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"Exchange Rate Regimes and Monetary
Discipline – Only Hard Pegs Make a Difference"

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Exchange Rate Regimes and Monetary Discipline –

Only Hard Pegs Make a Difference

by

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Abstract

Previous research has suggested that pegged exchange rates are associated with lower inflation than floating rates. In which direction does the causality run? Using data from a large sample of developing countries from 1984 to 2000, we confirm that "hard" pegs (currency boards or a shared currency) reduce inflation and money growth. There is no evidence that "soft" pegs confer any monetary discipline. The choice between soft pegs and floats is determined by inflation: when inflation is low, pegs tend to be chosen and sustained, and when inflation is high, either floats are chosen or there are frequent regime switches.

1. Introduction

The currency crises of the 1990s made fashionable the "bi-polar" model of exchange rate regime choice, according to which either extreme (a "hard" peg or a float) is preferable to an intermediate option. In the view of Fischer (2001), the bi-polar model is primarily a criticism of soft pegs, rather than of other forms of intermediate regime such as a managed float.

As we shall see below, up to 1995 developing countries did indeed abandon soft pegs and go over to floating in some numbers, but that tendency has been reversed more recently. It may well be that the disadvantages of soft pegs are less significant for countries that are not exposed to large capital flows, either because of capital controls or because of financial underdevelopment, and also that soft pegs have significant compensating advantages over managed floats which need to be taken into account. The most obvious possibility that springs to mind, and the one which we investigate here, is whether soft pegs encourage price stability by imposing a significant degree of discipline on the monetary authorities.

Much has been written recently about the classification of exchange rate regimes (ERRs), and their correlation with measures of macroeconomic performance such as inflation and growth. The conventional conclusion, based on official IMF classifications (which are essentially the declared regimes of each country), is that pegs of all kinds tend to be associated with lower inflation than floats (Bleaney and Fielding, 2000, 2002; Edwards, 1993; Ghosh *et al*., 1997, 2003; IMF, 1997). Bleaney and Fielding (2002) find that hard pegs have even lower inflation than soft pegs. There are however at least two reasons for re-examining these issues. One is the possible endogeneity of the ERR, which can arise from the aggregation of various regime categories as well as for the usual econometric reasons. Another is the recent concern that the ERRs in place differ significantly

from their official descriptions. This has led some authors to develop *de facto* classifications using various methods (Bubula and Ötker-Robe, 2002; Levy-Yeyati and Sturzenegger, 2001; Poirson 2001). Reinhart and Rogoff (2002) have extended the possibilities further by emphasising parallel-market rather than official exchange rates.

We develop a data set based on the declared exchange rate regime back to 1984, and check our results against the *de facto* classification of Bubula and Ötker-Robe (2002). The main issues which we explore are:

(1) Do hard pegs (e.g. a shared currency or a currency board) create significantly more monetary discipline than other pegs?

(2) Is the distinction between *de jure* and *de facto* classifications important?

(3) Which way does the causality run between inflation and exchange rate regimes?

Our analysis starts from four principles.

(1) If a pegged exchange rate is regarded as an attempt to import the anti-inflation credibility of the anchor currency, then the empirical analysis of the ERR-inflation relationship should exclude anchor currencies. Here we identify anchor currencies as those of the advanced countries. Developing countries lack the institutional strength of advanced countries (they emerge as consistently inferior in multi-dimensional measures of institutional quality), and are thus more likely to depend on an exchange rate peg rather than on domestic institutional arrangements as a nominal anchor. One index of this is that the median developing country has had significantly higher inflation than the median advanced country over the past twenty years. Although the currencies of smaller OECD countries tend not to be used as anchors, it is still convenient to exclude them in order to avoid the complications associated with the problem of how to classify the European Monetary System.

(2) The appropriate ERR classification depends on the issue under investigation, and is not likely to be the same if we are interested in, say, the degree of intervention rather than the ERR-inflation relationship. In the latter case, it is particularly important to avoid the bias involved in using a classification scheme in which arrangements designed to allow a pegged regime to adapt to high inflation – such as a pre-announced crawl – are treated as "intermediate" (semi-floating).

(3) Inflation in developing countries has fallen significantly during the 1990s, and therefore it is important to allow for shifts in the ERR-inflation relationship over time.

(4) Because of the positively skewed nature of the inflation distribution, the treatment of outlying observations at the high end is important in any empirical analysis, and results needed to be tested for robustness to high-inflation outliers.

The structure of our paper is as follows. In Section 2 we present a simple theoretical model. In Section 3 we discuss issues of exchange rate regime classification. Section 4 reports our results, and Section 5 concludes.

2. Theory

Suppose that the government cares about deviations of the real exchange rate from equilibrium, and about inflation relative to some target level. It may choose a floating exchange rate, in which case it can select monetary growth to hit its inflation target exactly, but then it has to accept whatever degree of real exchange rate volatility the market delivers. Alternatively it can peg the exchange rate to some anchor currency which is characterised by low inflation (below the government's target), and can control real exchange rate volatility by the frequency of parity adjustments. The government's loss function is:

$$L = (d - d^*)^2 + E(Q - Q^*)^2 + nC \tag{1}$$

where d represents inflation in non-traded goods, d^* the target rate of d, Q the real exchange rate (in logs), and Q^* the equilibrium or target real exchange rate, C is a cost which is incurred if a pegged exchange rate is adjusted, n is the frequency of exchange rate adjustments, and E is the expectations operator. Equation (1) says that the government dislikes inflation, real exchange rate volatility, and exchange rate adjustments. The relative strengths of these dislikes are expressed by the parameters d^* and C.[1]

The government operates monetary policy to fix a rate of inflation of non-traded goods (d). Consumer price inflation (p) is jointly determined by d, the rate of exchange rate appreciation (e) and foreign inflation (f) as follows:

$$p = a(f - e) + (1 - a)d \qquad\qquad 0 < a < 1 \tag{2}$$

By definition the rate of change of the real exchange rate (the price of non-tradeables relative to tradeables) is given by:

$$q = d - f + e \tag{3}$$

In a pegged regime the government has two degrees of freedom. It can choose both inflation (d) and the frequency of devaluation (n) (assuming that $d^* > f$).[2] Given these, it is optimal for devaluations to compensate exactly for inflation differentials since the last devaluation, and this will determine the variance of Q. Between devaluations, Q increases at the rate $d - f$. Each devaluation is of size $(d - f)/n$, and

$$E(Q - Q^*)^2 = (d - f)^2/12n^2 \tag{4}$$

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[1] Implicitly, if d^* is higher, we can think of this as the government being less concerned to achieve price stability.

[2] Clearly if $d^* = f$, no devaluation is ever necessary, and $Q = Q^*$ at all dates.

Substitution from (4) into (1) and differentiation with respect to n and d yields the optimal solution:

$$d - f = 48(d^*-d)^3/C^2 \qquad (5)$$

Equation (5) shows that the government chooses an inflation rate that is intermediate between the foreign rate (f) and that which it would choose under flexible exchange rates (d^*). Note that, even though the exchange rate peg has no credibility in the sense that devaluations are known to occur with frequency n and to compensate fully for accumulated real appreciation, the peg still results in lower inflation. If the cost (C) of exchange rate adjustments is higher, or the government values price stability more highly (d^* is lower), then inflation is lower. The frequency of devaluations is inversely related to C but increases with the inflation differential, since

$$n^3 = (d - f)^2/6C \qquad (6)$$

This analysis suggests that, in differentiating between different types of pegged regimes, one should focus on the political cost or difficulty of adjusting the parity (i.e. C). Assuming that a pre-announced crawl effectively means C close to zero and an infinite value of n, a "soft" peg that can be converted into a pre-announced crawl at any time arguably has a low value of C. On the other hand, if parity changes require the agreement of other countries (as in the European Monetary System or the CFA), then C is likely to be higher. Currency board arrangements, in which domestic monetary policy is automatically tightened in response to foreign reserve losses, are generally backed by strong commitments not to devalue. We classify currency boards and shared currencies (e.g. the CFA) as "hard pegs" on the grounds that they effectively have high values of C.

Thus we anticipate lower inflation for hard pegs than for soft pegs, and (probably) for soft pegs than for floats.

What about the choice of exchange rate regime? If the exchange rate is floated, the government hits its inflation target $d*$ and does not incur any devaluation costs (C). It therefore chooses to float if

$$L_{peg} > E(Q - Q*)^2_{float} \tag{7}$$

where L_{peg} is the value of the loss function under pegging, as given by (1), and $E(Q - Q*)^2_{float}$ is real exchange rate variance under floating. This is more likely if real exchange rate variance under floating is higher (perhaps because of greater terms-of-trade volatility), if the government is less averse to inflation ($d*$ is higher), or if perceived devaluation costs are larger (C is higher).

As far as the relationship between exchange rate regimes and inflation is concerned, there is two-way causality here: pegging reduces the inflation rate relative to floating, but countries with higher inflation propensities are more likely to choose to float. In testing the former hypothesis, we need to worry about potential endogeneity from the latter effect.

A further complication is that the theoretical model may not apply in some situations, particularly the outlying observations when inflation is very high. It strains credulity to say that economies in such a state have chosen to be there through some optimising procedure. It seems more likely that they have resorted to seigniorage financing of fiscal deficits as a default mechanism in the face of a deadlock between alternatives. In other words, they have succumbed to an inflationary crisis precisely out of a failure to optimise, perhaps because of an inability to agree on the form of the loss function in view of the distributional

issues involved.[3] These outlying observations are likely to have great leverage in any empirical test, but are best characterised as states of inflationary crisis in which the theoretical model breaks down and $d > d^*$.

The standard method of attempting to exit from such an inflationary crisis is some form of exchange-rate-based stabilisation (Dornbusch and Fischer, 1986). This involves pegging the exchange rate, but does not necessarily represent a shift to pegging, if previously some form of crawling peg was in operation rather than a float.[4] Nevertheless, if the exchange rate floats in a significant proportion of inflationary-crisis observations, we will observe a tendency for high inflation to be associated with a higher probability of a switch to a peg. This is the opposite prediction to that of the theoretical model developed above. Moreover, this effect is likely to bias standard Hausman-type tests in favour of a rejection of endogeneity, thereby attributing greater causality to the exchange rate regime than is justified.

The standard instrumental variable approach to the endogeneity problem does not work well in this case for several reasons. One is that we lack good models of exchange rate regime choice, so it is difficult to find suitable instruments for the ERR (Juhn and Mauro, 2002). Another is that many potential instruments may themselves be significant determinants of inflation and should be included in a fully specified inflation regression, so that there would be an omitted variable bias in treating them instead as instruments for the ERR. In addition, inflationary crises and exchange-rate-based stabilisations (ERBSs) complicate the issue of endogeneity. Instead of two possibilities, there are essentially three: that the exchange rate regime is always exogenous to inflation, that it is exogenous

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[3] See, for example, the model of delayed stabilisation in Alesina and Drazen (19**).
[4] This statement presumes that a crawling peg is counted as a peg and not as some form of intermediate regime, as has sometimes been the case. We discuss these classification issues in the next section.

except in the case of ERBSs, when high inflation tends to trigger a switch to a peg, and that it is always endogenous.

Our approach to the endogeneity issue proceeds in four steps, the first of which is more of an exploration of the data.

(1) *Splitting the sample of countries into those that have switched regime and those that have not.* Ignoring the case of ERBSs for the moment, if the ERR is exogenous and inflation reacts quickly to switches in the ERR, switchers should yield the same results as non-switchers. If inflation only adjusts slowly to switches in the ERR, there will be smaller differences in inflation rates across ERRs in the switcher sample than in the non-switcher sample. If the ERR is endogenous, differences in inflation rates across ERRs in the switcher sample may be very small, because the switcher sample may be dominated by countries whose inflation rates are such that they are more or less indifferent between floating and pegging. Since ERBSs occur at high inflation, they will tend to raise the average inflation rate of switchers currently pegging, which complicates the picture.

(2) *Adding fixed (country) effects and/or lagged inflation to the regression of inflation on exchange rate regime dummies.* The motivation for this is that *if* the exchange rate regime is endogenous *and* inflation is persistent, then both current inflation and the ERR will be explained by the fixed effects (or lagged inflation), and the partial correlation between the exchange rate regime and current inflation will disappear. In effect the fixed effects (or lagged inflation) will substitute for a structural model of the inflation process.

(3) *A Granger causality test between switches of exchange rate regime and changes in the inflation rate.* This is a standard method for distinguishing the direction of causality. We implement this test both for either-way switches (i.e. the dummy takes the value 1 (switch) or 0 (no switch)) and distinguishing the direction of switch (the dummy takes the value 1 (switch to float), 0 (no

switch) or –1 (switch to peg)). The former specification assumes identical effects whatever the direction of switch, and the latter assumes opposite but equal effects for opposite directions of switch.

(4) *A probit analysis of regime switches using the lagged level of inflation*. Note that the probit analysis uses the level rather than the change in the inflation rate, unlike the Granger causality tests. This tests whether the likelihood of a switch of ERR varies significantly with the level of inflation.

Since most countries on hard pegs (principally the CFA) have never switched regime, the last two tests are implemented on a sample omitting these countries, using switches between soft pegs and floats only.

Table 1 summarises the predictions of three hypotheses with respect to each of these tests: (1) the exchange rate regime is exogenous throughout; (2) that it is exogenous except for ERBSs; and (3) that it is endogenous. Each row of the table represents a different test, and each column a different hypothesis.

Table 1. Predictions of various hypotheses about exchange rate regime endogeneity

	ERR exogenous	*ERR exogenous except for ERBSs*	*ERR endogenous*
Average inflation rates by country	Permanent peggers < switchers < permanent floaters	Permanent peggers < switchers and floaters	Permanent peggers < switchers and floaters
Fixed effects inflation regression	Peg < float	Peg < float	No effect
Granger causality test	Switch to peg causes lower inflation; switch to float causes higher inflation. Change in inflation does not cause regime switch.	Switch to peg causes lower inflation; switch to float causes higher inflation. Increase in inflation may cause switch to peg at very high inflation rates.	Change in regime does not cause inflation; increase in inflation causes regime switch (either way)
Probit for regime switches	No effect	Switch to peg more likely at very high inflation	Switch in either direction more likely at higher inflation rates

The reasoning behind Table 1 is as follows. If the ERR is exogenous, then countries' inflation rates will be correlated with the proportion of the time that they floated, making switchers likely to have an intermediate level of average inflation. Allowing for ERBSs changes that, because countries with inflationary crises are likely to be switchers, thus pulling up the average for this category, possibly to a level above that of permanent floaters. In a fixed-effects inflation regression, the ERR effect should disappear if this variable is endogenous, because the determinants of inflation will be largely taken out by the fixed effects (or by the inclusion of lagged inflation in the regression), but should be maintained if the ERR is exogenous. In effect, if the ERR is endogenous, then lagged inflation (or country effects) will explain both current inflation and the

ERR, and the ERR will become insignificant in an inflation regression that includes these variables. The predictions of the probit and the Granger causality tests are fairly self-evident, the only complication being the possibility of an ERBS, which makes a switch to a peg more likely if inflation is high or increasing.

3. Classification of Exchange Rate Regimes

There are two approaches to the problem of classifying exchange rate regimes: a *de jure* classification based on the stated commitment of the Central Bank and a *de facto* classification based on the observed behaviour of the exchange rate. The *de facto* approach was given impetus by the observation, after the Asian crisis, that many of the countries involved were effectively pegging to the U.S. dollar, even though their announced regime was a basket peg or even a managed float. The *de facto* approach is labour-intensive, and liable to produce strange results if an inappropriate procedure is used. It is probably best regarded as a useful check on the *de jure* classification.

We construct a data set based on the IMF classification scheme, which until the mid-1990s was based exclusively on countries' own official definition of their ERR. There are two main difficulties involved in this. One is that the IMF system has not remained invariant across years. The other is that there are more categories than can be conveniently used in an empirical test, so there is an aggregation problem. The most common way to deal with this aggregation problem is to reduce the categories to two (pegged and floating) or three (pegged, intermediate and floating). The latter type of aggregation (pegged, intermediate, floating) has been used by many previous authors (Collins (1996),

Ghosh *et al.* (1997)[5], Bailiu, Lafrance and Perrault (2000), Bénassy-Quéré (2000), and Masson (2000)).

We have two major criticisms of this system of aggregation. The first is the treatment of "crawling pegs and bands". These are usually placed in the Intermediate category, presumably on the grounds that the authorities are not wedded to a fixed parity. The problem is that pegs only crawl *because* of a significant inflation problem. Classifying crawling pegs differently from other pegs is therefore likely to create a type of "classification endogeneity" in any test of the ERR/inflation relationship, whereby pegs with high inflation become categorised as non-pegs. Our second criticism is that it makes no distinction between "soft" and "hard" pegs, although theory suggests that inflation rates may be quite different in the two categories (and empirical evidence supports this hypothesis - Bleaney and Fielding (2002) find a highly significant CFA effect). The distinction between soft and hard pegs (such as currency unions or currency boards) was not made in the IMF classification until December 31st 1997, but it is not difficult to reconstruct the category for previous years.

The source for the classification of the exchange rate regime for each country was the IMF Annual Report on Exchange Arrangements and Exchange Restrictions. The layout of these reports has been changing over the years, which makes it difficult to create consistent criteria for grouping all the countries over the years on exchange rate regime categories. Essentially we aggregate the eight IMF classifications into three categories:

(1) Hard Peg (No Separate Legal Tender; Currency Board);

(2) Soft Peg (Peg to a Single Currency, Peg to a Composite of Currencies, Crawling Pegs and Bands, Limited Flexibility);

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[5] For the main results Ghosh *et al.* (1997) consider these three categories, which were disaggregated in nine categories for the robustness tests.

Floats (Managed Floating; Independently Floating). Details of how we dealt with these issues appear in the Appendix.

We check our results against the *de facto* classification of Bubula and Ötke-Robe (2002), hitherto called the BR classification. These authors attempt to backdate to 1990 the more *de facto* approach adopted by the IMF since 1999, paying attention to the historical behaviour of the exchange rate and to policy announcements. Relative to the official IMF classification up to 1998, the BR classification defines about 20% more of the observations as pegs of various kinds and about 20% fewer as floats.

The BR classification is disaggregated into 13 categories, which are grouped into Hard Pegs regimes, Intermediate regimes and Floating regimes. Their Hard Pegs regimes coincide with our classification – no separate legal tender (formal dollarisation and currency union), and currency boards. Their intermediate regime includes soft pegs and tightly managed floats. The broad pegs are: conventional fixed pegs (vis-à-vis a single currency, and vis-à-vis a basket), horizontal bands, crawling pegs (forward-looking and backward-looking), and crawling bands (forward-looking, and backward-looking). The floating category includes other managed floats with no predetermined exchange rate path and independently floating.

In order to make a comparison of results with the IMF classification we aggregate the BR classification in the same way: into hard pegs, soft pegs and floating. One difference between BR's aggregation and our is that we treat "tightly managed floats" as Floats rather than "Intermediate".

4. Data and Descriptive Analysis

Our sample covers annual observations for 102 developing countries (see Appendix I) over the period 1984 to 2000, excluding countries in transition. Other countries which experienced periods of war or which had incomplete data were also omitted.

Our analysis uses "transformed inflation" in percentage form $(100\pi/(1+\pi))$, where π is the change in the logarithm of the consumer price index since the previous year. This is a common practice to reduce the outlier effects of high-inflation observations, since it has a maximum of one as inflation tends to infinity, but makes little difference at low inflation. The same transformation was applied to money growth. As a robustness test we also explore the effect of excluding a group of high-inflation countries, which are defined as those with average inflation rates greater than 25% or with inflation in any one year greater than 170%.

4.1 Descriptive Analysis: IMF Classification

Graph 1 shows the evolution of exchange rate regimes over time, using Classification Two. In 1984 Soft Pegs were the dominant regime (62.7% of the sample, against 19.6% Hard Pegs, and 17.6% Floating regimes). From 1984 to 1995, the number of Soft Pegs fell by 37 (out of 102), and the number of Floats

Graph 1- Number of countries in the different categories
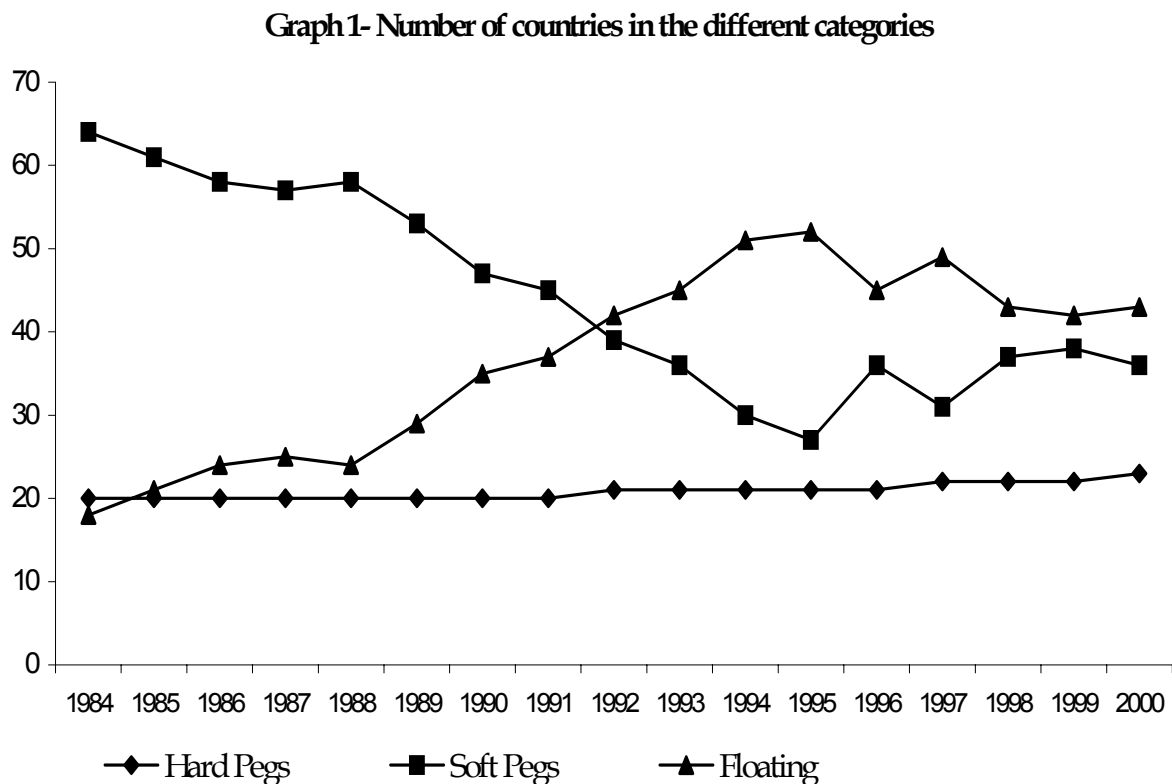
increased by 34. After 1995 this tendency was reversed: there was a net gain of 9 Soft Pegs (more precisely to Crawling Pegs and Bands, and Pegs to a Single Currency), and a net loss of 9 Floats. At the disaggregated level, the decline was greatest for a Peg to a Composite of Countries, and the increase was greatest for Independently Floating. The number of countries classified as Hard Pegs is virtually unchanged over this period.

Inflation rates in developing countries began to decrease after 1990, except for 1994 when inflation increased considerably as a result of the devaluation in the CFA Zone. Since then inflation has been decreasing sharply through the decade. Hard Peg is the category with the lowest inflation over the period, with the exception of 1994 when the CFA Zone devalued (Graph 2). The average inflation 1984-2000 was 3% for Hard Pegs, 11.5% Soft Pegs and 15.6% for Floating regimes for the whole sample (for the sub-sample that excludes high-inflation countries the figures are respectively 3%, 8.1% and 9.9%).

Floating regimes always have higher inflation than Soft Pegs, but the differential is highest during 1991-1995. This is also true for the sub-sample. In the 1990s inflation decreased in both regimes, but the decrease is larger for Floating regimes.

Graph 2 -Inflation and Exchange Rate Regimes (all sample)
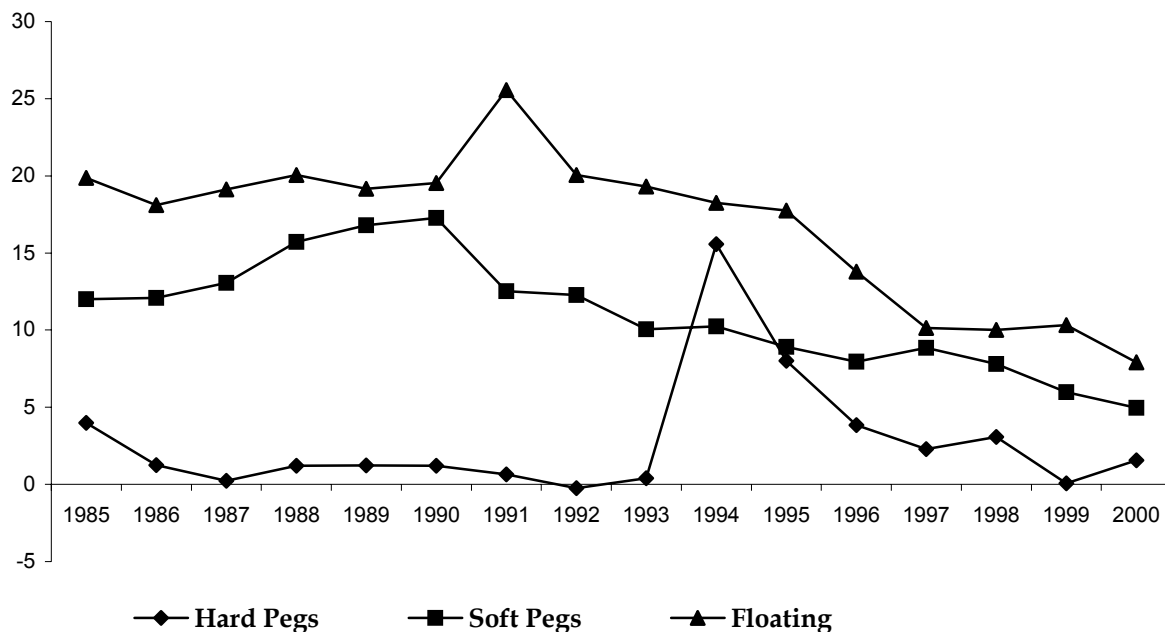
Graph 3 shows that average money growth and inflation across all developing countries have moved very closely together over time (but with less deceleration of money growth in the late 1990s). Graph 4 shows that the pattern of money growth across exchange rate regimes is very similar to that for inflation. The Floating regimes have the highest and the Hard Pegs the lowest levels of money growth. After 1995 the money growth rates across the exchange rate regimes converge. This is because of a consistent decrease in Floating regimes and an increase in Hard Pegs during the 1990s. The Soft Pegs decreased their rate of money growth in the late 1990s to a much smaller degree than the Floating regimes.

Graph 3- Money Growth and Inflation (all sample)
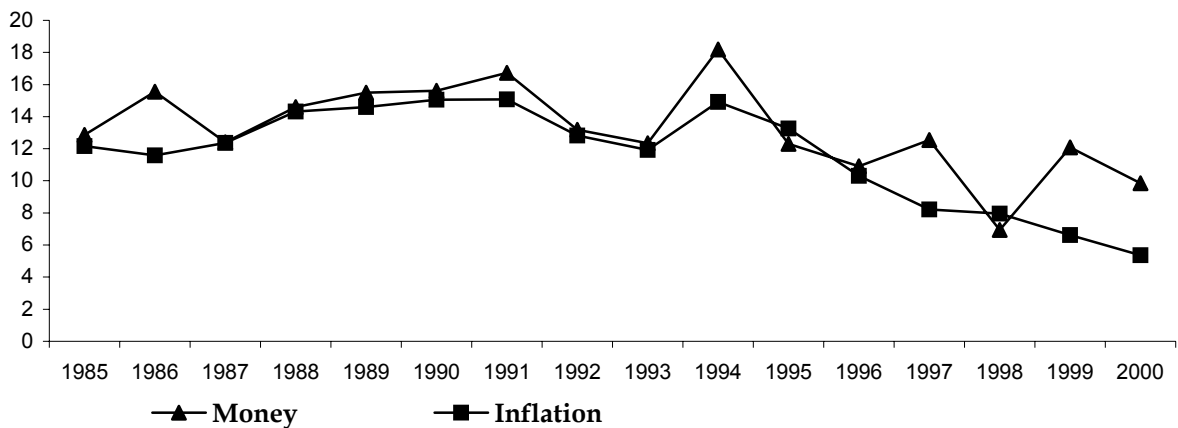
Graph 4- Money and Exchange Rate Regimes (all sample)
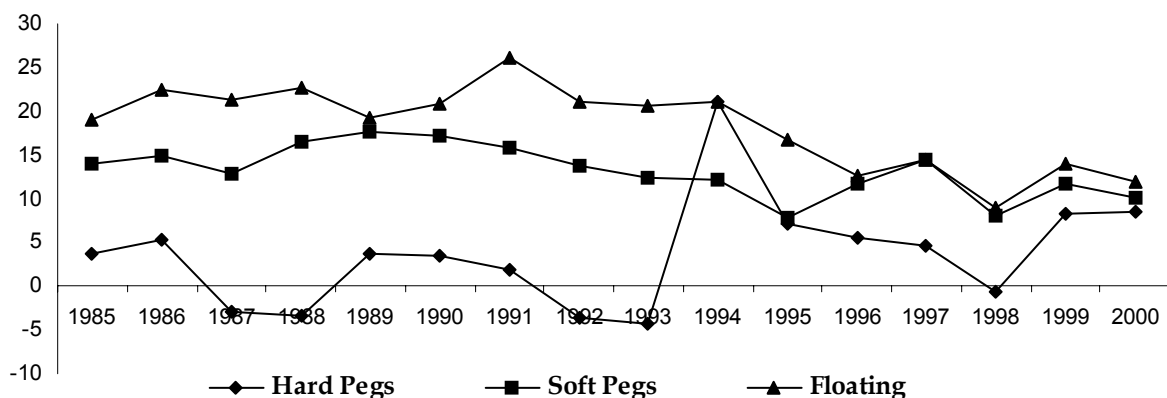
4.2 Comparison of the de jure and de facto classifications

Table 2 shows the frequency of Hard Pegs, Soft Pegs, and Floating regimes according to the two classifications.

Table 2: Distribution of Exchange Rate Regimes

	IMF[6] 1984-2000	IMF 1990-2000	BR 1990-2000
Hard pegs	355	235	235
Soft Pegs	737	386	532
Floating	640	499	355

According to the *de jure* classification Soft Pegs are the dominant regime in the 1980s. In the 1990s this pattern is reversed with a prevalence of Floating regimes over the Soft Pegs. In contrast, with *de facto* classifications there are more Soft Pegs than Floating regimes.

Table 3: Countries by classification

	IMF 1984-2000	IMF 1990-2000	BR 1990-2000
Non-switchers:			
Hard peggers	23	23	23
Soft peggers (Fixers)	19	20	25
Floaters	8	25	14
Switchers	52	34	40
Total classified countries	102	102	102

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[6] Iraq and Somalia are not classified in 1995.

Table 3 shows that during the 1990s the majority of countries stuck to the same regime (at this level of aggregation), with more countries identified as switchers according to the *de facto* classification (40 compared with 34). Using data back to 1984, just over half of all countries are switchers according to the *de jure* classification.

Table 4 shows the average inflation rates by exchange rate regime for 1984-2000 and 1990-2000 (IMF) and 1990-2000 (BR). Hard Peg regimes have consistently low levels of inflation, with an average below 5% p.a. Floating regimes have an average of about 15% p.a., and Soft Pegs are intermediate between these two extremes. When the sample is divided into Switchers and Non-Switchers, it becomes clear that Switchers have similar inflation rates to Permanent Floaters, and much higher rates than Permanent Peggers (Hard or Soft). Table 4 shows that this is because Switchers currently pegging have much higher inflation rates than Permanent Peggers. Table 5 shows that the same relationships hold for money growth.

Table 4: Average transformed inflation (% p.a.)

	IMF 84-00	IMF 90-00	BR 90-00
Hard pegs	2.90	4.08	4.08
Soft Pegs	11.72	9.49	11.51
Floating	15.99	15.39	14.83
Observations	*1480*	*975*	*975*
Non-switchers			
Hard peggers	6.54	6.14	6.14
Fixers	8.64	6.95	8.76
Floaters	15.54	13.77	13.48
Switchers	14.24	14.50	14.53
Currently floating	15.08	15.78	15.54
Currently pegging	13.30	12.84	13.63
Observations	*1480*	*975*	*975*

Table 5: Average money growth transformed (% p.a.)

	IMF 84-00	**BR 90-00**
Hard pegs	3.80	5.39
Soft Pegs	13.77	13.57
Floating	17.44	16.60
Observations	*1529*	*995*
Non-switchers		
Hard peggers	7.12	6.91
Fixers	11.58	11.51
Floaters	19.66	15.68
Switchers	15.61	16.12
Currently floating	16.29	17.25
Currently pegging	14.83	15.09
Observations	*1529*	*995*

5. Empirical Analysis

We estimate a pooled model with ERR dummies and year dummies. The year dummies prevent the results from being contaminated by a time-series relationship between exchange rate regimes and inflation in the average country. The model effectively estimates a cross-section relationship which is pooled across years, and ignores the time-series dimension.

We check that the estimates are robust to the exclusion of high-inflation countries by reporting results for a sub-sample omitting these countries. The ERR regime dummies (which correspond to the ERR regime as of 31 December) are lagged one period, so that inflation in 1990, say, is regressed on the ERR as at 31 December 1989. The omitted category is Soft Pegs, so coefficients of the other regimes (Hard Pegs and Floating) should be interpreted as inflation differentials relative to the Soft Peg regime.

The results of this test for the *de jure* classification are shown in Table 6. Table 6 shows that Hard Pegs have 5.1% less (transformed) inflation than Soft Pegs (when high-inflation countries are omitted), while Floats have 2.0% more inflation, with both coefficients significant at the 0.01 level. If the sample is divided into Switcher and Non-Switcher countries, the effects are still significant, but smaller for switcher countries (especially when high-inflation countries are included, probably because of the effects of exchange-rate-based stabilisations).

Table 7 shows that, if fixed country effects or lagged inflation are included in the regression, the fit improves dramatically, and the Hard Peg dummy remains significantly negative, but the Float dummy is always insignificant.[7]

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[7] The Hard Peg dummy cannot be estimated for the sub-sample because of collinearity with the fixed effects.

This suggests strongly that Hard Pegs help to maintain monetary discipline and reduce inflation, but that Soft Pegs do not, with the choice between Soft Pegs and Floats reflecting inflationary experience rather than determining it. We examine this hypothesis in more detail below by performing Granger causality tests and a probit analysis of switches of exchange rate regime.

Tables 8 and 9 show the results of equivalent exercises with the *de facto* (BR) classification. Table 8 is very similar to Table 6, except that the Float dummy is not significant for the Switcher country sample (excluding high-inflation countries). In addition, the Hard Peg dummies have slightly smaller (although still highly significant) coefficients. Table 9 shows that the Hard Peg dummy remains significantly negative with fixed effects and lagged inflation. The Float dummy always has a positive coefficient, but not one that is consistently significant.

Table 6: Inflation and Exchange Rate Regimes (*de jure* Classification)

| | IMF: 1984-2000 | | | | | |
| | All countries | | Switcher countries excluded | | Switcher Countries only | |
	All sample	Sub-sample	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-8.24***	-5.13***	-5.805***	-3.890***		
	(12.54)	(11.08)	(7.17)	(7.75)		
Floating dummy	5.345***	2.046***	10.38***	2.552***	2.812**	1.685**
	(6.42)	(4.43)	(6.31)	(3.73)	(2.59)	(2.49)
Obs.	1398	1127	671	582	727	545
Adj R-sq	0.17	0.20	0.24	0.25	0.08	0.09
Root MSE	12.754	6.4787	12.00	5.5229	13.252	7.2253

Dependent variable: inflation transformed [π/(1+ π)]%
Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

Table 7: With Fixed Effects and Inflation Persistence (*de jure* Classification)

| | Fixed Effects | | Lagged Inflation | |
	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-38.860***		-1.567***	-1.960***
	(10.72)		(3.34)	(4.76)
Floating dummy	-0.470	-0.206	0.176	0.483
	(0.61)	(0.38)	(0.40)	(1.41)
Lagged inflation			0.842***	0.635***
			(29.93)	(21.97)
Observations	1398	1127	1386	1118
No. of countries	92	74		
Root MSE	8.805	5.235	6.803	5.026
AdjR-squared	0.63	0.50	0.76	0.52

Dependent variable : inflation transformed [π/(1+ π)]%
Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

Table 8: Inflation and Exchange Rate Regimes (*de facto* Classification)

| | BR: 1990-2000 | | | | | |
| | All countries | | Switcher countries excluded | | Switcher countries only | |
	All sample	Sub-sample	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-7.138***	-4.119***	-5.620***	-2.202***		
	(9.68)	(7.04)	(6.85)	(3.75)		
Floating dummy	4.028***	2.322***	3.304***	3.777***	4.646***	0.530
	(3.91)	(3.82)	(3.01)	(5.33)	(2.62)	(0.54)
Obs.	887	716	533	434	353	281
Adj R-sq	0.16	0.19	0.19	0.25	0.11	0.10
Root MSE	11.491	6.475	9.073	5.456	14.187	7.391

Dependent variable : inflation transformed $[\pi/(1+\pi)]\%$
Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

Table 9: With Fixed Effects and Inflation Persistence (*de facto* Classification)

| | Fixed effects | | Lagged Inflation | |
	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-24.864***		-1.536**	-1.126**
	(5.72)		(2.48)	(2.12)
Floating dummy	1.856**	0.695	0.178	0.937**
	(2.08)	(1.05)	(0.32)	(2.11)
Lagged inflation			0.765***	0.632***
			(19.73)	(17.33)
Observations	887	716	881	710
No. of countries	92	74		
Root MSE	7.443	4.903	6.627	4.998
Adj R-squared	0.68	0.58	0.72	0.52

Dependent variable : inflation transformed $[\pi/(1+\pi)]\%$
Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

In Tables 10 to 13 the same exercises are repeated for money growth. The results for Hard Pegs are similar to those for inflation: the coefficient is always negative and significant. For Floats, the coefficient is positive and usually significant (although not always so for the *de facto* classification), but always insignificant and often negative when the regression is augmented by fixed effects. With lagged money growth, the Floating dummy is significantly positive with the *de jure* classification but not with the *de facto* classification. Thus it appears that the choice between Soft Pegs and Floats does not affect dynamics of the money supply, but the choice of a Hard Peg reduces monetary growth.

Table 10: Money Growth and Exchange Rate Regimes (*de jure* Classification)

	All countries		Switcher countries excluded		Switcher countries sample	
	All sample	Sub-sample	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-9.410***	-6.978***	-7.684***	-6.077***		
	(8.81)	(6.87)	(6.00)	(5.19)		
Floating dummy	4.607***	1.713**	9.323***	3.513***	2.958**	1.785*
	(5.13)	(2.38)	(5.27)	(3.02)	(2.51)	(1.68)
Obs	1441	1167	694	605	747	562
AdjR-sq	0.13	0.10	0.18	0.14	0.05	0.05
Root MSE	15.013	11.883	15.689	12.589	14.199	10.855

Dependent variable: money transformed [m/(1+ m)]%
Dro Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

Table 11: With Fixed Effects and Money Growth Persistence (*de jure* Classification)

	Fixed Effects		Lagged Money Growth	
	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-36.802***		-6.059***	-6.622***
	(7.09)		(5.04)	(6.35)
Floating dummy	-1.000	-1.120	2.371***	1.561**
	(0.92)	(0.97)	(3.02)	(2.15)
Lagged money growth			.380***	0.0536
			(5.82)	(1.12)
Observations	1441	1167	1434	1163
No. of countries	92	74		
Root MSE	12.662	11.523	13.748	11.887
Adj R-squared	0.25	0.20	0.27	0.10

Dependent variable : money transformed [m/(1+ m)]%
Dropped regime: Soft Pegs.   Sub-sample excludes high-inflation countries

Table 12: Money Growth and Exchange Rate Regimes (*de facto* Classification)

	All countries		Switcher countries excluded		Switcher countries sample	
	All sample	Sub-sample	All sample	Sub-sample	All sample	Sub-sample
Hard Peg dummy	-8.219***	-6.138***	-6.767***	-4.485***		
	(6.35)	(4.82)	(4.74)	(3.22)		
Floating dummy	2.733**	1.519	3.067**	3.135**	2.464	0.136
	(2.54)	(1.63)	(2.36)	(2.38)	(1.46)	(0.11)
Observations	904	731	547	447	356	283
AdjR-sq	0.11	0.10	0.11	0.10	0.09	0.11
Root MSE	13.825	11.523	13.643	12.527	13.895	9.3377

Dependent variable: money transformed $[m/(1+m)]\%$

Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

Table 13: With Fixed Effects and Money Growth Persistence (*de facto* Classification)

	Fixed Effects		Lagged Money Growth	
	All sample	Subsample	All sample	Subsample
Hard Peg dummy	-22.313***		-5.216***	-5.462***
	(3.21)		(3.75)	(4.11)
Floating dummy	0.060	-0.379	1.093	1.124
	(0.04)	(0.26)	(1.16)	(1.21)
Lagged money growth			0.368***	0.11
			(5.54)	(1.60)
Observations	904	731	900	728
Root MSE	11.917	11.088	12.819	11.482
Adj R-squared	0.40	0.24	0.24	0.11
No. of countries	92	74		

Dependent variable: money transformed $[m/(1+m)]\%$

Dropped regime: Soft Pegs. Sub-sample omits high-inflation countries

We now perform a Granger causality test between changes in exchange rate regime (excluding Hard Pegs, for which there were very few regime switches anyway) and changes in the inflation rate. The principle of the test is that if lagged changes in the ERR are significant in a regression for changes in the inflation rate, we can conclude that changes in the ERR cause changes in inflation. If lagged changes in inflation are significant in a regression for changes in the ERR, then we can conclude that changes in inflation cause changes in ERRs (bidirectional causality is a possible conclusion). A complication is that a change in the ERR can be formulated in two ways. One is as the first difference of the Float dummy (switch to float = 1; no switch = 0; switch to peg = -1); the other is as the absolute value of this (switch either way = 1; no switch = 0). Results for both formulations are shown in Table 14 for the IMF classification. In the regression for changes in inflation, we allow for different coefficients according to the direction of switch, but none is significant. When high-inflation countries are included, however, the lagged change in inflation has a positive coefficient in the regression for ERR changes, whichever specification is used. This suggests that a rise in inflation tends to trigger a switch of ERR, and is consistent with causality running from inflation to ERR choice, rather than *vice versa*.

Table 14: Granger Causality Tests

	Change in Inflation		Change in ERR		Change in ERR Either way	
	Hard Peggers countries excluded	High Inflation and Hard Pegger countries Excluded	Hard Peggers countries excluded	High Inflation and Hard Pegger countries Excluded	Hard Peggers countries excluded	High Inflation and Hard Pegger countries Excluded
Lagged Switch dummy	-3.384 (1.36)	0.223 (0.36)				
Lagged Switch to float dummy	2.355 (0.85)	0.0978 (0.07)				
Lagged change in Inflation			0.0029*** (2.71)	0.0034* (1.91)	0.0026** (2.36)	0.0023 (1.29)
Observations	1028	817	1093	869	1093	869
Adj R-sq	0.04	0.048	0.0285	0.0329	0.0433	0.0511
Root MSE	6.836	4.992	0.2587	0.2518	0.2658	0.2575
Dependent Variable	Inflation-Inflationlag1 (transformed inflation)		Switch=1, No switch=0		Floating dummy–Floating dummy lagged	

The earlier finding that Switcher countries had higher average inflation than Non-switchers suggests that the probability of an ERR switch may be positively correlated with the inflation rate. In fact, amongst Switcher countries, there is a significant positive correlation between the average inflation rate and the frequency of regime switches. To examine this hypothesis more formally, we undertake a probit analysis of switches of regime. We do this separately for countries that were on a Soft Peg and those that were Floating in the previous year. We include a time dummy to allow for possible shifts over time in the relevant probabilities. What emerges from Table 15 is that *both* a switch to a peg (for currently floating countries) and a switch to a float (for currently pegging countries) get significantly more probable as inflation increases. The coefficient

is about three times as great in the case of a switch to a float. This is consistent with the idea that with moderately high inflation, a switch to a float is more likely than at low inflation, but that with very high inflation, a switch to a peg becomes more likely (as happens in an exchange-rate-based stabilisation). In addition, a switch to a float has become significantly more probable over time at any given rate of inflation, as indicated by the significant positive coefficient of the time trend in this regression.

Table 15 is based on the *de jure* classification for 1984-2000. Table 16 shows the results for 1990-2000 using both classifications. For each classification the inflation coefficient is positive but insignificant in the case of a switch to a peg, perhaps because exchange-rate-based stabilisations were becoming rarer after 1989, but it is still significant for a switch to a float.

Table 15: Probit analysis of likelihood of ERR switch (*de jure* classification)

	ERR Switch 1984-2000	
	Switch to a Peg	Switch to a float
Inflation	0.0012**	0.0033***
	(2.05)	(4.99)
Time	0.0019	0.0074***
	(0.78)	(3.15)
No. of obs.	502	599
Pseudo-R²	0.016	0.0755
Wald χ²	4.64	32.83

Table 16: Probit analysis of likelihood of ERR switch (1990-2000)

	ERR Switch: 1990-2000			
	IMF		BR	
	Switch to a Peg	Switch to a Float	Switch to a Peg	Switch to a Float
Inflation	0.0007	0.0061***	0.0009	0.0028***
	(1.01)	(5.20)	(1.06)	(2.78)
Time	0.0044	0.0074	-0.00	0.0044
	(1.18)	(1.51)	(1.38)	(0.91)
No. of obs.	408	358	269	427
Pseudo-R²	0.0098	0.1008	0.0255	0.0264
Wald χ²	1.75	32.45	4.14	7.96

6.   Conclusions

The theoretical analysis suggested that pegs would be associated with lower inflation than floats, provided that the costs of devaluation were significant.   Whether the costs of devaluation represent a major deterrent to inflation in any given form of peg is an empirical question.   In our empirical work we distinguished Hard Pegs (a shared currency or a currency board) from other forms of Peg (Soft pegs), on the grounds that the obstacles or disincentives to devaluation are much higher for Hard Pegs.

Our empirical findings show that Hard Pegs are characterised by lower inflation and monetary growth than Soft Pegs, which in turn have slightly less inflation and monetary growth than Floats.   When we allowed for persistence in inflation and monetary growth (which is strong, and therefore significantly improves the fit of the regressions), the Float dummy became insignificant, whereas the Hard Peg dummy remained significant.   This suggests that past inflation is explaining *both* current inflation and the choice between a Soft Peg and a Float (i.e. that this choice is endogenous), whereas a decision to choose a Hard Peg significantly reduces inflation by imposing monetary discipline.

Our results for the choice between Soft pegs and Floats were confirmed by Granger causality tests, which showed that increases in inflation cause a switch of regime, but not *vice versa*.   In a probit analysis, the probability of a switch to a Float increases significantly with inflation, and in the 1980s (but not the 1990s, when major inflationary problems and exchange-rate-based stabilisations were rarer) the probability of a switch to a Peg also increases significantly with the inflation rate.   In general, countries with low inflation are likely to stay on a peg, whereas countries with higher inflation are likely to float or to switch between pegging and floating.

There has been much anxiety recently about official misrepresentation of the exchange rate regime in force. This anxiety seems overdone in this case, since we obtained very similar results using a classification based on what countries do rather than what they say.

Ghosh *et al*. (2002, p. 173) conclude unequivocally that "pegged exchange rates are associated with significantly better inflation performance" and that "this is an important benefit for the majority of developing and emerging market countries where policy credibility may be lower". Bleaney and Fielding (2000, 2002), Edwards (1993) and Ghosh *et al*. (1997) reach similar conclusions. By contrast we find that this is true only for Hard Pegs – there are no credibility gains from Soft Pegs. Our results are different for three reasons. One is that previous authors have not always distinguished between Hard and Soft Pegs. Another is that in previous investigations of this issue Crawling Pegs and Bands have often been classified as intermediate regimes. Both of these differences would reduce the apparent inflation rate for Soft Pegs. Finally, other authors have often not tested the robustness of the estimated ERR coefficients in inflation regressions to the inclusion of other variables in the model (notably past inflation and fixed country effects), that greatly improve the fit, so that their results suffer from a mis-specification bias.

The absence of any credibility benefits from soft pegs reinforces the argument for preferring some form of float (managed or otherwise) or a Hard Peg for countries exposed to sizeable capital inflows and outflows. In practice, Soft Pegs remain the most popular regime choice for developing countries which do not have inflationary problems.

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APPENDIX

Until 1995 the IMF reports three basic exchange rate arrangements:
a) peg to a single currency distinguishing between i)U.S. dollar, ii) pound sterling, iii) the French franc, iv) peg to other currencies and v) peg to a composite of currencies being indicated when the composite is a Special Drawing Rights (SDR). b) limited flexibility with respect to i) single currency and ii) co-operative arrangements; and c) more flexible arrangements: i) adjusted according to a set of indicators, ii) other managed floating, iii)independently floating.

In the IMF Reports relating to 1997 and 1998 the "Flexibility limited" category does not consider any more the subdivision into "single currency" and "cooperative arrangements". Amongst the "More flexible arrangements", the "adjusted according to a set of indicators" disappears, therefore presenting only "Managed floating" category, (which includes what was considered till then as "adjusted according to a set of indicators" and "other managed floating").

After 1998 IMF reports a more detailed classification considering eight categories: no separate legal tender, currency boards, conventional pegged arrangement (making distinction if it is a single currency or a composite of currencies), pegged exchange rate within horizontal bands, crawling pegs, crawling bands, managed floating with no-preannounced path for the exchange rate (dirty float) and independently floating. Lately, the IMF is aware that *de facto* exchange rate arrangements are different than the one announced by the countries, therefore, now IMF considers *de facto* policies in its classification. For instance, Jordan who in the years 1999 and 2000 had a de *jure* peg to the SRD but a de facto peg to the U.S. dollar is classified as peg to a single currency.

Since the construction of the classifications based on IMF Reports are not straightforward, some operations and assumptions had to be done, which were the following.

The crawling peg and bands category was disaggegated from the "Managed floating" category (IMF Report relating to 1996 and 1997). Looking at the countries which we suspect were crawling bands and pegs (Brazil, Chile, Colombia, Costa Rica, Honduras, Nicaragua, Sri Lanka, Tunisia, Turkey, Uruguay and Venezuela), we analysed the behaviour of the monthly exchange rate which suggest a crawling peg/band behaviour except in the case of Colombia. This classification does not coincide with that of Ghosh *et al.* (1997), which considers that only Chile has a crawling band in the period in analysis.

For 1998-2000 period we assume that currencies maintain the peg as before in order to distinguish peg to a single currency and peg to a composite of currencies, which are aggregated under "Other conventional fixed peg arrangements" category in IMF Reports.

The hard peg categories required the separation of these categories from the pegs to a single currency reported until 1997.

The countries considered as *no separate legal tender* were the following: i) the East Caribbean Common Market (ECCM): Antigua and Barbuda, Dominica, Grenada, St. Lucia and St. Vincent and Grenadines (St. Kitts and Nevis is not considered in the sample); ii) the CFA Franc Zone: the West African Economy and Monetary Union (WAEMU): Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau (which became part of French Franc Zone on 1st May 1997), Mali, Niger, Senegal and Togo. The Central African Economy and Monetary Community (CAEMC): Cameroon, Central African Republic, Republic of Congo, Equatorial Guinea and Gabon (although Comoros has the same arrangement with the French Treasury as do the CFA Franc Zone Countries is classified as peg); iii) Panama which adopted the dollar as legal tender in 1904. Considered as *Currency Boards* were Djibouti and Argentina. Argentina set up its currency board in 1991, however since the inflation figure for 1991 will reflect pre-CB events, so the hard peg dummy starts in 1992.

		As Reported by IMF for Exchange Rate Arrangements		
		Until 1995	**1996-1997**	**1998-2000**
Clasification 1	**Hard pegs**	Subset from the pegs to a single currency	Subset from the pegs to a single currency	No separate legal tender and currency boards
	Broad Pegs	Peg to a single and composite of currencies, limited flexibility with respect to a single currency and cooperative arrangements, and more flexible arrangements adjusted according to a set of indicators	Pegged to a single and composite of currencies, flexibility limited and the crawling pegs/bands subset from managed floating	conventional peg arrangements, pegged exchange rate within horizontal bands, crawling pegs and bands
	Floating	Other managed floating and independently floating	Managed floating (after excluded the crawling peg/ band) and Independently floating	Managed floating with no pre-announced path for the exchange rate and Independently Floating

	As Reported by IMF for Exchange Rate Arrangements		
	Until 1995	**1996-1997**	**1998-2000**
No separate Legal tender	Subset from Peg to a single currency	Subset from Peg to a single currency	No separate legal tender
Currency Board	Subset from peg to a single currency	Subset from peg to a single currency	Currency board
Peg to a single currency (USD, FF, GBP)	Peg to a single currency (report provides information which is the anchor currency)	Peg to a single currency (report provides information which is the anchor currency)	Subset from Conventional Peg arrangements (is assumed that the currency keeps the same anchor)
Peg to Other Single currency	Peg to a single currency (report provides information which is the anchor currency)	Peg to a single currency (report provides information which is the anchor currency)	Subset from Conventional Peg arrangements (is assumed that the currency keeps the same anchor)
Crawling Peg/Band	More Flexible arrangements adjusted according to a set of indicators	Subset from Managed Floating according to the analysis of the exchange rate behaviour	Crawling pegs and Bands
Limited Flexibility	Limited Flexibility with respect to a single currency and cooperative arrangements	Flexibility limited	Pegged exchange rate within horizontal bands
Managed Floating	Other managed floating	Managed floating after excluded the crawling peg/band	Managed floating with no pre-announced path for the exchange rate
Independently Floating	Independently floating	Independently floating	Independently floating

Classification 2 (row label, left margin)