides a brief review of the literature focusing on the link between exchange rate regimes and macroeconomic performance. Section 4 takes a cursory look at the evolution of key macroeconomic variables in transition economies under different exchange rate arrangements. Section 5 describes the empirical framework. Section 6 reports empirical findings. Finally, Section 7 concludes the paper.

2. A Brief Overview of the Evolution of the Exchange Rate Regimes in the 1990s

Following the collapse of the Bretton Woods system of fixed exchange rates in the early 1970s, there has been a gradual shift from fixed to more flexible exchange rates. Initially, many developing countries pegged their currencies either to a single currency (usually the USD or FF) or to a basket of currencies. By the late 1970s, they began to shift from single currency pegs to basket pegs. In the early 1980s, developing countries shifted away from currency pegs towards more flexible exchange rate arrangements.[11]

A glance at the evolution of the exchange rate regimes of developing countries and of the transition economies during the 1990s reveals an interesting trend (Figure 1). Since 1994, developing, including transition, countries appear to have shifted away from fixed and independent floating exchange rate regimes towards intermediate flexibility.

[11] In 1975, for example, 87 percent of developing countries had some type of pegged exchange rate. By 1996, this proportion had declined to well below 50 percent. When the relative size of economies is taken into consideration, the shift is even more pronounced. In 1975, countries with pegged rates accounted for 70 percent of the developing world's total trade; by 1996, this figure had dropped to about 20 percent.

Transition countries have adopted a broad variety of different exchange rate regimes.[12] A large number of countries, from the outset, let their currencies float while maintaining some scope for intervention [Albania (1992), Bulgaria (1991), Romania (1993), and Slovenia (1992) as well as several CIS republics]. Some countries, on the other hand, opted for a fixed regime from the outset [Croatia (1993), Czechoslovakia, later the Czech Republic, and Slovakia, Poland until 1991, and Macedonia (1994)]; three chose the extreme of a currency board (Estonia and later Lithuania as well as Bulgaria). Other countries decided to purse a more flexible approach and introduced a crawling peg system (Poland from October 1991, Hungary from March 1995) or a fixed but adjustable peg (Hungary until 1995).

Not surprisingly, the appropriate exchange rate regime for transition economies—both in the case of the initial phase of reform and more advance stage of economic transformation—has stimulated much debate. A recent statement by Václav Klaus (1997) on this particular issue is quite telling:

> The collapse of communism "happened" in the moment when the economic profession believed in fixed exchange rates and in the advantage of anchoring the economy by means of one fixed point—especially in a situation when all other variables undergo large changes and fluctuations. I have to confess that I was originally afraid of introducing such a rigid regime but the first impressions were positive because we succeeded in choosing an exchange rate which functioned well for a very long seventy-six moths. By sufficiently devaluing the crown on the eve of price liberalization we formed something what I later called the "transformation cushion". The exchange rate cushion (as well as the parallel wage cushion) appeared to be crucial for the whole subsequent transformation process. The inflation differential was, in our case, not as big as in some other transforming countries but the appreciation in real terms reached in seventy-six months was almost 80 percent, which was too much. Although we have been constantly checking the remaining thickness of our exchange rate cushion, as we see it now, we—probably in the middle of 1996—missed the most suitable moment for the abolition of the fixed exchange rate regime. The question is, however, whether the subsequent movements of the rate of exchange rate would have been less dramatic than they were in reality in recent months. The vulnerability of an emerging market economy is, in this respect, very high and, probably, unavoidable.

[12] See Corker et al (2000) for a more detailed discussion of this issue for selected advanced transition economies.

In terms of the choice of the exchange rate regime, he draws a tentative lesson: "*A fixed exchange regime should not last too long*".

Although it may sound trite, the clearest conclusion that has emerged from discussions over this controversial topic was that the adoption of a particular regime is neither a necessary nor a sufficient condition for the realization of desired macroeconomic outcomes. More specifically, it is argued that different exchange rate arrangements can contribute to macroeconomic stabilization provided that: (i) the authorities implement prudent macroeconomic policies consistent with the exchange rate regime in place; (i) the regime is compatible with intial macroeconomic conditions of the country; and (iii) the regime is not altered too frequently so that the necessary credibility can be established.[13]

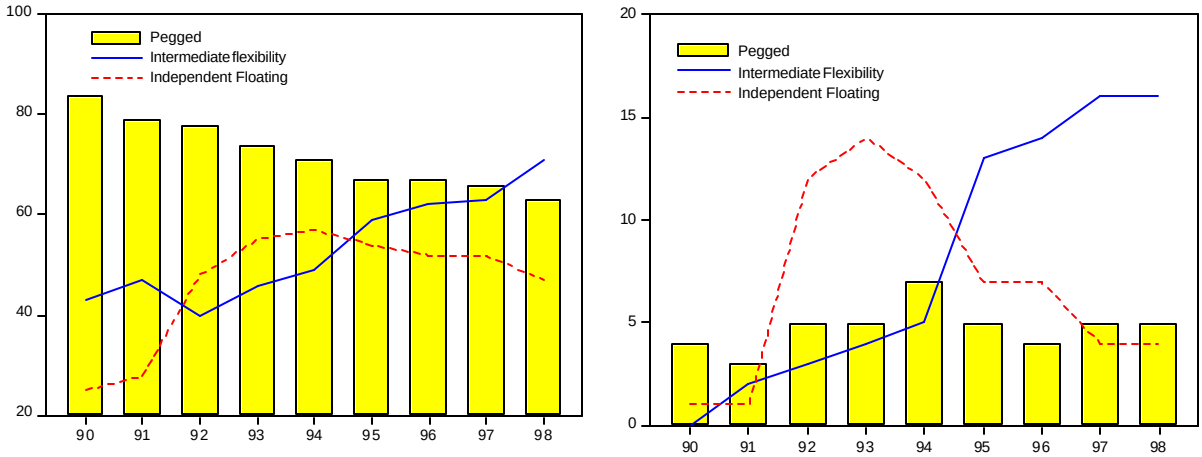
It is interesting to note that the recent trend towards intermediate regimes (see Figure 1) is in contrast to arguments set forth by some analysts, who assert that the growing integration of international capital markets over the past two decades *requires a clarification of the exchange rate regime*.[14] They argue that it is not possible to have hybrid solutions endeavoring to reconcile too many objectives. One has to opt for fairly free floating exchange rates or very credibly fixed ones. In short, they conclude that "middle way" solutions, involving fixed but adjustable exchange rates have been rendered more unstable by the growth of capital flows.

[13] See, for instance, Radzyner and Riesinger (1997).

[14] See, for example, Crockett (1997). However, Fischer (2001) argues that developing countries which are not very exposed to international capital inflows still encounter a wide range of intermediate options. Moreover, it should be noted that Figure 1 presents the developments up to 1998. As was shown in Fischer (2001), there was a notable decline in the number of countries with intermediate regimes in 1999.

Figure 1: Evolution of the Exchange Rate Regimes[a]

All Countries[b] **Transition Economies[c]**



Source: Exchange Rate Arrangements and Exchange Rate Restrictions, IMF.

a:The pegged regimes include single currency pegs, SDR pegs, other published basket pegs, and secret baskets. The intermediate group contains cooperative systems, unclassified floats, and floats with pre-determined range. The float group comprises of floats without pre-determined range and pure floats.

b: It consists of 181 countries (as of 1998) reported in the IMF's *Exchange Rate Arrangements and Exchange Rate Restriction*.

c: It consists of Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakstan, Kyrgyz Republic,Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, and Ukraine.

This view, however, does not enjoy unanimous support. Specifically, it is argued that there are good reasons for many countries to adopt intermediate regimes in spite of the substantial increase in capital mobility. Proponents of intermediate arrangements contend that presence of a number of safety valves can make such regimes viable, in particular if they are adopted in the context of a broader economic and political integration process.[15] They argue that corner solutions tend to be the exception rather than the rule for many countries: *currency boards entail very demanding preconditions to be viable, while flexible exchange rate arrangements tend to have considerable disadvantages for small-open economies*.

[15] See, for instance, Backe (1999).

Recent developments in the international monetary and financial environment have had a significant impact on the evolution of exchange rate regimes in at least three aspects.[16] First, recent advances in telecommunications and information technology have reduced transactions cost in financial markets and prompted both financial innovations and liberalization and deregulation of domestic and international transactions. As a consequence, there has been a sharp increase in capital mobility. The noticeable expansion of both gross and net capital flows between developed and emerging markets is a case in point. Balance of payments statistics demonstrate that net annual inflows into emerging economies increased from virtually zero in 1989 to reach $307 billion in 1996, before declining to about half that level in 1997 and 1998.[17]

Second, the increasing integration of emerging market economies into the world economy has enabled them to enjoy the benefits of globalization. At the same time, however, made these countries more susceptible to sudden reversal in capital flows. Private capital flows have emerged as one of the most important elements of adjustment and financing mechanisms in emerging economies.

Finally, the launch of the Euro marks the creation of a multi-polar currency system, moving away from dependence on the dollar as the dominant currency of the system. This development has important implications for the system as to whether the exchange rate between major currencies will continue to undergo large fluctuations as occurred in the 1980s and 1990s.[18] Indeed, evidence to date—i.e. the evolution of the Euro vis á vis the dollar—appears to suggest that such oscillations between major currencies are likely to resume in the future as well.

[16] IMF (2000).
[17] See IIF (1998).
[18] For instance, the appreciation of the dollar against the yen prior to the Asian crisis was considered as one of the contributing factors to the crisis since the exchange rate in most of the crisis countries was rigidly pegged either to the dollar or a basket dominated by the dollar.

The above described developments, to a large extent, contributed to the documented trend towards greater exchange rate flexibility and subsequent diminution in the use of the exchange rate to anchor monetary policy. More specifically, the fact that both developing and transition countries are more exposed to currency movements compared to developed countries and that they lack deep financial markets and strong financial institutions suggests that "*benign neglect*" of the exchange rate is not a feasible option for them. Consequently, many developing and transition countries are, perhaps, inclined to pursue a hybrid arrangement with limited flexibility to the exchange rate—via bands or other limits on fluctuations against some other currency or currencies—but without the rigidity embedded in currency pegs.

3. The Relationship between Nominal Exchange Rate Regimes and Economic Performance: A Brief Review of the Literature

Orthodox discussion of the choice between fixed and flexible regimes hinges on the nature of the shocks.[19] Standard models imply that floating rates will be advantageous when disturbances are primarily monetary and foreign, since in this case exchange rate changes can largely insulate the domestic economy. Pegged rates are preferable when shocks are associated mainly with unstable domestic monetary and financial policies as pegged rates will help discipline erratic policy makers.

Proponents of flexible exchange rates claim that these regimes are more efficient than fixed exchange rates in correcting balance of payments disequilibria. Furthermore, they underscore that by allowing a country to achieve external balance easily and automatically, flexible rates facilitate the achievement of internal balance and other economic objectives of the country. On the other hand, advocates of fixed exchange rates contend that by introducing a

degree of uncertainty not present under fixed rates, flexible exchange rates decrease the volume of international trade and investment, are more likely to lead destabilizing speculation, and are inflationary.

Furthermore, one of the main appealing features of floating exchange rates—the ability to absorb shocks—has recently been challenged. It is argued that countries with flexible exchange rates—except those with well-developed and sophisticated markets—are likely to experience a surge in the volatility of the real value of domestic assets due to increased capital mobility. Excessive fluctuations in the real value of domestic assets may, in turn, undermine stability [Cooper (1999)].

The modern literature—also considering the extreme arrangements of flexible and fixed regimes—places great emphasis on the presence of important trade-offs between credibility and flexibility.[20] A floating regime enables a country to have an independent monetary policy so that the economy can accommodate domestic and foreign shocks such as changes in terms of trade and interest rates. However, this flexibility is achieved at the cost of some loss in credibility which, in turn, tends to be associated with higher inflation. Fixed exchange rates, on the other hand, reduce the degree of flexibility but bring a higher degree of credibility to policy making. Since, under fixed rates, agents believe that the primary objective of monetary policy is to maintain the parity, they moderate their price and wage expectations, thereby leading the economy to achieve a lower inflation rate.

A careful review of the theoretical arguments put forth by each side does not lead to any definitive conclusion that one system is overwhelmingly superior to the other. For instance, contrary to the traditional ranking between fixed and floating regimes, which is based on a loss

[19] This ranking is based on a loss function that depends on output volatility.
[20] See, for instance, Edwards (1996) and Frankel (1995).

function that depends exclusively on output volatility, Calvo (1999b) shows that fixed exchange rates would always dominate flexible regimes if the function being optimized places weight on real exchange rate volatility.[21] Furthermore, since shocks could contain both real and nominal components in practice, the choice of exchange rate regime on the basis of the nature of shocks becomes problematic. In fact, recent crises episodes in which shocks have come largely through the capital account—affecting both aggregate demand as well as money demand—lend support to this conjecture and cast doubts about the usefulness of floating exchange rates as a shock absorber.

What is the empirical evidence linking inflation and output growth with the exchange rate regime? Although some suggestive stylized fact are beginning to emerge, the evidence is still quite limited.

More specifically, studies that have tried to ferret out the influence of exchange rate arrangements on economic performance can be grouped under two categories: *country specific studies and multi-country studies*. Country specific investigations has had a difficult time unraveling the independent effects of the nominal exchange rate regime on macroeconomic performance: detection of regularity associated with a particular regime in one study was followed by a counter example in another study. Multi-country studies have also found it difficult to make generalizations. For instance, Little et al. (1993) conducted a comprehensive study covering 18 developing countries. They found that while in some countries a fixed exchange rate regime was associated with lower inflation, in other episodes the exchange rate turned out to be an ineffective nominal anchor.

Edwards (1993) studied whether, *ex ante*, the exchange rate regime has an impact on inflationary performance by introducing financial discipline. He employed a sample from 52

[21] He also shows that this dominance weakens, but does not vanish, with full indexation to the exchange rate.

countries over the period 1980-89. His results showed that countries with fixed exchange rates had lower inflation rates during the 1980s compared to countries with flexible arrangements.

Tornell and Velasco (1999), however, challenged Edwards' findings on theoretical grounds, pointing out that a depreciating currency is a more immediate and observable signal of fiscal indiscipline than a decline in reserves that appears with delay and can be concealed. They found empirical support for their position by examining the behavior of 28 sub-Saharan African countries.

Ghosh et al. (1997)—one of the most comprehensive multi-country studies—examined the effects of the nominal exchange rate regime on inflation and growth using data from 136 countries during the period of 1960-89. They found that both the level and variability of inflation was markedly lower under fixed exchange rates than under floating exchange rates. However, their findings also suggest that the inflation bias of flexible exchange rate arrangements does not seem to be present among the pure floaters in the sample—particularly among the high and upper middle income ones. This implies that the positive association between exchange rate flexibility and inflation found in the study may not be monotonic.[22]

Their study failed to find a robust link between growth and currency regimes, probably because investment ratios are higher but trade growth somewhat lower under fixed than under floating exchange rates. However, they found that the variability of real output is noticeably higher under fixed than under floating exchange rates.[23]

Moreover, a recent study by Hausmann et al. (1999) demonstrated that during the 1990s Latin American countries with fixed exchange rates had greater financial depth—as measured by

[22] It should be noted that this finding seems to contradict the conclusion that Quirk (1994) reached in his review of previous empirical literature: there is not much linkage between exchange rate arrangements and inflation.

[23] A recent IMF study (1997) extends the period to mid-1990s and reaches similar conclusions. This implies that findings of Ghosh et al. (1997) were not greatly influenced by the increased access to international markets enjoyed by developing countries in the 1990s.

M2/GDP—lower interest rates, and less effective wage indexation than those with floating exchange rates. Their results also indicated that monetary policy under floating rates has been more pro-cyclical than under fixed rates.[24]

All in all, one recent review of the empirical literature suggests that empirical investigations in this area suffer from the following problems plaguing empirical work in economics:[25]

- Cross-country analyses investigating the inflation performance of countries with different regimes are potentially subject to a survival bias. The difficulty is that only countries that have succeeded in defending the peg are included in the fixed exchange rate group. Whereas, countries that adopted a fixed exchange rate, but could not sustain it, are usually grouped under flexible exchange rate regime category.[26]
- Discrepancies between declared and effective exchange rate arrangements can be an important source of error.
- Endogeneity of the choice of the exchange rate regime or reverse causation also constitutes a major problem in empirical studies. It is not clear whether a fixed exchange rate causes lower inflation or whether countries with low rates of inflation adopt this kind of arrangement.[27]

[24] A recent study by Domaç and Martinez-Peria (2000) investigated the issue at hand from a different aspect by considering the link between banking crises and the exchange rate regimes.
[25] Edwards and Savastano (1999).
[26] See Aghevli et al.(1991) for more on this.
[27] Indeed, this issues is closely related to the ultimate source of inflation: a fiscal deficit. The need to finance a fiscal deficit leads to the excessive growth in money supply, which, in turn, causes inflation. In this context, countries that need to finance a fiscal deficit using seigniorage will opt for an exchange rate system consistent with this target—a flexible exchange rate regime.

4. Macroeconomic Performance and the Exchange Rate Regime: Stylized Facts from Transition Countries

A wide variety of exchange rate regimes has been adopted in transition countries (Figure 1). Not only have the regimes been different, but also in some countries they have changed since the inception of the reforms. A summary of some stylized facts from three pairs of countries operating under alternative exchange rate regimes 1991-98 is shown in Table 1, which draws on the stated commitment of the central bank (as summarized in the IMF's Annual report on Exchange Rate Arrangements and Exchange Rate Restrictions). In other words, it uses a *de jure* classification based on the publicly stated commitment of the exchange rate instead of a *de facto* classification based on the observed behavior of the exchange rate.

Both classifications have their own shortcomings. A *de facto* classification has the advantage of being based on observable behavior, but it does not capture the distinction between stable nominal exchange rates resulting from the absence of shocks, and stability that stems from policy actions offsetting shocks. More importantly, it fails to reflect the commitment of the central bank to intervene in the foreign exchange market. Although the *de jure* classification captures this formal commitment, it falls short of capturing policies inconsistent with the commitment, which, in turn, lead to a collapse or frequent adjustments of the parity.

Following Ghosh et al (1997), we classify exchange rate arrangements into three categories: *pegged*; *intermediate*; and *floating regimes*.[28] The *pegged* regimes include single currency pegs, SDR pegs, other published basket pegs, and secret baskets. The *intermediate* group contains cooperative systems, unclassified floats, and floats with pre-determined ranges. The *float* group comprises of floats without pre-determined range and pure floats.

[28] To this end, we draw on the various issues of the IMF's Exchange Rate Arrangements and Exchange Rate Restrictions.

The analysis presented in Table 1 shows that countries with intermediate flexibility had better *growth performance*, compared to those that pegged and floated. In terms of *inflation performance*, countries with pegged exchange rates had the lowest inflation, whereas those with floating rates experienced the highest inflation during the period under consideration. Not surprisingly, countries with floating rates had considerably higher monetary growth compare to those with fixed or intermediate regimes—an observation confirming the conventional discipline argument arising from the impact of fixed regimes on the dynamics of money creation. Moreover, countries that pegged or adopted intermediate exchange rate arrangements exhibited noticeably better *fiscal discipline* compared to those that adopted floating rates.

Countries with fixed exchange rate regime appear to have *higher current account deficits* compared to those adopting intermediate and flexible regimes. However, once the outlier observation, Azerbaijan (1992), is excluded, countries with flexible exchange rate regimes have higher current account deficits than those with fixed and intermediate regimes. Finally, countries with fixed and intermediate regimes have higher ratios of reserves to base money than those with floating exchange regime.

These are, of course, simple observations without controlling for many relevant factors. It is, therefore, not possible to conclude how much of the better macroeconomic performance was in fact due to the particular exchange rate regime adopted and how much was due instead to other important factors.

Figure 2 provides more detailed information by presenting the evolution of selected key economic indicators of transition countries operating under alternative exchange rate regimes over the period 1991-98.

Table 1. Exchange Rate Regime and Macroeconomic Performance: Transition Economies

	Pegged	Intermediate Flexibility	Independent Floating
Growth Performance			
Mean	-0.40	0.73	-7.81
Median	3.24	2.30	-8.20
Inflation Performance			
Mean	71.02	228.12	933.70
Median	14.05	19.50	116.00
Inflation Performance[a]			
Mean	0.20	0.26	0.54
Median	0.12	0.16	0.54
Unemployment Performance			
Mean	8.97	10.61	9.16
Median	9.65	9.05	8.45
Budget Balance[b]			
Mean	-3.53	-3.55	-9.74
Median	-1.90	-3.10	-7.50
Broad Money Growth			
Mean	38.85	111.04	286.79
Median	20.40	29.10	92.15
Broad Money Growth[c]			
Mean	0.22	0.27	0.50
Median	0.17	0.23	0.48
Current Account Deficit[b]			
Mean	-5.21	-4.72	-3.86
Median	-5.02	-4.40	-7.70
Reserves to Base Money			
Mean	1.03	1.13	0.73
Median	1.13	0.98	0.60

Source: EBRD, IMF, WB, and authors' calculations.

Note: The sample, over the period of 1991-98, consists of Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakstan, Kyrgyz Republic,Latvia, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, and Ukraine.

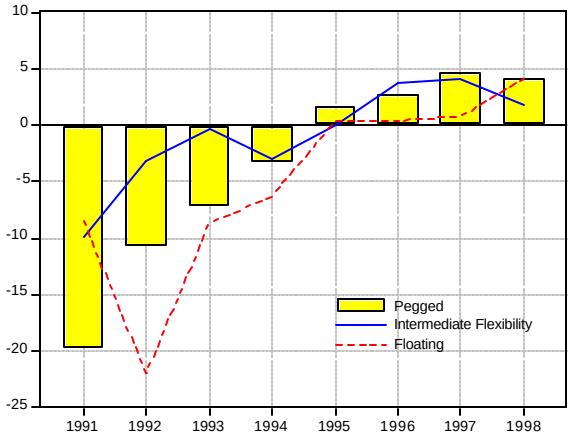
a: To reduce the importance of outliers, the inflation rate (π) is transformed to: $\pi/(1+\pi)$. Clearly, as π? 8, the inflation rate will approach to 1.

b: As a % of GDP

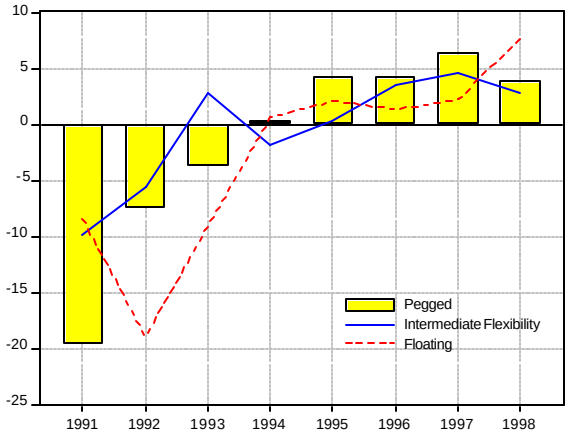
c: Similar transformation to reduce the importance of outliers for inflation is also performed for broad money growth.

Figure 2. Exchange Rate Regime and Macroeconomic Performance: Transition Economies

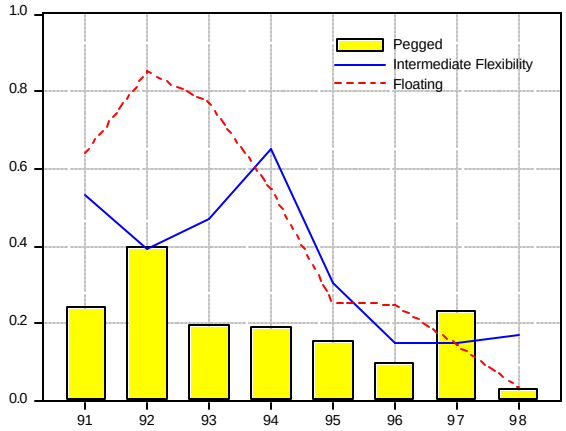
Growth Performance (Mean)



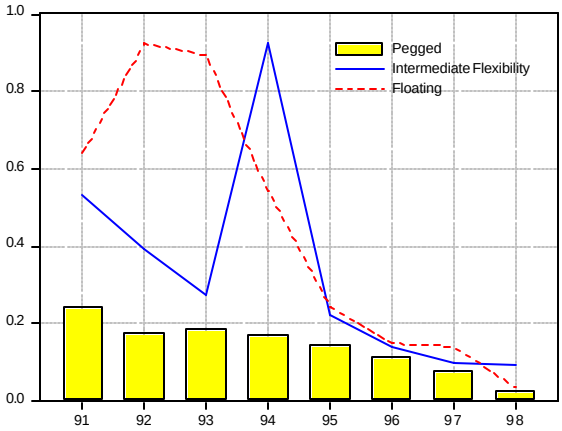
Growth Performance (Median)



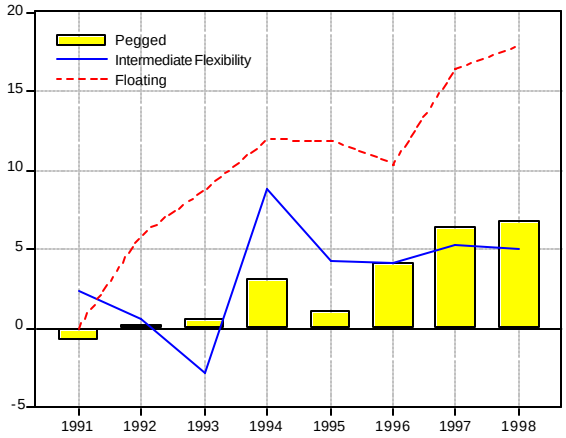
Inflation Performance (Mean)



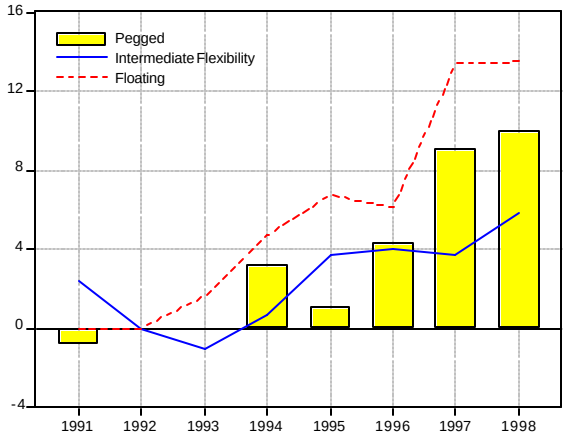
Inflation Performance (Median)



Current Account Deficit (Mean)[a]



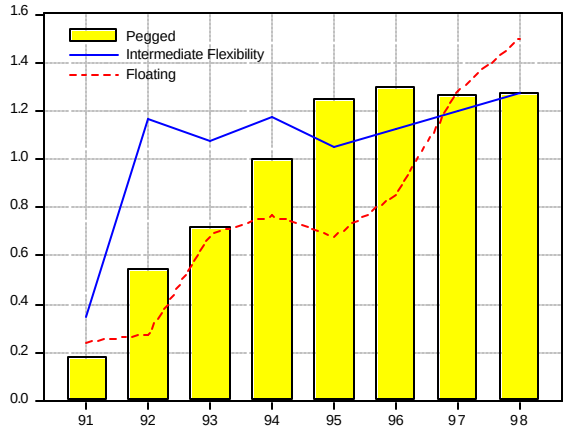
Current Account Deficit (Median)[a]



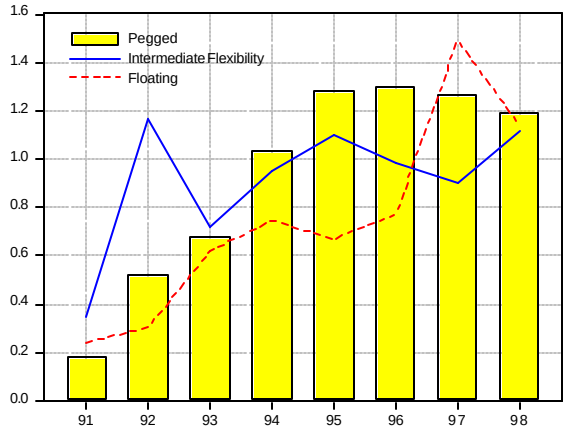
a: **as a % of GDP.**

Figure 2. Exchange Rate Regime and Macroeconomic Performance: Transition Economies (Concluded)

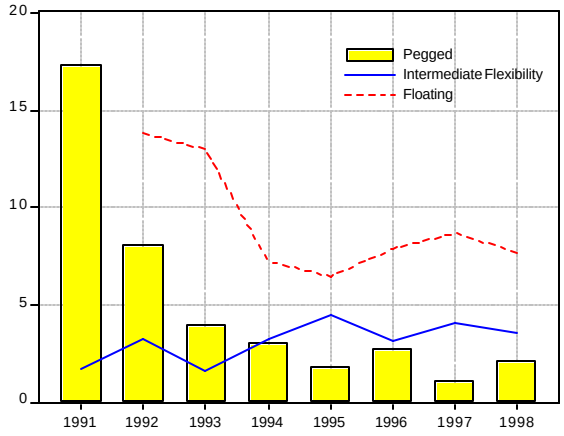
Reserves to Monetary Base Ratio (Mean)



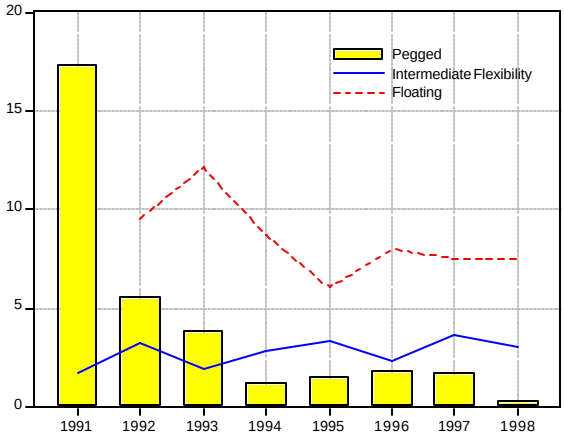
Reserves to Monetary Base Ratio (Median)



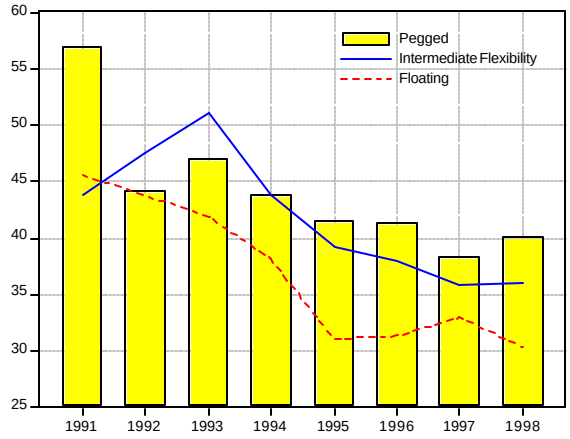
Budget Deficit (Mean)



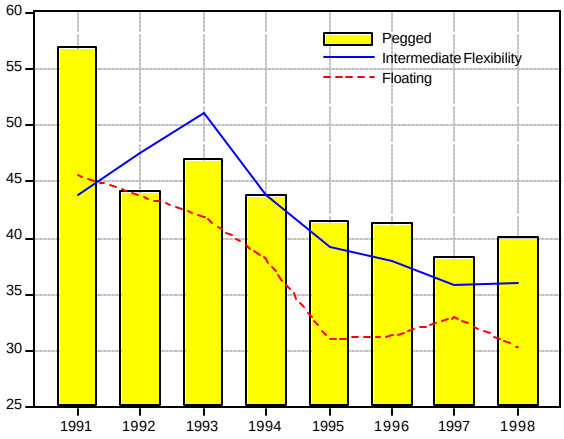
Budget Deficit (Median)



Government Expenditures (Mean) [a]



Government Expenditures (Median) [a]



a: **as a % of GDP.**

From this analysis, one can identify at least five key patterns from the behavior of the macroeconomic variables in question. First, countries with intermediate regimes appear to have experienced smaller contractions of output and faster recovery. Second, the lowest inflation throughout the period under consideration is observed in countries operating under fixed regime. However, the difference between inflation under floating and intermediate regimes tapers off overtime.

Third, countries with floating regimes clearly experience the highest budget deficit compared to those operating under fixed or intermediate regimes. The fiscal performance of countries with fixed regimes, however, is not noticeably better that those with intermediate regimes. It is interesting to note that the relatively poor fiscal performance of countries with flexible regime arises from weak revenue collection not from excessive spending. This could be due to the so called "*reverse Tanzi effect*" arising from increases in tax collection caused by immediately stabilizing prices—a phenomenon observed in successful exchange-rate based stabilization programs.

Fourth, contrary to the experience of other emerging markets where the current account deficit tends to be higher in countries with more stringent exchange regimes, it appears that, in the case of transition economies, countries with floating regimes experience, on average, higher current account deficits. Finally, it appears that the ratio of international reserves to monetary base tends to be somewhat lower in floating countries, though the difference is not very significant.

5. The Empirical Framework

It may be possible to underpin some of these stylized facts from a cursory look at the evolution of selected key economic indicators under alternative regimes. However, it is not possible to identify the *independent effects* of the nominal exchange rate regime on economic performance without a thorough analysis in which macroeconomic/financial fundamentals and institutional arrangements—affecting both economic performance and the choice of the exchange rate regime—are controlled for.

In an attempt to examine the impact of the exchange rate regime on macroeconomic performance, empirical studies often employ exchange rate dummies in reduced form equations for inflation and growth. The coefficient estimate of a particular exchange regime dummy is, in turn, deemed to reveal the effect of the exchange rate arrangement on the dependent variable. One of the major drawbacks of this approach is that at the time of the regime switch the coefficients associated with policy variables also change—a phenomenon referred to as the *Lucas critique*. One approach to avoid this problem is to estimate each equation representing different exchange rate regimes separately and then to test for the equality of coefficients. This approach, however, would fail to capture the causal link between macroeconomic fundamentals and the exchange rate regime—the ability of an economy and also policymakers' desire to implement certain exchange rate regimes under given fundamentals.

Moreover, existing studies, to the best of our knowledge, fail to address the issue of the sample selection problem. The sample selection problem arises from the fact that countries do not choose their exchange rate regimes randomly. Instead, their choice hinges on a set of fundamentals, which, in turn, affects macroeconomic outcomes such as inflation and growth. Consequently, the use of standard econometric techniques such as OLS or 2SLS will produce

biased results stemming from the correlation between the regime choice and the error term either in the inflation or growth equation.[29]

It should be noted that addressing the sample selection problem will also address the issue of the endogeneity of the choice of the exchange rate regime. This is not achieved by instrumenting the dummy variable for the exchange rate regime a la Ghosh (1997). Instead, it is achieved through the assumption of constant covariance between the error term in the structural equation and the normally distributed random variable whose realization determines the exchange rate regime.

In an attempt to address the above mentioned problems plaguing empirical work in this literature, we propose an empirical framework which is based on a *switching regression technique*. To this end, the investigation employs the following standard formulation of switching regression:

$$Y_i = X_i B_1 + u_{1i} \quad \text{if } v_i < Z_i g + a_1, \qquad i=1..I_1 \qquad (1)$$
$$Y_i = X_i B_2 + u_{2I} \quad \text{if } Z_i g + a_1 < v_i < Z_i g + a_2, \qquad i=1..I_2 \qquad (2)$$
$$Y_i = X_i B_3 + u_{3i} \quad \text{if } v_i > Z_i g + a_2, \qquad i=1..I_3 \qquad (3)$$

u_{ij} *is i i d* $N(0, s_j)$, while v_i *is i i d* $N(0, 1)$, $cov(u_{ij}, v_j) = s_{jv}$, $j=1,2,3$

where (1), (2), and (3) correspond to respective regimes. The only difference with respect to the standard switching regression model is that we employ the same set of regressors in each equation in order to be able to test the equality of the coefficients across the regimes. The regime is determined by the realization of normally distributed random variable v, which is not observable. We, however, know in which of three areas it is realized. Therefore, a_1, a_2, and γ

[29] To be more precise, this bias arises from the correlation between the error term of the latent variable capturing the regime choice and the error of the structural equation.

can be estimated by ordered probit approach. It should be noted that Z should not contain a constant term since a_1 and a_2 are already in the model.

Given the following equations:

$$E(u_{i1} \mid v_i < Z_i g + a_1) = -s_{1v} \frac{f(Z_i g + a_1)}{F(Z_i g + a_1)} = -s_{1v} h_1(Z_i g + a_1) = -s_{1v} h_{1i} \tag{4}$$

$$E(u_{i1} \mid v_i > Z_i g + a_2) = s_{3v} \frac{f(Z_i g + a_2)}{1 - F(Z_i g + a_2)} = s_{3v} h_3(Z_i g + a_2) = s_{3v} h_{3i}. \tag{5}$$

$$E(u_{i1} \mid Z_i g + a_1 < v_i < Z_i g + a_2) = s_{2v} \frac{f(Z_i g + a_1) - f(Z_i g + a_2)}{F(Z_i g + a_2) - F(Z_i g + a_1)} = s_{2v} h_2(Z_i g, a_1, a_2) = s_{2v} h_{2i} \tag{6}$$

where *f(.)* and *F(.)* stand for density and cumulative normal distribution functions, respectively. One can, then, express the equations for corresponding regimes as:

$$Y_i = X_i B_1 - s_{1v} h_{1i} + e_{1i} \tag{7}$$

$$Y_i = X_i B_2 + s_{2v} h_{2i} + e_{2i} \tag{8}$$

$$Y_i = X_i B_3 + s_{3v} h_{3i} + e_{3i} \tag{9}$$

where the disturbance term in each equation is of mean zero and heteroscedastic. The above presented model can be estimated in two steps. In the first step, we estimate α and γ by ordered probit approach. In the second step, we first insert the obtained estimates into the above system [(7)-(9)] and then run 2SLS (by instrumenting for endogenous variables) for each regime in the system presented below [(10)-(12)]:

$$Y_i = X_i B_1 - s_{1v}\hat{h}_1 + e_{1i} \quad (10)$$

$$Y_i = X_i B_2 + s_{2v}\hat{h}_2 + e_{2i} \quad (11)$$

$$Y_i = X_i B_3 + s_{3v}\hat{h}_3 + e_{3i} \quad (12)$$

Indeed, the above described estimation method amounts to *two-step Heckman procedure*. Once we acquire the rest of the coefficients from the first stage, and correct the variance and covariance matrix, we can then test for the relevance of regimes, that is H_0: $B_1=B_2=B_3$, $s_{1v}=s_{2v}=s_{3v}=0$; H_1: *otherwise*.

6. Empirical Results

6.1 The Determinants of the Choice of Exchange Rate Regime

The "*impossible trinity*" of fixed exchange rates, independent monetary policy, and freedom of capital movements has been widely acknowledged by economists for a long time. Countries cannot attain monetary independence, exchange rate stability, and full financial integration simultaneously. They have to choose which of these objectives they will drop, although most governments defy the choice and try to fudge in various way, often generating financial crises in the process [(Cooper (1999)].

As was pointed out by Cooper (1999), floating rates, independent monetary policy, and freedom of capital movements may also be incompatible—at least for countries with small and poorly developed domestic capital markets. In turn, this would leave the following choice for such countries: between floating rates with capital restrictions and some monetary autonomy or fixed rates free of capital restrictions but with loss of monetary autonomy. The unwelcome

conclusion, as he puts it, is that free movements of capital and a floating exchange rate are basically incompatible, except for large and diversified economies with well-developed and sophisticated financial markets.[30]

Where does the empirical research stand on the determinants of the choice of the exchange rate regime? Since the studies conducted by Dreyer (1978); Heller (1978) and Holden et al (1979), few empirical studies have focused on the choice of exchange rate regime. More recent studies [Honkapohja and Pikkarainen (1994) and Edwards (1996)] and dramatic events in Asia, Russia and Brazil have rekindled the interest on this topic. Majority of the studies to date, however, did not distinguish developing countries and transition economies and largely considered the importance of criteria resulting directly from the theory of optimum currency areas.

For instance, Edwards (1996) finds that countries' historical degree of political instability, various measures of the probability of abandoning pegged rates, and variables related to the relative importance of real targets in the preferences of monetary authorities have the most important explanatory powers. More precisely, his results suggest that more unstable countries have a lower probability of selecting pegged exchange-rate systems, while countries with a lower growth rate and capital account restrictions tend to prefer a more rigid exchange rate regime. More advanced countries, on the other hand, have a tendency to select more flexible rates.

A recent study by Rizzo (1998) analyzes the choice of exchange rate regimes by developing countries for the period of 1977-95. His results indicate that countries with low inflation tend to have fixed rather than flexible exchange rates. The levels of the external debt and the public deficit, however, do not have any significant explanatory power.

[30] See Eichengreen and Masson (1998) for a detailed discussion of criteria for exchange rate regime choice.

To analyze the determinants of the choice of exchange rate regime in transition countries, we employ ordered probit econometric technique. The econometric model is based on the assumption that one can order exchange rate regimes in terms of intensities, which seems plausible in the current context.

The variables that we consider largely draw on the empirical specifications employed in previous studies. More specifically, in our attempt to explain the choice of exchange rate regime we utilize variables capturing: progress in structural reforms[31]; macroeconomic policy; and macroeconomic conditions. All the variables are lagged to avoid simultaneity problems.

Table 2 reports the results of the ordered probit regression.[32] To conserve space, we exclude the variables that are jointly statistically insignificant.[33]

Table 2. Results of Ordered Probit Regressions for the Choice of the Exchange Rate Regime[a]

	Coefficient	Std. Deviation	z-statistics	Probability
Res./MB	0.790	0.255	3.093	[.002]
Budget Balance	-0.084	0.030	-2.840	[.005]
External Markets	4.149	1.407	2.950	[.003]
Private sector entry	-5.707	1.063	-5.370	[.000]
Internal Markets	-7.381	1.743	-4.236	[.000]
Openness	-2.199	0.496	-4.434	[.000]
a_1	-7.872	1.187	-6.632	[.000]
a_2	-5.573	1.044	-5.335	[.000]
Scaled R^2=0.64				
Number of observations =113				

a: Positive sign means that the flexible regime is more likely and the fixed regime is less

[31] We draw on indicators constructed by De Melo, Denizer, and Gelb (1997) in the following areas: (i) *internal markets* (liberalization of domestic prices and abolition of state trading monopolies); (ii) *external markets* (currency convertibility and liberalization of the foreign trade regime, including elimination of export controls and taxes as well as substitution of low to moderate import duties for import quotas and high import tariffs); and (iii) *private sector entry* (privatization of small-scale and large-scale enterprises and banking reform).

[32] See Appendix 4 for a detailed description of data.

[33] Among the variables that we included but found to be jointly insignificant are: lags of inflation ,external debt, GDP growth, and German as well as American interest rates (to capture the importance of the external conditions).

All the coefficients, with the exception of the ratio of reserves to monetary base, are significant and have the expected signs. The fact that reserves to monetary base ratio (Res/MB) carries a positive coefficient would mean that fixed exchange regimes are associated with a lower level of Res/MB compared to floating regimes. Although, at first blush, this findings appears to be counterintuitive, it raises the possibility of a non-linear relationship between choice of exchange rate regime and the ratio of reserves to monetary base. This non-linearity may arise because a country with a low level of reserves is likely to be in favor of more flexible arrangements. When a country has high reserves, however, the increase in credibility associated with fixing the exchange rate would be marginal. As a result, the country would be more likely to opt for more flexible arrangements.

In order to address the possibility of non-linearity between Res/MB and the choice of the exchange rate regime, we, first, included a squared term of this variable in the above estimated ordered probit regression. The square term, however, turned out to be insignificant. Next, we explored the possibility of a kinked relationship by breaking the variable into three intervals. We considered a continuous relationship in which each interval has its own slope. To determine the points of the kink, we ran a grid search. The result was quite surprising: for values smaller than 1.35 and higher than 1.40, the slope turns out to be insignificant. However, between these values the slope is not only large and positive, but also statistically significant.

Since the results suggest that the slope is statistically significant only in the middle portion of the kinked line—indeed a very small interval—one can infer that there is a threshold above which countries tend to avoid fixed regimes. This, in turn, provides a rationale to use a dummy variable to capture this threshold. To this end, we use a grid-search again. The results of the

grid-search indicate that the best fit is found for the dummy which takes value of one whenever reserve to monetary base ratio exceeds 1.34 and zero otherwise.[34]

Table 3 presents the results of the new probit regression which considers the above mentioned non-linearity between Res/MB and the choice of the exchange rate regime. As expected, more open economies and countries with lower budget deficits tend to accept more stringent exchange rate regimes. Countries that made more progress in the areas of internal markets and private sector entry are also more likely to opt for more stringent exchange rate arrangements. Countries that achieved more progress in openness to external markets, on the other hand, tend to adopt more flexible arrangements. Moreover, positive and significant coefficient associated with the dummy for Res/MB confirms that countries with Res/MB above certain threshold, 1.34, tend to adopt more flexible arrangements.

Table 3. Results of Ordered Probit Regressions for the Choice of the Exchange Rate Regime[a]

	Coefficient	Std. Deviation	z-statistics	Probability
Dummy for Res/MB[b]	1.309	0.352	3.717	[.000]
Budget Balance	-0.074	0.028	-2.623	[.009]
External Markets	3.656	1.408	2.597	[.009]
Private Sector Entry	-5.363	1.027	-5.223	[.000]
Internal Markets	-6.787	1.684	-4.031	[.000]
Openness	-2.097	0.489	-4.292	[.000]
a_1	-8.105	1.177	-6.887	[.000]
a_2	-5.768	1.037	-5.560	[.000]

Scaled R^2= 0.66
Number of observations = 113

a: Positive sign means that the flexible regime is more likely and the fixed regime is less
b: Variable takes value 1 if reserve to monetary Base ratio is greater than 1.34

[34] It should be noted that use of the dummy instead of actual values of the variable is justified by zero slopes outside the small interval.

All in all, the empirical findings suggest that transition economies tend to adopt more stringent exchange rate regimes when they: (i) have lower budget deficits; (ii) have a higher ratio of exports plus imports to GDP; and (iii) are more advanced in the areas of private sector entry and internal markets. While the results suggest that those with more progress in external markets and with Res/MB above 1.34 opt for more flexible exchange rate arrangements.

6.2 The Exchange Rate Regime and the Inflation Performance

A quick glance at the literature on exchange rate regimes and inflation suggests that fixed exchange rate regimes—in the presence of consistent macro policies—tend to deliver lower and more stable rates of inflation. These studies offer two explanations. Fixed rates provide a visible commitment, thereby raising the political costs of excessive monetary growth. A credible peg is likely to engender a more robust demand for money, which, in turn, reduces the inflationary consequences of a given monetary expansion.[35]

Ghosh et. al (1997) conducted one of the most comprehensive multi-country studies on the influence of exchange rate regimes on macroeconomic performance. In their investigation, they employ a comprehensive econometric framework and undertake several sensitivity and robustness tests. Their results suggest that the inflation rate is significantly lower under pegged exchange rates than under more flexible arrangements—even after controlling for the effects of money growth and interest rates.

Although their empirical investigation makes an attempt to address some of the usual problems plaguing empirical work in this strand of the literature, it is still subject to several limitations. The most obvious one is the *Lucas critique* which postulates that when there is a

[35] Ghosh et. al. (1995). Studies by Crockett and Goldstein (1976), Quirk (1994), and Tornell and Velasco (1995), however, dispute this conjecture.

policy switch the coefficients associated with policy variables should change. Indeed, one should expect a different response of inflation to changes in the budget deficit and money growth under different regimes.

The *Lucas critique* could be addressed by estimating the inflation equation separately for each exchange rate regime under an empirical framework similar to Ghosh et al (1997). However, such an approach would be subject to *sample selection problem*. The sample selection problem stems from the fact that the choice of exchange rate regimes is not a random process and that the decision on the exchange rate regime is based on factors that also affect inflation. Consequently, the use of standard econometric techniques such as OLS or 2SLS will produce biased results stemming from the correlation between the regime choice and the error term in inflation equation.

In order to address the above mentioned problems, we employ *switching regression framework*, as explained in Section 5. Prior to employing the switching regression analysis, we estimate a reduced form equation for inflation using a similar methodology employed by Ghosh et. al. (1997) for comparison purposes. Specifically, we use two-stage least squares (2SLS) in the estimation of the inflation equation, which includes *reserves to monetary base ratio*,[36] *the budget balance* (measured as a percent of GDP), *GDP growth*, *broad money growth*, and dummies for the exchange rate regimes.[37]

The results are reported in Table 4. The findings suggest that increases in Res/MB ratio and GDP growth lower inflation, while increases in broad money growth have a positive impact on inflation. Although the exchange rate dummies turn out to be statistically significant, the

[36] *Reserves to monetary base ratio* and *budget balance* reflect the credibility of monetary policy, which, in turn, affects inflation expectations.
[37] A more detailed discussion regarding the instruments employed in the estimation will be provided later in this section.

result of the Wald test (chi-square statistics of 3.946 with tail probability 0.14) suggests that the null hypothesis that dummies are equal cannot be rejected.[38] As indicated previously, the dummy variable approach does not control for sample selection bias and assumes identical slopes for all regimes. This, in turn, may create a substantial bias in the results.

Next, we estimate the second stage regression for inflation equation, which includes, in addition to the variables listed previously, the generalized residuals of the ordered probit regression—the covariance term—using switching regression technique described in Section 5.[39] In essence, this regression is a second stage of *Heckman's two-step procedure* to estimate switching regression (the first step was the ordered probit).

Table 4. The Exchange Rate Regime and the Inflation Performance (2SLS)

	Coefficient	**Std. Deviation**	**t-statistic**
Dummy for fix	0.093	0.042	2.200
Dummy for intermediate	0.152	0.044	3.432
Dummy for float	0.123	0.052	2.365
Lagged Res/MB	-0.104	0.023	-4.621
Budget Balance	0.002	0.004	0.439
GDP growth	-0.012	0.002	-5.804
Broad money growth	0.666	0.075	8.901
Dummy for Central Europe	0.056	0.022	2.518
Dummy for Baltic Countries	0.079	0.047	1.684
R^2=0.22			
Adj. R^2=0.14			
Number of observations=113			

Ideally, we would like to run fixed effects as the fixed effects dummies would capture initial conditions pertaining to inflation. Unfortunately, inadequate degrees of freedom for fixed regimes prevent us from employing fixed effects. As a result, we group the countries involved into three categories and create three dummy variables: *former Soviet Union, Eastern Europe*

[38] The exchange rate dummy for the fixed regime is lower than the others, though not statistically significant from them.

and Baltic countries. Since we use a constant term in each regime the regression contains only two of the dummies.

Prior to presenting the empirical results, several comments are in order. In the estimation, we instrument GDP growth, budget balance and broad money growth for potential endogeneity.[40] In this respect, endogeneity of money growth deserves a special consideration. Clearly, this variable cannot be considered as a policy variable under fixed and intermediate regimes since it is endogeneously determined . However, a series of recent papers demonstrated that countries that claim they allow their exchange rate to float mostly do not—a phenomenon referred to as "*fear of floating*".[41] To clarify this, we employ a Hausman test to determine whether broad money growth is endogenous under flexible regime. The result of this test—chi-square statistics of 19 with 0.006 tail probability—suggests that this variable is endogeneous under float as well.[42]

Table 5 reports the results of switching regression estimates. In our attempt to study whether the exchange rate regime matters for inflation performance, we, first, test joint hypothesis that all coefficients are equal across the regimes, and the estimated covariances are all equal to zero (that is in our notation: H_0: $B_1=B_2=B_3$, $s_{1v}=s_{2v}=s_{3v}=0$). The result of the Wald test statistics, which is equal to 30 with tail probability 0.003, suggests that exchange rate regime does make a difference for inflation performance. Moreover, we also conduct two additional

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[39] We, in the second step, have also tried maximum likelihood estimation in lieu of 2SLS, but failed to achieve convergence.

[40] The instrument list for the *budget balance* includes lagged budget balance, lagged inflation, external debt to GDP ratio, lagged GDP growth. For *broad money growth*, it includes lagged money growth, lagged inflation, lagged budget deficit, and lagged GDP growth. For *GDP growth*, it includes lag liberalization index, lag of change in liberalization index, lagged budget deficit, lagged GDP growth, lagged inflation, initial condition, and the covariance term. The inclusion of the switching term into the GDP growth instrument list is justified by the presence of it in the structural equation for GDP growth.

[41] See, for instance, Calvo and Reinhart (2000a, 2000b).

[42] One of the implications of this test might be that the countries announcing floating regime also intervene in the exchange market, which makes it dirty float along the lines of the arguments put forth by Calvo and Reinhart (2000a, 2000b). However the above presented evidence is not sufficient for making such a strong statement. There could be other factors making money growth endogeneous. For instance, interactions between inflation and money growth – in the presence of sticky prices a government would avoid cutting rate of expansion of money supply to prevent high interest rates and consequent recession.

tests, namely the equality of coefficients associated with the budget balance and money growth across the regimes. The results suggest that the null hypothesis of the equality of the coefficients associated with the budget balance cannot be rejected at 5 percent significance level (chi-square statistics of 4.6 with tail probability 0.10), while the null of the equality of the coefficients associated with broad money growth is rejected (chi-square statistics of 17.9 with tail probability 0.006).

The covariance term appears to be significant only under flexible regime.[43] It has a negative and statistically significant coefficient. This finding suggests that the more unanticipated the floating regime on the basis of fundamentals considered in our ordered probit regression, the lower the inflation. Put differently, an *unanticipated float*—a country that with its fundamentals would be likely to adopt another regime, but it adopts floating regime—results in lower inflation.

The empirical findings also confirm that money growth has a positive and statistically significant impact on inflation under all regimes. It is interesting to note that the effect of money growth on inflation is the largest under the intermediate regime.[44] However, this finding should not be interpreted as money growth causing higher inflation under intermediate regime compared to fixed and floating regime. It might be arising from the fact that larger part of the impact of money growth on inflation under fixed and floating regimes is captured by other variables. Indeed, a glance at the correlation matrix of variables involved indicates that broad money growth is more correlated with budget deficit and GDP growth under fixed regime, while it is more correlated with GDP growth and Res/MB under floating compared to intermediate regime.

[43] This finding also suggests that there is no sample selection problem under fixed and intermediate regimes.
[44] It should be noted that the reported coefficients are partial derivatives and should be interpreted accordingly.

The results suggest that economic growth has a negative and statistically significant impact on inflation under floating and fixed regimes. While the budget balance appears to be significant only under a fixed regime. The negative sign associated with the budget balance is likely to reflect two channels: credibility (inflation rises under imperfect credibility) and Keynesian (expansionary fiscal policy increases inflation).

Table 5. Results of the Switching Regression Estimates : Inflation Equation

	Coefficient	Std. Deviation	t-statistic
Fixed Exchange rate Regime			
Constant	-0.004	0.081	-0.052
Lagged Res/MB	-0.005	0.050	-0.099
Budget Balance	-0.010	0.005	-2.161
GDP growth	-0.008	0.004	-2.194
Broad money growth	0.336	0.140	2.399
Covariance	0.010	0.023	0.422
Intermediate Exchange rate Regime			
Constant	-0.037	0.074	-0.497
Lagged Res/MB	-0.078	0.034	-2.274
Budget Balance	-0.012	0.008	-1.587
GDP growth	0.006	0.004	1.465
Broad money growth	0.986	0.110	8.924
Covariance	-0.003	0.037	-0.092
Floating Exchange rate Regime			
Constant	0.434	0.137	3.164
Lagged Res/MB	-0.152	0.070	-2.164
Budget Balance	0.008	0.008	1.021
GDP growth	-0.016	0.003	-5.112
Broad money growth	0.304	0.173	1.756
Covariance	-0.159	0.069	-2.304
Dummy for Central Europe	0.047	0.045	1.046
Dummy for Baltic Countries	0.105	0.058	1.807

R^2=0.69
Adj. R^2=0.63
Number of observations =113

The empirical findings also indicate that, contrary to intermediate and floating regimes, reserves to monetary base ratio—a variable which captures the credibility of the monetary authorities in defending the exchange rate—does not play any role under a fixed regimes. This finding could be attributed to several factors. First, it is possible that countries with fixed exchange rate regime use other mechanisms to enhance credibility. Second, it is also possible that countries with fixed exchange regimes usually have a sufficiently high level of reserves and variation in reserves does not affect the credibility of the regime and thus inflation.

Furthermore, the finding that reserves to monetary base ratio is negative and significant under both intermediate and floating regimes could be explained by the phenomenon referred to as *fear of floating* arising from lack of credibility. More specifically, it is argued that developing countries are often plagued by a lack of credibility and limited access to international markets, more pronounced adverse effects of exchange rate volatility on trade, high liability dollarization, and higher passthrough from exchange rate to inflation—all of which cause the authorities to resist large movements in the exchange rate.[45] As a result, the reserves to monetary base ratio reflects the authorities' ability to smooth large fluctuations in the exchange rate even under floating and intermediate regimes and, in turn, will be deemed as an important sign of credibility by agents.

In light of our findings, what can we conclude concerning the impact of the exchange regime on inflation? To this end, we perform simulations to determine whether a particular exchange rate regime would have delivered lower (or higher) inflation compared to the one already adopted. We acknowledge that such an exercise has its limitations. In particular, this exercise is conducted by using the realized values of variables involved under one regime to determine how the country in question would have performed under another exchange rate

arrangement (see Appendix 3). In other words, it is assumed that countries that are simulated to adopt another regime follow the same policies as before. Obviously, this shortcoming would be much more pronounced under simulation exercises involving the two extreme cases: fixed and floating regimes.[46] Moreover, since we rely on an *ad hoc* model for inflation in transition countries, the simulation results should be interpreted with caution. Nonetheless, with these limitations recognized, this approach relies on a much less restrictive assumption compared to existing empirical work, which imposes the same coefficients for all regimes.

Table 6. Inflation Simulations

	Mean	**Median**
If float were running Intermediate		
Fitted inflation (float)	0.32	0.31
Simulated inflation (intermediate)	0.37	0.36
If Intermediate were running float		
Fitted inflation (intermediate)	0.21	0.20
Simulated inflation (float)	0.33	0.28
If Intermediate were running Fix		
Fitted inflation (intermediate)	0.21	0.20
Simulated inflation (fix)	0.13	0.10
If Fix were running Intermediate		
Fitted inflation (fix)	0.13	0.10
Simulated inflation (intermediate)	0.19	0.19

Based on the simulation results, the following observations emerge: (i) if a country with a floating regime were to move an intermediate regime, it would have higher inflation; (ii) if a country with an intermediate regime adopted floating regime, it would experience higher inflation; (iii) if a country with an intermediate regime were to run a fixed regime, the country

[45] See Calvo and Reinhart (2000a, 2000b) for more on this.
[46] Consequently, we do not perform the simulation exercises involving fixed and floating regimes.

would experience lower inflation; (iv) if a country with a fixed regime were to adopt an intermediate regime, it would experience higher inflation.

With above mentioned caveats, the results imply that countries with intermediate arrangements may achieve lower inflation if they were to adopt a fixed regime. The findings also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation since existing fundamentals of the countries with floating regime are likely to be inappropriate for intermediate regime.

6.3 The Exchange Rate Regime and the Growth Performance

Contrary to the attention paid to the nominal effects of the exchange regime choice, only a few studies have attempted to investigate the consequences of the exchange regime in place for economic growth.[47] The existing literature has highlighted two main channels through which the exchange rate can affect output growth: either through the rate of factor accumulation—investment or employment—or through the growth rate of total factor productivity. More specifically, it has been argued that fixed exchange rate regime promote investment by reducing: (i) policy uncertainties; (ii) exchange rate volatility; and (iii) real interest rates. Fixed rates, however, could exacerbate protectionist pressures and, in turn, decrease the efficiency of a given stock of capital. In addition, fix rates may lead to misalignment of the real exchange and thereby undermine efficient resource allocation.

The burgeoning empirical work on growth in transition economies has paid little attention to the potential non-neutrality of the exchange rate regime in terms of growth.[48] Relatively few studies attempted to investigate this issue only by including a dummy variable for the fixed

[47] Aizman (1991), Mills and Wood (1993), and Ghosh et. al. (1997).

exchange rate regime.[49] For instance, Fischer et al (1996) found that the coefficient associated with the fixed exchange rate regime in their growth equation is positive and significant, underscoring the positive impact of the use of the fixed rates on growth. However, more recent studies showed that the pegged regime did not have statistically significant impact on growth [Berg et al (1999) and Christofersen and Doyle (1998)].

Empirical studies investigating growth in transition economies usually include various indices capturing the progress in structural reforms and key macro variables expected to affect growth along with a set of variables reflecting initial conditions. The most comprehensive study is conducted by Berg et. al (1999). They employ several specifications and a general-to-specific econometric approach to decompose the relative contributions to growth of initial conditions, structural reforms, and macroeconomic variables. Contrary to the previous studies, they attempt to address the issue of endogeneity of right-hand-side variables. In particular, they instrument budget deficit with IMF programs' forecasts. Their empirical findings underscore the superiority of structural reforms over both initial conditions and macroeconomic variables in explaining cross-country differences in performance and the timing of the recovery.

Our main objective in this section is not to conduct a comprehensive empirical investigation of economic growth in transition economies. Indeed, explaining growth is a much more difficult task than explaining inflation since it is a multi-dimensional process involving numerous interactions among economic agents. Instead, our main goal is to investigate whether the exchange rate regime has any impact on growth in transition economies by utilizing a reduced form equation for growth that draws on existing empirical studies. Contrary to the previous studies, our empirical framework does not assume that coefficients of policy variables

[48] See, for instance, De Melo et al (1996), Fischer et al (1996a, 1996b, 1997), Selowsky and Martin (1997), Havyrylyshn et al (1998), Heybey and Murrell(1999), and Fischer et al (2000).

are the same under all regimes and hence it is not subject to the *Lucas Critique*. Moreover, our framework considers the endogeneity of inflation, the budget balance, change in the liberalization index as well as of the exchange rate regime in the growth equation and also addresses the issue of the sample selection problem.

Once again, prior to employing the switching regression analysis, we estimate our reduced form equation for growth using a similar methodology employed by Ghosh et. al. (1997). More precisely, we use 2SLS to estimate the growth equation which includes the *budget balance*, *change in the liberalization index*, *lagged liberalization index*, *inflation* and *initial conditions* (the number of years under communism, share of industry, urbanization, share of CMEA trade). In our specification, we instrument all the contemporaneous variables (including change in liberalization index) with their lagged values and with other exogenous variables.[50]

Table 7 presents the empirical results of 2SLS estimation. The empirical findings suggest that inflation, change in the liberalization index, lagged liberalization index all have a negative impact on growth. The results also imply that an increase in the budget balance has an adverse effect on growth. The exchange rate dummies turn out to be statistically insignificant. Moreover, the result of the Wald test suggests that we cannot reject the null hypothesis that dummies are jointly equal to zero at 5 percent significance level (chi-square statistics of 4.95 with tail probability 0.175).

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[49] See, for instance, Fischer et al (1996), Christofersen and Doyle (1998) and Berg et al (1999)

[50] The instrument list for *inflation* includes lagged budget balance, lagged inflation, lagged money growth, lagged liberalization index, Res/MB ratio, initial conditions, and the covariance term. For the *budget balance*, it includes: lagged budget balance, lagged inflation, lagged GDP growth, and lagged external debt to GDP ratio. For change in the liberalization index, it includes: lagged change in liberalization index, lagged liberalization index, lagged GDP growth, and lagged inflation.

Table 7. The Exchange Rate Regime and the Growth Performance (2SLS)

	Coefficient	Std Deviation	t-statistic
Dummy for fix regime	0.10	0.20	0.50
Dummy for intermediate	0.13	0.20	0.63
Dummy for float	0.08	0.20	0.42
Budget Balance	-0.01	0.00	-3.31
Change in liberalization Index	-0.63	0.20	-3.21
Lagged Liberalization Index	-0.31	0.11	-2.86
Inflation	-0.34	0.06	-5.56
Urbanization	0.00	0.00	-0.36
CMEA	0.00	0.00	-1.06
Years under communism	0.00	0.00	0.45
Industry	0.21	0.09	2.47
Dummy for Central Europe	0.08	0.07	1.14
Dummy for Baltic Countries	0.13	0.06	2.03
R^2=0.17			
Adj. R^2=0.06			
Number of observations=113			

Next, we estimate the growth equation using switching regression technique described in Section 5. Table 8 presents the empirical results. We, first, test joint hypothesis that all coefficients are equal across the regimes, and the estimated covariances are all equal to zero. The result of the Wald test statistics, which is equal to 26.23 with tail probability 0.016, suggests that *policy actions (and also variables affecting economic activity) have different impacts on growth under different exchange rate regimes*. Moreover, we also perform an additional test, namely all coefficients associated with the covariance terms are jointly equal to zero. The result of the Wald test indicate that the null hypothesis cannot be rejected (chi-square statistics of 1.5 with tail probability 0.67), suggesting that there is no sample selection problem. Based on these results, it is not possible to make any inferences about a particular exchange rate regime being superior to another in terms of growth performance. Nonetheless, it is possible to conclude that the impact of policy and non-policy factors on growth is different under different exchange rate arrangements.

The empirical findings also underscore the deleterious effect of inflation on growth across the regimes. The empirical results, on the other hand, do not produce clear-cut evidence on the impact of lagged liberalization index and change in liberalization index. For instance, lagged liberalization index has a positive effect on growth under a fixed regime, while it is negatively associated with growth under intermediate regime and not significant at all under floating regime. Change in liberalization index turns out to have a negative and statistically significant influence on growth only under intermediate regimes. These findings are not surprising; previous empirical studies also failed to report a strong clear-cut relationship between these variables.[51]

It is interesting to note that the explanatory powers of the regressions reported in Tables 11 and 12 are considerably lower than the previous empirical studies investigating growth in transition economies. This is likely to arise from the fact that majority of the previous studies did not use instruments for endogenous variables—with the exception of Berg et al (1999) who instrumented for the budget balance—and thus not only over-estimated the explanatory power of their regressions, but also suffered from inconsistent estimates. Indeed, when we estimate our regressions reported in Tables 11 and 12 without using instruments, we get noticeably higher R^2s. It could be argued since we use lagged values of relevant variables as instruments, this may significantly lower the efficiency of our regressions in view of the drastic changes that transition countries have been undergoing. Nonetheless, we prefer consistent estimates with low R^2s over the biased estimates with high indicators of explanatory powers.

[51] See, for instance, Popov (2000) for more detailed discussion of this issue.

Table 8. Results of the Switching Regression Estimates : Growth Equation

	Coefficient	Std Dev	t-statistic
Fixed Exchange rate Regime			
Constant	-0.80	0.32	-2.50
Budget Balance	0.00	0.00	-1.47
Change in liberalization Index	0.73	0.51	1.45
Lagged Liberalization Index	0.76	0.34	2.26
Inflation	-0.44	0.14	-3.14
Covariance	-0.01	0.02	-0.63
Intermediate Exchange rate Regime			
Constant	0.16	0.17	0.94
Budget Balance	-0.01	0.00	-2.44
Change in liberalization Index	-1.20	0.26	-4.60
Lagged Liberalization Index	-0.36	0.14	-2.64
Inflation	-0.25	0.07	-3.60
Covariance	0.00	0.02	-0.16
Floating Exchange rate Regime			
Constant	-0.09	0.18	-0.53
Budget Balance	0.00	0.00	0.26
Change in liberalization Index	0.06	0.25	0.25
Lagged Liberalization Index	0.04	0.17	0.22
Inflation	-0.26	0.08	-3.37
Covariance	-0.04	0.04	-1.04
Urbanization	0.00	0.00	-0.05
CMEA	0.00	0.00	0.18
Years under communism	0.00	0.00	0.87
Industry	0.10	0.12	0.84
Dummy for Central Europe	0.10	0.05	2.09
Dummy for Baltic Countries	0.08	0.05	1.69

R^2=0.35
Adj. R^2=0.17
Number of observations = 113

What can be gleaned from our empirical findings in terms of the link between growth and the exchange rate regime in place? Recognizing the poor performance of the growth equation and previously mentioned limitations of the simulation exercise, the results of this exercise are reported in Table 9.

Table 9. Growth Simulations

	Mean	Median
If float were running Intermediate		
Fitted growth (float)	-0.13	-0.009
Simulated growth (intermediate)	0.003	0.007
If Intermediate were running float		
Fitted growth (intermediate)	0.017	0.023
Simulated growth (float)	0.073	0.086
If Intermediate were running Fix		
Fitted growth (intermediate)	0.017	0.023
Simulated growth (fix)	-0.04	-0.0004
If Fix were running Intermediate		
Fitted growth (fix)	0.031	0.046
Simulated growth (intermediate)	0.018	0.038

Based on the simulation results, the followings observations can be made: (i) if a country with a floating regime were to run an intermediate regime, it would have slightly higher growth; (ii) if a country with an intermediate regime were to adopt a floating regime, it would experience higher growth; (iii) if a country with an intermediate regime were to run a fixed regime, the country would experience lower growth; (iv) if a country with a fixed regime were to adopt an intermediate regime, it would experience lower growth.

Unfortunately, given the poor performance of estimates of the growth equation and inconclusive simulation results, it is not possible to draw firm conclusions concerning the link between the exchange rate regime and growth.

6.4 Robustness Test

As a robustness test, we make an attempt to test the sensitivity of our findings with respect to survival bias by excluding the switch year. More precisely, we exclude the switch year to check the validity of our conclusions.[52] Both in the case of inflation and growth equations, our previous results concerning the joint hypothesis that all coefficients are equal across the regimes and the estimated covariances are all equal to zero remain intact (23.5 with tail probability 0.036 for the inflation equation and 42.8 with tail probability 0.00005 for the growth equation). Moreover, the coefficient estimates in the case of the inflation equation, including the covariance term, do not change significantly except for the budget deficit under fixed regime whose significance declines. The growth equation, however, does not perform very well with respect to this robustness test, particularly in the case of fixed regime.

7. Conclusions

The debate over the most appropriate exchange rate arrangement has been one of the most controversial topics in the literature. Economists have debated for a century without reaching any firm conclusions. In spite of its increasing policy relevance, the literature offers relatively few empirical studies and those that do exist focus mainly on developed or developing countries, without providing any evidence on transition countries. To this end, we attempt to make two contributions. First, we develop an empirical framework to address some of the main problems plaguing empirical work in this strand of the literature, namely the *Lucas Critique, endogeneity of the exchange rate regime*, and *the sample selection problem*. We employ a *switching regression model* which is estimated using a *two-step Heckman procedure*. More specifically,

[52] Due to degrees of freedom limitations, we cannot exclude three observations (that is one year before and after the regime change) a la Ghosh (1997).

we, first, estimate the equation for the choice of the exchange rate regime by using ordered probit and then utilize a switching regression technique to investigate whether the exchange rate regime affects macroeconomic performance

Second, we use this framework to study whether the exchange regime affects macroeconomic performance in transition countries—an issue which has not been subject to a thorough empirical investigation to date.

Prior to highlighting the principal conclusions that emerge from our study, we recognize the limitations of our empirical findings that arise from the inclusion of a relatively small number of countries (only 22 countries) and a time period of less than 10 years as well as from questions concerning the reliability of data (particularly data on GDP growth) for transition economies. Another limitation arises from the use of a *de jure* exchange rate classification, which is based on the publicly stated commitment of the exchange rate.[53]

Our empirical findings on the choice of the exchange rate regime suggest that transition economies that: (i) have lower budget deficits; (ii) are more open (i.e. have a higher ratio of exports plus imports to GDP); and (iii) made more progress in the areas of private sector entry and internal markets tend to adopt more stringent exchange rate regimes. While the results suggest that those with more progress in external markets and with a reserves to monetary base ratio above 1.34 opt for more flexible exchange rate arrangements.

Moreover, our empirical results suggest that the exchange rate regime does make a difference for inflation performance. More specifically, the findings imply that countries with intermediate arrangements may achieve lower inflation if they were to adopt a fixed regime. The

[53] Although a recent promising study by Levy-Yeyati and Sturzenegger (2000) constructed a de facto classification of the exchange rate regimes for the period of 1990-98, the use of their classification in our research would be undesirable on two grounds. First, the use of their data set would reduce the number of observations significantly and thus would not be comparable to our findings based on de jure classification. Second, their attempt to construct de facto classification of the exchange rate

results also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation since existing fundamentals of the countries with floating regime tend to be inappropriate for an intermediate regime. However, when a country with an intermediate regime switches to a floating regime, it experiences a higher inflation.

The results also suggest that an *unanticipated float*—a situation describing a country where fundamentals suggest it is likely to adopt another regime, but it adopts instead a floating regime—results in lower inflation.

Based on our empirical results, however, it is not possible to make any inference about any particular exchange rate regime being superior to another in terms of growth performance. Nonetheless, empirical findings suggest that policy variables—and also other variables influencing economic activity—do have different effects on economic growth under different exchange rate arrangements.

As an additional exercise, we attempt to shed some light on the issue of the appropriate nominal anchor by drawing on the transition experience (see Appendix 1). A cursory look at the performance of different nominal anchors suggests that countries that included some form of a fixed exchange rate regime in their stabilization packages appear to have been more successful in curbing inflation and inducing fiscal discipline. Countries that adopted money-based stabilization programs or intermediate exchange rate arrangements, on the other hand, seem to have experienced faster output recovery than countries that pursued exchange rate based stabilization programs. Although these inferences are not conclusive in the absence of a more

regimes overlooks the possibility that countries often utilize interest rates to affect the exchange rate movements—a point acknowledged in their paper. In fact, Calvo and Reinhart (2000a) provide some evidence confirming this phenomenon.

systematic review that incorporates other relevant factors, they are consistent with previous studies that conducted more formal investigations.[54]

In light of these findings, can one conclude that a particular exchange rate regime is superior to other exchange rate arrangements in delivering better macroeconomic outcomes in transition economies? As is widely recognized, there is no single exchange rate regime that is best for all countries, at all times, in all circumstances. Nonetheless, our findings suggest that fixed regimes, after controlling for other relevant factors affecting inflation, do deliver lower inflation. This finding lends support to those who argue that the credibility associated with fixed regimes helps policy makers achieve lower inflation outcomes.

Our results also suggest that commitment can be useful even if devaluations happen from time to time. Although experience has shown that few countries manage to keep exchanges rates fixed for very long periods [Obstfeld and Rogoff (1995)], this does not necessarily mean that fixed exchange rates are a bad idea. By contrast, an unlimited commitment to a fixed rate may be harmful, since it means that one may have to endure the consequences of severe shocks without any accommodation. Consequently, policy makers' success in countries with fixed regimes will hinge, inter alia, on their ability to address a challenging policy issue: *the optimal level of commitment*.

[54] See, for instance, Sahay and Vegh (1996).

Appendix 1:Exchange Rate Versus Money Based Stabilization: A Cursory Look at the Transition Experience

The Southern Cone stabilization programs of the 1970s have stimulated much debate as to whether money or the exchange rate provides a better nominal anchor.[55] The outcome of Southern Cone programs has, indeed, come to be associated with the expression of "*recession now versus recession later*". More precisely, it is argued that in the case of money based stabilization the output costs are paid in up front, while in the case of exchange rate base stabilization the costs paid at a later stage. In light of rather disappointing outcome of a large number of programs with a single anchor, some observers contended that a single anchor may not be sufficient to achieve rapid disinflation due to lack of credibility, backward indexation, and non-synchronized price setting. As a result, the adoption of additional nominal anchors such as incomes policy was employed in the programs of the mid-1980s in Argentina, Brazil, Israel, and Mexico.

Table A1 summarizes the key empirical regularities associated with stabilization programs with different anchors.[56] In addition to the common characteristics associated with the adoption of a particular anchor (Table 2), the existence of a widespread phenomenon in many developing (and also in transition countries), namely *currency substitution*, also plays an important role in the selection of the appropriate nominal anchor. If the elasticity of substitution between foreign and domestic currency is very high, then the system may lack a nominal anchor under flexible exchange rates. Thus, ceteris paribus, the presence of currency substitution makes the exchange rate more suitable as the nominal anchor.

[55] See, for instance, Vegh (1992), and Calvo and Végh (1999,1993, 1994).
[56] The sample consists of 11 major programs in Latin America and Israel.

The issue of the appropriate anchor for the stabilization in transition economies also received a lot of attention at the outset of the transition process during the early 1990s. It was argued that freeing wages and prices simultaneously in transition economies could leave them without any nominal anchors.[57] Consequently, unless new anchors such as the exchange rate and money are successfully put in place, large scale liberalization can be destabilizing. In recognition of this potential threat, stabilization program of many transition countries relied on two nominal anchors, namely money or the exchange rate, and wages.

Table A1. The Main Empirical Regularities of Stabilization Programs

Exchange Rate Based Stabilization	*Money Based Stabilization*
Slow convergence of inflation to the rate of devaluation	Slow convergence of inflation to the rate of money growth
Real appreciation of the domestic currency	Real appreciation of the domestic currency
Deterioration of the trade balance and the current account	No clear-cut response in the trade balance and current account
Initial increase in real activity (i.e., real private consumption and real GDP) followed by a later contraction	Initial contraction in economic activity
Ambiguous response of domestic real interest rates	Initial increase in domestic real interest rates

Source: Calvo and Végh (1994)

Did transition countries with different anchors have significantly different experience in terms of lowering inflation and output loss associated with their adoption? Although providing an answer to this question through a formal analysis is beyond the scope of this section, Table A2—drawing on the existing literature—attempts to summarize the main advantages and drawbacks of money and exchange rate based stabilizations in the context of transition countries.

[57] Sahay and Vegh (1996).

Table A2. The Choice of the Nominal Anchor in the Transition Process: Fixed Versus Flexible

Selection Criteria	Fixed	Flexible	Tentative Conclusion
The costs of stabilization while the program is in place	Money demand shocks have smaller consequences for output, while that of real shocks are magnified.	Money demand shocks have larger consequences for output, while in the face of real shocks has better output stabilizing properties	It is difficult to determine a priori which type of shock will dominate. In the face of sharp contractions due to structural change and political developments, the added output losses associated with the particular anchor will be a less significant consideration in determining the choice of nominal anchor.
The effectiveness of the approach in lowering inflation	In the face of shifts in money demand and unstable velocity, an exchange rate peg provides a better anchor and thus may be more effective in controlling inflation.	Money based stabilization will be more effective if: (i) money demand is stable and (ii) money is more closely linked to the price level.	At first blush, the fact that the situation of transition economies can be characterized by shifts in money demand and unstable velocity suggests that exchange rate anchors may seem to be more effective. However, it should be noted that the objective of lowering inflation from very high levels to moderate levels is very different from achieving narrowly defined low inflation targets. Thus, the laxity in inflationary control associated with monetary anchor may be of secondary importance. The success of several money based stabilization programs in transition economies, e.g. Albania, Slovenia, Latvia, and Lithuania, is a case in point.
The costs resulting from the program failure	The costs of failure may be higher in the case of exchange rate based stabilization. The reputational cost to the government is likely to be higher in the aftermath of the collapse of the peg.	If the public is perceived as highly skeptical, a money based stabilization can be less risky. The lack of success in meeting monetary targets may be perceived less explicitly as a failure of the government than the forced floating of the currency or a sharp devaluation.	Lack of credibility is more disruptive under fixed exchange regime than under monetary anchor. If the credibility is high, the exchange rate should probably be favored as it allows for a faster adjustment of real money balances.
The chances of failure and the conditions that would minimize the risk of failure	The public observability of the exchange rate may enhance the credibility of an exchange rate based approach. To the extent that the undesirable consequences of failure act as a deterrent to dropping the program, it may lead to a higher commitment to pursue the required accompanying stabilization measures, fiscal adjustment in particular.	Money based stabilization may be desirable if (i) the underlying commitment of policy makers to fiscal discipline, *that is the exogenous preferences of policy makers as opposed to the actual behavior of policy makers*, is deemed incompatible with the exchange rate as a nominal anchor and (ii) the risk of adverse shocks, which are beyond the authorities' control is high.	The commitment to an exchange rate is only one of the factors likely to affect fiscal discipline. A fixed exchange rate arrangement may strengthen the determination for fiscal adjustment, though it is unlikely to produce political miracles.

In light of Table A2, three comments are in order. First, standard policy advice promoted the exchange rate as the nominal anchor in lieu of money was the instability of demand for money during transition, which, in turn, would make setting monetary targets difficult. Furthermore, it was argued monetary based stabilization had the danger of Dornbusch-style exchange rate overshooting (Fischer 1986). Nonetheless, when the magnitude of the fiscal deficit rendered substantial monetization unavoidable, pegging exchange rates had little

credibility. It was argued that under such circumstances, there was a little alternative to a floating exchange rate, and monetary targets would have to do the best they could. In a nutshell, for more optimistic cases exchange rate was recommended to be employed as the nominal anchor, however, where the fundamentals were more problematic money based stabilization was favored.

Second, despite the often claimed problem of instability of demand for money, some studies showed that one can estimate a reasonably good demand equation for M2 using a panel of quarterly data for 13 countries.[58] Many analysts, however, considered the noticeable uncertainties about real output and prices during early transition as a valid argument against the use of monetary targeting. Although this conjecture appears to have provided some support for the advice to favor exchange rate based stabilization where possible, one should acknowledge the success of several money based stabilization programs in spite of the documented instability of velocity.[59]

Third, an important issue associated with pegging the exchange rate was the implicit rule for subsequent re-alignments. This hinged both on inflation differential and changes in equilibrium exchange rate induced by differential productivity growth at home and abroad, which led to the following question: *is productivity growth more predictable than the fluctuations in real money demand*? Begg (1997) argued that productivity growth is likely to be more predictable than the gyrations in real money demand due to drastic changes in financial structure and/or currency substitution. He drew a tentative conclusion that exchange rate pegs,

[58] See, for instance, Begg (1996).

[59] The widely quoted successful money based stabilization programs in Albania, Slovenia, Latvia, and Lithuania had three important common characteristics: (i) nominal target that turned inappropriate were simply adjusted ex post; (ii) multiple nominal anchors were employed; and (iii) for any nominal anchor, fiscal discipline mattered even more.

although with regular alignments, may provide a more reliable basis for navigation during initial stabilization period so long as prudent fiscal and monetary policies are pursued.

What are the stylized facts concerning the performance of different anchors that can be gleaned from a cursory look at the available data? Drawing upon Fischer and Sahay (2000) in determining the dates of stabilization programs, Table A3 and Table A4 present a summary of some stylized facts under alternative anchors. Table A3 includes only first stabilization attempts and excludes those countries that switch their anchors to avoid the survival bias. Table A4, on the other hand, contains both first and second attempts to stabilize but excludes those countries that switch their anchors once they achieve stabilization. Both tables report the evolution of the mean and median of key macro variables under different anchors since the introduction of the stabilization program (t=0).

Table A3. Evolution of Key Macro Variables Under Different Anchors [a]

	t=0		t=1		t=2		t=3		t=4	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Inflation[b]										
Fixed	0.50	0.34	0.21	0.24	0.21	0.19	0.15	0.14	0.11	0.10
	(3) [c]	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(4)
Intermediate	0.61	0.60	0.22	0.19	0.16	0.10	0.25	0.17	0.11	0.08
	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(7)	(3)	(3)
Floating	0.61	0.70	0.30	0.25	0.20	0.19	0.12	0.06	0.18	0.15
	(11)	(11)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)
Budget Balance										
Fixed	-0.47	-0.30	-2.50	-3.10	-3.20	-3.25	-3.15	-1.30	-3.03	-1.85
	(3)	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(4)
Intermediate	-3.31	-3.69	-3.72	-3.20	-3.86	-3.80	-2.57	-2.70	-1.67	-1.70
	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(7)	(3)	(3)
Floating	-6.74	-6.20	-5.70	-4.25	-6.30	-5.30	-6.60	-5.80	-8.67	-7.50
	(10)	(10)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)
GDP Growth										
Fixed	-9.73	-9.77	-8.06	-9.00	-2.04	-2.53	2.96	3.75	5.04	5.15
	(3)	(3)	(3)	(3)	(4)	(4)	(4)	(4)	(4)	(4)
Intermediate	-5.27	-4.82	-0.79	-1.20	3.96	2.63	2.04	2.90	3.90	3.50
	(6)	(6)	(7)	(7)	(7)	(7)	(7)	(7)	(3)	(3)
Floating	-11.51	-11.8	-4.58	-5.14	1.75	1.85	5.86	7.20	0.87	2.10
	(11)	(11)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)

a: The sample consists of the following countries: Albania (1992-98), Armenia (1995-98), Azerbaijan (1995-98), Belarus (1995-98), Bulgaria (1991-96), Croatia (1994-98), Czech Republic (1991-95), Estonia (1992-98), Georgia (1995-98), Hungary (1990-94), Kazakstan (1994-96), Kyrgyz Republic (1993-94), Latvia (1992-94), Lithuania (1992-93), Macedonia (1994-98), Moldova (1994-98), Poland (1991-98), Romania (1994-96), Russia (1995-98), Slovak Republic (1993-98), Slovenia (1992-98), and Ukraine (1995-98).

b: To reduce the importance of outliers, the inflation rate (π) is transformed to: $\pi/(1+\pi)$.

c: Figures in parentheses denote number of observations.

On balance, countries that adopted exchange rate based stabilization or intermediate exchange rate arrangements appear to have been more successful in bringing inflation down compared to countries that employed money-based stabilization programs (Tables A3 and A4). The same observation also applies to lowering fiscal deficit. In terms of output recovery—or output costs of a particular anchor adopted—countries that adopted intermediate exchange rate

arrangements or implemented money-based stabilization programs seem to have fared better than countries that pursued exchange rate based stabilization program.

Table A4. Evolution of Key Macro Variables Under Different Anchors [a]

	t=0		t=1		t=2		t=3		t=4	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**	**Mean**	**Median**
Inflation[b]										
Fixed	0.53	0.34	0.18	0.24	0.19	0.18	0.13	0.10	0.09	0.07
	(5) [c]	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Intermediate	0.51	0.56	0.22	0.22	0.14	0.10	0.22	0.15	0.11	0.08
	(9)	(9)	(10)	(10)	(9)	(9)	(9)	(9)	(3)	(3)
Floating	0.61	0.70	0.30	0.25	0.20	0.19	0.12	0.06	0.18	0.15
	(11)	(11)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)
Budget Balance										
Fixed	-1.98	-1.90	-2.20	-3.10	-3.46	-4.50	-2.88	-1.30	-3.62	-1.90
	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Intermediate	-4.62	-3.60	-3.93	-3.25	-4.15	-3.80	-2.83	-2.70	-1.67	-1.70
	(9)	(9)	(10)	(10)	(9)	(9)	(9)	(9)	(3)	(3)
Floating	-6.74	-6.20	-5.70	-4.25	-6.30	-5.30	-6.60	-5.80	-8.67	-7.50
	(10)	(10)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)
GDP Growth										
Fixed	-9.18	-9.77	-3.48	-3.30	-0.68	-2.00	3.83	4.30	5.05	5.10
	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)	(5)
Intermediate	-4.09	-5.4	0.20	0.80	4.90	5.30	2.04	2.30	3.90	3.50
	(9)	(9)	(10)	(10)	(9)	(9)	(9)	(9)	(3)	(3)
Floating	-11.51	-11.8	-4.58	-5.14	1.75	1.85	5.86	7.20	0.87	2.10
	(11)	(11)	(10)	(10)	(8)	(8)	(5)	(5)	(3)	(3)

a: The sample consists of Albania (1992-98), Armenia (1995-98), Azerbaijan (1995-98), Belarus (1995-98), Bulgaria(1991-96 and 1997-98), Croatia (1994-98), Czech Republic (1991-95), Estonia (1992-98), Georgia (1995-98), Hungary (1990-94), Kazakstan (1994-96), Kyrgyz Republic (1993-94 and 1995-98), Latvia (1992-94), Lithuania (1992-1993 and 1994-98), Macedonia (1994-98), Moldova (1994-98), Poland (1991-98), Romania (1994-96 and 1997-98), Russia (1995-98), Slovak Republic (1993-98), Slovenia (1992-98), and Ukraine (1995-98).
b: To reduce the importance of outliers, the inflation rate (π) is transformed to: $\pi/(1+\pi)$.
c: Figures in parentheses denote number of observations.

In short, countries that included some form of fixed exchange rate regime in their stabilization packages appear to have been more successful in curbing inflation and inducing fiscal discipline. Countries that adopted money based stabilization programs or intermediate exchange rate arrangements, on the other hand, seem to have experienced faster output recovery

than countries that pursued exchange rate based stabilization programs. Clearly, since these inferences are based on stylized facts without a systematic review that considers other relevant factors, they cannot be deemed as conclusive conjectures. Nonetheless, a more formal treatment of the issue at hand also seems to reach a similar conclusion: *the exchange rate has been more effective than money as nominal anchor in reducing inflation in transition to a market economy* [Sahay and Vegh (1996)].

Appendix 2: Extension of the Heckman Procedure for three Regimes

Heckman (1979) derives the correct asymptotic variance-covariance (VC) matrix in the two-stage procedure for the case of two regimes. In the context of our paper, his formulas can be applied to the first and the third regimes. However, for the second regime it needs some modification since the probability the regime is calculated on the basis of two constants (limit points). In this Appendix, we, consistent with Heckman's (1979) notation, modify the asymptotic VC matrix in the two-stage procedure for the second regime.

We, first, derive the estimate for the variance of the disturbance term, u_2. Rewriting (5) in Section 6 yields to:

$$E(u_{i1} \mid Z_i g < v_i < Z_i g + a) = s_{2v} \frac{f(c_1) - f(c_2)}{F(c_2) - F(c_1)} = s_{2v} h_3$$

where $c_1 = Zg + a_1$ and $c_2 = Zg + a_2$. Then, the expression for variance of e^2_{2i} can be written as:

$$E(e_{2i}^2) = s_2^2 - s_{2v}^2 \left[h_2^2 - \frac{c_1 f(c_1) - c_2 f(c_2)}{F(c_2) - F(c_1)} \right]$$

Therefore, the expression for the estimated variance is

$$\hat{s}_2^2 = \frac{1}{I_2} \sum_1^{I_2} \hat{v}_{2i}^2 + \frac{\hat{s}_{2v}^2}{I_2} \sum_1^{I_2} \left[\hat{h}_{2i}^2 - \frac{\hat{c}_{1i} f(\hat{c}_{1i}) - \hat{c}_{2i} f(\hat{c}_{2i})}{F(\hat{c}_{2i}) - F(\hat{c}_{1i})} \right],$$

where $\hat{h}_{2i} = \frac{f(\hat{c}_{i1}) - f(\hat{c}_{2i})}{F(\hat{c}_{2i}) - F(\hat{c}_{1i})}$, $\hat{c}_{1i} = Z_i \hat{g} + \hat{a}_1$, $\hat{c}_{2i} = Z_i \hat{g} + \hat{a}_2$, $\hat{e}_{2i}$ are residuals obtained from the second step Heckman procedure along with $\hat{s}_{2v}$, $\hat{a}_1, \hat{a}_2$ and $\hat{g}$ are coming from the ordered probit regression in the first stage, I_2 is the number of observations in the second regime.

Next, we derive the assymptotic VC matrix of the estimated parameters. Drawing on Heckman (1979), we can write:

$$\sqrt{I_2} \begin{pmatrix} \hat{B}_2 - B_2 \\ \hat{s}_{2v} - s_{2v} \end{pmatrix} \xrightarrow{D} N(0, B y B'), \text{ where}$$

$$B = \underset{I, I_2 \to \infty}{p\lim}\, I_2 \begin{pmatrix} X_2' X_2 & X_2' \hat{h}_2 \\ \hat{h}_2' X_2 & \hat{h}_2' \hat{h}_2 \end{pmatrix}^{-1} = \underset{I, I_2 \to \infty}{p\lim}\, I_2 \begin{pmatrix} X_2' X_2 & X_2' h_2 \\ h_2' X_2 & h_2' h_2 \end{pmatrix}^{-1},$$

$$y = \underset{I, I_1 \to \infty}{p\lim} (y_1 + y_2)$$

$$y_1 = \frac{s_2^2}{I_1} \sum h_i \begin{pmatrix} X_{2i}' X_{2i} & X_{2i}' h_{2i} \\ h_{2i} X_{2i} & h_{2i}^2 \end{pmatrix}$$

$$y_1 = \frac{s_{2v}^2}{II_1} \sum \sum q_{ij} \begin{pmatrix} X_{2i}' X_{2j} & X_{2i}' h_{2j} \\ h_{2i}' X_{2j} & h_{2i} h_{2j} \end{pmatrix}$$

$$h_i = \frac{Ee_{2i}^2}{s_2^2} = 1 - \frac{s_{2v}^2}{s_2^2} \left(h_{2i}^2 - \frac{c_{1i} f(c_{1i}) - c_{2i} f(c_{2i})}{F(c_{2i}) - F(c_{1i})} \right),$$

$$q_{ij} = \left[\frac{\partial h_{2i}}{\partial a_1} \frac{\partial h_{2i}}{\partial a_2} \left(\frac{\partial h_{2i}}{\partial g} Z \right) \right] \Omega \left[\frac{\partial h_{2j}}{\partial a_1'} \frac{\partial h_{2j}}{\partial a_2'} \left(Z' \frac{\partial h_{2j}}{\partial g'} \right) \right]',$$

$$\frac{\partial h_{2i}}{\partial a_1} = \frac{f(c_{1i})}{F(c_{2i}) - F(c_{1i})} (h_{2i} - c_{1i}),$$

$$\frac{\partial h_{2i}}{\partial a_2} = -\frac{f(c_{2i})}{F(c_{2i}) - F(c_{1i})} (h_{2i} - c_{2i}),$$

$$\frac{\partial h_{2i}}{\partial a_2} = h_{2i}^2 - \frac{c_{1i} f(c_{1i}) - c_{2i} f(c_{2i})}{F(c_{2i}) - F(c_{1i})}$$

$$\frac{\partial h_{2i}}{\partial g} = h_{2i}^2 - \frac{c_{1i} f(c_{1i}) - c_{2i} f(c_{2i})}{F(c_{2i}) - F(c_{1i})}$$

In the above expressions Ω is a variance-covariance matrix of $(\hat{a}_1, \hat{a}_2, \hat{g})$, I is the total number of observations. Expression in square brackets is a stacked vector.

Appendix 3: Simulation Exercise

In the simulation exercise, we place the values of right hand side variables of one regime into the structural equation of another. The resulting value would be the expected inflation if the country were to run the other regime. It should be kept in mind that when conducting this kind of simulations the term associated with the covariance in the simulated equation should be substituted by the corresponding term from the original equation. For instance, if we were to simulate intermediate countries to find our how they would perform under fix regime, the original equations for fix and intermediate regimes are the following:

$$E(Y_i \mid X_i, Z_i, fix) = X_i\hat{B}_1 - \hat{s}_{1v}\frac{f(Z_i\hat{g} + \hat{a}_1)}{F(Z_i\hat{g} + \hat{a}_1)},$$

$$E(Y_j \mid X_j, Z_j, \text{int } erm.) = X_j\hat{B}_2 + \hat{s}_{2v}\frac{f(Z_j\hat{g} + a_1) - f(Z_j\hat{g} + \hat{a}_2)}{F(Z_j\hat{g} + \hat{a}_2) - F(Z_j\hat{g} + \hat{a}_1)} \quad ,$$

where observations denoted by the notation i represent fix regimes, while those with j stand for intermediate arrangements. Now, we substitute the intermediate observations into the equation for fix and obtain the simulated inflation from the following equation:

$$E(Y_j \mid X_j, Z_j, fix) = X_j\hat{B}_1 - \hat{s}_{1v}\frac{f(Z_j\hat{g} + \hat{a}_1) - f(Z_j\hat{g} + \hat{a}_2)}{F(Z_j\hat{g} + \hat{a}_2) - F(Z_j\hat{g} + \hat{a}_1)}$$

Note that after covariance, we have a term from coming form the original equation for intermediate regime. Substituting only Z_j into the "fix" equation would be incorrect.

Finally, from the last expression, we obtain the expected values of inflation or growth if a country under intermediate regime were to run fix.

Appendix 4: Description of Data

Data on *GDP growth, inflation, budget deficit* are obtained from various EBRD reports. Data on *international reserves* and *monetary base* were taken from IFS. Unfortunately, for the majority of transition countries financial statistics in the beginning of transition were unavailable. Consequently, those observations could not be included in the regression analysis. *Liberalization indices* are taken from De Melo et al and updated for 1998 from the EBRD report. *Classification of the exchange rate regimes* is obtained from the IMF's Exchange Rate Arrangements and Exchange Rate Restrictions.

Moreover, observations corresponding to the year 1997 for Bulgaria were excluded on the grounds that Bulgaria accepted currency board in the middle of the year while experiencing extremely high inflation prior to the month and, as a result, for the entire year. Since this particular year, 1997, would be treated as a fixed regime in the annual data, it would become an obvious outlier.

We also excluded years of war and severe regional conflicts involving the following countries: Armenia, Azerbaijan, Georgia, Moldova, Macedonia, Croatia. In addition, Tajikistan, Turkmenistan and Uzbekistan were excluded from the sample due to data problems. Time period for Czech Republic and Slovak republic was considered after they separated to avoid inconsistency in the data.

The countries and the periods for the regression analysis are the followings: Albania 1993-98, Armenia 1995-98, Azerbaijan 1995-98, Belarus 1995-98, Bulgaria 1995-98, Croatia 1995-98, Czech Republic 1994-97, Estonia 1993-98, Georgia 1994-98, Hungary 1992-98, Kazakhstan 1994-98, Kyrgyz Republic 1994-98, Latvia 1994-98, Lithuania 1994-98, Macedonia 1996-98, Moldova 1993-98, Poland 1992-98, Romania 1992-98, Russia 1995-98, Slovak Republic 1994-98, Slovenia 1993-98, and Ukraine 1994-98.

The series employed in the regression analysis contains 24, 54, and 35 observations under fixed, intermediate, and floating regimes, respectively.

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