Classifying International Aspects of Currency Regimes

by

Thomas Willett[*]
Claremont Graduate University
and Claremont McKenna College
Thomas.Willett@cgu.edu

Eric M.P. Chiu
National Chung-Hsing University
ericchiu@nchu.edu.tw

Sirathorn (B.J.) Dechsakulthorn
DLA Piper
sirathorn.d@gmail.com

Ramya Ghosh
Drexel University
ramya.ghosh@drexel.edu

Bernard Kibesse
Claremont Graduate University
Bernard.Kibesse@cgu.edu

Kenneth Kim
Claremont Graduate University
Kenneth.Kim@cgu.edu

Jeff (Yongbok) Kim
The Bank of Korea
jeffybkim@bok.or.kr

Alice Ouyang
Central University of Finance and Economics
alice.ouyang@gmail.com

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[*] Corresponding author: Thomas.Willett@cgu.edu

I. Introduction

There has been considerable recent interest in the classification of exchange rate regimes in order to investigate a wide range of hypotheses including the relationships of alternative exchange rate regimes with inflation, growth, and currency crisis etc. It might seem that exchange rate regimes should be an easy type of policy to classify. After all exchange rates are highly visible and data on them is easily available for most countries. On closer investigation, however, it turns out that while classifying some types of regimes such as official crawling pegs is easy in other cases such as attempting to distinguish between managed floaters and unofficial crawling bands can be quite hard. As another example there has been controversy about whether after the crisis of 1997-98 most exchange rate regimes in Asia are better described as managed floating or a continuation of a soft dollar standard (See McKinnon and Schnabl (2004) and Willett *et al.,* (2010)).

A major difficulty is that for many purposes we would like to classify regimes by how heavily they are managed by governments. Typically we cannot tell this by looking at the behavior of the exchange rate alone. Low volatility could be due to heavy management or to an absence of large shocks. In section III we discuss how the concept of exchange market pressure (EMP) can be applied to address this issue.

Early empirical studies used the old IMF classifications based on countries' official reports. It has become widely recognized, however, that such official reports are often misleading. Consequently, an important and active research agenda has been to produce behavioral measures characterizing exchange rate policies based on what governments actually do rather than what they say they do.

Unfortunately such efforts have often reached conflicting classifications for particular countries' exchange rate regimes. For example, the new classifications by the IMF and by Reinhart and Rogoff (2004) wrongly classify the Korean exchange rate regime in 2000 as being in their most flexible categories. While there was considerable movement of the exchange rate there was also substantial intervention (See Willett and Kim (2006)). Thus Korea actually had a managed float. At the other extreme the study by Levy Yeyati and Sturzenegger (2005) classified the regime as a fixed rate.

Despite such difficulties these recent efforts at large N classifications of exchange rate regimes make substantial improvements over the old official classifications. As we will discuss, however, there is no one ideal method of classifying exchange rate regimes. While we will indicate some pitfalls to avoid in developing classifications, it is important to recognize that there is no one optimal measure. The best classifications may vary depending on the type of question for which they are being used.

It is also important to recognize that the international aspects of currency policies are not limited to just the degree of flexibility of the exchange rate. One important dimension is the extent to which developments in the foreign exchange market, i.e., changes in exchange rates and the balance of payments, affect domestic monetary policy. In this context it can make a huge difference whether or not intervention is sterilized. Whether currencies are defended by capital controls can also be important. (The measurement of capital controls is covered in the paper on financial openness).

In the following section we discuss strengths and weaknesses of the major recent efforts at classifying exchange rate regimes that cover a large number of countries. In section III we discuss a number of the conceptual issues involved in studying particular

countries' policies in more detail. In the longer version of this paper available on our web site we provide illustrations of such analysis for India, Korea, and Tanzania and discussion of the many of the types of questions which classifications of currency policies are used to study.

II. Reviews of Major Efforts at Exchange Rate Classifications

1. The New IMF *De Facto* Measures

The IMF traditionally provided data on exchange rate regimes based on their official reports. Studies find that in practice exchange rate regimes are often substantially different from what governments said they were doing. Therefore, the IMF has published classifications since 1999 based on the staff's judgment of what kinds of regimes are actually being followed. The original *de facto* classifications were back dated to 1990 and are discussed in the IMF working paper by Bubula and Ötker-Robe (2002). The revised classification is available since 2009 and was published in the 2009 Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER).

The IMF approach focused on whether a country targeted a path for the exchange rate?" This provided a substantial improvement on the old IMF classification and in our judgment became the best available large N set of classifications. Its main difficulty was in its classifications of the degree of management of flexible rate regimes. These were divided into three types. The most flexible category was labeled "independent" floating and described as follows: "The exchange rate is market determined; any foreign exchange intervention aims at moderating the rate of change and preventing undue fluctuations that are not justified by the fundamentals, rather than establishing a level for the exchange

rate" (Bubula and Ötker-Robe (2002), p. 15). This was contrasted with "Tightly or Other Managed Floating" where "The authorities influence exchange rate movements through interventions to counter the long-term trend of the exchange rate, without specifying a predetermined exchange rate path, or without having a specific exchange rate target ('dirty floating')" (Bubula and Ötker-Robe (2002), p. 15).

Their analytical basis for distinguishing between "tightly" and "other" managed floating was not clear. These three categories need not correspond to the degree of heaviness of management. Even the distinction between independent and managed floating does not seem clear, however, since "moderating the rate of change" and "countering the long-term trend" can both be forms of "leaning against the wind" intervention. In other words, under both the IMF's categories of managed and independent floating there could be heavy or light exchange rate management. Since both Japan and Korea were classified as independently floaters during years in which they intervened heavily, it is not clear that it was useful to distinguish between these categories.

In part because of such concerns in 2009 the IMF revised its *de facto* classifications, using only two categories of floating based on the degree of intervention. They also distinguish more clearly between formal and informal pegs and crawls (See Habermeier *et al.,* (2009)).

2. Studies that Focus Only on the Behavior of the Exchange Rate

2.1. Reinhart and Rogoff (2004, hereafter RR) Classifications

RR 's heroic effort of classification presents the best currently available large source for long time period. A strong advantage of these classifications is that they use

market rather than official rates. Apart from not taking the degree of exchange market pressure into account, RR 's approach has difficulty with short-lived *de facto* pegs. They classify episodes as short-lived *de facto* pegs if the absolute monthly percentage change in the exchange rate is equal to zero for four consecutive months or more. This decision rule is too strict to detect actual short-lived *de facto* pegs. It is practically impossible for the monthly percentage changes to be zero consecutively except for hard pegs such as currency unions. In many studies, pegs are therefore assumed to have a certain level of narrow bands. In order to discover long-lived *de facto* pegs, they use the probability that monthly percentage changes in exchange rates is less than 1% over a rolling five-year period. If it is larger than 80%, they classify the episodes as pegs. This scheme cannot detect pegs with frequent breaks in exchange rates. Such two methodologies in RR therefore have weakness in detecting short-lived *de facto* pegs.

RR develop a new category they call freely falling regimes. These are floating regimes for countries with inflation rates above 40 per cent. This category is open to the criticism that it biases results toward finding favorable macroeconomic performance for floating regimes by throwing out cases of bad performance. On the other hand it seems unlikely that the exchange rate regime would be a major cause of very high inflation rates (See Chiu *et al.,* (2011)).

RR use a special probability measure to distinguish the freely floating from the managed float. They construct an exchange rate flexibility index,

$$\frac{\varepsilon}{P(\varepsilon < 1\%)},$$

based on the probability that percentage changes of exchange rates over rolling 5-year period remain within 1%. RR compare the frequency distribution of the index of each

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country with what they deem to be free floaters such as the US dollar against the euro over the post 1973 period.

Their decision rule is very conservative for classifying managed floats. This combined with the use only of the behavior of exchange rates results in misclassifying some cases of managed floats as free floats. The cases of Korea and Japan who allowed substantial exchange rate movements while also engaging in heavy intervention in a number of years are important examples. Since free floats are commonly defined as floats with little or no official intervention this problem could have been avoided by labeling such cases as floats and deleting the 'free'.

Another problem concerns their coarse classification. They group their fine classifications into five coarse regimes to investigate their associations with macroeconomic variables such as inflation and growth. As suggested by Angkinand *et al.,* (2009), a major problem with their grouping is that it fails to distinguish between hard pegs and soft pegs. They group (2) pre-announced peg, (3) pre-announced horizontal band that is narrower than or equal to 2%, and (4) *de facto* peg with (1) no separate legal tender all in the same category.[1] While this may be reasonable for some purposes we have found that distinguishing between hard and soft pegs is essential for analyzing the effects of exchange rate regimes on currency and financial crises and on macroeconomic discipline (See Angkinand *et al.,* (2009), Angkinand and Willett (forthcoming) and Chiu *et al.,* (2011)).

2.2. Two way Classifications: Klein and Shambaugh (2010).

This major book focuses primarily on comparing the effects of fixed versus

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[1] Numbers in parenthesis refer to their fine classification.

flexible exchange rates. As we noted above such two way distinctions may be useful for some purposes, but for issues such as discipline and currency and banking crises such a limited breakdown is seriously flawed. The same type of criticism applies to the early studies of capital controls that used only zero-one dummies. (See the accompanying paper on financial openness and interdependence). Like the RR study their method only employs the behavior of the exchange rate, and thus does not control for shocks .The criteria for distinguishing between fixed and flexible rates are based on whether the exchange rate stays inside a band. Specifically, +/- 2.0 percent bands against base currencies are used for annual classifications. If the exchange rate change does not exceed the threshold in 11 months out of 12 months, it is classified as the fixed.

Emphasis on the choice of base currencies is a valuable contribution since the automatic use of the dollar can be misleading for countries more oriented toward other currencies such as the euro. Another question involves the extent to which governments pay attention to different foreign currencies. While it is common to refer to a country's exchange rate against the dollar (or the euro) there are many exchange rates, one for each other independent currency. Focusing on the exchange rate against just one currency can give a misleading picture when there are substantial changes in cross rates among other currencies. A number of countries peg more or less closely to a basket of currencies. While the list of these currencies is sometimes made public, the relative weights given to the different currencies is seldom made public. This has led to efforts to estimate the implicit weights in such baskets (See Frankel and Wei (1994)). Where countries follow a managed float such estimation becomes more difficult but the issue retains its importance

(See Frankel and Wei (2008) and Frankel and Xie (2010).[2]

2.3 Statistical Cluster Analysis: Levy Yeyati, and Sturzenegger (2005, hereafter LYS)

LYS classify exchange rate regimes across 183 countries for 1974-2004. They classify episodes into five categories - flexible, dirty float, crawling peg, fixed, and inconclusive - using three classifying variables, exchange rate volatility, volatility of exchange rate changes, and volatility of reserves. They use the volatility of the rate of change of the exchange rate to identify crawling pegs.

Exchange rate volatility is measured by the average of the absolute monthly percentage changes in the nominal bilateral exchange rate during a calendar year. The volatility of exchange rate changes is measured by the standard deviation of the monthly percentage changes in the exchange rate. To compute the volatility of reserves they first subtract central government deposits from net foreign assets and divide this by the exchange rate. Then they compute its first order differenced value and divide this by the lagged money base. The volatility of reserves is measured by the average absolute monthly changes in this measure.

They use K-means cluster (KMC) analysis with three classifying variables. The K-means cluster algorithm produces groups such that they have the smallest total distance between episodes and the center of the group. They divide each variable into just two categories, high and low volatility.

While their analysis does have the advantage of being objective, they provide no clear economic rationale for their particular formulations and the thresholds used, nor do they explain why they don't consider the case of a highly volatile exchange rate combined

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[2] These issues are discussed in the longer version of this paper.

with low volatility of exchange rate changes and reserves. Additional limitations of the LYS classification are its inability to distinguish hard from soft fixes and wide band crawling pegs from dirty float regimes. LYS classify regimes by calendar years. For years in which the regimes or the parity changes or there are transitional periods of instability, it is unclear how the LYS calculations should be interpreted.

III Some Major Conceptual Issues

3.1 The Exchange Market Pressure Approach

The concept of exchange market pressure introduced by Girton and Roper (1977) is a measure of the gap between quantities demanded and supplied in the foreign exchange market at a particular exchange rate. It provides a way of comparing pressures under alternative exchange rate regimes by adding changes in reserves (as a measure of official intervention) and exchange rate changes.[3] Conceptually these should be weighted by the slope of the excess demand function in the foreign exchange market but in the absence of good measures of these parameters, equal weights are often used. The measure of the degree of flexibility of an exchange rate regime then becomes the ratio of exchange market pressure taken by changes on reserves versus changes in the exchange rate. Depending on which way one formulates the ratio this will give a measure of the propensity of the authorities to intervene in the foreign exchange market or its reciprocal, the degree of exchange rate flexibility. This approach is superior to just looking at exchange rate changes alone since these movements are influenced by the size of shocks as well as the propensity to intervene.

The basic idea of the EMP underlies many of the recent efforts at classification

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[3] In the monetary model used by Girton and Roper this slope is one.

of exchange rate regimes. However, these studies often do not fully conform to the concept of the proportion of exchange market pressure taken on the exchange rate versus intervention.

The first explicit use of the concept of EMP to classify exchange rate regimes was by Weymark (1995, 1997, and 1998). She defines the degree of intervention as the proportion of exchange market pressure absorbed by exchange market intervention. Weymark's index has a range from -∞ to +∞. When the sign of changes in exchange rate and reserves is correct for leaning against wind intervention, then Weymark's index has a range from 0 to 1, with values closer to 1 indicating a higher degree of fixity. When the exchange rate changes are of the same sign, but have a greater absolute magnitude than the changes that would have occurred in the case of no intervention, Weymark's index is negative. When the exchange rate appreciates (depreciates) with excess supply (demand) of domestic currency, Weymark's index is greater than one. As was discussed in section 2 the interpretation of the degree of intervention in cases of wrong sign observations in Weymark's index is not straightforward. (Further discussion of technical aspects of Weymark's papers is discussed in the longer web version of this paper).

In more recent papers Calvo and Reinhart (CR) (2002), and Hernández and Montiel (HM) (2003) also draw on the concept of EMP to offer procedures for classifying exchange rate regimes. Their approaches, however, suffer from several technical problems. CR and HM both look at the volatilities of the exchange rate, international reserves and interest rates to characterize exchange rate policies. CR look at the ratio of variances while HM compare the volatilities of each variable across countries separately rather than comparing their ratios. However, relative variances can be misleading when

trends are present. This is less of a problem when exchange rate variability is measured in terms of the variability of changes rather than levels.

Furthermore ratios of variances do not distinguish cases of wrong signs and as Calvo and Reinhart (CR) note, variances may be distorted by outliers. Thus they advocate an approach based on the frequency with which classifying variables remain within a threshold limit, arguing that "the probabilistic nature of the statistic conveys information about the underlying frequency distribution that is not apparent from the variance." (p.384).[4] The choice of thresholds is of course somewhat arbitrary. CR use 1 and 2.5 percent for monthly percentage changes. With the use of variances, however, this approach does not distinguish between correct and wrong signed pairs of observations.

3.2 The Problem of Trends and Wrong Signs

As noted previously the conceptual basis of the EMP approach assumes governments intervene to slow or halt exchange rate movements. Cases where intervention is used to accelerate exchange rate flexibility are thus not well defined. It is not easy to know how these wrong sign observations should be treated. They can be caused by imperfections in the reserve change proxy as well as by episodes of leaning with the wind i.e. pushing the rate even further than the market has been taking it or of extreme forms of leaning against the wind where the rate is forced in the opposite direction from market forces. Actual leaning with the wind in a downward direction is classic beggar thy neighbor policy and is discouraged by the IMF's guidelines except for cases where a currency is judged to be seriously overvalued. Leaning with the wind in the

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[4] RR also use the similar approach. For example, RR classify a case as a *de facto* peg if the probability that the monthly exchange rate change remains within one percent band over rolling 5-year period is 80 percent or higher.

upward direction may be justified during periods in which country's currencies are considered to have over-depreciated. The aftermath of the Asian crisis is a prominent example of such over-depreciation.

Where imperfect proxies are the cause of the wrong sign, the best solution would likely be to drop these observations. With true leaning with the wind, one could argue either that this is a case of government management or that it should be considered as super flexibility. Which interpretation is better may depend on the use to be made of the classification.

Wrong signs could also result from an extreme form of leaning against the wind, i.e., instead of allowing domestic currency to depreciate in the face of excess supply in the foreign exchange market, the government could actively appreciate the exchange rate. Likewise, despite an excess demand in foreign exchange market, a mercantilist government could force down the exchange rate. It would seem that these should be treated as cases of strong government management or of super fixity. Thus depending on the cause of the wrong sign, it can be argued that a value of zero or one should be assigned or that the observation should be deleted.

Trends in exchange rates and reserve changes also present substantial problems for applying the EMP approach. A major difficulty is that there is no clear cut theoretical rationale for how to compare the comparative degrees of flexibility of a faster crawl with a smaller band of fluctuations around it with a slower rate of crawl but larger fluctuations around it. For example the former which cause less problems for an export-import firm whose transactions have a short time horizon but cause greater problems for a manufacturing exporter with a much longer time horizon. Given this problem Willett *et*

al., (2007) argue that a two parameter approach is necessary to fully characterize exchange rate regimes, one for trend relationships and one for fluctuations around trend.

This approach runs into the substantial operational difficulty involved with detecting changes in trends. There is no clear cut rule for deciding when changes are large enough to justify treating them as shifts in regime, and the most appropriate degree of sensitivity can vary with the purpose of the investigation. For the purpose of deciding whether a country is following a managed float or not taking a single trend line over a long time period is likely to be satisfactory, while if one is investigating whether a country is changing its intervention strategy under a managed float a much more micro approach needs to be taken and one may need a number of short term changes in trends. For this purpose we are inclined to favor a judgmental approach while admitting that this is open to possible subjective biases. There are of course a number of formal tests for structural breaks. See, for example, Bai and Perron (1998, and 2003). It is often not clear, however, which aspects of behavior are responsible for the statistical results. (On this issue see the discussion in Ghosh (2011) of the conflicting findings for structural breaks in India's exchange rate policy).

3.3 Issues of Constructing Intervention Proxies

One of the most difficult problems in applying the EMP approach is that few countries make data on their exchange market intervention publicly available. Most empirical studies use changes in reserves as a proxy but acknowledge that this is far from perfect. Reserves can change due to interest earnings, valuation changes, and official borrowings as well as intervention. And interventions can include actions in forward, not

just spot markets.[5] These problems have led some researchers to give up using reserve measures all together. (See Ghosh *et al.,* (2003)). This seems too strong a reaction, however, since where reserve accumulations are very large, such as those at times by Japan and Korea, there can be little doubt that intervention was a primary cause.

One adjustment that can be made fairly easily is to subtract an estimate of interest earnings from the reserve figures.[6] Since dollar values of reserves are used in most cross national empirical studies, valuation changes due to exchange rate movements can also be important. Since exchange rate changes among reserve currencies are often much larger over short periods than interest rate differences, estimates of the currency composition of reserves are particularly important for such calculations. For many countries published figures or good estimates about the currency composition of reserves are not available, but efforts to take valuation changes into account have been made in some country studies. See, for example, Ouyang *et al.,* (2008). Where countries mark their reserve figures to market, interest rate changes in reserve currency countries can also affect valuation for longer maturity assets.

A final problem regarding the intervention proxy is that a constant amount of intervention per period in the same direction would give rise to varying percentage changes as reserve levels rose or fell.[7] Likewise, initial reserve levels can make a substantial difference. Studies such as Calvo and Reinhart (2002), and Hernández and Montiel (2003) characterize Japan as having a low volatility in foreign reserves. Although

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[5] CR give a nice discussion of several of these issues.

[6] Willett *et al.,* (2007) adjust reserve changes for Japan for estimates of interest earnings, but just find that this makes little difference for their estimates. Both series fairly closely track the data on Japan's actual interventions over the period 1991 to 2005. Of course, this proxy may not work as well for other countries, but our results for Japan suggest that this approach is worth using in the absence of better information.

[7] This problem can of course also apply to continued appreciation or depreciation.

Japan intervened heavily in absolute terms in the foreign exchange market in the early 2000s, the percentage changes in reserves were fairly small due to the high initial levels of reserves.

There are several ways to deal with this problem. The most popular method has been to use scaling variables for intervention proxies. Weymark (1997) and LYS use the lagged money base, lagged narrow money and the sum of exports and imports for 12 months as scaling variables. This is also a problem for measures of currency crises that are also based on the EMP concept but typically use unscaled percentage changes in reserves and exchange rates.

3.4 Rationales for Intervention

There has been considerable debate about the degree of post-crisis exchange rate flexibility in Asia.[8] While it is widely assumed that there has been a substantial increase in exchange rate flexibility, there has also been considerable accumulation of reserves. This has led some economists to argue that there has really been little change in exchange rate policies.[9] We can help clarify this debate by distinguishing (conceptually at least) between intervention designed to accumulate reserves such as may be highly desirable after a period of reserve losses, intervention to hold down the average level of the exchange rate for competitive advantage, and intervention to smooth out short-run fluctuations in the exchange rate.[10]

The first two motives will be observationally equivalent in terms of the statistical

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[8] This debate is discussed in the longer version of this paper.

[9] See McKinnon and Schnabl (2004).

[10] Of course, there could also be the intervention to prop up the rate to avoid inflation. This is especially likely before elections.

data during the early stages of recouping reserve losses. In the later stages of reserve accumulation distinctions would have to be based on judgments about whether reserve accumulations were becoming "excessive". The appropriate level of reserves for a country can of course be a matter of considerable dispute.

The third type of intervention – to limit short-term fluctuations in the exchange rate - is more easily identified. Indeed that is what our suggested methodology is designed to capture, once we detrend changes in reserves as well as changes in the exchange rate.

Even when we distinguish trends from deviations from trends, we have no clear theoretical basis for comparing their relative importance in terms of the overall degree of flexibility of a regime. How do we compare the degree of flexibility of two crawling band regimes, one of which has a faster rate of crawl while the other has a wider band? Since there is no clear theoretical basis for the weight in adding these two dimensions together we suggest in the next section that a two parameter approach is needed.

The same type of problem applies to the use of measures of interest rate variability.[11] It is clearly appropriate to use changes in interest rates or other monetary variables such as money supplies or degrees of sterilization in classifying countries' overall monetary cum exchange rate regimes, but it is not clear how the behaviors of these monetary policy variables should be related to the classification of the degree of flexibility of the exchange rate regime. CR are able to make a strong link only by making the assumption that interest rate changes are only used to limit exchange rate movements. They argue correctly that "such interest rate volatility is not the result of adhering to strict

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[11] See Hausmann *et al.,* (2001), Baig (2001), CR (2002), Hernández and Montiel (2003), Cavoli and Rajan (2005), Siregar and Pontines (2005) etc.

monetary targets in the face of large and frequent money demand shocks…" (p 392).

However, they then jump directly from this statement to the conclusion that "Interest rate

volatility would appear to be the byproduct of a combination of trying to stabilize the

exchange rate through domestic open market operation and lack of credibility" (p 392).

This leaves out the possibility of the effects of other types of shocks and of domestically

motivated monetary policy actions dictated by discretion rather than a monetary rule.

Interest rate changes can also be used to protect reserve levels. Thus we see no clear basis

for a presumption that higher interest rate variability should be considered as an indicator

of less flexibility in the exchange rate regime. This is certainly an issue worthy of further

investigation.

Post-crisis exchange rate regimes in Asian countries have been important issues

with regard to this subject recently but there has still been considerable disagreement.

While the view that most of the crisis countries shifted from pre-crisis fixed rates to post-

crisis floating rates has become popular, many scholars point out its oversimplification.

Siregar and Pontines (2005) find that Indonesia, Korea, and Thailand have maintained a

de-facto flexible exchange rate regime during the post-1997 period but Singapore has

increased intervention. They use an intervention index which is composed of probabilities

that exchange rate, international reserves, and interest rate are in regimes with high

volatilities based on Markov-Regime Switching ARCH model. However, Calvo and

Reinhart (2002) argue that countries announcing officially free floating tend to still

intervene in the foreign exchange market, so-called fear of floating. McKinnon and

Schnabl (2004) even argue that post-crisis Asian foreign exchange policies shows strong

intervention and they indeed have returned to soft dollar peg. Dooley *et al.,* (2003)

describe recent phenomenon including the Asian regimes as a new *de facto* Bretton Woods regime. Finally, Hernández and Montiel (2003) argue that post-crisis foreign exchange policies in East Asia have become more flexible than before but less than real free floating.

3.5 Sterilization and the Effects of Exchange Rates on Domestic Monetary Policy

Exchange rate policy is only one aspect of monetary regimes (see Rose (2007)). An exchange rate regime requires a corresponding domestic monetary policy to avoid generating crises. In the short run countries may use sterilized foreign exchange interventions to break the link between exchange rate and monetary policy, for example to deal with capital movements that are believed to be temporary. Unsterilized intervention on the other hand will generate corresponding changes in domestic monetary aggregates. Thus it is important to distinguish between sterilized and unsterilized intervention.

As is emphasized in Mundell-Fleming models and trilemma analysis under fixed exchange rates and perfect capital mobility sterilization is not possible. The trilemma analysis argues that one cannot have all three of fixed exchange rates, independent monetary policy, and absence of controls as these are the three main ways to correct balance of payments disequilibria. With imperfect capital mobility, however, this set of constraints can be violated in the short run through sterilized intervention. Many commentators have wrongly assumed that because China has been following a fairly tight peg against the dollar it must be importing the United States' monetary policy. This misses that China has substantial capital controls and has been able to sterilize most of its

balance of payments surplus over a number of years (See Ouyang *et al.,* (2010)).

There has been considerable controversy over how much attention countries should pay to exchange rate and balance of payments developments in setting domestic monetary policy. This is an issue even for open economies that have adopted inflation targeting. In this context Willett (2003a and b) has suggested that instead of just being used to decide if a country should join a currency area or adopt some other form of hard fix such as a currency board, the Optimal Currency Area criteria can be used to investigate how much weight a country should give to foreign exchange market developments in setting domestic monetary policy. This can run from 100% for a hard fix to 0% with a free float for a large country.

Many countries that have floating rates have practiced heavy intervention in the foreign exchange market. Korea is a good example. Officials frequently describe Korea's exchange rate regime as free floating, but it has at times intervened heavily in the foreign exchange market (Kim and Willett, 2006). Korea has adopted inflation targeting but the exchange rate seems to still play an important role in its monetary policy. Both Eichengreen (2004) and Parsley and Popper (2009) have found that Korea's overnight call rate has responded to movement in the dollar-won exchange rate as well as to expected inflation and the output gap. Ouyang and Willett (2010) find that a high proportion of Korea's intervention in the foreign exchange market has been sterilized.

Estimating the degree of sterilization can be tricky. Simple correlations do not distinguish between whether changes in monetary policy are causing changes in reserves or changes in reserves are causing changes in monetary policy. Thus it is necessary to estimate policy reaction functions to attempt to make this distinction. Many of the issues

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involved in such efforts are discussed in the longer version of this paper because it is necessary to attempt to distinguish

There is also an issue of whether interest rate variability should be included in measures of exchange rate flexibility. It is clearly appropriate to use changes in interest rates or other monetary variables such as money supplies or degrees of sterilization in classifying countries' overall monetary cum exchange rate regimes, but it is not clear how the behaviors of these monetary policy variables should be related to the classification of the degree of flexibility of the exchange rate regime. CR are able to make a strong link only by making the assumption that interest rate changes are only used to limit exchange rate movements. They argue correctly that "such interest rate volatility is not the result of adhering to strict monetary targets in the face of large and frequent money demand shocks…" (p.392). However, they then jump directly from this statement to the conclusion that "Interest rate volatility would appear to be the byproduct of a combination of trying to stabilize the exchange rate through domestic open market operation and lack of credibility" (p.392). This leaves out the possibility of the effects of other types of shocks and of domestically motivated monetary policy actions dictated by discretion rather than a monetary rule. Interest rate changes can also be used to protect reserve levels. Thus we see no clear basis for a presumption that higher interest rate variability should be considered as an indicator of less flexibility in the exchange rate regime. This is certainly an issue worthy of further investigation.

IV Concluding Remarks

In the limited space of this article there are many issues with which we have not

been able to deal. We hope, however, that we have given the reader a useful introduction to the major large data sets available that classify exchange rate regimes and an overview of some of the major conceptual issues involved in classifying exchange rate regimes and their relation to domestic monetary policies.

In the longer version of this paper available on the web we provide examples of how our favored EMP approach can be applied and how it compares with the other major approaches using the cases of India, Korea, and Tanzania. We also discuss a number of the research areas for which classifications of currency regimes are used. In particular we review studies of the effects of currency regimes on international trade, economic growth, inflation and other aspects of macroeconomic discipline, and on currency and financial crises and the debate about best to characterize post crisis exchange rate regimes in Asia.

In closing we would like to reiterate what we view as some of the most important methodological conclusions that we have reached.

1. The degree of exchange rate flexibility is not the only important international dimension of a country's currency policies. Also important are the degree to which international exchanges are controlled and the role given to developments in the foreign exchange market in setting domestic monetary policy. For this latter purpose it is important to distinguish between sterilized and unsterilized interventions in the foreign exchange market. Since it is difficult to know to what extent a country changes its interest to protect its exchange rate or its reserves it is probably not a good idea to use changes in interest rates in measures of exchange rate flexibility.

2. Official statements about exchange rate policies are often misleading guides to the practices that countries actually follow.

3. In general the degree of flexibility of an exchange rate regime cannot be measured correctly by the behavior of the exchange rate alone. Low levels of fluctuation can be caused either by heavy intervention or by there being only small shocks. To distinguish between these cases it is useful to use the concept of exchange market pressure and look at the ratio of the pressures that lead to changes in the exchange rate versus changes in reserves. This gives us an index of flexibility or its inverse, the propensity to intervene. This framework assumes that countries intervene to lean against the wind i.e. to slow down exchange rate movements. Where governments intervene to accelerate exchange rate movements the degree of exchange rate flexibility is not well defined. Measures that use the ratios of variances do not make such distinctions

4. In using this EMP approach it will often be important to distinguish between relationships between trends in reserves and exchange rates and fluctuations around these trends.

5. Each country's currency has exchange rates against many other currencies. It will often be misleading to consider its exchange rate against only one other currency such as the dollar or the euro.

6. One should be very suspicious of classifications that are binary, i.e., that only distinguish between fixed and flexible exchange rates since there are many versions of both fixed and flexible rates. For example, when investigating relationships with macroeconomic discipline and currency and financial crises it is essential to distinguish between hard and soft fixes. Likewise under a two way classification it isn't at all clear whether crawling band regimes should be placed under fixed or flexible rates. By varying such placements a researcher could often get almost any results that they wanted a priori.

7. There is no one best number of categories to use. That will depend on the purpose of the study. The same goes for the best time periods over which to measure regimes.

8. The most complex statistical measures are not always the most accurate. It is sometimes not clear what they are actually measuring.

9. Since there is no perfect way to implement the concept of exchange rate flexibility or its inverse, how heavily a government is managing its exchange rate it is important for researchers to test the robustness of their results to alternative methods.

This may seem a daunting list of considerations to take into account. However the fact that it is unlikely that we can create perfect measures should not deflect us from trying to construct less imperfect measures, nor from using measures that we know are imperfect but we think are the best available. When we do this, however, we should be humble about our results and test them against alternative measures. Science often progresses in little jumps.

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