

# *A de facto* Classification of Exchange Rate Regimes: A Methodological Note<sup>1</sup>

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<sup>1</sup> This note summarizes the methodology in Levy-Yeyati and Sturzenegger (2002).

# 1. Introduction

Most of the empirical discussion on exchange rate regimes has used the *de jure* (legal) regime as compiled by the IMF, which is based on the regime the country declares to be running.<sup>2</sup> However, many countries that *in theory* have a flexible rate intervene in exchange markets so pervasively that *in practice* very little difference exists (in terms of observable performance) with countries that have explicit fixed exchange rate regimes. Conversely, periodic devaluations of pegs in inflation-prone countries are the result of the implementation of monetary policies that are inconsistent with fixed exchange rates and that make the effective regime resemble a flexible arrangement.<sup>3</sup>

In Eduardo Levy-Yeyati and Federico Sturzenegger (2002), we construct an alternative classification, by proposing a new *de facto* classification of exchange rate regimes that reflects actual policies. We believe this may provide an interesting complement or alternative to the standard *de jure* classification. More precisely, we define exchange rate regimes according to the behavior of three classification variables: changes in the nominal exchange rate, the volatility of these changes, and the volatility of international reserves. Underlying the selection of these variables is the textbook definition of exchange rate regimes, where fixed exchange rate regimes are associated with changes in international reserves aimed at reducing the volatility in the nominal exchange rate, and where flexible regimes are characterized by substantial volatility in nominal rates with relatively stable reserves. Thus, the combined behavior of these three classification variables should be sufficient to determine the regime to which each country should be assigned at each point in time.

To construct the classification we use a cluster analysis methodology that, once we define the number of exchange rate regimes to be identified from the data, groups the cases according to similarity in the behavior of the three variables of reference. For example, the cluster with high volatility of reserves and low volatility in the nominal exchange rate identifies the group of fixers. Conversely, the cluster with low volatility in international reserves and substantial volatility in the nominal exchange rate corresponds to countries with flexible arrangements. While this allows to classify most country data points since 1974, for several countries this classification procedure is not feasible as data may be lacking on some of the classification variables. In some of these cases, however, the exchange rate regime may be uncontroversial, either because the country was successfully sustaining a peg or didn't have separate legal tender. For these uncontroversial cases we extend the classification using this ad-hoc information.

## 2. Methodology

### *Cluster analysis*

Cluster analysis is a technique used to identify homogeneous groups of observations.<sup>4</sup> While the standard discriminant analysis starts from a known classification of the sample to derive a classification rule to be

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<sup>2</sup> See the IMF's *Exchange Arrangements and Exchange Restrictions*. An example of the IMF *de jure* classification can be found in any issue of the *International Financial Statistics*.

<sup>3</sup> As Frankel (1999) points out: "Out of 185 economies, the IMF classifies 47 as independently floating and 45 as following rigid pegs... Most of those classified as fixed have in fact had realignments within the last ten years.... Similarly, most of those listed as floating in fact intervene in the foreign exchange market frequently." Similarly, Fischer (2001) concisely states: "... authorities own descriptions of exchange rate regimes in *Exchange Arrangements and Exchange Restrictions* is patently inaccurate for some countries..."

<sup>4</sup> The most common examples of the use of this technique come from the areas in which it is most frequently used: numerical taxonomy of animals and plants (biology), distinct pathological groups (medicine), people with similar buying habits (marketing), etc.

applied to out-of-sample cases, cluster analysis works in the opposite direction, constructing groups according to similarities (distances) between the sample elements.

In K-means cluster analysis (KMC), based on *nearest centroid sorting* (Anderberg, 1973), a case is assigned to the cluster with the smallest distance between the case and the center of the cluster (centroid). The number of clusters is specified *ex-ante* by the user, and cluster centers are iteratively estimated from the data. This method requires the least intervention from the researcher: just a definition of the numbers of clusters to be generated by the algorithm. Since it is crucial to our work that the resulting classification entails as minimal a manipulation of the classification criteria as possible, we choose KMC as our classification method.<sup>5</sup>

### ***Classification Variables***

According to the textbook description, flexible exchange rates are characterized by little intervention in the exchange rate markets together with unlimited volatility of the nominal exchange rate. Conversely, a fixed exchange rate regime occurs when the exchange rate does not move while reserves are allowed to fluctuate. A crawling peg corresponds to the case where changes in the nominal exchange rates occur with stable increments (i.e. low volatility in the rate of change of the exchange rate) while active intervention keeps the exchange rate along that path. Finally, a dirty float should be associated to the case in which volatility is relatively high across all variables, with intervention only partially smoothing exchange rate fluctuations.<sup>6</sup> With this in mind we chose the volatility of the nominal exchange rate, the volatility of its rate of change and the volatility of international reserves as our three classification variables.

*Exchange rate volatility* ( $\sigma_e$ ), was measured as the average of the absolute monthly percentage changes in the nominal exchange rate during a calendar year.<sup>7</sup> The *volatility of exchange rate changes* ( $\sigma_{\Delta e}$ ), was computed as the standard deviation of the monthly percentage changes in the exchange rate.

In order to compute these variables we need to find the appropriate currency of reference for each country. In some cases the answer seemed to pose no problem (for example, we use the U.S. dollar for Mexico or the DM for Italy). But the currency of reference is not clearly identifiable in all cases. For example, for the UK or for Switzerland, the US dollar and the German DM are, apparently, equally good candidates. To resolve these cases we use the following procedure. For countries that report a fixed exchange rate regime

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<sup>5</sup> We use SPSS 8.0 as our computational device. The algorithm for the K-means classification proceeds as follows: “The first  $k$  cases in the data file, where  $k$  is the number of clusters requested, are selected as temporary centers. As subsequent cases are processed, a case replaces a center if the smallest distance to a center is greater than the distance between the two closest centers. The center that is closer to the case is replaced. A case also replaces a center if the smallest distance from the case to a center is larger than the smallest distance between the center and all other centers. Again, it replaces the center closest to it” (Norusis, 1994).

<sup>6</sup> Frankel (1999) identifies nine exchange rate regimes: currency union, currency board, “truly fixed” exchange rates, adjustable peg, crawling peg, basket peg, target zone or band, managed float and free float. These nine groups can be broadly mapped into the four categories identified in our work, with the first three groups corresponding to a fix, the next three to a crawling peg, and the last two to a dirty and a pure float. Exchange rate bands may behave either as a crawling peg (when the exchange rate hits one of the bounds), as a float (when it fluctuates within the band) or as a dirty float (in the presence of intramarginal intervention). At any rate, it is interesting to stress that an increase in the number of clusters in our specification did not lead to the appearance of a new and clearly identifiable group, suggesting that, from the point of view of the observed behavior of the data, there is no much information to be gained by going beyond our four-way classification.

<sup>7</sup> Choosing a calendar year as unit of account implies that in years where the exchange rate regime changes, the yearly number will reflect a combination of both regimes. Argentina, for example, implemented a fixed exchange rate in April of 1991. Our yearly data takes into account the strong movements in the nominal exchange rate during the first three months of the year and, as a result, the country is classified as a dirty float. Similarly Ecuador, which dollarized in late January 2000 is classified as crawling peg for that year. This improves upon IMF (1997) and Ghosh *et al.* (1997), which use the legal regime as of the end of each year, thus assigning the country to an ex-post regime which may be, to a large extent, endogenous. See Edwards and Savastano (1999).

we use the legal peg currency. For the rest, we use the currency against which their exchange rate exhibits the lowest volatility.<sup>8</sup> Countries that pegged their currency to a basket, were eliminated from the sample unless the central peg parity or the basket weights were known. The reference currency for each country is presented in Appendix 1.

Reserves are notoriously difficult to measure and there is usually a large difference between changes in reserves and interventions. Thus, our measure of the third classification variable, the *volatility of reserves* ( $\sigma_r$ ) requires particular care. To approximate as closely as possible the change in reserves that reflects intervention in the foreign exchange market we subtracted government deposits at the central bank from the central bank's net foreign assets.<sup>9</sup> More specifically, we define net reserves in dollars as:

$$R_t = \frac{ForeignAssets_t - ForeignLiabilities_t - CentralGov.Deposits_t}{e_t},$$

where  $e$  indicates the price of a dollar in terms of local currency. All Central Bank items are denominated in local currency and the time period for all variables corresponds to the end of period for a specific month. Our measure of monthly intervention in the foreign market  $r_t$ , is defined as:

$$r_t = \frac{\frac{R_t - R_{t-1}}{e_{t-1}}}{\frac{MonetaryBase_{t-1}}{e_{t-1}}} = \frac{\Delta R}{MonetaryBase_{t-1}}.$$

Our measure of volatility is the average of the absolute monthly change in  $r$ , i.e. the average of the absolute monthly change in net dollar international reserves relative to the monetary base in the previous month, also in dollars.<sup>10</sup>

We compute a yearly figure for each classification variable for all 183 countries that report to the IMF.<sup>11</sup> The period of analysis is 1974-2000. In all, for this period there are 4604 classifiable country-year data points. Of these 553 are left out as they belong to undisclosed basket pegs and 1062 lack data for one of the classifying variables. For the remaining 2989 observations we construct our data set, which

<sup>8</sup> For this exercise we considered the US dollar, the French franc, the German marc, the British pound, the SDR, the ECU and the Japanese yen. For some small countries the currency of a large neighbor was also considered.

<sup>9</sup> Oil producing countries and countries with important privatization programs are examples of cases where the latter correction matters. Calvo and Reinhart (2000) indicate other reasons (hidden foreign exchange transactions, use of credit lines, derivative transactions, or issuance of debt in foreign currency) that make it difficult to compute the real movement in reserves. To these one could add coordinated intervention by other central banks (though this should be limited to G-3 economies) and the measurement error introduced by the fact that all accounts are transformed to dollar units. If the Central Bank holds a portfolio of assets with several currencies, changes in the parities between the reserve currencies can be mistaken for foreign exchange interventions. We believe this measurement error problem should not be very significant as most of the reserves are in dollar denominated assets.

<sup>10</sup> In practice we use line 11 from the IFS for foreign assets, line 16c for foreign liabilities and 16d for central government deposits. Line 14 (or 14a if line 14 was not available) lagged one month is used as a measure of the monetary base. *Contrary to* Calvo and Reinhart (2000) we use the changes relative to the monetary base rather than the percentage change in reserves. We believe this is a better measure, as a given percentage change in reserves in countries with low monetization implies a larger relative intervention in forex markets.

<sup>11</sup> This still excludes some fixed exchange rate countries that are not IMF country members such as Andorra, Liechtenstein, Monaco, Nauru, Tuvalu and Vatican City, all of them fixed throughout the post Bretton Woods period (Tuvalu since 1979). See Obstfeld and Rogoff (1995). We also exclude many semi-independent countries, dependencies or territories. On these see Rose (2000). All other countries are included.

corresponds to the number of cases in which country-year data for the three reference variables could be computed.

### ***The Exchange Rate Regime Classification***

Once the three classification measures are computed for our universe of countries, we use *cluster analysis* as a way of assigning the data to different groups. We consider each cluster as representing a distinct exchange rate regime, independently of the “legal” regime stated by the country that is assigned to this group. Table 1 presents our prior as to how the three classification variables described above map into exchange rate regimes. The only clarification required relates to those countries that by displaying little variability along the three variables cannot be assigned to any particular type of regime, and which we label “inconclusives.” The wording is not arbitrary. First, if neither the nominal exchange rate nor reserves move, it is not obvious the exchange rate regime the country is implementing. Second, given the magnitude of the changes involved, the experience of these countries may not tell us much about the specific impact of the exchange rate regime on the behavior of the economy.

**Table 1**

	$\sigma_e$	$\sigma_{De}$	$\sigma_r$
<b>Inconclusive</b>	Low	Low	Low
<b>Flexible</b>	High	High	Low
<b>Dirty Float</b>	High	High	High
<b>Crawling Peg</b>	High	Low	High
<b>Fixed</b>	Low	Low	High

The classification procedure is depicted in the diagram of Figure 1. Because KMC relies on the relative distance between points it is important that measures be comparable in order to obtain a relevant classification along all dimensions. Therefore, we first eliminate the two percent-upper tail of observations for each of the three classification variables, which entails leaving 129 outliers (out of 2989 data points) out of the sample.<sup>12</sup> We then z-normalize the remaining 2860 observations. Next, we use the K-means algorithm to classify the data into the 5 clusters described in Table 1. We call this first pass at the data the 1<sup>st</sup> round classification.<sup>13</sup> The clusters are shown in Figure 2.

This initial classification assigns a regime to 1062 data points but allocates a high number of countries within the “inconclusive” category (1798 out of 2860 cases). However, while variations in the classification variables within this group may be small relative to the data points clustered in the 1<sup>st</sup> round, the data still displays enough volatility to identify exchange rate regimes among these observations. In order to unveil these, while maintaining the distinction between high and low variability cases, we reclassify the “inconclusives” using the same methodology used in the 1<sup>st</sup> round. That is, we re-normalize the data for these 1798 observations, and apply the K-means algorithm on the new values, again allowing for five groups. We call the resulting grouping of the “inconclusive” sub-sample the 2<sup>nd</sup> round

<sup>12</sup> Because these outliers do not present classification problems, we re-classify these observations ex-post, by assigning them to the cluster with the nearest centroid. In the tables countries classified according to this criteria are denoted by the indicator (3). The 2% threshold was chosen arbitrarily. Alternative values for this threshold deliver a virtually identical classification.

<sup>13</sup> We start with a number of clusters that we believe should describe all exchange rate regimes. We check robustness of our exchange rate regimes prior by increasing the number of clusters beyond the original five. However, we found that by doing this we simply partition an existing cluster adding no richness to the description of the data. In this sense, the methodology helps identify the right numbers of regimes that can be distinguished in the data.

classification.<sup>14</sup> The two-round procedure assigns an exchange rate regime to 1100 of the original 1798 data points in the original sample, with only 698 2<sup>nd</sup> round inconclusives left unclassified. Again, the clusters can be seen in Figure 2.

The distinction between first and second round, which mirrors observations with high and low variability, provides an additional refinement in the classification. By introducing this variability dimension, this methodology allows to discriminate, albeit in a crude manner, the *intensity* of the shocks to which the regime is subject, something that qualitative indexes previously used did not allow for. This may turn out to be crucial for empirical work, if, as we suspect, policy responses under different exchange rate regimes, and the impact of the regime on other economic variables, depend on the relative magnitude of underlying shocks.

Table 2 shows central value for the classification variables as well as the upper and lower bounds for each cluster. Fixed regimes are characterized by relatively low nominal exchange rate volatility (with centroid absolute change of 0.20% per month as opposed to 2.31% in the case of floats), and high volatility in reserves (14.68% for fixers against 4.59% for pure floats). The two intermediate groups, on the other hand, exhibit not only substantial intervention in the exchange rate market but also the highest exchange rate volatility. This evidence suggests the following important point: *Pure floats appear to tolerate relatively minor fluctuations in the exchange rate.* Conversely, as a rule, countries with substantial movements in the nominal exchange rate usually intervene actively.

Table 2 also shows that 2<sup>nd</sup> round groups are characterized by less overlap between fixers and floaters. While fixers exhibit an absolute monthly volatility of the nominal exchange rate that ranges from zero to 0.63%, the minimum volatility for floaters is 0.72%. On the reserves dimension, floaters have an absolute change in reserves ranging between 0.25% and 6.46% of the monetary base, whereas for fixers the minimum intervention is 5.65%. Within the 2<sup>nd</sup> round crawling pegs are associated with substantially smaller reserve intervention.

### ***A refined classification***

While the method proposed has been successful in assigning an exchange rate regime to most data points, the fact that 698 data points remain unclassified begs the questions as to why not undertake additional rounds of classification until all observations are assigned a regime. Additionally, one could ask whether some regimes within the 1062 data points for which one of the classification variables was not available could be identified in an uncontroversial fashion independently of availability of data for the classification variables. For example, shouldn't dollarized Panama or Hong-Kong's currency board be classified regardless of the fact that no data on reserves is available? As the objective is to provide as comprehensive as possible a database on exchange rate regimes for the post Bretton-Woods period, we do use additional information to classify those countries that were not assigned a regime through the previous methodology.

The first refinement corresponds to the classification of the 698 2<sup>nd</sup> round inconclusives. Among this group a fixed exchange rate regime was assigned to all those data points that exhibited zero volatility in the nominal exchange rate as well as to those data points identified by the IMF as corresponding to countries with a fixed exchange rate and which had an average volatility in the nominal exchange rate smaller than 0.1% (placing them safely off limits to 2<sup>nd</sup> round floats and dirty floats).<sup>15</sup> As this criteria classified 625 of the 698 cases, we decided that no additional iterations of the cluster analysis methodology were necessary. In the end, only 73 cases (2.4%) out of the original 2989 data points were left unclassified.

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<sup>14</sup> In the tables, the countries that are classified in this second round are denoted by the indicator (2) to keep track of low variability countries within each category.

<sup>15</sup> The cases identified in the data base through this methodology are identified with a \*.

In addition there are 1062 data points for which at least one of the classification variables is not available. Countries without a separate legal tender, for which no data on reserves is accessible, are an example. Many of these countries, which include cases such as Panama, San Marino or Hong Kong's currency board can be safely assigned a fixed exchange rate regime. Again, we assigned a fixed exchange rate regime to all hard pegs according to Rose (2000) or the IFS, to those cases that exhibited zero volatility in the nominal exchange rate, and to data points identified by the IMF as corresponding to countries with a fixed exchange rate and which had an average volatility in the nominal exchange rate smaller than 0.1%. The country year data points classified in this manner are identified as uncontroversial fixes in the database.<sup>16</sup> The complete classification is presented in Appendix B.<sup>17</sup>

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<sup>16</sup> These countries are identified in the data base by the symbol †.

<sup>17</sup> The complete database is available at <http://www.utdt.edu/~ely> or <http://www.utdt.edu/~fsturzen>.

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## **Appendix A: Currencies of Reference**

### **To the US dollar**

Afghanistan, Algeria, Angola, Antigua and Barbuda (77-), Argentina, Armenia, Aruba, Australia, Azerbaijan, Bahamas, Bahrain, Bangladesh (89), Barbados (75-), Belarus (95-), Belize (77-), Bolivia, Brazil, Brunei, Bulgaria (94-95), Burundi (74-83;92-), Cambodia, Canada, Chile (74-89;99-), China, Colombia, Democratic Republic of Congo, previously Zaire, (74-75;83-), Costa Rica, Djibouti, Dominica (79-), Dominican Republic, Ecuador, Egypt, El Salvador, Ethiopia, The Gambia (86-), Georgia, Germany, Ghana, Grenada (77-), Guatemala, Guinea (86-), Guyana (76-), Haiti, Honduras, Hong Kong, Hungary, India (75-), Indonesia, Iran (74-80, 93-), Iraq, Israel, Jamaica, Japan, Jordan (88-), Kenya (74;87-), Korea, Kyrgyz Republic, Lao PDR, Lebanon, Liberia, Libya (74-86), Lithuania, Malawi (74; 84-), Malaysia, Maldives, Marshall Islands, Mauritania, Mauritius (83-), Mexico, Micronesia, Mongolia, Mozambique, Nepal, Netherlands Antilles, New Zealand, Nicaragua, Nigeria, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Poland (74-79), Qatar, Romania, Russia, Rwanda (74-82;94-), Sao Tomé and Príncipe, Saudi Arabia, Seychelles (96-), Sierra Leone (83-), Singapore, Solomon Islands, Somalia, South Africa, Sri Lanka, St. Kitts and Nevis (77-), St. Lucia (77-), St. Vincent and the Grenadines (77-), Sudan, Suriname, Syrian Arab Republic, Tajikistan, Tanzania (74; 79-), Thailand, Trinidad and Tobago (76-), Turkey, Turkmenistan, Uganda (74-78; 81-), Ukraine, United Arab Emirates, United Kingdom (74-86; 95-), Uruguay, Venezuela, Yemen, Zambia (74-75; 83-), Zimbabwe.

### **To the British Pound**

Antigua and Barbuda (74-76), Bangladesh (74-78), Barbados (74), Belize (74-76), Dominica (74-78), The Gambia (74-85), Grenada (74-76), Guinea (74-85), Guyana (74-75), India (74), Ireland (74-78), Seychelles (74-78), Sierra Leone (74-77), St. Kitts and Nevis (74-76), St. Lucia (74-76), St. Vincent and the Grenadines (74-76), Trinidad and Tobago (74-75).

### **To the German Mark**

Albania, Austria, Belgium, Bosnia and Herzegovina, Bulgaria (96-), Croatia, Czech Republic, Denmark, Estonia, Finland, France, Greece, Iceland, Ireland (79-), Italy, Macedonia FYR, Moldova, Netherlands, Norway, Poland (80-), Portugal, Slovak Republic, Slovenia, Spain, Sweden Switzerland, United Kingdom (87-94), United States.

### **To the French Franc**

Benin, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Republic of Congo, Cote d'Ivoire, Equatorial Guinea, Gabon, Guinea Bissau, Madagascar, Mali, Morocco, Niger, Senegal, Togo, Tunisia.

### **To the SDR**

Burundi (84-91), Democratic Republic of Congo, previously Zaire, (76-82), Iran (81-92), Jordan (74-87), Kazakhstan, Kenya (75-86), Latvia, Libya (87-), Malawi (75-83), Mauritania, Mauritius (74-82), Myanmar, Rwanda (83-93), Seychelles (79-95), Sierra Leone (78-82), Tanzania (75-78), Zambia (76-82).

### **Other**

Bhutan, Indian Rupee

Botswana, South African Rand  
Chile, Central band parity as published by the Central Bank of Chile (90-98)  
Cyprus, ECU/Euro  
Kiribati, Australian Dollar  
Lesotho, South African Rand  
Luxembourg, Belgium Franc  
Malta, Italian Lira/Euro  
Namibia, South African Rand  
San Marino, Italian Lira/Euro  
Swaziland, South African Rand  
Tonga, Australian Dollar

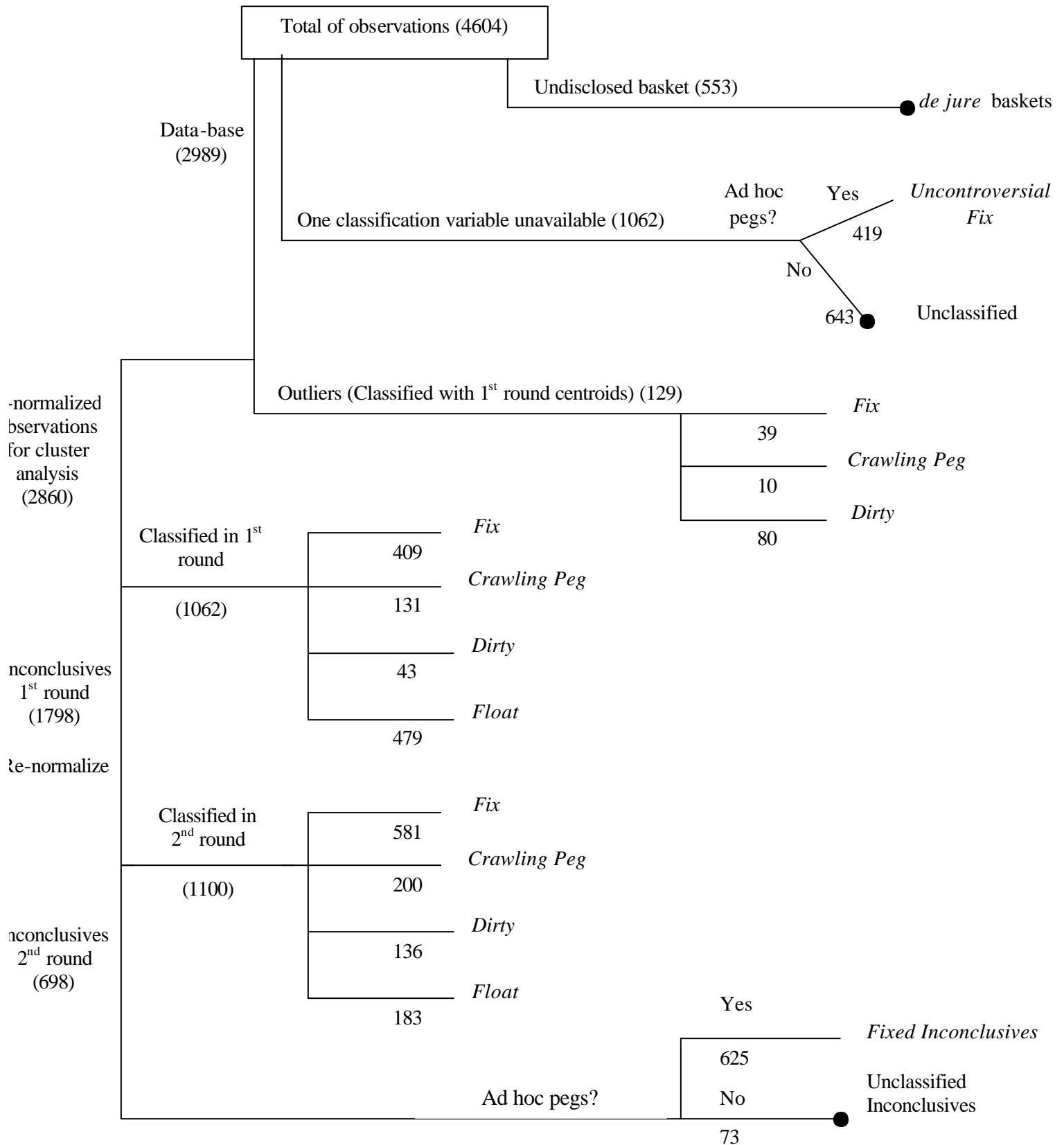
## Appendix B: Regimes for all countries

[illegible]

Country	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
INDONESIA**	Fix †	Fix <sup>2</sup>	Fix †	Fix †	Interm*	Floa <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Interm*	Interm <sup>2</sup>	Fix <sup>2</sup>	Interm*	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix †	Fix †	Fix †	Fix Incon	Fix <sup>2</sup> Inter <sup>3</sup>	Incon	Incon	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>
IRAN, I.R. OF	Fix †	Interm* <sup>2</sup>	Fix †	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Incon	Fix <sup>2</sup>	Fix <sup>2</sup>	Interm <sup>2</sup>	Fix <sup>2</sup>	Interm*	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix †	Fix †	Fix †	Fix Incon	Fix <sup>2</sup> Inter <sup>3</sup>	Incon	Incon	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>
IRAQ	Fix*	Fix*	Fix	Fix*	Fix*	Fix*	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*
IRELAND*	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix	Fix	Fix	Interm <sup>2</sup>	Fix <sup>2</sup>	Fix	Fix	Fix	Fix	Fix	Floa <sup>2</sup>	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix
ISRAEL**	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>3</sup>	Interm*	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
ITALY*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm*	Fix	Fix	Fix	Interm* <sup>2</sup>	Interm* <sup>3</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Interm*	Incon	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>
JAMAICA	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix	Interm*	Fix	Fix	Fix	Fix <sup>3</sup>	Interm* <sup>3</sup>	Fix	Fix	Fix	Fix	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix	Interm*	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>
JAPAN*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix	Fix	Fix	Fix	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm*	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>
JORDAN**	Floa <sup>2</sup>	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>
KAZAKHSTAN																											
KENYA	Interm* <sup>2</sup>	Floa <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix	Fix	Interm <sup>2</sup>	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*
KIRIBATI																											
KOREA**	Floa <sup>2</sup>	Interm* <sup>2</sup>	Fix †	Fix †	Fix †	Fix †	Fix †	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Fix	Fix	Fix	Interm <sup>2</sup>	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*
KUWAIT																											
KYRGYZ REPUBLIC																											
LAO PEOPLE'S DEM.REP																											
LATVIA																											
LEBANON**	Floa <sup>2</sup>	Fix*	Fix*	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm*	Interm	Interm <sup>3</sup>	Interm <sup>3</sup>	Fix <sup>3</sup>	Interm*	Interm	Interm*	Interm <sup>3</sup>	Fix <sup>3</sup>	Fix	Fix	Fix <sup>2</sup>	Fix †	Fix †	Fix †	Fix †
LESOTHO	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Interm*	Interm	Interm <sup>3</sup>	Interm <sup>3</sup>	Fix <sup>3</sup>	Interm*	Interm	Interm*	Interm <sup>3</sup>	Fix <sup>3</sup>	Fix	Fix	Fix	Fix	Fix	Fix	Fix
LIBERIA	Fix	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*
LIBYA	Fix	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix †	Fix †	Fix †	Interm* <sup>2</sup>	Fix †	Fix †	Fix †	Fix †	Fix †	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
LITHUANIA																											
LUXEMBOURG	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix †	Fix <sup>2</sup>	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †
MACEDONIA, FYR																											
MADAGASCAR	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Fix †	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>				Fix	Interm*	Fix	Fix	Fix										
MALAWI																											
MALAYSIA**	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Fix	Fix	Interm <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm <sup>2</sup>	Interm* <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>
MALDIVES	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †
MALI	Fix <sup>2</sup>	Fix	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †
MALTA																											
MARSHALL ISLANDS																											
MAURITANIA																											
MAURITIUS	Fix <sup>3</sup>	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix <sup>2</sup>	Interm <sup>3</sup>	Interm*	Floa <sup>2</sup>	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*
MEXICO**	Fix †	Fix †	Interm	Floa <sup>2</sup>	Incon	Floa <sup>2</sup>	Incon	Incon	Interm <sup>2</sup>	Interm <sup>3</sup>	Interm*	Floa <sup>2</sup>	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*	Interm*
MICRONESIA, FED.STS.																											
MOLDOVA																											
MONGOLIA																											
MOROCCO**					Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>3</sup>	Interm <sup>2</sup>	Interm*	Interm*	Interm*	Interm*	Interm*
MOZAMBIQUE																											
MYANMAR	Interm* <sup>2</sup>	Floa <sup>2</sup>	Fix*	Floa <sup>2</sup>	Fix †	Fix	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
NAMIBIA																											
NEPAL	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix †	Fix †	Interm* <sup>2</sup>	Fix †	Fix †	Floa <sup>2</sup>	Interm <sup>2</sup>	Fix <sup>2</sup>	Fix																
NETHERLANDS*	Floa <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Fix	Incon	Incon	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Incon	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>
NETHERLANDS ANTILLES	Fix †	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Fix †	Interm <sup>2</sup>	Fix †	Fix †	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix
NEW ZEALAND*																											
NICARAGUA	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>		Fix <sup>2</sup>	Fix	Fix <sup>2</sup>	Fix †	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*
NIGER	Fix <sup>2</sup>	Fix †	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix †	Interm*	Fix †	Interm*	Fix †	Fix †	Fix †	Fix †	Interm <sup>3</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>
NIGERIA**	Fix	Interm <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Fix <sup>2</sup>	Fix †	Interm <sup>3</sup>	Fix <sup>2</sup>	Interm*	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix
NORWAY*	Fix	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Fix	Fix <sup>2</sup>	Fix †	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix <sup>2</sup>	Interm*	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix
OMAN	Fix <sup>2</sup>	Fix <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Fix	Fix <sup>2</sup>	Fix †	Fix †	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix <sup>2</sup>	Interm*	Fix	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>
PAKISTAN**		Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Floa <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Interm* <sup>2</sup>	Floa <sup>2</sup>	Incon	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
PALAU																											
PANAMA**	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*	Fix*
PAPUA NEW GUINEA	Floa <sup>2</sup>	Interm <sup>2</sup>	Fix	Interm* <sup>2</sup>	Floa <sup>2</sup>	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix	Fix
PARAGUAY	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Fix †	Interm	Interm*	Interm	Fix †	Fix †	Interm	Floa <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
PERU**	Fix †	Floa <sup>2</sup>	Interm*	Interm*	Floa <sup>2</sup>	Floa <sup>2</sup>	Fix †	Fix †	Fix †	Fix †	Interm*	Interm*	Interm	Fix †	Fix †	Interm	Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>
PHILIPPINES**	Interm <sup>2</sup>	Interm <sup>2</sup>	Fix <sup>2</sup>	Incon	Incon	Fix <sup>2</sup>	Fix <sup>2</sup>	Fix <sup>2</sup>	Interm <sup>2</sup>								Floa <sup>2</sup>	Interm <sup>2</sup>	Interm <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>	Floa <sup>2</sup>			

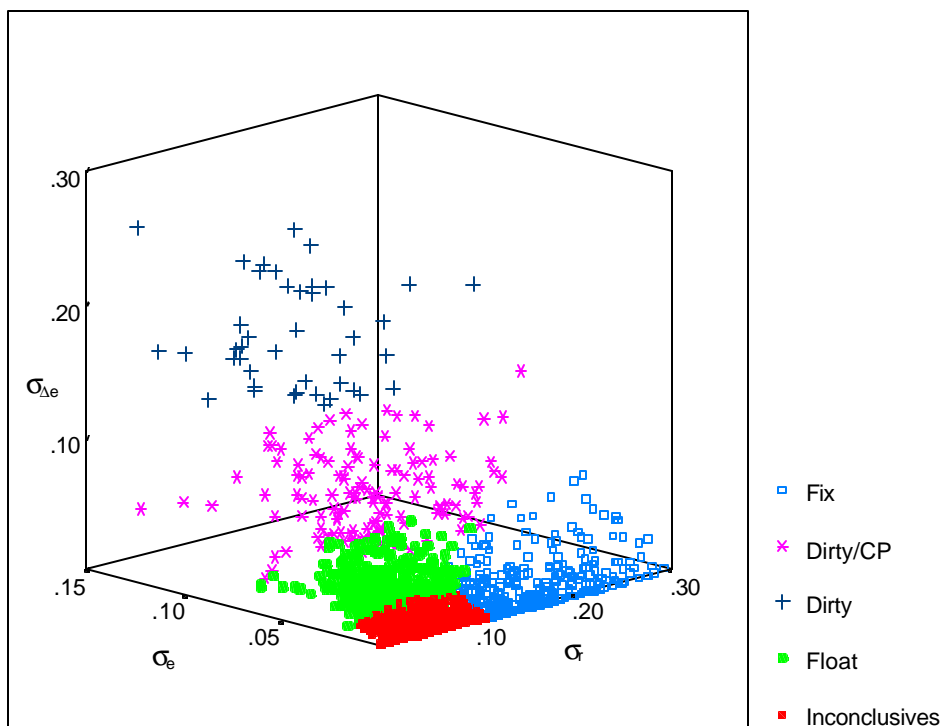


**Figure 1: Exchange Rate Classification**

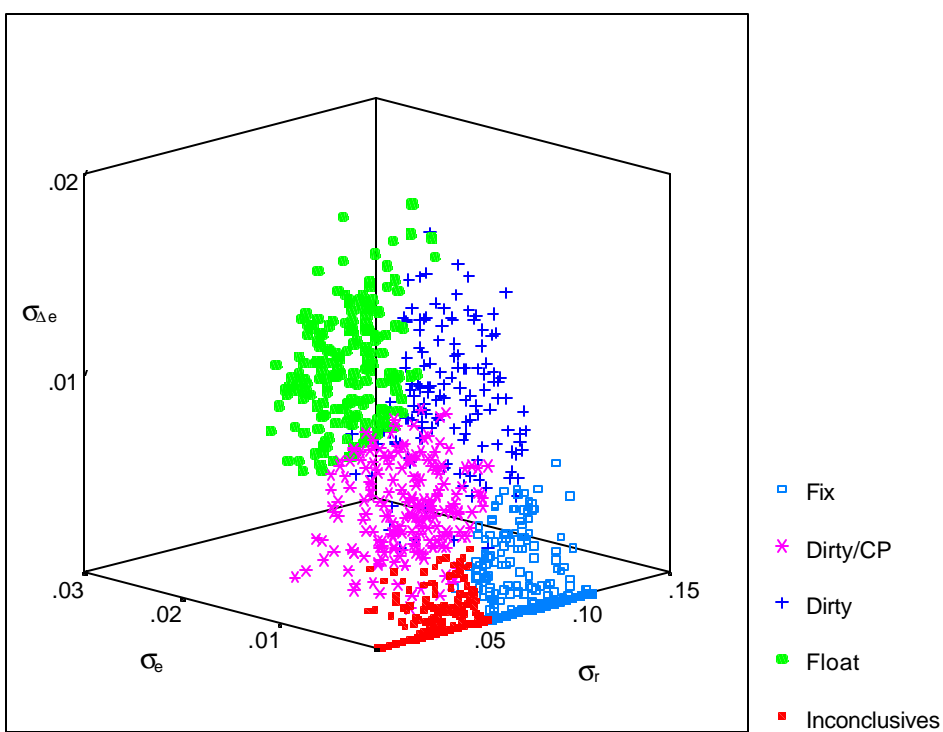


**Figure 2**

a) 1<sup>st</sup> round



a) 2<sup>nd</sup> round



**Table 2: Cluster Boundaries**

	Average monthly volatility in the exchange rate			Average monthly volatility in the change of the exchange rate			Average monthly volatility in international reserves (relative to monetary base)		
1st Round Boundaries									
	Minimum	Centroid	Maximum	Minimum	Centroid	Maximum	Minimum	Centroid	Maximum
Float	0.09%	2.31%	7.22%	0.81%	2.03%	6.70%	0.60%	4.59%	13.44%
Dirty	12.80%	17.27%	26.94%	4.76%	8.51%	13.68%	0.88%	6.98%	23.07%
Dirty / CP	0.53%	6.96%	14.22%	2.49%	5.21%	13.74%	1.38%	8.67%	27.52%
Fixed	0.00%	0.20%	7.22%	0.00%	0.23%	4.61%	10.57%	14.68%	29.87%
2nd Round Boundaries									
	Minimum	Centroid	Maximum	Minimum	Centroid	Maximum	Minimum	Centroid	Maximum
Float	0.72%	1.18%	2.37%	0.36%	0.96%	1.37%	0.25%	3.19%	6.46%
Dirty	0.16%	0.95%	1.77%	0.33%	0.86%	1.58%	5.38%	7.86%	10.63%
Dirty / CP	0.02%	0.53%	1.05%	0.24%	0.50%	1.44%	0.35%	4.29%	7.53%
Fixed	0.00%	0.00%	0.63%	0.00%	0.00%	0.66%	5.65%	7.51%	11.02%