Inflation Targeting or Fear of Floating in Disguise? A Broader Perspective

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Abstract

Calvo and Reinhart (2002) argue that many countries claim to float but actually display a "fear of floating" (FF) and that credible inflation targeting (IT) and FF are identical regimes. We analyze exchange rates, reserves, interest rates and inflation across 88 exchange rate regimes for 20 countries. We find IT is empirically distinguishable from fixed, floating, managed floating, and FF regimes. Credible IT appears to be more similar to floating and managed floating than to fixing or FF. Being able to identify these regimes accurately allows one to distinguish between cases where countries claim to IT but actually FF.

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1. Introduction

Calvo and Reinhart (2002), hereinafter C&R, argue that the bipolar view that exchange rate regimes today tend to be either fixed or floating is not accurate. In particular, they show that many regimes that claim to float actually use the domestic interest rate to prevent large fluctuations in their currency's value. While not fixing their exchange rate in the traditional sense, neither are these countries allowing it truly to float. C&R term such behavior fear of floating (FF).

The problem with C&R's framework is that it does not distinguish between a credible inflation targeting (IT) regime, a fixed exchange rate (FIX) regime, and FF. Their analysis is based on a model which argues that credible IT is identical to FF. In their words, "in this setting inflation targeting can explain fear of floating." (Calvo and Reinhart, 2002, p. 399). Since the rate of inflation and the rate of currency depreciation are identical in their model, it follows that IT, which targets inflation, and FIX, which targets the depreciation rate, are identical. One thus arrives at the conclusion that credible IT, FF and FIX are three equivalent regimes. Rather than clarify matters, this complicates attempts to classify *de facto* exchange rate regimes based on their work since their argument is that these regimes, when fully credible, are indistinguishable from one another.

The focus of this paper is on the differences between IT from FF. We develop a simple theoretical model to help organize our data. The essence of the model is an open economy Taylor rule for a strict IT regime. That is, it focuses solely on differences between the realized inflation rate and the inflation target, not on the output gap[1]. In this framework we then show that nominal exchange rate movements feed into overall domestic inflation in an open economy. For this reason alone, IT regimes will sometimes act to fight exchange rate movements, but they will be doing so for inflation reasons. We then add a separate term for exchange rate movements to the Taylor rule to model an FF regime's additional weight on exchange rate movements for non-inflation related reasons. This allows us to distinguish between three regimes – strict IT, strict exchange rate targeting, and FF – all based on different weights in the same Taylor rule. This approach is intuitive and in line with Taylor's (2001) and Edwards's (2006) discussion of classifying open economy Taylor rules.

Based on our analytical framework we extend C&R's analysis to include IT as a separate regime and generate the priors we expect to find in the data. Analyzing the variability of exchange rates, international reserves and nominal and real interest rates we find that IT generally appears to be distinguishable from other regimes. To further investigate how IT is different from other regimes we conduct regression analysis that looks at how the real interest rate responds to domestic currency depreciation, changes in international reserves, and changes in the inflation rate, while controlling for different monetary policy regimes that have been implemented. Our results show that some countries can be identified as FF and, again, that IT is generally distinguishable from FF, FIX, and flex. That IT is identifiably different comes across fairly strongly throughout all of our results.

We believe that our analysis is able to identify IT regimes, especially those that are strict. While our interest here is limited to distinguishing between IT and FF, we do hope that our work contributes to the growing and broader literature on exchange rate regime classification. Other studies that have followed C&R's FF work include Reinhart and Rogoff (2004), Levy-Yeyati and Sturzenegger (2005), and Dubas, Lee and Mark (2005). These works are all serious attempts to place exchange rate regime classification on more sure footing in general. They all focus on *de facto* classifications as a way beyond the traditional *de jure* classifications used for so long by the IMF. The lessons coming from this line of work is that accurate classification matters if we are to evaluate accurately the performance of various regimes. Despite these insights and gains, none of these studies agree on how to classify IT regimes and thus none of them include IT as a distinct regime. It is our hope that our notion of distinguishing between honest and dishonest regimes as well as our empirical approach in general helps overcome some of the barriers to classifying IT regimes more accurately within this broader research context.

The paper proceeds as follows. Section 2 focuses on Calvo and Reinhart's (2002) work. Section 3 presents our analytical framework. Section 4 discusses our data. Section 5 discusses our analysis and results. Section 6 concludes.

2. Fear of Floating and Inflation Targeting

At the heart of C&R's (2002) FF analysis is an appeal to the logic of the various *de facto* regimes. Fixers should display relatively constant exchange rates and lots of international reserve variation while floaters should display the opposite. Fear of floaters should then display less exchange rate variation than floaters, but more than fixers. Their international reserve variation should be less than fixers and more than floaters. That is, they should lie somewhere between the two extremes. The new twist C&R add is that the data on fear of floaters should also display a much higher variation in domestic interest rates due either to a lack of credibility and/or the policymaker's reaction function.

The C&R analysis uses these behavioral implications to generate statistical predictions to organize their data. They use these predictions to classify 39 countries into floaters at one extreme, fixers at the other and fear of floaters somewhere in between. To establish benchmark cases for their analysis they show that there is a 79 percent probability that domestic currency depreciation of recent floaters[2] is within a two-and-a-half-percent band while the probability for managed (or, limited flexibility) regimes and pegs is 92 to 95 percent, respectively. Based solely on exchange rate fluctuations they find that, of the IT countries in their sample, Canada, Sweden and Chile do not appear to float while Mexico and Korea appear to float. When they look at the variation of international reserves, the list of countries that are IT but found to be non floaters is Canada, Sweden, Mexico and Korea. Finally, in analyzing changes in the nominal interest rate they find that the interest rate of "true" floaters is within their pre-defined bands about 83 percent of the time. By way of comparison, Canada's interest rate is within that same band 62 percent while the Korean and Mexican rates are only within the band 20 and 9.4 percent of the time, respectively.

The problem with their analysis is that their theoretical foundation predicts that credible IT is equivalent to FF and FIX. In organizing their data for empirical analysis, however, they include known IT regimes as floating regimes and even use an IT regime (Australia) as a benchmark floater[3]. This unintentionally adds an element of confusion to their analysis that obscures rather than clarifies their regime classification results.

C&R's contribution remains extremely influential in highlighting the importance of *de facto* versus *de jure* classifications, however. Following their lead, other major works in this area have come forth in recent years. The two most prominent at this point are Reinhart and Rogoff (2004) and Levy-Yeyati and Sturzenegger (2005)[4].

Reinhart and Rogoff (2004) reclassify regimes for 153 countries from 1946 – 2001. Their scheme is very comprehensive, incorporating information from parallel and dual exchange rate markets. To capture all the subtleties of the real world, they end up with fourteen categories of exchange rate regimes. Their only mention of inflation targeting however is to comment that "[f]loating could be consistent with monetary targets, interest rate targets, or inflation targeting" but that several of the inflation targeters in their sample are classified as managed floaters although there are many variants of inflation targeting (Reinhart and Rogoff, 2004, p. 27 and fn. 27 on same page).

Levy-Yeyati and Sturzenegger (2005) use fewer categories for exchange rates. They have a five group and a three group scheme to classify 183 countries since 1974. Levy-Yeyati and Sturzenegger, however, remove interest rates from their analysis altogether. They argue that cases like IT confuse the role of interest rates in open economies. In contrast to Reinhart and

Rogoff, inflation targeters according Levy-Yeyati and Sturzenegger behave as floaters and are thus classified[5].

While agreement on how to classify regimes in general and inflation targeting in particular is still not settled, the results of these efforts are already bearing fruit. In a recent NBER working paper Dubas, Lee and Mark (2005) emphasize the importance on getting the classification right. They argue that empirical approaches based on *de jure* classifications were unable to add clarity to the theoretical discussion on the role of exchange rate regimes in growth. Using a *de facto* classification, developed in their paper, they find a positive relationship between fixed regimes and growth. Of great relevance to our work, they find that a country claiming to fix but actually floating has less growth than a country claiming to float but actually fixing. "For nonindustrialized countries, we find growth to be significantly higher for *de jure* floaters who effectively fix *de facto*" (Dubas et al., 2005, p. 5.) This may help explain why we and others find FF behavior in the data and, moreover, why an FF country may choose IT as its disguise.

Lastly, Ball and Reyes (2004) go after IT more directly. They examine Mexican data and argue that at least some of Mexico's interest rate variability can be ascribed to IT behavior as *distinct from* FF. This does not say that Mexico doesn't exhibit any FF, but merely that it doesn't appear to do so to the degree implied by the C&R analysis. The current study continues in that vein by modifying C&R's original analysis and by treating IT as a regime distinct from both floating and fixing in an attempt to empirically identify it as such.

3.1 Modified Approach

> "Many of the recent converts to floating exchange rates (several of whom were forcibly converted) have opted for inflation targeting, and that system seems to be working well and has much to commend it. With the inflation targeting approach to monetary policy, movements in the exchange rate will be taken into account indirectly in setting monetary policy, because the exchange rate affects price behavior. This will generally produce a pattern of monetary tightening when the exchange rate depreciates, *a response similar, but not necessarily of the same magnitude, to that which would be undertaken if the exchange rate were being targeted directly.*"
>
> (Fischer, 2004, pp.328-241, italics added)

We build on the logic presented in Fischer's quote and focus on the Taylor rule that results from a wide range of central bank optimization problems. The basic Taylor rule for a strict IT regime is

$$r_t = r^* + b(\Pi_t - \Pi^T) \qquad (1)$$

where r_t is the real interest rate, r^* is the world real interest rate, Π_t is the overall inflation rate, Π^T is the inflation target, b is a parameter, and by "strict" IT we mean that there is zero policy weight placed on the output gap.

Equation (1) follows the literature on Taylor rules in that interest rates react to current inflation even though the target is not formulated in terms of current inflation. Instead, the target is in terms of forecasted future inflation (usually two dates in the future). Current inflation is part of the rule because it, along with current output and exogenous shocks in most models, is a predictor of future inflation (Svensson 1997). In our analysis we will exploit that interest rates and targeted variables vary contemporaneously.

The rule is in terms of the real, not the nominal, interest rate. This is appropriate for economies where the short-term nominal interest rate is the instrument. Additionally, we chose this form to better distinguish between interest rates and inflation. Vegh (2001) argues that real-interest rate rules are frequently observed in emerging markets and that under certain restrictions, like Cagan-form money demand specifications, they are equivalent to nominal interest rate rules. To address possible concerns, however, we include the results for nominal interest rates in all our reported results.

For an open economy, the interpretation of equation (1) must be modified since pass through from exchange rate movements to traded goods prices link inflation and exchange rates. The presence of current exchange rates in the central bank's reaction function implies that domestic interest rates will respond regularly to changes in the nominal and/or real exchange rate. For this reason, an IT country may appear to be FF as noted by Agenor (2002), Ball and Reyes (2004), Edwards (2006), Eichengreen (2002), Fischer (2004), Mishkin (2004), Reyes (2006), and Taylor (2001) to name only a few.

The problem we address here is one of measurement. There is a difference between changes in the domestic interest rate that are associated with exchange rate fluctuations but are due to what might be termed "honest IT" – that is, strict adherence to an open economy IT regime and the resultant interest rate reaction function – and changes due to FF which imply an additional and generally hidden policy goal of managing the exchange rate. No country has ever publicly announced a policy of FF, for example. Since revelation of this additional policy objective may be negatively perceived, it is not in the central bank's interest to reveal this information in a clear manner. Thus a regime like IT may be appealing because it is classified as a flexible exchange rate regime but requires occasional changes in the domestic interest rate "for exchange rate reasons". For this reason, some closet fear of floaters may be hiding behind IT regimes to mask their true intentions. That is, they may claim IT, but actually are FF in disguise.

Finally, we should note that an additional explanation for FF behavior may be positive policy weight placed on an output gap. In an open economy, exchange rate movements can lead to output fluctuations for expenditure switching and other reasons. In that case, IT countries with weight on the output gap would be observed offsetting exchange rate fluctuations for non-inflationary reasons and this could be perceived as FF[6]. Conceptually an honest IT regime that openly states that it is placing positive weight on the output gap would not be FF. Alternatively, if they announce weight for output, but act to offset exchange rate movements for reasons not related to either inflation or output, they would still be FF. In empirically distinguishing between regimes, one must be clear. We thus treat IT in our study to mean strict and honest IT. By abstracting from the output gap, our framework implies that changes in the interest rate for exchange rate reasons associated with output concerns but not inflation target concerns would be empirical evidence of FF. This says that an IT country with an output gap positively weighted, will be identified as FF. While this is extreme, it allows us to take a clear first step in empirically identifying IT regimes. Future research should take the next step and attempt the more subtle distinction when output gaps are included more explicitly[7].

3.2 Analytical Framework

We assume that countries have some goods that are not traded ("home" goods) and that the law of one price holds perfectly for all goods that are traded. The price level for this economy is thus a combination of home and traded good prices, P_H and P_T, respectively.

$$P = P_H^{\alpha} P_T^{1-\alpha} \tag{2}$$

Allowing the law of one price to hold for traded goods and assuming zero foreign inflation, this economy's overall inflation rate is determined by

$$\Pi = \alpha \Pi_H + (1-\alpha)\hat{E} \tag{3}$$

We will assume that $\alpha = 1 - \alpha$ to avoid putting unwarranted weight on either price. Further, let both home good inflation, Π_H, and traded good depreciation, $\hat{E}$, be subject to small random shocks such that

$$\Pi_H = \pi_H + \phi \tag{4}$$

where ϕ is a zero mean and constant variance shocks. And,

$$\hat{E} = \hat{e} + \varepsilon \tag{5}$$

where ε is a zero mean and constant variance shocks.

3.3 A Stylized Example

To see the empirical implications of this framework consider the following simple example. First, let the inflation target, Π^T, be zero. Second, let world interest rates, r^*, also be zero along with world inflation, Π^*. It then follows from (1) that any change in inflation, $\Delta\Pi$, will translate into a change in interest rates, Δr, differing in magnitude by parameter b. Since b is assumed to be positive, interest rates and inflation will move together.

Let there be a common upper, x^{HI}, and lower, x^{LO}, bound on the shocks to home good inflation and exchange rate depreciation so that there is no analytical favor given to either shock *ex ante*. In particular let either shock take either its lower or upper bound value with equal probability.

$$pr\left(\phi = x^{LO}\right) = pr\left(\phi = x^{HI}\right) \tag{6}$$

and

$$pr\left(\varepsilon = x^{LO}\right) = pr\left(\varepsilon = x^{HI}\right) \tag{7}$$

To allow for regime differences, restate the Taylor rule in the following general form

$$r = r^* + b\left[\Pi - \Pi^T\right] + c\left[\hat{E} - \hat{E}^T\right] \tag{8}$$

Letting the targets be zero and substituting equations (3), (4) and (5) into this yields

$$r = r^* + b\left[\alpha\left(\pi_H + \phi\right) + (1-\alpha)\left(\hat{e} + \varepsilon\right)\right] + c\left[\hat{e} + \varepsilon\right] \tag{9}$$

Regime differences are captured by the differences in the weights b and c.

Strict *Inflation* Targeting (IT): $r = r^* + b\left[\alpha\left(\pi_H + \phi\right) + (1-\alpha)\left(\hat{e} + \varepsilon\right)\right] \quad s.t.\ b > 0$

Strict *Exchange* Rate Targeting (FIX): $r = r^* + c\left(\hat{e} + \varepsilon\right) \quad s.t.\ c > 0$

Fear of Floating (FF): $r = r^* + B\left(\pi_H + \phi\right) + C\left(\hat{e} + \varepsilon\right) \quad s.t.\ B > 0 \,\&\, C > 0$

where $B = \alpha b$ and $C = c + b(1-\alpha)$. These formulations follow from the way we are defining each regime. IT places zero weight on the target for currency depreciation, $c = 0$, and positive weight on the overall CPI inflation target, $b > 0$. FIX only cares about the exchange rate and thus has the opposite, $b = 0$ and $c < 0$. An FF regime is concerned with both targets and thus places positive weight on both targets, $b > 0$ and $c > 0$. For our purposes, the exact values of *b* and *c* are not as important as the fact that $c = 0$ and $b > 0$ for IT, the opposite for FIX and both are positive for FF. One would generally expect, however, that *b* exceeds unity, at least in the IT case, in order to maintain the Taylor principle and thus price level determinacy (Woodford, 2003).

Since there are only two shocks and they can only take on two values each, this framework is simple enough that we can use our example to consider the effects of all four cases for the shocks and the empirical implications for interest rate movements under each regime. This information is summarized in Table 1. The single, double, and triple inequality signs are notation to indicate whether there is one, two or three factors pushing interest rates in a given direction and thus indicate the expected magnitude of the change. FF is the only regime that can obtain three inequalities, for example, because it weighs exchange rate movements twice (*b* and *c* are positive). Lastly, note that these are movements in *ex post* real interest rates because *ex ante* the expected value of the shocks are zero.

[Insert Table 1 here]

Strict *Inflation* Targeting (IT)

Giving all shocks equal weight implies that there is an equal probability of an upward ($pr(\Delta r > 0) = ¼$) and a downward ($pr(\Delta r < 0) = ¼$) movement in the interest rate in response to shocks while the probability of no movement is one half ($pr(\Delta r = 0) = ½$). This is the same as the probability of observing a movement in inflation. In other words, there is an equal chance of seeing no interest rate change and some interest rate change. The empirical implication is that, under IT, the probability that we observe the interest rate movements equals the probability of a movement in inflation and there is an equal probability that the interest moves and that it doesn't.

Strict *Exchange* Rate Targeting (FIX)

Giving all shocks equal weight implies that there is an equal probability of an upward ($pr(\Delta r > 0) = ½$) and a downward ($pr(\Delta r < 0) = ½$) movement in the interest rate in response to shocks while the probability of no movement is zero ($pr(\Delta r \neq 0) = 1$). The empirical implication is that, under exchange rate targeting, we should see lots of interest rate variability (in theory the $pr(\Delta r \neq 0) = 1$). This is the case that C&R termed FF or credible IT and their observation was indeed that interest rate variability tends to be high in these countries.

Although this example is very simple, a general prediction already starts to emerge allowing one to begin distinguishing between a FIX (strict exchange rate targeting) and IT. The probability of observing a movement in an IT regime's interest rate should be less than the probability of observing a movement in the fixed exchange rate regime's interest rate.

Fear of Floating (FF)

Several things are worth noting here. First, the interest rate always moves. Based on this metric alone, $pr(\Delta r \neq 0) = 1$, the regime is indistinguishable from the FIX regime. Second, the clean link between just $\Delta\Pi$ and Δr as in the IT case has been broken. In Cases 2 and 3 the change in overall inflation is zero, but interest rates still move. In other words, if a country is fear of floating, we should observe that, while inflation also varies, interest rate movements are more associated with movements in the exchange rate than with the overall inflation rate alone. Lastly, the swings in the interest rate are always at least as large as the largest movement under the other two regimes. This suggests that interest rate volatility should be high and large in magnitude in FF countries.

While our model here is not any more general than the model in C&R's original work, it is actually general enough that one could easily add an output gap to equation (1). Our results will carry over to that case as well. An honest IT regime would care about exchange rates to the extent they feed into inflation *and output*. An FF regime would care about exchange rates for the same reasons as IT plus for additional, non-inflation and non-output reasons.

We next generalize our results to derive the priors in our modified analysis of exchange rate regimes.

3.4. Modified Fear of Floating Analysis

Modifying C&R's original analysis to distinguish between FF and IT regimes adds information to our understanding of why and when interest rates vary so much in IT countries. We follow their lead in forming priors that are used to distinguish between regimes. We will be looking at variable changes that exceed some predefined threshold and at the co-movement of these variables. One must however be very careful, as always, about the degree to which these co-movements can be interpreted as causality.

If a country is IT, then we anticipate the following priors will be born out in the data. These come from the implications of the model presented in Section 3.3 of this paper as well as from C&R's original paper.

$$P\left(\%\Delta E > x \mid FF\right) < P\left(\%\Delta E > x \mid IT\right) \tag{10}$$

$$P\left(\Delta\pi > x \mid FF\right) > P\left(\Delta\pi > x \mid IT\right) \tag{11}$$

$$P\left(\%\Delta R > x \mid FF\right) > P\left(\%\Delta R > x \mid IT\right) \tag{12}$$

$$P\left(\Delta r > x \mid FF\right) > P\left(\Delta r > x \mid IT\right) \tag{13}$$

$$corr(r, \pi \mid IT) > corr(r, \%\Delta E \mid IT) \tag{14}$$

where Δ is the change in a variable, $\%\Delta$ is the percentage change, and x is the critical threshold. Inflation, π, is the $\%\Delta$ in CPI. We use C&R's thresholds for all variables that they included (x = 2.5 % for E and R but 4% for i) and use $x = 2.5\%$ for all new variables (π and r).

Expression (10) argues that we expect to see the exchange rate changing more under IT than FF. This is because FF, by definition, explicitly implies intervention to offset changes in E while IT implies less frequent intervention. Likewise, expression (11) argues that we expect to see the rate of inflation (or inflation gap) changing more under FF than IT. Again, IT requires intervention to keep inflation near its target which implies not allowing inflation to fluctuate much. FF does not. In theory neither a pure float (i.e., monetary rule) nor IT should use reserves. In reality all countries use reserves to some extent. Expression (12) results from the view that IT, at least in theory, should not use R to fight inflation while FF in theory may very well use R to offset E fluctuations given an FF regime's additional, if secret, policy weight on E. As a matter of empirical application, expression (12) doesn't claim that IT does not use reserves, it merely states that, observationally, we expect them to use reserves less than an FF regime does. Expression (13) and (14) follow directly from our model. That is, interest rates should vary more under FF than IT in general; and, for IT, interest changes should be more closely related to inflation than to depreciation. While the whole analysis does not turn on any one single prior, the hope with such an approach is that the cumulative strength of the entire arsenal of priors will be sufficient. We believe that is the case here.

4. The Data

We have striven to include only those countries that both claim and actually seem to inflation target. While this might imply periodic exchange rate concerns, such concerns should not openly override the target itself. Instead, exchange rate related policy actions should only be means to IT ends.

To determine the countries, we first used C&R's 2002 paper (p. 393). The countries they count as IT are: Australia, Brazil, Canada, Colombia, Czech Republic, Finland, Israel, South Korea, Switzerland, Mexico, New Zealand, Peru, Poland, South Africa, Spain, Sweden, Thailand, and the United Kingdom. To this we added the Chile, a known IT country. The United States and Japan were added as benchmark floating countries. C&R included Australia as a benchmark floater, but since we are comparing IT against other regimes, we could not include Australia – an IT country – as a benchmark float as well.

Our regime definitions are those used by C&R (2002). They follow the IMF's classification scheme in grouping countries into four types of exchange rate arrangements: peg, limited flexibility, managed floating, and, freely-floating[8]. Their classification is monthly from 1970 – 1999. This left us with two remaining issues. First, since IT is a relatively new phenomenon we must include more recent data, thus we had to update all of the countries in our sample. This was not a major issue since most of our sample countries were simply updated as having IT regimes. This left the United States and Japan, both known to have kept their floating exchange rate regimes and are updated as such[9]. The next issue was that some IT countries were not included in C&R's original paper (Czech Republic, Finland, Israel and the UK) and others in their data had no entries for the early 1970s (Chile, Mexico, Peru, South Africa, Spain and South Korea). To fill in those holes, we wanted to pick a widely accepted and easily accessible source. There are two prominent classification schemes to choose from: Reinhart and Rogoff (2004) and Levy-Yeyati and Sturzenegger (2005). We chose to use Reinhart and Rogoff (2004)[10]. We chose their work because it was monthly, thus fitting our existing data from C&R, and because Levy-Yeyati and Sturzenegger (2005) only goes back to 1974. Thus, with Reinhart and Rogoff (2004) and their very extensive comments we were able to fill in the holes in C&R's classification for the early 1970s and include from 1970 onward the other countries not in C&R's work.

Our data come from the International Monetary Fund's International Financial Statistics (IFS) and the countries' own central banks. For most countries the data starts in 1970 and is monthly. Australia and New Zealand are exceptions since they only report quarterly CPI data[11].

We gathered data on CPI, nominal end-of-period bilateral exchange rates (domestic currency to US dollars for all but the European countries where implied domestic currency to Deutsch Mark, then Eruo, was used), nominal interest rates (using the actual policy instruments where possible), and international reserves. Appendix B contains the specific IFS codes for each series used in the analysis. From there we constructed real ex post interest rates, again following C&R's 2002 methodology (p. 406)[12].

5. Analysis and Results

Table 2 summarizes the results of replicating C&R's basic analysis for the countries in our sample, organized according to regime. It presents evidence on the frequency of changes in the exchange rate, foreign exchange reserves, and nominal interest rates. Additionally it contains variations in inflation and *ex post* real interest rates following the analysis in section 3.

[Insert Table 2 here]

In terms of exchange rate variation (Column 2), the probability that monthly variation exceeds the threshold level is highest for the floating regimes. IT falls between floating and fixing. This is in line with our prior (10). It suggests that while IT is not a true floating exchange rate regime, neither is it a fixed exchange rate regime. Numerically its probability value is nearly midway between those of FIX and flex. The t-test for the difference between the mean for IT and for flex is -2.48 with p-value 0.018 and for the difference between IT and fix, it is 3.63 with p-value 0.001. Thus the results for IT indicate that statistically it lies in between the flex and the FIX results.

In terms of reserve usage (Column 3), IT displays the lowest probability of exceeding the threshold, lower even than the floating regimes[13]. Prior (12) implies that FF countries, looking more like fixing countries, should have higher probability values than IT. By IT having the lowest probability of all regimes in Table 2, prior (12) appears to hold. At first glance this may appear a bit surprising given that others[14] have found that IT regimes use reserves and that it might even be optimal for IT to use interest rates to fight inflation but reserves to fight exchange rate movements as argued. Willett (2003) argues a similar point along purely conceptual lines. He argues that the theory of optimal currency areas suggests that domestic monetary and exchange rate policies need in general to be jointly determined, not treated as isolated issues. This leaves room for some reserve usage to address exchange rate movements. Our result doesn't contest that. Our prior doesn't argue that IT never uses reserves, just that, relatively speaking, IT appears to use reserves less than other regimes. That is, this result is in line with our prior (12).

While we do not focus on nominal interest rates to the extent C&R do, the results in Table 2, Column 4 indicate that IT is the least likely regime to display large fluctuations in nominal interest rates. Although the magnitudes are higher, the same result carries over to real interest rate variability (Column 6). Statistically IT has the lowest probability of exceeding the threshold[15]. While this is in line with prior (13), the inflation numbers (Column 5) appear to be driving this result. Inflation variability is consistent with prior (11) but also suggests something more. If IT does anything, it should be targeting and thus controlling inflation. The major objective of IT is to keep actual inflation at or near its target, something very precisely defined by a point or range target. Thus it is no surprise that inflation variation appears lowest under IT as seen in Column 5. Since IT links inflation variation to interest rate variation by equation (1), it follows that in lowering inflation variability, the need to adjust interest rates is less too. Thus, on the logic of credibly IT alone, one should observe less interest rate variability too.

[Insert Table 3 here]

While our focus is not on reserves, for comparison purposes, Table 3 is included to replicate C&R's F-test analysis for reserve usage. The alternative hypothesis being tested is that, if FF is present, the variance in reserves should be greater than for the benchmark country. By this measure, the results strongly indicate that IT and FF are not the same. The results thus run very counter to C&R's model but are in line with our prior (12). That IT uses reserves less than FF (and thus displays lower reserve variance than FF) should not be surprising if IT actually goes hand in hand with a Taylor-rule approach to targeting. That is, IT shouldn't be using reserves, it should be using interest rates leading to results like those in Table 3. What is surprising in Table 3 is that floating and fixing look so similar, especially against the Japanese benchmark. This suggests that we still don't understand reserve usage in practice across floating and FIX regimes, a result also consistent with C&R's findings.

Up to this point, we have essentially replicated C&R's analytical approach but with a different division of the data. Whereas they classify IT as floating for empirical exercises but as FIX for theory, we have considered IT a distinct regime throughout. Our modified analysis – and the basic arguments for IT – predicts an additional prior in the data, our prior (14). Table 4 summarizes the results for this prior.

[Insert Table 4 here]

Table 4 compares the absolute values of the correlations of potential policy instruments with possible target variables. Column 1 indicates that changes in the nominal interest rate are more highly correlated with inflation than with currency fluctuations for all regimes (FIX, flex, IT and average of intermediate regimes). While in line with our expectations for IT, it is a bit surprising for the intermediate and FIX regimes since we expect nominal interest rates to be more correlated with exchange rate fluctuations than with inflation for these regimes.

Column 2 allows us to evaluate prior (14) directly since the correlations are in terms of the real, not the nominal, interest rate. That for IT the real interest rate is more closely correlated with inflation than with exchange rate movements in our sample is strong support that prior (14) holds. It suggests that the countries claiming to IT do indeed appear to care more about inflation than exchange rate variation when using their policy tools. That the numbers are relatively high for all of the regimes, including the fixed regime, does raise questions about the significance of the high IT result. That IT has the highest proportion in both Columns 1 and 2 suggest that the result is not, however, dependent on whether one uses the nominal or the real interest rate for evaluation purposes. The t-tests for the difference between FIX at .88 and IT at 1.00 yields a t-statistic of 1.51 with p-value 0.14. The t-test for the difference between Flex at .94 and IT at 1.00 yields a t-statistic of 1.03 with p-value 0.174[16]. Therefore the statistical significance of these numerical differences is not supported and further analysis is needed.

Following this line of thought, given that IT should use the interest rate as the policy control variable, the following is a regression analysis of the behavior of this variable. Once again we use the real interest rate for the reasons discussed in Section 3.1. The objective of the analysis here is to determine whether the real interest rate responds differently to changes in inflation under various regimes. We use simple OLS to estimate the following,

$$\hat{r}_t = \beta_0 + \beta_1 \hat{E}_t + \beta_2 \hat{\pi}_t + \beta_3 \hat{R}_t + \sum_i \gamma_i D_{it} \hat{\pi}_t + \sum_i \delta_i D_{it} \hat{E}_t \qquad (15)$$

where $\hat{r}_t$, $\hat{E}_t$, $\hat{R}_t$, and $\hat{\pi}_t$ denote, respectively, changes (level differences) in the real interest rate, domestic currency depreciation, percentage changes in international reserves, and changes (level differences) in the inflation rate. D_i's denote dummy variables for each of the different regimes (minus one) that have been implemented (or for which we have data) in the specific country being considered. In order to investigate whether the real interest rate is more or less responsive to changes in inflation and the nominal exchange rate under different regimes, equation (15) includes an interaction term between the regime dummy variable and $\hat{\pi}_t$ and $\hat{E}_t$ [17]. Finally, to address possible endogeneity issues, we include lags of the explanatory variables and choose the lag structure using the Akaike information criteria. The country specific lag structure is reported with the results in Table 5.

For most of the cases in our analysis we used the managed float regime as the benchmark regime because sixteen out of the nineteen IT countries considered have, at some point in time, adopted such a regime. For example, for the time period considered, Brazil implemented flex, FIX, IT and managed floating regimes over different periods. Therefore in the regression for Brazil we include three dummy variables, one for flex, one for FIX, and one for IT, excluding the managed float regime. We perform this analysis for seventeen of the nineteen IT countries. For comparison purposes we only include those countries for which there is monthly inflation data (Australia and New Zealand were excluded). When the country in question did not implement a managed float an alternative base regime (omitted dummy variable) was chosen. This is specifically addressed in the discussion that follows and indicated in Table 5. As an aside, even though lags are introduced in the regression with the objective of dealing with possible endogeneity issues, the theoretical predictions deal with the effects at time *t*, therefore we base the discussion of our results on the coefficients for the explanatory variables at time *t*. In what follows, we focus first on the results corresponding to responses to changes in inflation. We then turn to responses to nominal exchange rate changes.

[Insert Table 5 here]

The results in Table 5 show that there is a difference between IT and the other regimes considered. The real interest rate of nine countries responds differently under IT to changes in inflation[18]. For these countries (Canada, Chile, Czech Republic, Israel, Mexico, Sweden, Switzerland, Thailand and the UK), the coefficients of the regime dummy variable for IT is positive and statistically significant while the ones for the dummy variable of all the other regimes are not. The positive sign means that changes in the inflation rate bring about bigger changes in the real interest rate under the IT regime, relative to those observed under the base regime. For these nine countries, except Canada and Thailand, the base regime is the managed float. According to C&R's classification, Thailand never implemented a managed float regime and thus the FIX regime is used as the base regime. For Canada we use the flex regime as a base because our data does not include the period in which this country implemented a FIX regime. Having taken into consideration the differences in specification (i.e., base regimes), the results for these nine countries show that the real interest rate displays very different behavior under IT.

There is one case, Korea, where the coefficients for the dummy variable (interacting with $\hat{\pi}_t$) for IT and FIX are both significant and of opposite sign. The coefficient is positive for IT and negative for FIX. Since the base regime is the managed float, the real interest rate changes (differences) are bigger under IT (in line with the findings discussed before) and smaller for FIX relative to those observed under a managed float. Again, this result is in line with intuition since the main policy tool under a traditional FIX is the management of international reserves, not the interest rate. This suggests that Korea is not a "modern" FF-style fixed regimes using interest rates as C&R suggest.

Finland requires more in depth analysis. The results show that the behavior of the real interest rate under flex and IT is statistically different from that observed under a managed float[19]. Both dummy variable coefficients are positive and, according to the Wald test results, they are not statistically different from each other. The implication is that in this case the behavior of the real interest rate under IT and flex is the same but statistically different from that observed under the managed float. Therefore the argument that IT is different from a FIX/managed float still holds. In the case of Spain the results and the conclusions are less obvious. Here the dummy variables for IT and limited flexibility are both positive and statistically significant. Real interest rate responses to changes in inflation are thus bigger under these regimes when compared to the FIX, the managed float, and the flex regimes. The results for the Wald tests show that the coefficient on the dummy variables for IT and limited flexibility are not statistically different from each other. Once again IT is different from FIX/managed float and flex, but not statistically different from limited flexibility.

Finally, there is evidence of FF in five countries: Brazil, Colombia, Peru, Poland, and South Africa. For the cases of Peru and Poland there is no statistical difference in the behavior of the real interest rate under IT and managed float, but there is a difference between FIX and managed float. This suggests that the real interest rate under IT responds to changes in inflation as much as it did (statistically) under the managed float regime[20]. For Colombia and South Africa a similar result emerges but there is no difference between IT and FIX while managed float and IT are found to differ[21]. We see these cases as evidence of FF since there is no clear difference between the behavior of the real interest rate under the IT and FIX. Regarding FF in Brazil, the initial results were seriously contaminated by the period of hyperinflation[22]. If these periods are removed, which translates into only analyzing flex, IT and managed floating regimes in Brazil, then the results are in line with those discussed above for Finland, where the behavior of the real interest rate under flex and IT is statistically different from that observed under a managed float and therefore there is no evidence of FF[23]. These are the results presented in Table 5 for "Brazil". While the result that some specific regimes are identified as FF is important, we are more interested in the result that IT generally appears to be distinguishable from FF, FIX, and flex. That IT is identifiably different comes across fairly strongly throughout all of our results.

Before discussing the results for the interaction terms of the regime dummies and $\hat{E}$, it is important to emphasize that for the cases where the IT regime dummy is statistically significant, the economic significance is also of relevant magnitude. Table 5 reports the effects on the real interest rate of changes in $\hat{\pi}_t$ for those countries where the IT regime dummy was significant. The results show that, in every case, a one standard deviation increase in $\hat{\pi}_t$ results in a larger increase in the real interest rate, in terms of standard deviations, under IT than under the managed float (or the respective base regime). Take the case of Chile for example. A one standard deviation increase in $\hat{\pi}_t$ results in a change of the real interest rate under the base regime of managed float equal to 0.62 of a standard deviation, while under IT the real interest rate would increase by 1.29 standard deviations[24]. Although the more than one standard deviation increase is not observed for every country in our sample, the change of the real interest rate under IT in every case is at least 25 percent higher than under the base regime, in terms of standard deviations.

Regarding the response of the real interest rate to changes of the nominal exchange rate, the results of table 5 show that there are not many significant differences between the real interest rate behavior, with respect to changes in $\hat{E}$ under IT and the managed float, FIX and limited flexibility regimes. In fact, only Chile's and Brazil's real interest rate response to the changes in the nominal exchange rate is lower under IT, relative to the response under managed float. In addition to Brazil, four other countries display less real interest rate response to changes in the nominal exchange rate under the Flexible regime. Japan, Finland, Mexico, and Peru also show negative and statistically significant coefficients for the flex regime dummy variable. Finally, only for Brazil (hyperinflation period), Chile, Peru, and Korea do we observe any significance differences under a Fix regime. Once again this is in line with theory since under a FIX the instrument of choice to control the fixed level of the nominal exchange rate should be international reserves.

6. Conclusion

Following C&R, many today argue that there appears to be an epidemic case of "fear of floating" where countries claim to float but instead use domestic interest rates to mitigate large swings in their currency's value. At the same time, the adoption of interest-rate-rule IT regimes around the world continues to spread. These two observations are not independent.

The problem with their analysis is that their theoretical foundation predicts that credible IT is equivalent to FF and FIX. In organizing their data for empirical analysis, however, they include known IT regimes as floating regimes and even use an IT regime (Australia) as a benchmark floater. This unintentionally adds an element of confusion to their analysis that obscures rather than clarifies their regime classification results. Our paper has attempted to place the distinction between IT and FF on more sure footing within the context of their contribution.

At first glance IT can look like fear of floating because traded good prices appear in overall inflation targets thus explaining some of the interest rate and exchange rate variation observed in the literature. But, IT and FF should not be the same because interest rate movements under IT should only occur when hitting the inflation target is threatened and not whenever the currency's depreciation rate changes. This insight and the contemporaneous relationship between the variables in a standard Taylor rule allow us to distinguish between IT and FF.

We analyze the behavior of exchange rates, reserves, interest rates and inflation across 88 exchange rate regimes for 20 countries to study the degree to which IT regimes are distinct from other regimes and how much this matters. We find that IT, as a regime, is empirically distinguishable from pegged, floating, managed floating, limited flexibility and FF regimes. Credible IT appears to be more similar to floating and managed floating than to fixing and FF.

Being able to identify these regimes accurately allows one to distinguish between cases where countries claim to inflation target but actually fear of float.

In general we find that most countries that claim to inflation target do in fact inflation target. It is important for the credibility of these regimes that this be recognized. We also find evidence that five of the IT regimes (Brazil, Colombia, Peru, Poland, and South Africa) do behave more like fear of floaters and thus might be claiming to be IT, but are FF in disguise.

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1 Later in the paper we briefly discuss how to carry our results over to the case where output gaps are included.

2 Australia is included as a benchmark floater in their work, even for the years it is IT.

3 On page 393 they list Australia as IT since January 1994. In Table 1 (p. 385), however, they use Australia as one of the three benchmark *floating* regime countries from January 1984 – November 1999 which includes the years they claim Australia is IT. But their theoretical model argues that credible IT is identical to FF and FIX. For the countries they recognize as inflation targeters and the dates for which they inflation target see C&R page 393, fn. 15.

4 For an excellent overview of this literature and the technical issues therein see Nitithanprapas and Willett (2002).

5 See Levy-Yeyati and Sturzenegger (2005), p. 1608 and fn. 17 on same page.

6 For a discussion of these issues see Edwards (2006), Ho and McCauley (2003), Lahiri and Vegh (2001), Taylor (2001) and Willett (2003).

7 This is consistent with the empirical results in, say, Ho and McCauley (2003), who find that many IT countries intervene for output reasons and thus appear to display FF. Conceptually it also follows Lahiri and Vegh (2001) who model FF for output reasons explicitly. Thus, while a simplification, our exclusion of the output gap for identification purposes may not be too far off the empirical mark.

8 Their exact categories and the ones we use can be found in Calvo and Reinhart's (2001) "Exchange Rate Flexibility Indices: Background Material to Fear of Floating" available from Reinhart's website (http://www.wam.umd.edu/~creinhar/Papers.html).

9 This classification continues up to 2005, prior to any movement in the US under Fed Chair Bernanke to IT.

10 Technically we use their "Country Chronologies and Chartbook Background Material" (2003), also available on Reinhart's site (http://www.wam.umd.edu/~creinhar/Papers.html).

11 A data appendix, additional tables, and econometric (EViews) code are readily available upon request from the authors.

12 The real interest rate is calculated as $100\times[((1 + i_t)P_t / P_{t+1}) - 1]$ where i_t is the nominal interest rate at date t and P_t is CPI at date t.

13 The t-test supports this result as well.

14 See Ho and McCauley (2003) for an excellent example of this.

15 The t-statistic for the comparison between IT and flex is -2.61 with a probability of 0.014 and for the comparison between IT and FIX the results are a t-statistic of -2.92 and a probability value of 0.006

16 Similar conclusions follow from the statistical analysis of the numbers presented in column 1. Statistically, at least from the correlation analysis perspective, the numbers are not different.

17 It's important to note that Kaminsky, Reinhart and Vegh (2004) find that developing-economy monetary policy is often procyclical. This is not the case for any of the countries in our sample.

18 These nine countries are: Canada, Chile, Czech Republic, Israel, Mexico, Sweden, Switzerland, Thailand, and the UK.

[19] Finland has implemented flex, FIX, IT and managed float regimes but our data does not include the period in which the exchange rate was fixed. Therefore our analysis can only draw comparisons for flex, IT and managed float.

[20] The dummy variables for the flex and FIX regime, in the case of Peru, are both positive and significant. Wald test results show that they are not statistically different from each other at the ninety percent confidence level.

[21] For both cases, Colombia and South Africa, the dummy variables for IT and Fix are positive and statistically significant. According to the Wald test results, they are not statistically different from each other.

[22] The possibility of periods of hyperinflation, or other instances of high volatility and erratic behavior, was explored in the data for Poland, Peru, and South Africa. But, unlike Brazil, the results did not change.

[23] The Wald test results suggest that both dummy coefficients are not statistically different from each other.

[24] The numbers reported in the table are computed by using the standard deviations of $\hat{r}$ and $\hat{\pi}$, σ_r and σ_π, respectively, both computed from the data for each country, and the estimated coefficients in equation (15) for $\hat{\pi}$ and $D_{IT}\hat{\pi}$ (interaction term for IT regime dummy). The computation for the effect under the base regime is as follows, $(\sigma_{IT} \cdot \beta_2)/\sigma_r$, while under IT it is determined by, $(\sigma_{IT} \cdot (\beta_2 + \gamma_{IT}))/\sigma_r$.

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Table 1: Example Ex Post Interest Rate Reactions To Shocks Across Regimes

$$r = r^* + b\left[\alpha\left(\pi_H + \phi\right) + (1-\alpha)\left(\hat{e} + \varepsilon\right)\right] + c\left(\hat{e} + \varepsilon\right)$$

Case			IT	FIX	FF
	Π_H	$\hat{E}$	(b > 0 , c = 0)	(b = 0 , c > 0)	(b > 0 , c > 0)
1	$\phi = x^{HI}$	$\varepsilon = x^{HI}$	$\Delta r >> 0$	$\Delta r > 0$	$\Delta r >>> 0$
2	$\phi = x^{LO}$	$\varepsilon = x^{HI}$	$\Delta r = 0$	$\Delta r > 0$	$\Delta r >> 0$
3	$\phi = x^{HI}$	$\varepsilon = x^{LO}$	$\Delta r = 0$	$\Delta r < 0$	$\Delta r << 0$
4	$\phi = x^{LO}$	$\varepsilon = x^{LO}$	$\Delta r << 0$	$\Delta r < 0$	$\Delta r <<< 0$

Note: The single, double, and triple inequality signs are notation to indicate whether there is one, two or three factors pushing interest rates in a given direction and thus indicate the expected magnitude of the change

Table 2: Summary of Threshold Analysis Across Regimes

	Probability that monthly change is				
	Greater than a +/- 2.5 percent band:		Greater than +/- 4 percent (400 basis points):	Greater than a +/- 2.5 percent band:	
Regime (1)	Exchange Rate (2)	Reserves (3)	Nominal Interest Rate (4)	Inflation (5)	Ex Post Real Interest Rates (6)
Floating Exchange Rate	45.06	58.01	21.71	22.03	61.06
Fixed Exchange Rate	9.39	69.03	14.76	23.12	62.28
Inflation Targeting	26.88	38.82	0.80	0.66	43.23
Limited Flexibility	6.13	56.06	1.12	3.38	62.63
Managed Float	32.39	64.44	28.28	33.43	67.18

Table 3: Proportion of Cases Where The Volatility of Reserves Significantly Exceeds That of The Benchmark Country: Summary of the F-Tests

		Benchmark is	
Regime	Number of Cases	Japan	United States
Floating	18	0.88	0.65
Fix	26	0.88	0.84
Inflation Targeting	19	0.42	0.42
Managed Floating	22	0.91	0.91
Limited Flexibility	3	0.67	0.67
Total	88		
Average		0.75	0.70

Note: The alternative hypothesis, if fear of floating is present, is that the variances in reserves for country and episode is greater than for the benchmark country.

Table 4: Summary of Average Relative Correlation Within Regime

	corr(Δi,π) >corr(Δi,ΔE) (1)	corr(Δr,π) >corr(Δr,ΔE) (2)	corr(ΔR,π) >corr(ΔR,ΔE) (3)
Fix	0.56	0.88	0.57
Flex	0.63	0.94	0.38
Inflation Targeting	***0.71***	***1.00***	***0.41***
Limited Floating	0.67	1.00	0.33
Managed Flexibility	0.50	0.90	0.48
Average of Intermediate Regimes	0.58	0.95	0.40

Note: π is CPI inflation, ΔE is the percentage change in the nominal exchange rate, Δi is the change in the nominal interest rate, Δr is the change in the *ex post* real interest rate, and ΔR is percentage change in foreign exchange reserves. "Limited Floating" and "Managed Flexibility" are considered "Intermediate Regimes"

Table 5: Summary of Regression Coefficients for Dummy Variables.

	Coefficient for Interaction Terms between Inflation and Regime Dummies					Coefficient for Interaction Terms between Currency Depreciation and Regime Dummies					Effects on the Real Interest rate of a One Standard Deviation Increase in Inflation/1				
	Flex	Fix	IT	Man. Float	Lim. Flex	Flex	Fix	IT	Man. Float	Lim. Flex	under Base Regime	under IT	Sample	Base Regime	Lag Structure
US													1970M02 2005M04	Fix	2
Japan						(-)**							1970M02 2005M03	Fix	2
Brazil		(+) ***				(-) ***	(-) **	(-) ***					1980M01 2005M04	Managed Float	1
Canada			(+) *								0.63	0.88	1975M02 2005M03	Flex	2
Chile			(+) **				(-) *	(-) **			0.62	1.29	1977M02 2005M04	Managed Float	2
Colombia		(+) **	(+) *								0.38	0.74	1970M02 2005M04	Managed Float	2
Czech Rep.			(+) *								0.42	0.78	1993M02 2005M04	Managed Float	2
Finland	(+) *		(+) *			(-) ***					0.56	1.02	1978M01 2005M04	Managed Float	2
Israel			(+) **								1.09	1.66	1984M07 2005M04	Managed Float	2
Mexico			(+) **			(-) *					0.51	1.51	1981M07 2005M04	Managed Float	2
Peru	(+) **	(+) *				(-) **	(-) *						1970M02 2005M04	Managed Float	1
Poland		(-) **											1991M01 2005M01	Managed Float	1
South Africa		(+) ***	(+) ***								0.63	0.80	1970M02 2005M03	Managed Float	1
Korea		(-) **	(+) **				(-) **				0.65	0.86	1976M02 2005M03	Managed Float	1
Spain			(+) ***		(+) **					(+) **	0.57	1.08	1974M02 2005M04	Managed Float	2
Sweden			(+) **								0.51	0.73	1970M02 2005M04	Managed Float	1
Switzerland			(+) **								0.64	0.83	1975M10 2005M04	Managed Float	2
Thailand			(+) ***								0.56	0.85	1977M02 2005M04	Fix	2
UK			(+) *								0.55	1.01	1972M02 2005M04	Managed Float	2
"Brazil"	(+) ***		(+) **			(-) **		(-) **			0.22	0.49	1995M01 2005M04	Managed Float	2

Notes:
- (black box) No data available for the time period when this regime was implemented
- (white box) Regime never implemented
- (grey box) Data is available for the time period when this regime was implemented

*, **, and *** denote significance of the coefficient at one, five and ten percent. Signs in parentheses denote the sign for the coefficient for the corresponding dummy variable (regime)

/1 Reports the effects, in terms of standard deviations, of a one standard deviation increase in the change (level difference) in the inflation rate on the change (level difference) in the real interest rate.