The role of the effective exchange rate in monetary frameworks: options, operations and effects

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1. Introduction

The choice of exchange rate policy of individual countries has been receiving much attention in recent years; possibly more than often before[2]. One reason is to be found in the financial crises that hit many emerging market countries in the 1990s. These have partly been blamed on inappropriate exchange rate policies[3]. Another reason is that in current conditions the issue is linked to questions about the future evolution of the international monetary system. Furthermore, some consider changes in the US-dollar pegs of important Asian countries to be an important part of the orderly resolution of global economic imbalances.

In this paper the focus is somewhat more narrow, ie the international experience of using the effective exchange rate in monetary frameworks. The motivation for investigating this issue is twofold. First, there seems to be somewhat of a contradiction between the frequency of single currency pegs observed in the real world and the literature on optimal pegs that indicates that pegging to an effective exchange rate index would in most cases be more optimal. Second, China recently changed its dollar peg to a managed float with reference to a basket. Although the reninmbi has so far been relatively stable vis-à-vis the dollar, it still raises interesting macroeconomic and operational issues.

These issues give rise to several questions. First, what are the pros and cons of single currency versus a basket peg? Second, looking at the historical record is it indeed the case that basket pegs have been intermediate steps in the process from fixity to flexibility? How do the operational aspects of single currency pegs and basket pegs compare? What might be the effects of the composition of reserves of changing from a single currency to a basket peg? Finally, in the case of medium-size and large countries, what might the effects on other currencies be from such a move?

The rest of the paper is organised as follows. Section 2 discusses the concept of the effective exchange rate and some of the general principles regarding its measurements. Section 3 discusses the potential role of effective exchange rate indices in monetary frameworks; ranging from indicators to targets. That will lead to a deeper analysis of the use of the effective exchange rate as an intermediate target of monetary policy. In that connection the paper provides an overview of the current world landscape regarding

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[2] Mussa et al (2000) give a useful summary of the world landscape of exchange rate regimes and discuss some of the factors that may explain their recent development. Fujiki and Otani (2002) argue that exchange rate regimes will be an important policy concern in the 21st century. Frankel (2003), Goldstein (2002) and Williamson (2000) discuss the experience and policy options of emerging market countries.

[3] Turner (2002) discusses the role of dollar exchange rate targets in the Asian crisis. Edwards (2001) discusses the relationship between exchange rate regimes, capital flows and currency crises in emerging economies.

exchange rate regimes, in particular regarding the reference currencies of pegs, and on the entry and exit to such a regime. Section 7 will then discuss some operational aspects, including the implications for forex interventions. The next section has some very general discussion of the implications that might be involved regarding the currency composition of foreign exchange reserves. Section 9 will contain some preliminary analysis on the effects on other currencies and Section 10 concludes.

2.   The concept of the effective exchange rate

The real effective exchange rate (REER) is a macroeconomic concept. It refers to a weighted average of bilateral exchange rates of foreign currencies vis-à-vis the local currency that have been corrected for inflation differentials and where the weights are such that there would be no effect on employment, inflation and the current account from changes in cross-rates of foreign currencies so long as the real effective exchange rate is constant. The nominal effective exchange rate (NEER) is then the weighted average of bilateral nominal exchange rates using the same weights as in the real rate. It is important to notice that changes in cross-rates, say the dollar-yen rate, will have microeconomic effects in a given country, even if the real effective exchange rate is held constant. Exporters and importers that operate in these currencies and those that have positions in them are affected; but the weights should be designed in such a way that the micro level effects cancel out at the macro level.

The EER is a theoretical concept. It is like the natural interest rate or the output gap in being not directly observable. It is therefore much easier to define than to measure. The relative weights to be given to currencies in the EER should depend on their effects on macroeconomic variables of the relevant country. In principle, it will require a disaggregated international macroeconomic model. That is, however, a very tall order and to my knowledge no official estimates of EER are based on weights derived in such a way.[4] Even the simplest of models will indicate that the weights should not only depend on the relative share of trading partner countries in exports and imports but also on the degree they are competitors in third markets and on the elasticities of supply and demand in all the markets involved. Moreover, these should in principle cover trade in both goods and services.

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[4] Turnovsky (1982) uses a general equilibrium macro model of a small open economy with perfect capital mobility to derive weights that minimise the variance of domestic output. These depend in a complicated way on the parameters of the model and the variances and covariances of shocks. The weights thus depend on the variance of the nominal interest rate differential vis-à-vis abroad, its covariance with foreign shocks to domestic demand and parameters which measure the effects of foreign exchange rates on real domestic demand.

Most actual estimates compromise these standards in order to be manageable. Most estimates of effective exchange rates ignore price elasticities as their estimates are resource consuming and subject significant uncertainty. It is though noteworthy that weights based on the IMF multilateral exchange rate model (MERM) that was used to calculate EER indices in the 1970s did take estimated price elasticities of supply and demand into account.[5] Current IMF indices do, however, not.[6] They do though take third country effects into account which are often excluded in estimates of EER-weights for individual countries as their proper treatment requires that the trading pattern of a big sample of countries is analysed simultaneously. Services are in many cases ignored.

To date, the BIS has calculated for 21 industrial countries[7], the 4 newly industrialised countries and Mexico, and shown in its various reports, a set of nominal effective exchange rates, and three sets in real terms.[8] In terms of methodology, the BIS uses a double-weighting scheme.[9] Import weights are thus derived on the basis of bilateral import shares, while export weights take account of competition in each of the 26 markets considered, between domestic suppliers to the home market and exporters from the other 25 countries. Overall trade weights are derived by combining the bilateral import weights with the double export weights (taking into account the "third-market" effect), using the relative size of country's imports and exports in overall country's trade (exports plus imports) to average both sets of weights. In addition, for the major emerging market economies, effective rates have been calculated following an initial ad hoc request, but without the same rigorous methodology,[10] making certain country comparisons tenuous.[11]

It should be clear from this that actual trade-weighted currency baskets are in the best of cases incomplete approximations of the underlying theoretical concept. But they can come close enough and will have to be pretty bad in order not to give a better indicator than any bilateral rate of the macroeconomic effects of exchange rate movements on individual countries with relatively diversified trade.

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[5] See Artus and Rhomberg (1973) and Rhomberg (1976).

[6] See Zanello and Desruelle (1997).

[7] The Group of Ten, as well as Australia, Austria, Denmark, Finland, Greece, Ireland, New Zealand, Norway, Portugal and Spain.

[8] Three set of deflators were used (consumer and producer price indices and unit labour costs).

[9] The weights are based on trade flows in, and domestic output (measured by value added) of, manufactured goods (SITC 5 to 8, average 1989-91).

[10] In most cases using a simple single weighting scheme.

[11] Turner and Van't dack (1993) provide a more detailed description of the methodology used by the BIS.

## 3.	Role in monetary frameworks

When the EER has been estimated it can be used in various ways as a part of the toolkit that central banks have to assist them in setting monetary policy. It can rank from being an ordinary indicator to being a target. Each will be considered in turn.

Indicator

For countries that do not directly target an estimate of the effective exchange rate and have a relatively diversified foreign trade the nominal and real effective exchange rates will be important indicators for monetary policy and more relevant than any bilateral rate. They will be especially important for countries that are either very open and/or where the exchange rate channel is a relatively important in the transmission of monetary policy. The REER is the relevant indicator for employment, competitiveness and the current account. The NEER is important for the inflation dynamics.[12] In steady state both inflation and the real exchange rate are constant and the change in the NEER is equal to the inflation differential vis-à-vis abroad. Changes in NEER that are in excess of this will then lead to changes in the REER and give positive or negative impulses to inflation, provided that everything else is equal. However, in actual situations everything else is usually not the same. Care must therefore be exercised before interpreting observed changes in the NEER as a sign of a change in future inflation, possibly being caused by monetary policy. It could as well be a sign of shocks hitting the economy that have altered the equilibrium exchange rate. In that case the REER will adjust to the new equilibrium and provided the NEER is flexible, part of the adjustment will take place through its movement. Inflation might change temporarily but will return to its original level once the adjustment process is over, so long as there is no change in the stance of monetary policy. However, a different level of the REER is now compatible with the same inflation rate. This is, in a nutshell, the problem with using the NEER in monetary condition indices or more broadly financial condition indices to which we turn next.

Financial condition indices

The short-term interest rate and the exchange rate are sometimes combined in a so-called monetary condition index, where the weights are supposed to reflect the relative importance of the interest rate versus the exchange rate channel. For this purpose the EER is by construction the most relevant exchange rate as the focus is on the effects of monetary conditions on employment and the current account in the short run and on inflation in the

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[12]	The NEER, or its import weighted part, is the relevant metric to use for the exchange rate in models of the inflation process.

long run. The same considerations apply when the exchange rate is included in a broader financial condition index that adds long term interest rates and equity prices. However, the use of monetary condition indices as guides for monetary policy has been criticised.[13] As was demonstrated above, changes in the EER might have nothing to do with the stance of monetary policy. Let us take the example of a negative shock to exports or the terms of trade. The equilibrium exchange rate will fall and the NEER will follow if it is free to do so. This need not be inflationary at all as the negative shock is depressing demand from another direction. In principle, what should be put into monetary condition indices is the deviation of the REER from the real equilibrium exchange rate. But if the EER is difficult to estimate the equilibrium rate is several times more so.

Intermediate target

An intermediate target for monetary policy is a specific value of a variable that has a close medium- to long-term correlation with the final goal of price stability, but is better controlled by monetary instruments in the short term and/or is more easily observable. The exchange rate and the quantity of narrow or broad money are examples of such variables. Some would also argue that so is the inflation forecast in inflation targeting frameworks. A measure of the effective exchange rate is a candidate for an intermediate target. But other baskets or a bilateral exchange rate could also serve such a purpose and the pros and cons of such a choice will be discussed later.

Operational target

The operational target of monetary policy is the variable that central banks seek to control most closely and on a daily basis, but is one step removed from the immediate central bank instruments. In developed countries most central banks use short-term money market rates as operational targets. The same applies to many emerging market countries. In countries where financial markets are not fully developed and market-based indirect monetary control has not been firmly established market liquidity or the monetary base are often used as operational targets, but they could also be used in other conditions. The exchange rate (effective, another basket or a bilateral) can serve as an operational target. In that case the instruments of the central banks, especially foreign exchange intervention, are used to control the exchange rate. Singapore is an example of this.[14] In the case where the exchange

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[13] Svensson (2001), criticised the use of the monetary condition index in the case of New Zealand as a guide for the setting of monetary policy.

[14] Khor, Robinson and Lee (2004) analyse the role of the exchange rate in Singapore's monetary framework.

rate is an intermediate target but not an operational target the central bank will target the exchange rate through the operational target, often short-term money market rates.

4. A basket or a single currency peg?

There is a vast literature on the pros and cons of exchange rate targeting. In the recent period there has, however, been less written on the issue of what the peg should be if exchange rate targeting is deemed preferable.[15] In particular we are interested in the relative merits of targeting a basket that is an estimate of the effective exchange rate and that of targeting a bilateral rate vis-à-vis a major currency.[16] On macroeconomic grounds countries with a relatively diversified trade pattern should peg to an estimate of the EER rather than to a single currency. That kind of a peg will minimise the effects of international exchange rate movements on the internal and external macroeconomic balance at the same time as it should provide the desirable intermediate target and a nominal anchor if major low inflation currencies dominate in the basket. For small countries that have one major trading partner it can make sense to peg to that currency instead of a basket, especially if financial integration with that trading partner is considered to be an important goal. However, this leaves unexplained why so many medium-size and even large countries with a diversified trade pattern have opted for a peg to a single major currency. Let us look at some of the factors that might explain why.

First, a bilateral peg is more transparent and more easily understood by the public. It is therefore conceivable that a bilateral peg is in some sense more firm and more credible.[17] However, the nature of the peg (currency board, horizontal, crawling, fluctuation band, etc) might be as important, if not more, regarding how hard it is. Moreover, the credibility argument can work in both directions. It is easier for the public to monitor a bilateral peg and it is more difficult for the authorities to cheat (changing weights to follow depreciating currencies etc). In that sense it can be said to be a more credible commitment. But if a bilateral peg is clearly not optimal due to the diversity of trade, and that is perceived by market participants, it might turn out to be less credible as it will not be as resilient to shocks.

Second, a bilateral peg to a major currency may give extra stimulus to the financial integration with the country being pegged to. It will reduce exchange rate uncertainty in

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[15] There was a literature on this in the 1970s. See a survey by Williamson (1982).

[16] Frankel (1999), McKinnon (2000) and Williamson (2001) have some discussion of this issue.

[17] Frankel (2003), p 26, makes this point.

financial transactions with the financial centre, the more so the tighter and more credible the peg is. However, history has shown that this strategy can be risky. If the peg is not resilient to shocks then financial markets could before the shock hits underestimate the actual exchange rate risk and take positions that will turn sour at the day of reckoning. Actually, so long as countries maintain their own currency some exchange rate volatility might be beneficial in order to remind markets that there are no sustainable one-way-bets.

Third, the preferred exit strategy from a peg might be a still firmer link to a major currency or even a monetary union. In that case it makes sense to peg to the currency rather than a basket. This applies to those EU-accession countries that have opted for exchange rate targeting. If, however, a flexible exchange rate is the preferred exit strategy then this argument is not valid.

5.   A look at the landscape

We now turn to the current landscape of exchange rate policies. It is a well documented fact that the world distribution of exchange rate regimes has in recent years been flatter in the sense that the share of soft pegs has fallen relative to hard pegs and floating. This tendency has sometimes been labelled "the vanishing middle".[18] That term is however an overstatement as the middle is still there and the tendency might have peaked. Table 1 and Graph 1 document the evolution of the distribution of exchange rate regimes according to major categories. We see that a move away from soft pegs is strongly evident in all types of countries. What concerns us here, however, is that the share of pegs of all sorts has fallen in all groups of countries over this period. Its share among emerging countries was 75% in 1991 but had fallen to 40% in 2004. For developing countries the figures are respectively 87% and 67%.

Looking at the reference currencies for pegged regimes in 1991 and in 2004 (Table 2 and Graph 2) reveal that the share of basket pegs has fallen in total and in all groups of countries, notwithstanding that the share of SDR pegs has also decreased. In the emerging countries group this is partly explained by the peg of some EU-accession countries to the euro. However, basket pegs have also fallen relative to dollar pegs both among emerging and developing countries.

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[18]   See for instance Fischer (2001).

This is somewhat counter-intuitive and seems to be in contradiction to the statement that trade-weighted basket pegs are superior for countries with relatively diversified trade patterns. It could be a temporary anomaly. But it could also reflect benefits of single currency pegs relative to basket pegs that we have not properly identified.

A somewhat different result emerges if we look at those countries where we can measure relative volatilities of weekly dollar or euro rates on the one hand and the nominal effective exchange rate on the other (see Table 3). Data availability limits us to industrial and important emerging market countries. For most of the countries the volatility of the trade-weighted exchange rate was in 2004 significantly lower than that of single major currencies. The exceptions are Denmark, Russia, China, Hong Kong SAR and Malaysia. India was in this group until 2003.[19]

6.   Entry and exit

No one correct time independent answer can be given on the choice of exchange rate regime for an individual country.[20] The actual choices will be affected by the stage of development of the economy and its financial markets, the external environment and the options that exist in terms of pegs or monetary unions with trading partners. Exchange rate regimes should therefore be reviewed periodically and the issue of entry and exit is relevant.

Where do basket-peggers come from and where do they go? Theoretical considerations suggest that entry to basket pegs should either be made from bilateral pegs or managed floating. The first suggestion is based on the observation that basket pegs are in some sense more flexible than bilateral pegs and more complicated. This suggests that once countries develop and their financial markets deepen they are better suited for basket pegs than bilateral pegs, provided that they want to keep on pegging. The exception to this is very small countries that continue to find a bilateral peg to an overwhelming trading partner optimal or countries that have decided to enter to a monetary union. The second suggestion comes from those cases where countries have used exchange rate-based disinflation strategies.

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[19]   This evolution is consistent with the findings of Ho, Ma and McCauley (2005) that the effective exchange rate orientation of Asian currencies has been increasing in the recent period. However, they find more countries in Asia where the volatility of the effective exchange rate is bigger than that of the bilateral US-dollar rate. That seems partly to be explained by their use of daily data whereas the calculations in Table 3 are done with weekly data.

[20]   Frankel (1999) makes this point forcefully.

In those cases where a basket peg is a part of an evolution from fixity to flexibility we would expect the exit to be floating. The same should apply to exchange rate-based disinflation programmes. However, if a country went prematurely over to a basket peg it could go back. The same applies if a bilateral peg is a better medium- or longer-term solution (very small countries with concentrated trade patterns). Finally, if the exit is a part of a strategy to enter a monetary union the best exit might be to a temporary peg to a single currency.

How do these preconceptions agree with recent experience? Table 4 lists all episodes of basket pegs[21] during the period 1985-2004. Table 5 then counts the entries and exits that occurred during this period. The entries are by almost 2/3 made from other types of pegs with the rest being made from managed floating. This does not contradict what was just suggested. The bulk of the exits, however, are to some kind of floating, in good agreement with the theory. For developing and emerging markets countries the fit is even closer as all of those exited to floating.

7.   Operational aspects

Five operational aspects will be considered here. First, how is basket targeting done in practice and how is it different to targeting, say, the US-dollar? Second, should there be a fluctuation band? Third, what are the implications for the conduct of foreign exchange interventions? Fourth, should the development of the trade-weighted exchange rate index and/or the weights be published? Fifth, how should changes in the composition of the basket be managed? Before going into these questions it is important to make the distinction between setting and targeting exchange rates.

Setting versus targeting

During former periods of capital controls and absence of interbank markets for foreign currency many central banks acted as market-makers in foreign currency. They did *set* exchange rates for a given period and provided foreign currencies to banks on demand at the given rates. The banks in turn were often not allowed to have overnight balances in foreign exchange. The incentives for interbank trading were therefore very weak.

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[21]   SDR pegs are not counted as basket pegs in this exercise, although strictly speaking they are. The reason is that the focus is on the role of measures of effective exchange rates in monetary framework. The presumption is that most trade-weighted baskets are supposed to be some kind of an incomplete estimate of the EER, whereas SDR would only by change reflect the weights in the EER.

This mechanism worked so long as capital movements were tightly controlled or the central bank did not set more than one rate, usually vis-à-vis the US dollar. However, if the central bank quoted all major currencies once a day, as was often the case, but traded with the banks throughout the day, there would be risk-free profit opportunities for the banks as international cross-rates moved within the day. These opportunities would be used by banks as soon as the relevant restrictions were lifted. As capital controls were removed interbank markets were therefore developed and central banks relinquished their market-making function. In as so much as the exchange rate was an intermediate goal of monetary policy the central banks reverted to *targeting*, ie used monetary instruments and foreign exchange interventions to keep the exchange rate within the parameters of the policy.

A similar kind of problem arose where central banks were *setting* exchange rates but *targeting* a basket. In that case the central bank would *set* the dollar rate that was on a given time of the day compatible with the desired level of the *target*. However, as international cross rates moved within the day that dollar rate became "wrong". Moreover, as the day progressed banks could make an informed guess of the likely level of the dollar that would be *set* the next day and use that information to get arbitrage profits at the expense of the central bank. An example of this is Australia in 1974-1976.

This problem disappears as soon as we move from exchange rate *setting* to exchange rate *targeting* within a framework of a market determined exchange rate. It is though important to bear in mind that such a framework presupposes a minimum infrastructure in terms of an interbank market for foreign exchange, ie even if the exchange rate policy is not one of a managed float the infrastructure of a managed float is needed for targeting a basket. Both current account and capital account transactions would probably have to be highly regulated for basket targeting to work in an exchange rate setting environment. The paper is therefore premised on exchange rate targeting.

Basket targeting

Let us for the sake of the exposition assume that a country is entering a basket peg from pegging to the US-dollar. Let us further assume that the US-dollar is the vehicle currency in the domestic foreign exchange market. If there is no change in fluctuation bands or other parameters of the existing exchange rate policy there should be no instantaneous effect on the bilateral rate against the US-dollar when the regime change occurs.[22] However, from then

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[22] If the change triggers a change in market expectations regarding international currencies, for instance because markets expect the composition for foreign exchange reserves to change, international cross-rates could be affected.

on the peg is to the basket. What will happen to the bilateral dollar rate will depend on the development of international cross rates and the share of major currencies in the basket.

Initially at least, there is no trading in the basket as such; only in the individual currencies. Later, derivative trading in the basket could develop, but experience indicates that it is usually done in much thinner markets than for individual currencies. In practice this means that at each point in time the basket is used to calculate the US-dollar rate that will keep the basket at the desired level. However, the relevant US-dollar rate will change throughout the day as international cross rates move about. The central bank then uses its instruments (short-term interest rates, forex and money market interventions) in exactly the same way as when targeting the US-dollar. The only difference is that the target is moving through time, although being known precisely at each point in time.

Fluctuation band?

As there are some lags involved it might be difficult and would probably require very frequent interventions if some short term deviations from the point target are not allowed. There is thus a case to be made of having some kind of a fluctuation band. For this purpose the band does not have to be wide or announced. It is interesting that of the episodes of basket pegs listed in Table 4 most did not have announced fluctuation bands. However, there might be other reasons to have announced bands. Such bands might discourage speculative capital flows based promoted by the assumption of an absence of exchange rate risk in terms of the basket on by introducing an extra element of exchange rate uncertainty. The case can be made that these bands should be widened as capital movements become gradually more liberalised.[23]

Foreign exchange intervention

What about foreign exchange intervention? Should it not be done in at least all the major currencies in the basket? Not necessarily. The intervention can all be done in the vehicle currency, ie the US-dollar. Forex intervention has the purpose to affect the value of the domestic currency vis-à-vis all foreign currencies and not to affect international cross rates. The choice of a vehicle currency and the composition of foreign exchange reserves will though probably affect international cross rates, at least in the case of larger countries, but that is another issue.

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[23]   Williamson (2001) argues for wide bands for the East Asian countries.

Let us take the example of Iceland to illustrate the point. The interbank market for foreign exchange was established in 1993, two years before the final steps in the liberation of capital movements were taken. It was organised around a fixing meeting where the banks traded all major currencies. At that time a relatively stable value (fluctuation margins of ±2¼%) of a trade-weighted basket of currencies was the intermediate target of monetary policy. The market was changed to a continuous and the banks became market-makers in US-dollars in 1997. From then on the market only dealt in US-dollars and all foreign exchange interventions of the central bank were also done in US-dollars. This was in spite of the fact that the share of the USD was only 22% in the basket at the same time as that of the euro was 33% (42% if the Danish krona that was closely pegged to the D-mark is also included).[24]

Disclosure?

Central banks that have targeted a trade-weighted basket have taken various approaches to making the index and the weights public. Some have done both, some have published the index and some have done neither. Most countries have published the index. Several have also published the weights. That was also the case in Iceland in the 1990s. At the other end of the spectrum, Singapore publishes neither the index nor the weights. However, the Monetary Authority of Singapore has published a graph that has allowed market participants to estimate the weights, while leaving MAS plausible deniability and ability to change the weights.

There are of course pros and cons here. Publishing the index and being transparent about the target might promote market corrections of deviations from the target, provided the central bank and the target itself are deemed to be credible. Publishing the weights are a way to convince markets that the peg is indeed reasonable and should be resilient as the weights are in some sense "correct". It could also contribute to market stabilisation as banks can calculate the value of the index themselves.[25] However, there are also arguments for not publishing the weights or the index. It will make it more difficult for market participants to know what bilateral USD rate the authorities are targeting at any point in time, thus making speculation-based one-way-bets less likely. Although this problem could be reduced by having fluctuations bands it will re-emerge at the margins of the band except if they are considered to be soft or not announced.

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[24] See Central Bank of Iceland (1998).

[25] In Iceland, in addition to publishing the weights, the Central Bank provided the banks with the necessary programs and databases and saw to it that everybody calculated the index in the same way.

Changing weights

Trade patterns will evolve over time. Weights in trade-weighted currency baskets might therefore become worse estimates of optimal EER weights. Pegs based on outdated weights could then become less resilient. This gives rise to the need to update the weights from time to time. How frequently should that be done and should these changes be announced? The considerations above on transparency versus flexibility are of course relevant for this issue. But there might be additional problems relating to credibility. Such changes should not give rise to any suspicions that the authorities are trying to rig the peg by, for instance, tilting weights towards weakening currencies. What is best in this sense will depend on country-specific features in terms of the culture of transparency, the credibility of the central bank and other relevant authorities and the understanding that market participants have for the issues involved.[26]

8.   The composition of foreign exchange reserves

What could be the effect on the currency composition of foreign exchange reserves of changing a peg from a single currency to a basket? The first thing to note is that there is not one-to-one correspondence between the optimal currency basket and the optimal composition of reserves. These are guided by different principles. The basket is based on minimising the effects of changes in foreign cross rates on the macroeconomic balance. The composition of reserves should take account of what they are needed for, ie for intervention and access to international liquidity. These considerations will give a premium to the share of the vehicle currency in the reserves. Matching reserve composition with the basket weights would, however, hold the local currency value of the reserves constant and thus minimise valuation effects on the profitability of the central bank. However, these are secondary considerations as central bank profitability is in general not important. Valuation effects in terms of local currency should anyhow be either ignored or smoothed for the purposes of calculating profitability transfers from the central bank to the government.

Some central banks are using estimates of the minimum variance portfolio to assist them in deciding the composition of the reserves. A composition based on this method will depend on the choice of currencies to be included in the reserves and the numeraire in terms of which the variance is minimised. In general there will be much fewer currencies in the reserves than there are in the trade-weighted basket as it does not serve much purpose to

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[26] The Central Bank of Iceland changed the weights yearly and made them public. For other countries that will be far too frequent.

include other than major international currencies in the reserves. In most cases the minimum variance calculation is limited to 3-5 currencies. There is, however, no general consensus on what the numeraire should be. One approach is to adopt the trade-weighted basket as the numeraire. Others have used a basket that at least partly reflects the weights of currencies traded in the domestic foreign exchange market. Such a basket would reflect the currency denomination of exports and imports of both goods and services and capital flows. Major international currencies, especially the vehicle currency, will then have much higher weights than in the traditional trade-weighted basket. Still others have used the vehicle currency as a numeraire.[27]

It is not easy to deduce the actual relationship between currency baskets and the composition of foreign exchange reserves from central bank behaviour as only few publish the necessary information. The Central Bank of Iceland is one of those that do. Although it has a floating exchange rate the basic principles guiding the composition of reserves have not changed much. In 2003 the currency basket used to estimate the EER had a 25% weight for the US-dollar, 47% for the euro (and the pegged Danish kroner), 12% for the pound sterling and 16% for five other currencies. However, the reserves were at the end of the year composed of US-dollar (40%), euro (40%), pound sterling (15%) and yen (5%). The divergence from the currency basket comes from the minimum variance calculation and a use of a numeraire that reflects the role of currencies in foreign exchange traded in the domestic currency market.[28] Rikkonen (1989) has shown in the case of Finland that the optimal composition is sensitive to the choice of numeraire. An extra weight for the vehicle currency based on liquidity considerations would give a still higher weight for the USD than in both of these examples.

The composition of reserves can thus diverge from the composition of the currency basket for the following reasons:

• The vehicle currency gets an extra weight;

• Only a limited number of currencies are considered eligible for the reserves;

• Minimum variance portfolios diverge from the chosen numeraire as correlations between the nominal returns of currencies in terms of the numeraire are taken into account;

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[27] The methodology is described with an application to Israel in Ben-Bassat (1980), Rikkonen (1989) with application to Finland and Pétursson (1995) with an application to Iceland. Ramaswamy (1999) provides a framework based on the same principle but that does not require explicit assumptions about the risk preferences of the central bank or knowledge of the currency numeraire.

- The numeraire can be different from the basket.

9.   Effects on other currencies

What could be the effect on other currencies of a move from a single currency peg to a basket peg? It is clear that there would be no effects to speak of if the country in question is small enough for its exchange rate not to affect major international cross rates. However, we are interested in the case where the country is a large enough player in the world economy that its exchange rate might affect other cross rates.

At the time of change there will be no effects so long as expectations about the future are unchanged because all that has happened is that an announcement has been made by the authorities on how they will allow the exchange rate to react to shocks in the *future*. However, these expectations are indeed likely to change in ways that is hard to predict. It will depend partly on how markets expect the composition of reserves to change in the future as a result of the basket peg and what they think might happen about the currencies to be used for interventions.

Let us for the time being ignore the potential changes in expectations and market psychology. Let us further assume that there are only three currencies. Two are floating - call them dollar and euro - and one is pegged to the dollar, call it renminbi (RMB). What happens if the RMB switches from a dollar peg to a peg against a basket of dollar and euro? For a given fall in the effective exchange rate of the dollar, the rise in the bilateral euro-dollar rate will be smaller than in the case of the peg of RMB to the dollar. The rise in the effective exchange rate of the euro can also be shown to be smaller. The reason is that a smaller portion of the fall in the effective exchange rate of the dollar is *displaced* over to the euro due to the bilateral RMB-dollar rate being fixed.

However, for a given pressure (meaning given net sales against all other currencies) on the dollar, we cannot take the effective depreciation to be the same in both cases, even if there is no change in the intervention currency or the composition of reserves. The reason is that the dollar will now be less supported by interventions of the RMB-country.

If the share of the euro in interventions or the currency composition of the reserves of the country having currency RMB increases, then the euro will appreciate more than otherwise, both in bilateral and effective terms. However, we have seen that there is no need for either

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[28]   See Central Bank of Iceland (2004).

to change due to the basket peg as such and the historical record seems to indicate that the change of the intervention currency is not very likely in this case.

If we, finally, lift the assumption of unchanged expectations then anything can happen. It is for instance possible that the downside potential of the dollar against all currencies will be considered greater than before. In the limit there might be significant short- to medium-term undershooting of the equilibrium rate.

To conclude, the basket peg as such, ie holding expectations, intervention currency and composition of reserves constant, will probably lead to a smaller appreciation of the euro in both bilateral and effective terms than in the case of a bilateral peg of the RMB to the dollar. However, if we lift these assumptions the conclusion might be reversed in the short to medium term.

10.   Concluding remarks

Estimates of the EER are better indicators of the macroeconomic effects of exchange rate changes than any bilateral rates. Furthermore, the literature on optimal currency pegs suggests that pegging to a basket is preferable to pegging to a single currency, except for small countries with concentrated trading patterns. However, there might be other considerations that favour a single currency peg, like transparency, financial integration and an exit strategy of entering a monetary union. Single currency pegs seem to be more common than is consistent with the theory of an optimal peg. However, data on entry and exit are consistent with the view that a move from a single currency peg to a basket peg might be a milestone on the way to greater exchange rate flexibility.

Many of the operational aspects of a basket peg are not very different from a single currency peg. However, the case for a fluctuation band might be stronger. Central banks that have targeted a trade-weighted basket have had various approaches to whether to make the index and the weights public and arguments can be made for both. There is a need to periodically update weights in currency baskets, but the changes will have to be managed carefully. There is not one-to-one correspondence between currency basket weights and the composition of foreign reserves. The vehicle currency will usually have a significantly higher weight than in the reserves than in the currency basket.

The effects on other exchange rates of a country changing from a bilateral peg to a basket peg depends amongst other things on the size of the country; the changes that might follow in terms of composition of reserves and even of intervention currencies; and how expectations and market psychology are affected.

Table 1   **Distribution of exchange rate regimes, end of period[1]**

	All countries		Developed		Emerging[5]		Other developing		*Memo: Emerging Asia*	
	1991	**2004**	**1991**	**2004**	**1991**	**2004**	**1991**	**2004**	**1991**	**2004**
Hard pegs[2]	15.7	25.3	0	48.1	7.1	17.1	21.5	22.6	*11.1*	*11.1*
Soft pegs[3]	67.3	29.6	75	14.8	67.9	22.9	65.4	34.7	*55.6*	*22.2*
Floating[4]	17.0	45.2	25	37.0	25.0	60.0	13.1	42.7	*33.3*	*66.7*
Memo: number of countries	*159*	*186*	*24*	*27*	*28*	*35*	*107*	*124*	*9*	*9*

[1] As a percentage of countries in each category.   [2] Composed by regimes with another currency as legal tender, currency unions and currency boards.   [3] Composed by regimes with conventional fixed peg to a single currency or to a basket, peg within a horizontal band, crawling peg and crawling band.   [4] Independently and other managed floating regimes.   [5] Including: Argentina ,Belarus, Bosnia and Herzegovina, Brazil, Bulgaria , Chile, China, Colombia, Croatia, Czech Republic, Ecuador, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Serbia and Montenegro, Singapore, Slovak Republic, South Africa , Thailand, Turkey, Venezuela.

Sources: IMF, *Annual Report On Exchange Rate Arrangements And Exchange Rate Restrictions*; Bubula and Ötker-Robe (2002); author's calculations.

Table 2	Reference currencies of pegged regimes, end of period[1]									
	All countries		Developed		Emerging[3]		Other developing		*Memo: Emerging Asia*	
	1991	**2004**	**1991**	**2004**	**1991**	**2004**	**1991**	**2004**	**1991**	**2004**
US dollar	28.0	45.2	0	0	22.2	28.6	35.1	54.5	*33.3*	*66.7*
Basket	43.0	17.7	100	25.0	55.6	14.3	28.4	18.2	*66.7*	*33.3*
SDR	10.0	3.2	0	0	11.1	7.1	12.2	2.3	*0*	*0*
Euro[2]	14.0	21.0	0	75.0		42.9	18.9	9.1	*0*	*0*
Other	5.0	12.9	0	0	11.1	7.1	5.4	15.9	*0*	*0*
Memo: number of countries	*100*	*62*	*17*	*4*	*9*	*14*	*74*	*44*	*3*	*3*

[1]As a percentage of countries in each category. [2] French franc for 1991. [3] Including: Argentina, Belarus, Bosnia and Herzegovina, Brazil, Bulgaria , Chile, China, Colombia, Croatia, Czech Rep, Ecuador, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Serbia and Montenegro, Singapore, Slovak Republic, South Africa , Thailand, Turkey, Venezuela.

Sources: IMF, *Annual report on exchange rate arrangements and exchange rate restrictions*; author's calculations.

Table 3	Exchange rate volatility[1]																			
	2001					2002					2003					2004				
	Volatility			Ratios		Volatility			Ratios		Volatility			Ratios		Volatility			Ratios	
	USD[2]	EUR[3]	NE[4]	$/NE	€/NE	USD[2]	EUR[3]	NE[4]	$/NE	€/NE	USD[2]	EUR[3]	NE[4]	$/NE	€/NE	USD[2]	EUR[3]	NE[4]	$/NE	€/NE
Industrial countries																				
Australia	12.7	18.7	5.2	2.4	3.6	7.8	12.2	3.6	2.2	3.4	11.1	18.4	3.4	3.3	5.5	14.0	21.5	4.3	3.3	5.0
Canada	5.2	11.3	2.4	2.1	4.6	6.0	8.8	2.9	2.1	3.1	8.6	10.0	3.7	2.3	2.7	8.8	8.6	3.6	2.5	2.4
Denmark	11.2	0.3	1.6	7.1	0.2	8.0	0.2	1.2	6.7	0.2	9.8	0.2	1.3	7.6	0.2	9.1	0.2	1.0	9.1	0.2
Euro area	11.3	-	1.7	6.5	-	8.0	-	1.3	6.4	-	9.8	-	1.4	6.9	-	9.1	-	1.2	7.7	-
Japan	9.2	12.3	4.2	2.2	2.9	10.6	9.1	3.8	2.8	2.4	7.5	10.2	3.2	2.4	3.2	10.1	8.8	3.6	2.8	2.4
Norway	10.0	5.1	2.0	4.9	2.5	8.6	4.7	2.2	3.9	2.1	12.6	7.5	3.0	4.2	2.5	11.0	6.5	3.2	3.5	2.0
New Zealand	11.4	19.0	4.4	2.6	4.3	9.9	14.9	4.0	2.5	3.7	9.4	16.6	3.3	2.9	5.1	13.4	20.9	4.2	3.2	5.0
Sweden	11.6	7.3	3.4	3.4	2.2	9.4	5.7	2.8	3.3	2.0	10.5	4.5	2.4	4.3	1.9	10.0	3.1	2.1	4.8	1.5
Switzerland	11.7	3.7	2.4	4.9	1.6	9.0	3.2	1.9	4.8	1.7	10.5	3.9	2.3	4.6	1.7	9.3	3.4	2.0	4.8	1.7
United Kingdom	8.1	17.7	2.5	3.3	7.1	6.2	13.1	1.8	3.5	7.4	7.7	16.1	2.5	3.1	6.4	9.8	17.8	2.7	3.6	6.5
United States	-	11.3	1.7	-	6.6	-	8.0	1.9	-	4.3	-	9.8	2.1	-	4.7	-	9.1	2.3	-	3.9
Emerging markets																				
Central & eastern Europe																				
Czech Republic	9.9	3.7	2.0	4.9	1.9	10.8	7.0	3.3	3.3	2.1	11.0	4.5	2.4	4.6	1.9	11.4	5.7	2.4	4.9	2.4
Hungary	12.7	9.5	3.6	3.6	2.6	9.4	4.5	2.3	4.1	2.0	14.1	11.0	4.6	3.0	2.4	11.3	6.2	3.1	3.6	2.0
Poland	12.0	13.3	5.1	2.3	2.6	9.3	7.6	4.1	2.3	1.8	11.8	9.5	4.0	3.0	2.4	10.7	6.7	3.0	3.6	2.2
Russia	1.7	12.1	5.7	0.3	2.1	1.7	8.2	4.5	0.4	1.8	2.7	10.7	5.2	0.5	2.1	3.2	9.2	4.9	0.7	1.9
Slovakia	10.3	3.8	1.6	6.6	2.4	9.0	6.0	2.2	4.1	2.7	11.1	4.8	1.9	5.9	2.6	10.6	2.6	1.5	7.3	1.8
Asia																				
China	0.1	11.3	1.8	0.0	6.3	0.0	8.2	2.1	0.0	4.0	0.0	9.9	2.0	0.0	5.1	0.0	9.2	2.1	0.0	4.3
Hong Kong SAR	0.1	11.3	1.5	0.0	7.8	0.0	8.0	1.7	0.0	4.7	0.7	9.7	1.6	0.4	6.1	0.4	8.8	1.7	0.2	5.1
Indonesia	21.8	24.7	9.8	2.2	2.5	9.7	10.0	4.9	2.0	2.0	6.7	11.1	3.1	2.2	3.6	8.1	10.5	3.2	2.6	3.3
India	1.8	11.3	2.8	0.6	4.0	1.0	7.8	2.2	0.4	3.5	2.1	10.0	2.3	0.9	4.3	5.1	9.2	2.7	1.9	3.4
Korea	7.5	14.5	3.5	2.2	4.2	7.3	7.5	3.0	2.4	2.5	7.4	11.1	3.3	2.2	3.3	6.4	8.7	2.3	2.8	3.8
Malaysia	0.0	11.3	1.5	0.0	7.4	0.0	8.0	1.8	0.0	4.4	0.0	9.9	1.6	0.0	6.0	0.0	9.0	1.9	0.0	4.8
Philippines	15.6	20.4	6.1	2.6	3.4	4.2	8.2	2.1	2.0	3.9	4.9	11.0	2.2	2.2	5.0	2.3	8.6	1.8	1.3	4.7
Singapore	5.0	10.7	1.9	2.6	5.6	4.0	6.9	1.6	2.5	4.3	4.9	8.4	1.8	2.7	4.7	4.6	6.4	1.8	2.5	3.5
Taiwan (China)	4.0	11.0	2.2	1.8	5.1	3.6	6.8	1.6	2.3	4.4	2.1	9.7	1.7	1.2	5.8	4.1	8.2	2.2	1.9	3.7
Thailand	4.7	11.0	2.2	2.1	4.9	5.4	6.6	2.0	2.7	3.3	3.6	9.6	1.9	1.9	5.1	5.1	7.7	1.9	2.7	4.1
Others																				
Argentina	0.4	11.3	2.5	0.1	4.5	59.0	57.5	23.8	2.5	2.4	14.2	16.0	7.1	2.0	2.3	6.3	10.8	3.2	2.0	3.4
Brazil	15.7	19.1	7.9	2.0	2.4	31.2	31.7	11.5	2.7	2.7	15.0	18.2	6.8	2.2	2.7	9.5	11.0	4.5	2.1	2.4
Mexico	7.7	14.7	3.4	2.2	4.3	8.2	12.4	3.7	2.2	3.4	10.0	15.4	4.3	2.4	3.6	7.5	10.1	3.1	2.4	3.3
South Africa	25.7	27.9	8.7	2.9	3.2	14.6	16.7	8.3	1.8	2.0	17.6	18.9	9.0	2.0	2.1	17.6	14.7	8.9	2.0	1.6

[1] Volatility in standard deviation of annualised percentage changes, calculated over weekly data (on Thursday closings). The table lists the economies with whose effective exchange rates currently maintained by the BIS. [2] Bilateral exchange rate vis-à-vis the US dollar. [3] Bilateral exchange rate vis-à-vis the euro. [4] Nominal effective exchange rate.
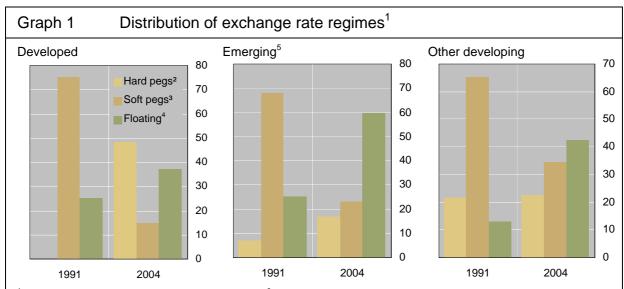
Table 4

Episodes of basket pegs, 1985-2004

	Period	Number of years	Fluctuation band[1]	Previous regime	New regime
Developed economies:					
Austria	1985-1994	10	No	na	MF
Cyprus	1985-1996	12	No	na	MF
Finland	1985-1991	7	± 2%	na	IF
Iceland	1989-2000	12	± 2.25%	MF	IF
Malta	1985-2004	20	No	na	na
Norway	1985-1991	7	± 2.25%	na	IF
Sweden	1985-1992	8	± 1.5%	na	IF
Emerging markets:					
China	1985-1986	2	No	na	MF
Czech Republic	1991-1996	6	No	Other peg	MF
Hungary	1985-1994	10	No	na	MF
Israel	1987-1992	6	± 5%	MF	MF
Latvia	1997-2004	8	No	MF	na
Malaysia	1985-1993	9	± 2.25%	na	MF
Poland	1986-1990	5	No	na	MF
Romania	1985-1991	7	No	na	MF
Singapore	1985-1987	3	No	na	MF
Slovak Republic	1995-1997	3	± 3%	Other peg	MF
Thailand	1985-1996	12	No	na	MF
Other developing					
Albania	1990-1991	2	No	na	IF
Algeria	1985-1992	8	No	na	MF
Bangladesh	1985-2001	17	No	na	USD peg
Botswana	1985-2004	20	No	na	na
Burundi	1993-1998	6	No	SDR peg	MF
Cape Verde	1985-1997	13	No	na	Other peg
Fiji	1985-2004	20	No	na	na
Guyana	1985-1986	2	No	na	USD peg
Jordan	1990-1996	7	No	SDR peg	SDR peg
Kenya	1988-1993	6	No	SDR peg	IF
Kuwait	1985-2002	18	No	na	USD peg
Madagascar	1985-1986	2	No	na	MF
Malawi	1985-1993	9	No	na	IF
Maldives	1985-1986	2	No	na	IF
Mauritania	1985-1986	3	No	na	MF
	1993-1995	3	No	MF	IF
Mauritius	1985-1994	10	No	na	MF
Morocco	1990-2004	15	± 3%	MF	na
Mozambique	1985-1986	2	No	na	USD peg
Nepal	1985-1992	8	No	na	IF
	1994-1996	3	No	IF	Other peg
Papua New Guinea	1985-1994	10	No	na	IF
Samoa	1988-2004	17	No	MF	na
Sao Tome and Principe	1988-1990	3	No	SDR peg	MF
Seychelles	1997-2004	8	No	SDR peg	na
Solomon Islands	1985-1996	12	No	na	MF
	1998-2001	4	No	MF	MF
Somalia	1989-1990	2	No	USD peg	MF
Sudan	1986-1987	2	No	USD peg	USD peg
Tanzania	1985-1993	9	No	na	IF
Tonga	1991-2004	14	No	Other peg	na
Tunisia	1985-1986	2	No	na	MF
Uganda	1990-1992	3	No	USD peg	IF
Vanuatu	1988-2004	17	No	SDR peg	na
Zambia	1985	1	No	na	IF
Zimbabwe	1985-1994	10	No	na	IF

Note: IF = independent float; MF = managed float. The average length of episode since 1985 is 8.1 years. Number of countries in 1985 = 32 and in 2004 = 10.
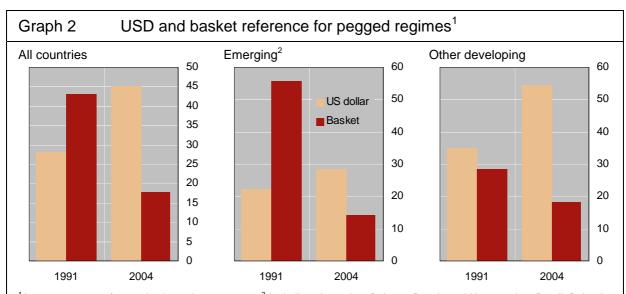
[1] Value for the middle of the period.

Sources: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions; author's calculations.

Table 5				**Entry and exit regimes**		
	Total	**Dollar peg**	**SDR peg**	**Other peg**	**Managed floating**	**Floating**
Entry	19	3	6	3	7	0
Exit	46	5	1	2	22	16

Source: Table 4.

Graph 1   Distribution of exchange rate regimes[1]

Developed

Legend:
- Hard pegs[2]
- Soft pegs[3]
- Floating[4]

(bar chart, years 1991 and 2004, scale 0–80)

Emerging[5]

(bar chart, years 1991 and 2004, scale 0–80)

Other developing

(bar chart, years 1991 and 2004, scale 0–70)

[1] As a percentage of countries in each category.   [2] Composed by regimes with another currency as legal tender, currency unions and currency boards.   [3] Composed by regimes with conventional fixed peg to a single currency or to a basket, peg within a horizontal band, crawling peg and crawling band.   [4] Independently and other managed floating regimes.
[5] Including: Argentina ,Belarus, Bosnia and Herzegovina, Brazil, Bulgaria , Chile, China, Colombia, Croatia, Czech Republic, Ecuador, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Serbia and Montenegro, Singapore, Slovak Republic, South Africa , Thailand, Turkey, Venezuela.

Sources: IMF, *Annual Report On Exchange Rate Arrangements And Exchange Rate Restrictions*; Bubula and Ötker-Robe (2002); author's calculations.

Graph 2   USD and basket reference for pegged regimes[1]

All countries

(bar chart, years 1991 and 2004, scale 0–50)

Emerging[2]

Legend:
- US dollar
- Basket

(bar chart, years 1991 and 2004, scale 0–60)

Other developing

(bar chart, years 1991 and 2004, scale 0–60)

[1] As a percentage of countries in each category.   [2] Including: Argentina, Belarus, Bosnia and Herzegovina, Brazil, Bulgaria , Chile, China, Colombia, Croatia, Czech Rep, Ecuador, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Korea, Latvia, Lithuania, Malaysia, Mexico, Peru, Philippines, Poland, Romania, Russian Federation, Saudi Arabia, Serbia and Montenegro, Singapore, Slovak Republic, South Africa , Thailand, Turkey, Venezuela.

Sources: IMF, *Annual Report On Exchange Rate Arrangements And Exchange Rate Restrictions*; author's calculations.

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