SMU ECONOMICS & STATISTICS
WORKING PAPER SERIES

SMU
SINGAPORE MANAGEMENT UNIVERSITY

Asian Currency Baskets: An Answer in Search of a Question?

Charles Adams, Hwee Kwan Chow

March 2007

Paper No. 02-2007

Asian Currency Baskets: An Answer in Search of a Question?

Charles ADAMS
National University of Singapore
Lee Kuan Yew School of Public Policy
469C Bukit Timah Road
Singapore 259772
(Email) sppac@nus.edu.sg

Hwee Kwan CHOW
Singapore Management University
School of Economics
90 Stamford Road
Singapore 178903
(Email) hkchow@smu.edu.sg

March 2007

Abstract

This paper considers how a regional currency basket and the associated divergence indicators could be used in official surveillance. Recently, proponents of Asian currency baskets have referred to the role the ECU played in constructing exchange rate divergence indicators in Europe as evidence of the intrinsic usefulness of currency baskets for exchange rate monitoring. We show in this paper a number of problems with the use of regional currency-basket based divergence indicators. First, at a technical level, such indicators involve tracking regional exchange rates against a moving currency basket and can obscure underlying movements in bilateral exchange rates. Second, currency baskets generally treat currencies asymmetrically leading to difficulties interpreting the derived measures of divergence. Third, intra-regional exchange rate monitoring can lead to potentially serious N-1 or anchor problems. Some of these difficulties can be addressed by bilateral divergence indicators but means will need to be found to anchor regional exchange rate surveillance vis-à-vis currencies outside the region.

JEL Classification: E58, F31, F33

Key Words: Regional Currency Basket; Exchange Rate Divergence Indicators; Surveillance

I. Introduction.

There has recently been much discussion about the possible introduction of an official (virtual[1]) basket of Asian currencies. The currency basket has been variously referred to as an Asian Currency Unit (ACU), an Asian Currency Index (ACI) or an Asian Monetary Unit (AMU). The discussion has been carried out largely with reference to ASEAN+3[2] but consideration has also been given to baskets based on wider and narrower regional groupings[3]. Both official regional bodies (such as the Asian Development Bank), semi-official research institutes (such as, for example, the Japanese Research Institute of Economy, Trade and Industry (RIETI)) and a number of private academic economists have been looking at the usefulness of Asian currency baskets. And, most recently, an ASEAN+3 research group has been set up to explore the properties of alternative currency baskets.

Drawing on the experience with the European Currency Unit (ECU) in the European Monetary System (EMS), proponents of an Asian currency basket have argued that the basket could play two key roles in the context of ASEAN+3. First, the basket could provide a framework for specifying exchange rate objectives as part of any **formal** effort to coordinate exchange rate policies. Such an approach would build, in particular, on the role the ECU notionally played in specifying exchange rate targets and divergence indicators in the exchange rate mechanism of the European Monetary System (EMS). Second, irrespective of whether there is formal agreement on exchange rate polices, the creation of an **official currency basket could usefully catalyze the private sector into** denominating financial assets in the basket along the lines the official ECU[4] played in European Monetary System (EMS). Within the region, this has become known

[1] By the basket being virtual is intended to mean that it would have no physical manifestation.
[2] The ASEAN+3 comprises the ten ASEAN countries together with China, Korea and Japan.
[3] Wider currency baskets include baskets consisting of the currencies of Hong Kong and Taiwan in addition to the ASEAN+3 currencies while a number of narrower baskets have been considered, particularly in the context of convertible currencies.
[4] Based on the experience with the ECU, the view among currency-basket proponents appears to be that once the official sector introduces an official ACU there would be private sector interest in denominating assets and liabilities in the basket.

(somewhat misleadingly[5]) as the parallel currency proposal (Eichengreen (2006)) and as leading (potentially) to the emergence of the ACU as a parallel currency alongside national currencies.

These two roles for an Asian currency basket have not gone unchallenged. A number of papers have questioned whether it would be desirable or feasible in the foreseeable future for the relatively diverse thirteen ASEAN+3 countries to formally coordinate their monetary/exchange rate policies. The relevant questions here have frequently been cast in terms of whether ASEAN+3 (or other groupings) constitute an Optimum Currency Area[6]. And, drawing on the experience with official and private ECUs—in which special factors such as a lack of internationalization of the deutsche mark and speculative convergence plays drove the private ECU market— Dammers and McCauley (2006) have questioned whether the conditions are in place for a strong private sector interest in an Asian currency basket.

Cognizant of concerns about whether the region is ready to formally co-ordinate exchange rate policies, some regional currency-basket proponents have argued that a regional basket could still play an important role in the official ASEAN+3 surveillance of intra regional exchange rates. More specifically, the Asian Development Bank (ADB) has argued that the monitoring of regional exchange rate movements against some "appropriately" defined regional currency basket could be helpful for identifying divergences in exchange rates and clarifying the policy requirements for seeking to achieve greater stability in intra regional exchange rates and/or avoid misalignments[7]. And a number of senior ADB officials have referred to the role the ECU played in

[5] As best can be gleaned, the intention (at most) is for the currency basket to serve as a numeraire in which the private sector can denominate financial assets. There do not appear to be any plans for the basket to be used to be used as a (virtual) medium of exchange.

[6] Chow and Kim (2002) found, using a structural VAR model, the region was dominated by domestic rather than common regional shocks; Eichengreen and Bayoumi (1996) argued that the region was not ready for monetary union in view of political considerations; while Wyplosz (2001) cited the lack of regional institutions as well as the diversity in the stage of economic development in East Asia as key factors pointing to the non-viability of a single currency area in the near future.

[7] In practice, there is some ambiguity about whether it is the intention to reduce intra-regional exchange rate variability or avoid fundamental misalignments in intra-regional exchange rates.

constructing exchange rate divergence indicators as evidence of the intrinsic usefulness of an Asian currency basket for surveillance purposes. At the same time, there have been suggestions that the creation of an ACU could be a useful first step towards any eventual more formal moves toward exchange rate management and, perhaps, in the very long run, monetary union.

The purpose of this paper is to consider how a regional currency basket and the associated divergence indicators could be used in official surveillance. A number of questions are considered: How much information would divergences of regional currencies from the currency basket contain? How much clarity would there be in the signals on intra-regional exchange rates emitted by basket-based divergence indicators? How would intra-basket exchange rate surveillance take into account movements in regional exchange rates vis-à-vis external currencies? And how would regional monetary policies/currencies be anchored under such an approach?

To anticipate our main conclusions: We find that for a number of reasons regional currency-basket based divergence indicators are unlikely to be very helpful for exchange rate surveillance. At a technical level, the key problems are that such indicators involve tracking regional exchange rates against a moving currency basket and can obscure underlying movements in bilateral exchange rates. In addition, currency baskets generally treat currencies asymmetrically leading to difficulties interpreting the derived measures of divergence. More fundamentally, however, the use of a regional currency basket for surveillance purposes can lead to potentially serious N-1 or anchor problems[8] unless means are found to anchor regional monetary/exchange rate policies vis-à-vis currencies outside the region. Comparable lessons were learnt in Europe over twenty years ago and will need to be addressed by those calling for a regional currency basket approach to exchange rate surveillance.

[8] The problems relate to the fact that any configuration of intra-regional exchange rates can be consistent, in principle, with an infinite range of values of the basket in terms of external currencies.

The paper is organized as follows. Section II considers the key properties of a general Asian currency basket and some alternative measures of exchange rate divergence. Section III reviews the recent behavior of a number of hypothetical currency baskets and divergence indicators for the ASEAN +3 and illustrates some of the key difficulties interpreting them. Section IV considers the behavior of hypothetical currency baskets in response to shocks and the circumstances under which the indicators might be useful for exchange rate surveillance. Finally, Section V concludes the paper.

II. General properties of an Asian Currency Basket and Divergence Indicators.

An Asian currency basket can be defined as a bundle of specific quantities of different Asian currencies. Such a basket can be entirely virtual with no physical manifestation or can be reflected in physical form with notes and coins issued. Recent discussion has focused on the virtual currency case with the suggestion that the official sector create the basket as a potential parallel currency for the region (Eichengreen (2006)). There is some ambiguity as to whether the basket would be created by an official regional body such as the Asian Development Bank (ADB) or would be launched jointly by national authorities in the region.

The value of the Asian currency basket will depend on the amounts of various currencies included in the basket[9]. In principle, the basket could contain fixed quantities of currencies or the quantities of currencies in the basket could be changed continuously to hold currency weights in the basket fixed. In what follows, we focus on fixed-quantity currency baskets since these have been the ones in the recent regional discussion[10].

[9] Here, and in what follows, we abstract from any differences in official and private currency baskets.

[10] In order to deal with the tendency for strong currencies to dominate these baskets over time, fixed-weight baskets typically allow for periodic reviews of weights to avoid the baskets evolving into baskets that are excessively dominated by the strong currencies.

Moreover, the ECU was itself a fixed quantity basket albeit with periodic changes in the quantities of currencies to avoid the basket becoming dominated by strong currencies[11].

The value of a hypothetical fixed-quantity ACU for the ASEAN +3 in terms of, say, the U.S. dollar will depend on the amounts of the thirteen ASEAN +3 currencies included in the basket and the exchange rates of those currencies with the U.S. dollar as given by (1):

$$(1)\quad S(\$/ACU) = \sum_{J=1}^{13} Q(J)S(\$/J) \qquad Q(J) > 0$$

In this equation, the summation runs from unity to thirteen as the ACU includes the thirteen currencies of the ASEAN +3, S ($ / J) is the bilateral exchange rate between the U.S. dollar and currency J (expressed as the U.S. dollar price of currency J) and Q (J) is the (by assumption) positive[12] quantity of currency J in the ACU.

By construction, S ($ /ACU) will be homogeneous of degree one in the S ($ / J) terms which is a desirable property for a currency basket. The assumption implies that a one percent appreciation of all the currencies in the basket will lead to the ACU appreciating in terms of the US dollar by (approximately) one percent[13]. The impact that any individual currency will have on the value of the basket will depend, as we note below, on its weight in the basket.

[11] Changes in weights in Europe were typically undertaken is such as way as to avoid jumps in the value of the currency basket. The currency basket was also changed from time to time to allow for the inclusion of new members in the EMS.

[12] In principle, a currency basket could include negative as well as positive amounts of different currencies. In such a case, the basket would be "short" certain currencies and "long" other currencies. Such baskets could arise in situations in which the basket is determined on the basis of an optimization problem directed, for example, to minimizing or maximizing some objective function.

[13] Here, and in what follows, we hold the weights in the basket fixed in considering "small" changes in exchange rates.

It is convenient to define the weight of any currency in the basket[14]. Dividing equation (1) through by S ($ /ACU), the weight of any currency J (J=1,...,13) in the ACU can be defined as in equation (2) and the sum of the weights will be given by equation (3):

$$(2)\ \Omega(J) = Q(J)S(\$/J)/S(\$/ACU) = Q(J)S(ACU/J)$$

$$(3)\ \sum_{J=1}^{13}\Omega(J) = \sum_{J=1}^{13}Q(J)S(ACU/J) = 1 \qquad 0 < \Omega(J) < 1$$

Here $S(ACU/J)$ is the ACU price of a unit of currency J. According to equation (2), the weight of any currency J in the ACU will depend on how much of it is included in the basket multiplied by its ACU price. When the quantities of currencies in the ACU are fixed, the weights will vary over time when there are changes in the values of component currencies. As noted, relatively strong currencies will see their weights increase and conversely for relatively weak currencies[15]. As can be seen from equation (3), the weights of the thirteen currencies in the ACU will sum to unity and each weight will lie between zero and unity as the basket is assumed to include positive quantities of component currencies.

In principle, as noted in the next section, a variety of different approaches can be taken to selecting the (initial) set of weights in the currency basket. Depending on the approach adopted, the basket could have similar or different currency weights and/or be dominated by one or more currencies. The weights in the currency basket will have important implications for the behavior of the basket and the derived divergence indicators.

[14] We use the term "quantities" to refer to the physical amounts of currencies in the basket and "weights" to refer to the shares of currencies in the basket evaluated at a given set of exchange rates. This follows the approach taken in the EMS.

[15] Within the EMS there was a tendency for the weights of strong currencies such as the deutsche mark to increase over time. Periodic adjustments were made to address this effect.

For several purposes, it is useful to consider the exchange rates between the ACU and each of its component currencies. The value of the ACU in terms of any its component currencies (say, currency K for K=1,...,13) can be obtained by multiplying equation (1) by S (K/ $) to give a set of thirteen equations of the general form:

$$(4)\quad S(K/ACU) = \sum_{J=1}^{13} Q(J)S(\$/J)S(\$/K) = \sum_{J=1}^{13} Q(J)S(K/J)$$

In each of these equations, S (K, K) is identically equal to unity ("own" exchange rates are equal to one) and S (K, J) = S (J, K) $^{-1}$.

According to equation (4) the currency K price of the ACU will depend on the amounts of **all** the currencies in the basket multiplied by their exchange rates in terms of currency K. Unlike equation (1), each of the K=1, 13 equations in (4) will not be homogeneous of degree one in exchange rates. Reflecting the fact that each of the thirteen currencies is included in the basket, a one percent depreciation of currency K in terms of all other currencies will not lead to a one percent depreciation of currency K vis-à-vis the basket. In fact, from the set of thirteen equations given by (4), it is straightforward to show that the ACU exchange rate of currency K in the basket will be homogeneous of degree $(1-\Omega_0(K))$ in the other currencies in the basket where $\Omega_0(K)$ is the weight of currency K in the basket. This will be a general feature of all currency baskets we are considering. In general, the larger is the weight of a currency in the ACU the greater will be the impact of movements in that currency on the value of the ACU and the smaller will be the movement in the value of that currency relative to the ACU.

An ACU-based currency basket can be used to construct measures of exchange rate divergence. In principle, exchange rate divergence can be considered vis-a-vis currencies outside the currency basket (extra regional exchange rates) or between currencies in the basket (intra regional exchange rates). As we note below, intra-regional exchange rate surveillance will generally need to take into account movements in the basket vis-a-vis external currencies.

Extra regional exchange rates can be monitored by tracking changes in the ACU in terms of extra-regional currencies using equations such as (1). Some benchmark or reference rate for the ACU in terms of, say, a basket of external currencies would need to be specified and movements in the value of the ACU monitored relative to that benchmark. Such an approach could be based on an equation such as (1*) where changes in exchange rates vis-à-vis the US dollar (the external currency[16]) relative to a benchmark can be assessed using the weights in the currency basket evaluated at a given reference point ($\Omega(J)_0$).

$$(1^*) \qquad \Delta S(\$/ACU)/S_0(\$/ACU) = \sum_{J=1}^{13} \Omega(J)_0 \Delta S(\$/J)/S_0(\$/J)$$

Equation (1*) implies that the impact of any currency on the external value of the basket will depend on its weight in the basket. In the case, for example, of a single currency K moving uniformly in terms of all other currencies by x percent the basket will move by $\Omega(K)_0$ times x. When many currencies are moving, the effects will depend on the weights of all the adjusting currencies.

Largely because currency basket arrangements (such as the EMS) did not include explicit targets for the currency basket vis-à-vis external currencies, monitoring of the external value of the basket was not central to that system's exchange rate mechanism. Moreover, in the case of the EMS, it was not necessary to "track" the value of the ECU in terms of external currencies as the system de facto became based on the deutsche mark with the external value of the ECU tied down by German monetary policy. In effect, the deutsche mark became the Nth currency of the EMS with all other currencies shadowing the deutsche mark rather than the ECU (Gros and Thygesen (1998)).

Currency basket based indicators of intra-regional exchange rate divergence can be derived from equations such as given by (4). Such indicators will quantify the extent

[16] In principle, the external value of the basket can also be tracked in terms of baskets of external currencies. Several recent papers have tracked the external value of a number of hypothetical ACUs in terms of a basket of U.S. dollars and euros (see *inter alia* Ogawa and Shimizu, 2005).

to which individual currencies diverge from the ACU. In constructing such indicators it is necessary to specify reference or benchmark rates for each currency in terms of the ACU against which currency movements can be monitored. If there are formally agreed bilateral exchange rate parities among intra-regional currencies (as in the exchange rate mechanism of the EMS) these would provide "natural" benchmarks[17] for assessing divergence. In the absence of formal agreement on (bilateral or basket parities) benchmarks would need to be selected using, for example, exchange rates in some base period when equilibrium was assumed to have held. Alternatively, benchmark bilateral rates could be based on independently determined estimates of future equilibrium exchange rates.

Effectively, the intra-regional divergence measure will track the extent to which individual currencies "follow" the currency basket; as in the EMS, divergence thresholds can be specified when exchange rates diverge by a certain proportion of any maximum allowable or desirable deviation. In the case of the EMS, divergence thresholds were set at seventy-five percent of the maximum allowable fluctuation in terms of the ECU as a means of signaling when policy action was needed.

Totally differentiating equation (4) for "small" changes and expressing changes in proportional change form an (approximate) ACU-based measure of divergence can be derived as in equation (5) below. In equation (5), Δ measures the deviation of currency K from a reference value at point t=0 and the weights $\Omega(J)_0$ (J= 1, 13) –which are assumed fixed—are those at the reference point.

$$(5)\ \Delta S_T(K/ACU)/S_0(K/ACU) = \sum_{J=1}^{13}(\Omega(J)_0 \Delta S_T(K/J)/S_0(K/J)\ /\ \text{MAD})$$

Here $\Delta S_T(K,K)$ is equal to zero, $\Delta S_T(K/ACU) = S_T(K/ACU) - S_0(K/ACU)$ and

[17] Bilateral parities for each currency can be used to generate reference points in terms of the ACU using equations such as given by (4).

$\Delta S_T(K,J) = S_T(K,J) - S_0(K,J)$. The superscript 0 refers to the reference point while T is the period for which the divergence indicator is calculated. MAD refers to the maximum allowable proportional deviation of each currency relative to the currency basket. While the latter was based on allowable movements in bilateral exchange rates (relative to bilateral central rates) in the EMS[18], it would need in a surveillance exercise to be based on soft target or monitoring zones for exchange rates.

The divergence indicator in equation (5) corresponds (approximately) to the divergence indicator used in the EMS[19]. Effectively **the basket-based divergence indicator for any currency is the ratio of its actual proportional movement in terms of the currency basket relative to its maximum permitted movement vis-vis the currency basket.** Both because it will be difficult to formally specify maximum allowable exchange rate movements in a surveillance exercise and on account of the fact that recent work on divergence indicators in the region has tended not to work with the MAD term in the denominator of equation (5), we work in what follows in terms of the proportional deviation of a currency vis-à-vis the basket as the divergence indicator (Equation (6)).

$$(6)\ \Delta S_T(K/ACU)/S_0(K/ACU) = \sum_{J=1}^{13} \Omega(J)_0 \Delta S_T(K/J)/S_0(K/J)$$

In equation (6), **the divergence indicator is simply the (proportional) divergence of currency K in terms of the ACU and is a weighted average of its proportional divergences from each other currency in the basket multiplied by the weights in the currency basket.**

Three particular features of the divergence indicator (as we have defined it) can be noted: (1) In the event of any currency J moving by X % against all other currencies,

[18] Note than in the EMS, the maximum allowable movements in currencies vis-a-vis the ECU was based on maximum allowable movements in bilateral rates.
[19] In practice, as we note in the next section, the indicators in the EMS were based on logarithmic first differences being used to approximate proportional changes.

the divergence indicator for that currency will equal (1 - $\Omega\ (J)_0$) times X % and, from equation (1*) above, the currency will move the currency basket by $\Omega(J)_0$ times X percent. Accordingly, in the single errant currency case, the sum of the currency's divergence indicator and its basket-moving effects will sum to 1 times the X percentage movement in the currency; (2) the divergence indicators for all currencies will have the same weights applied all **other** currencies in the basket thus exhibiting a degree of commonality; in short, currency H will be as important for currency J as it is for currency K in the divergence indicator; and (3), except in the special case when all weights are equal and proportional changes are approximated by logarithmic differences, the divergence indicators for currencies in the basket will not sum to zero.

Divergence indicators given by equation (6) can be computed and displayed graphically. A chart can be drawn with negative and positive exchange rate divergences on the vertical axis and time periods along the horizontal. The divergence measure for each currency can be plotted with movements relative to the zero line (when currencies are at their reference values) indicating the extent to which a currency is diverging from the ACU. In addition, trigger points related, for example, to when currencies move by more than a certain amount in relation to the currency basket can be drawn in the diagram. These could represent early warning indicators.

In the case of the exchange rate mechanism of the EMS, divergence indicators were seen, in principle, as providing a reference point for considering the policy requirements for fostering exchange rate convergence. Formally, intervention responsibilities in the system were to be shared between "strong" and "weak" currency countries. In practice, however, as been widely noted, the system did not operate this way and evolved into a de facto deutsche mark zone in which currencies shadowed the deutsche mark and Germany played the N*th* country role (Gros and Thygesen (1998)). Not only did this serve to "harden" the system given Germany's strong monetary policy but it also addressed the problem that the formal system lacked a clear nominal anchor for monetary policy. With all currencies in the system tracking the deutsche mark and the deutsche mark floating against external currencies such as the U.S. dollar and the

Japanese yen, both the internal and external value of the ECU currency basket were tied down.

Notwithstanding a number of attractive features, there are three technical difficulties with the use of the basket-based divergence indicators for monitoring intra-regional exchange rate movements. These difficulties were noted very early on when the ECU basket-based divergence indicators were used in the EMS[20].

First, **the basket-based indicator will not always signal large changes in the bilateral exchange rates of currencies included in the basket[21].** The reason for this is that the divergence indicator is a weighted average of one currency's **movement against all other currencies in the basket** and there can be offsetting effects. In short, the divergence indicator only measures deviations from (weighted) average behavior. The divergence indicator will tend to transmit the clearest signals about intra-regional exchange rate movements **when there is a single, small "errant" currency in the basket that is either relatively strong or relatively weak vis-à-vis all other currencies in the basket.** In these circumstances, the errant currency will stand out and show a value for its deviation indicator that is different in size and sign from all other currencies in the basket. Counter intuitively perhaps—but reflecting the fact those currencies with large weights can move the basket by large amount—a single errant currency with a large weight will move the divergence indicators for **all** currencies by non-trivial amounts. Only in the limiting case where the weight of an errant currency is very close to zero will it be the only currency to show a meaningful divergence from the basket[22] (See equation

[20] In addition to the difficulties noted in the text, the EMS has additional difficulties related to the fact that not all currencies in the ECU were in the exchange rate mechanism at all times and the permissible range of bilateral exchange rate changes differed between currencies in the narrow and wide bands of the exchange rate mechanism of the EMS. Further, intra marginal intervention within the exchange rate band reduced the signaling role of the divergence indicator.

[21] This was a significant problem in the early days of the EMS as the allowable range of exchange rate fluctuations was specified in bilateral terms and not in terms of the ACU. It implied that a currency might not trigger the divergence indicator even when it was moving by more than the (approximate) plus or minus 2 ¼ percent allowable range in the narrow band or the (approximate) plus or minus 6 percent range in the wide band.

[22] These cases are illustrated in the scenarios included in Section IV.

(6)). Of course, if all currencies in the basket are at all times at their reference rates in terms of the basket there will be no offsetting effects.

The second difficulty arises from the fact that the **value of the ACU in terms of external currencies is itself influenced by the movements of currencies in the basket.** In these circumstances, even the movement of a single currency has the potential to bring about movements in **all** currencies' divergence indicators. This implies—especially in the case of any currencies with large weights in the basket—the need to continually take into account movements in the value of the basket when assessing exchange rate movements. In short, the basket itself is a "moving indicator" and its external value must be monitored alongside the divergence indicators.

Finally, a third difficulty arises **from the asymmetrical treatment of currencies in the basket and the possibility that movements in key exchange rates may be obscured.** As noted, any differences in weights in the basket imply that currencies are not treated symmetrically when their basket-based divergence indicators are calculated. Currencies with large weights in the basket will tend to move by less in terms of the ACU basket than those with small weights and tend to have smaller divergence indicators in terms of magnitude. The reason for this is that large currencies will tend to move the basket with them by much more than small currencies. It is not clear, however, why currencies should be treated differently in an exchange rate surveillance exercise if the intention is to seek to induce greater intra-regional exchange rate stability or convergence. Were a case for asymmetrical treatment to be made, it would most likely be based on the view that some intra regional exchange rates are more "important" than others because, perhaps, they are the rates of "large" countries[23]. This, however, would most likely lead to surveillance paying more attention to these currencies while the divergence indicators with weights based on country size would lead to less attention

[23] The criteria that would be used to assess importance are not, however, clear and may differ according to the shocks hitting the system. Arguably, the currency of a relatively small country (the Thai baht) was very important pre Asian crisis but currently the Japanese yen and Chinese RMB may be much more important in the case of a US dollar shock.

being paid to these currencies in the divergence indicators[24]. If it is the intention to treat all currencies uniformly in measuring exchange rate divergences, consideration might be given either to equal-weight currency baskets or to directly monitoring bilateral intra-regional exchange rate movements.

An alternative to an ACU-based divergence indicator would be to directly monitor bilateral divergences in intra-regional exchange rates[25]. The use of bilateral exchange rate based indicators was the main approach in the EMS after the ECU-based divergence indicator. For countries participating in the EMS's exchange rate mechanism, deviations of bilateral exchange rates from bilateral central rates were regularly calculated and displayed graphically in a moving band. Such an approach fit well with the de jure specification of exchange rate commitments and intervention obligations in the EMS in bilateral terms[26]. In general, bilateral deviations can be calculated relative to selected reference exchange rates when there are not formal central rates as in the EMS. Effectively, what can be done is that for every period a spread between the strongest (or weakest) intra-regional currency can be calculated with all other intra-regional exchange rates lying somewhere in the band. Given the use of logarithmic first differences to approximate proportional deviations from bilateral central rates in the EMS, positions in

[24] One way to reduce the importance of any asymmetries in weights is to divide the divergence indicator for any currency by one minus its weight in the currency basket (in the reference period) or adjustments can be made to any allowable margins of exchange rate fluctuation. The former adjustment gives the set of equations given by:

$$\Delta S_T(K/ACU)/S_0(K/ACU) = \sum_{J=1}^{13}\{\Omega(J)_0 \Delta S_T(K/J)/S_0(K/J)\}/(1-\Omega(K)_0)$$

The division by (1 - $\Omega(K)_0$) partially undoes any asymmetry associated with different currency weights. The divergences from the ACU in the case of countries with large weights are adjusted upward (in absolute value) by a relatively large amount. Divergences from the ACU in the case of countries with small weights are adjusted upward by a relatively smaller amount. As a result, the ACU-based deviations in the case of currencies with large weights are magnified. Effectively, such an approach moves away somewhat from any asymmetrical treatment of currencies and produces divergence indicators more similar to those generated by an equal weights index or those obtained directly from bilateral divergence indicators (see below).

[25] In principle, bilateral divergences could be monitored either through the recording of bilateral exchange rates of intra-regional currencies in terms of an external currency such as the U.S. dollar or in terms of each other. The latter approach is considered below.

[26] Within the EMS, the possibility that a country might approach its maximum bilateral exchange rate deviation before it crossed its divergence threshold was a potential concern.

the band are independent of the way in which exchange rates are measured and are symmetric[27].

The bilateral deviation indicators can be displayed graphically. A chart can be constructed with deviations in bilateral exchange rates on the vertical axis and time on the horizontal axis. By convention, the approach in the EMS was to identify the pair of currencies in the exchange rate arrangement with the largest (absolute) bilateral deviation (say, currency one and three) in terms of bilateral central rates. A band would then be defined (centered around zero) with a width equal to the deviation between these two currencies. The top of the band would be associated with the strong currency (say, currency one) and the bottom with the weak currency (say, currency three). All other currencies in the system would be located at different points within the band by considering the deviations in their exchange rates either from the currency at the top of the band or the currency at the bottom.

By construction, the bilateral indicator displays the degree of convergence or divergence of currencies within a band. Such an approach avoids the potential offset and asymmetry ambiguities associated with the use of a currency basket-based approach to divergence (discussed above). In addition, it does not directly require the tracking of the value of a currency basket in terms of external currencies. In practice, the bilateral divergence indicator was used more in the EMS that the ECU-based deviation indicator as result of noted difficulties with the basket-based deviation indicator.

Both the regional basket-based and the bilateral deviations indicator are potentially subject to serious N-1 or anchor problems. The problems are related to the fact that any dispersion of intra-regional exchange rates can, in principle, be consistent with a potentially infinite number of configurations of extra-regional exchange rates. This problem does not arise in the case of currency baskets that include **both extra and intra**

[27] Note also that the specification of allowable deviations from bilateral central rates in the EMS was also based on logarithmic changes. Hence, for example, the narrow band of allowable bilateral exchange rate fluctuations when the system was set up was actually a little different from the widely reported plus or minus 2 ¼ percent since it was based on logarithmic approximations.

regional currencies since each regional currency is ultimately linked to the extra-regional currencies. Mixed extra and intra regional baskets were widely discussed in the region for several years in the context of the Basket, Band and Crawl (BBC) approach to exchange rate management (see, *inter alia*, de Brower (2004) and Williamson (2005)) but have since been replaced by interest in currency baskets including only regional currencies (Ogawa and Shimizu, 2006b)[28]. For exchange rate surveillance purposes, account must be taken not only of intra regional exchange rate movements but also of extra-regional exchange rates if one is to determine the "appropriate" policy adjustments to "excessive" divergences in intra-regional exchange rates[29].

How movements in currencies relative to extra-regional currencies will be assessed in a regional currency-basket framework is unclear. Essentially, what is required, is either that there be agreement about the appropriate external value of the currency basket (the "managed" external exchange rate case) or that there be agreement that the external value of the basket will be market determined (the "floating" external exchange rate case). **In both instances, however, one or more of the countries in the currency basket arrangement must be assigned the responsibility to anchor the system and act passively vis-a-vis other countries in the basket as regards intra-regional exchange rates.**

For example, in the "managed" external exchange rate case, one or more countries must agree to manage their currencies relative to external currencies and not intervene vis-à-vis other currencies in the basket. In the "floating" external exchange rate case, one or more countries in the basket arrangement must focus monetary policy on internal price stability and not intervene vis-à-vis other currencies in the basket. In short, as was discovered in the EMS, regional currency basket approaches, in practice, require one or more currencies to adopt a passive role in the system vis-a-vis internal currencies.

[28] Note that the baskets considered in the earlier approach tended to treat the Japanese yen as a currency external to the region together with the U.S. dollar and euro. The Asian currency basket approach discussed in the current paper includes the yen in the regional basket.

[29] Hence, for example, in a situation in which the Chinese RMB has appreciated sharply vis-à-vis the Japanese yen it is necessary to decide whether it is the RMB that is too strong or the yen too weak in order to reach agreement on the appropriate policy responses.

A key difficulty in Asia at the current juncture, of course, is that there is not (as there was in the EMS) a natural currency (or pair of currencies) to play such a role. The lack of natural anchor currencies not only—together with other considerations--precludes the adoption of formal exchange rate targets in the region but also will cause difficulties for surveillance exercises based on regional currency baskets.

III. Historical Behavior of Some Hypothetical ACUs and Divergence Indictors

This section considers the historical behavior of a number of hypothetical ACUs and divergence indicators. In addition, we consider the implications of two alternative reference points for assessing the external value of the ACU and the divergence indicators. As the official sector has not yet reached agreement on the composition of the ACU, there is no guarantee that either of the baskets we consider will correspond to the (official) basket (or baskets) that may eventually be created. By considering two "extreme" currency baskets, however, we believe we are spanning the likely range of possibilities and consideration of these cases allows us to consider qualitatively the implications of slightly different weighting schemes.

The two different currency baskets we consider differ according to the weights assigned to different currencies.

- **Asymmetrical Currency Basket** is one of a number of ASEAN +3 baskets constructed by researchers at the Japanese Research Institute of Economy, Trade and Industry (RIETI). In this basket, the (fixed) quantities of the thirteen ASEAN + 3 currencies are set to deliver fixed weights for each currency in the ACU in line with the relative sizes of countries over the years 2001-02 as measured by average real GDPs (evaluated at PPP exchange rates) and foreign trade (Table I). This index is dominated by China, Korea and Japan which account together for almost 75 percent of the basket.

- **Symmetrical Currency Basket** is assumed to include each ASEAN +3 currency with equal weight so that the basket is not dominated by any single currency. In such a basket, of course, the weight of very small currencies such as that of Lao is identical to that of the "giants" of China and Japan.

As regards divergence indicators, we consider the two indicators discussed in the previous section: the basket-based divergence indicator (equation (6)) and the bilateral deviation indicator[30]. In order to highlight the importance of the reference point, one set of results is backward looking and uses average exchange rates in 2000-01 as the reference point[31]; the other is forward looking and uses hypothetical equilibrium exchange rates in the future. The equilibrium exchange rates used were chosen to imply significant but different degrees of misalignment of the two large ASEAN + 3 currencies relative to the U.S. dollar. The misalignments are assumed to amount to an undervaluation of 30 percent in the case of both the Chinese renminbi and the Japanese yen while all other currencies are assumed to be in equilibrium. We would obviously not want to defend these arbitrary numbers as the intention is only to illustrate that the reference values have significant implications for which currencies are identified as "convergers" (those shadowing the ACU closely) and those identified as "divergers" (those that deviate sharply from the ACU). These "visual" effects would be expected to be important if divergence indicators were used for surveillance purposes.

We use logarithmic approximations for the currency basket (as given by equation (1)) and the various divergence indicators. The approximations are given below in equations (7) and (8) where J and K run from 1, 13 to reflect the thirteen ASEAN + 3 currencies in the basket. The logarithmic approximations do not substantially change the conclusions that would be reached with raw numbers[32].

[30] In results available from the authors on request, we also considered the behavior of a weight adjusted deviation indicator. Generally, however, the results differed little from the results from the basket-based deviation indicator.
[31] This is the reference point used in many studies on the ACU. See, for example, Ogawa and Shimizu (2006a). It is not clear, however, that rates were in equilibrium during this period.
[32] Note that logarithmic first differences were used to approximate proportional exchange rate changes in the EMS.

$$(7)\ \ln S_T(\$/ACU) - \ln S_0(\$/ACU) = \sum_{J=1}^{13} \Omega_0(J)(\ln S_T(\$/J) - \ln S_0(\$/J))$$

$$(8)\ \ln S_T(K/ACU) - \ln S_0(K/ACU) = \sum_{J=1}^{13} \Omega_0(J)_0(\ln S_T(K/J) - \ln S_0(K/J))$$

According to equation (7), the deviation of the U.S. dollar-ACU exchange rate (measured as a log difference) is a weighted average of the first difference of logarithms of each country's bilateral exchange rate in terms of the dollar from its reference point. Equation (8) indicates that the deviation of each country's exchange rate from the ACU (measured in log differences) is a weighted average of the deviations of the exchange rates between currencies in the ACU. The latter, of course, is a logarithmic first-difference approximation to the basket-based divergence indicator of (6) in the previous section.

Before considering the various indicators, it is useful to review the behavior of the currencies in the basket. Each exhibit in Figure I displays the value of a component currency in terms of the U.S. dollar (measured as the U.S. dollar value of a unit of domestic currency) using monthly data from early 2000 through late 2005. Exchange rates are indexed to be 100 in January 2000. As can be seen there is considerable diversity of (bilateral US dollar) exchange rate behavior. On the one hand, there are currencies such as the Korean won, Thai baht, Japanese yen and Vietnamese dong that have shown relatively large in-sample movements vis-a-vis the U.S. dollar in recent years. On the other hand, there are currencies such as the Chinese RMB and Malaysian ringgit that have shown a relatively high degree of stability. These differences imply, of course, that the historical behavior of the ACU will depend on the weights attached to "flexible" and "stable" currencies. Baskets that place a very high weight on relative stable currencies such as the RMB and ringgit will imply considerable stability of the ACU in terms of the U.S. dollar. Baskets that are heavily weighted toward more flexible currencies will display much more movement[33].

Insert Figure I

[33] In practice, of course the volatility of any currency basket will depend not only on the volatility of its component currencies but also on the covariance among currencies.

Figure II shows the behavior of the ACU (expressed as the US dollar value of an ACU) while Figure III depicts the divergence indictors for the two currency baskets we are considering. Figure IIIa shows the indicators using 2000-01 exchange rates as the reference point (Backward Reference) while Figures IIIb and IIIc are based on benchmarking on our hypothetical forward-looking equilibrium exchange rates (Forward Reference) for the asymmetric basket and symmetric basket respectively.

Insert Figure II and III

Several observations can be made.

(1) The overall behavior of the ACU depends on the weights in the basket. As it is dominated by the relatively stable Chinese RMB and by the Japanese Yen, which moves little over the sample period, the asymmetric basket display smaller movements in terms of the U.S. dollar relative to symmetric basket, which is influenced by the higher variability in many of the smaller currencies (see Figure II). However, we note that the difference based on historical values is small since the component regional currencies are mostly tracking the US dollar (see McKinnon and Schnabl (2004)). Nevertheless, the different weighting schemes will have an important impact on the external value of ACU should the regional currencies become more flexible vis-à-vis the US dollar going forward.

(2) The basket-based divergence indicators behave differently according to whether they are derived from the asymmetrical currency basket or from the symmetric basket. Generally, both the Chinese RMB and Japanese yen show relatively small basket-based divergences based on asymmetric basket (see Figure IIIa) unless they are far away from their equilibrium values as assumed in the forward-looking reference point cases (see Figures IIIb and IIIc). When symmetric currency basket is used (Figure IIIc), the divergence indicators for these currencies generally show much more movement in divergence indicators than in the asymmetrical basket (Figure IIIb) with the reason being that their weights are reduced relative to the first basket. Different

effects occur in the case of the other currencies many of whose weights increase as one moves from asymmetric basket to symmetric basket.

(3) To the extent to which some currencies are currently misaligned relative to long-run equilibrium, the basket based divergence indicators based on the forward looking reference point give a clearer sense of the misalignment than the backward-looking indicators. In particular, the forward-looking indicators convey the assumed undervaluation of the larger currencies even in the case of the asymmetrical currency basket (see Figure IIIb).

Based on the above, the weighting scheme clearly plays a critical role in determining the behavior of the currency basket and the associated divergence indicators. In addition, while the reference point potentially plays an important role in benchmarking the sign and sizes of basket-based divergence indicators, large asymmetries in weights can obscure exchange rate movements. Against this background, a natural question is whether there are any criteria that could be specified to determine an optimal set of weights when a currency basket is used for surveillance purposes. Unfortunately, the answer to this question appears to be in the negative. While, in principle, an optimal set of weights might be derived for currency baskets that are intended to serve as a parallel currencies—with weights based on seeking to create a currency basket with desirable risk, return and liquidity characteristics—no comparable criteria suggest themselves in the case of baskets that will be used for surveillance purposes.

IV. Regional Currency Basket and Other Indicators' Responses to Shocks

The usefulness of regional currency baskets and the associated divergence indicators for surveillance purposes will depend on their behavior in response to shocks and the ease with which they can be used to identify the policy requirements for fostering greater intra-regional exchange rate stability. This section considers the responses of the various currency and divergence indicators to a number of "shocks" and the circumstances under which they transmit clear signals for surveillance purposes. As in

the previous sections, we consider basket-based divergence indicators for alternative currency baskets and the bilateral deviation indicators. As the behavior of the various indicators is considered relative to the baseline ("shock minus control") it is not necessary to take into account alternative benchmark or reference points as in the previous section.

The five sets of scenarios ("shocks") are intended to illustrate plausible perturbations to the baseline that might confront policymakers using the divergence indicators for surveillance purposes. The five sets of scenarios are as follows.

- **Scenario I.** The first set of scenarios deal with the situation of a single "errant" currency that moves sharply against all other currencies. In one instance (Scenario IA), the errant currency is assumed to be that of a smaller ASEAN country (Indonesia) that depreciates by 10 percent against all other currencies. In the other instance (Scenario IB), the errant currency is assumed to be that of a larger "plus three" country (Japan) that depreciates by ten percent against all other currencies. As noted earlier, currency-basket based divergence indicators tend to transmit their clearest signals in instances of a single errant currency. At the same time, however, the weight of the errant currency in the currency basket will influence the degree to which the currency basket itself moves and the amount by which basket-based divergence indicators change. Bilateral deviation indicators are not, of course, influenced by weightings.

- **Scenario II.** The second scenario involves a uniform depreciation of an external currency (here, the US dollar) by 20 percent vis-à-vis all the currencies in the basket. By assumption, this scenario involves no movement in intra-regional exchange rates and the scenario is expected to produce clear signals.

- **Scenario III.** The third scenario addresses situations in which there are differential movements of all currencies in the basket vis-à-vis the US dollar. Specifically, it is assumed that while the Chinese RMB appreciates by 40 percent in terms of the dollar

all the other currencies appreciate by 20 percent. This scenario involves potentially significant movements in intra-regional currencies and is intended to illustrate the role of the currency basket weights.

- **Scenario IV.** The fourth scenario involves a situation in which there are several errant currencies that differ in the degree to which they depreciate vis-à-vis other currencies. In this scenario, the deprecation of the Japanese yen and Korean won are each assumed to be 30 percent while the weakening of the Philippine peso and Thai baht are assumed to be 15 percent. The scenario is included to demonstrate the role of offsetting effects and the possibility that basket-based divergence indicators may miss movements of one of the errant currencies.

- **Scenario V.** The fifth set of scenarios capture situations in which identical movements in basket currencies vis-a-vis each other are brought about by very different adjustments vis-à-vis external currencies. In scenario VA the currencies of Japan, Korea, Indonesia, the Philippines and Thailand appreciate by 10 percent vis-à-vis the US dollar, currencies other than the Chinese RMB and Malaysian ringgit appreciate by 5 percent, and the Chinese RMB and Malaysian ringgit remain stable vis-a-vis the US dollar. In scenario VB, the currencies of Japan, Korea, Indonesia, the Philippines and Thailand remain stable, all currencies other than China and Malaysia depreciate by 5 percent, while the RMB and ringgit depreciate by 10 percent. Both scenarios involve, therefore, the Chinese RMB and ringgit depreciating by 10 percent relative to the currencies of Japan, Korea, Indonesia, the Philippines and Thailand and by 5 percent against all other currencies. The external value of the basket, however, behaves very differently in the two scenarios.

The key features of the scenarios are displayed in Table II where for each scenario we display the behavior of the currency basket, the basket-based deviation indicators and the bilateral deviation indicators. All results are presented as deviations from the baseline. Several observations can be made about the scenarios.

Insert Table II

The results of scenarios IA and IB confirm that the case of a single errant currency is one of the "cleanest" for the basket-based deviation indicators and for the currency basket. Both when the errant currency is that of a small country (Scenario IA) and a large country (Scenario IB), the various deviation indicators clearly identify the currency due to differently sized and signed basket-based deviations. In addition, the fact that the deviation indicators **for all currencies other than the errant currencies** display the same movement within each scenario confirms that it is a single currency moving out of line[34]. Reflecting differences in weighting schemes, however, the different currency baskets move by different amounts: the movement in the currency basket is largest (in absolute value) in the case of the errant currency with the largest weight in the basket. Both scenarios also indicate a general feature of the basket-based indicators: even a shock to a single currency has the potential to move **all** the divergence indicators; this is especially the case in Scenario IIB when the errant currency has a relatively large weight in the currency basket. Among the various indicators, the bilateral deviation indicator clearly shows the behavior of the single errant currency vis-à-vis the other currencies in the basket.

Scenario II is based on a uniform movement of an external currency against all currencies in the basket; as result, none of measures of intra-regional divergence change. The key result in this scenario is that the value of the currency basket moves one for one with the external currency as the basket (as noted in Section II) is homogenous of degree one in its component currencies.

The results become considerably less clear when we move to the other scenarios. Scenario III is intended to show the effects of a relatively simple form of differential currency movement and highlights the role of currency weights. In this scenario, the Chinese RMB appreciates by 40 percent and all other currencies are assumed to appreciate by 20 percent. In the case of both currency baskets, the divergence indicators

[34] This symmetry of the basket based deviation indicator was noted in Section II.

show that the Chinese RMB has strengthened by much more than other currencies. In the case of the basket in which China has a large weight, however, the effects are muted in so far the RMB moves the basket and the basket appreciates strongly vis-à-vis the US dollar.

Scenario V illustrates the problem of offsetting effects that can arise when there are differential movements in currencies. In this scenario, the deprecation of the Japanese yen and Korean won are each assumed to be 30 percent while the weakening of the Philippine peso and Thai baht are assumed to be 15 percent. Interestingly, the divergence indicators for the peso and the baht show very little movement in the scenario even though these currencies have moved substantially against other currencies in the band; on the other hand, the divergence indicators for currencies that have not moved in terms of the US dollar show large movements. The differential movements of the currencies are clearly identified by the bilateral divergence indicator. The behavior of the basket-based divergence indicators—and the "dog that didn't bark" effect—reflects, of course, as discussed in section II the fact that the divergence indicators capture deviations from average behavior and not measure bilateral deviations.

The final set of scenarios highlights N-1 problems. In both Scenario VA and VB, assumed differences in the behavior of currencies lead to identical basket-based deviation indicators even when the currency basket is behaving very differently. For concreteness, consider the case of the currency basket dominated by the "plus three" countries. Under Scenario VA this basket depreciates vis-à-vis the US dollar while in Scenario VB the basket appreciates. At the same time, however, **all the intra-regional currencies display the same deviations in the two scenarios**. The reason for this is that both scenarios (by construction) involve the Chinese RMB and Malaysian ringgit depreciating by 5 or 10 percent against all other intra-regional currencies; they **differ only with respect to whether the (relative) movement is brought about by the RMB and ringgit remaining stable vis-à-vis the US dollar while other intra-regional currencies move (Scenario VA), or by these currencies depreciating against the dollar while the other intra-regional currencies either appreciate or remain stable in terms of the US dollar (Scenario VB).** This N-1 problem illustrates why it is not sufficient to focus only

on intra-regional movements to interpret exchange rate behavior. It is necessary either to take into account changes in the external value of the currency basket or the movements in the external values of currencies must be directly monitored.

V. Conclusions

The key argument of the paper is that regional currency-basket based divergence indicators are unlikely to be very helpful for exchange rate surveillance. Using the recent behavior of hypothetical regional currency baskets as well as a number of simple scenarios, the paper has shown that such indicators are subject to a number of technical problems related to the endogenous movement in the currency basket, asymmetries in currency weights and offsetting effects, and that they can obscure underlying movements in bilateral exchange rates. More fundamentally, a key difficulty for any intra-regional exchange rate indicator is the existence of potentially serious N-1 or anchor effects. Some of the difficulties can be addressed by bilateral divergence indicators but means will need to be found to anchor regional exchange rate surveillance vis-à-vis currencies outside the region. Comparable lessons were learnt in Europe over twenty years ago and will need to be applied by those calling for a regional currency basket approach to exchange rate surveillance.

Acknowledgements

The authors would like to thank Rachel Li for excellent research assistance and are grateful to the Office of Research, Singapore Management University for research grant support.

References

Chow, H.K. and Y. Kim (2003), "A Common Currency Peg in East Asia? Perspectives from Western Europe," *Journal of Macroeconomics*, 25, pp.331-350.

Dammers, C. R., and R. N. MacCauley (2006) "Basket Weaving: The Euromarket Experience with Basket Currency Bonds," *BIS Quarterly Review*, March, pp 79-92.

de Brouwer, G. (2004), "Does a Formal Common-Basket Peg in East Asia Make Economic Sense?," in G. de Brouwer, eds., *Financial Markets and Policies in East Asia*, pp.286-314, Routledge.

Eichengreen, B. (2006), "The Parallel-Currency Approach to Asian Monetary Integration," *American Economic Review*, 96, pp.432-436.

Eichengreen, B. and T. Bayoumi (1996), "Is Asia an optimum currency area? Can it become one? Regional, global and historical perspectives on Asian monetary relations" in Collignon et al.,eds., *Exchange rate policies in emerging Asian countries*, London: Routledge.

Gros, D., and N. Thygesen (1998) *European Monetary Integration: from the European Monetary System to Economic and Monetary Union*. Addison-Wesley UK.

McKinnon, R. I. and G. Schnabl (2004) "The East Asian Dollar Standard, Fear of Floating, and Original Sin," *Review of Development Economics*, Vol. 8, No. 3, pp 331-360.

Ogawa, E., and J. Shimizu (2005) "A Deviation Measurement for Coordinated Exchange Rate Policies in East Asia," *RIETI Discussion Paper Series*, 05-E-017.

Ogawa, E., and J. Shimizu (2006a) "AMU Deviation Indicator for Coordinated Exchange Rate Policies in East Asia and Its Relation with Effective Exchange Rates," *RIETI Discussion Paper Series*, 06-E-002.

Ogawa, E. and J. Shimizu (2006b), "Stabilization of Effective Exchange Rates under Common Currency Basket Systems," *NBER Working Paper* No. 12198.

Williamson, J. (2005), "A Currency Basket for East Asia, Not Just China," *Policy Briefs in International Economics*, PB05-1, Institute for International Economics.

Wyplosz, C. (2001), "A Monetary Union in Asia? Some European Lessons," in Gruen, D. and J. Simon, eds., "Proceedings of the Reserve Bank of Australia's 2001 Conference: *Futures Directions for Monetary Policy in East Asia*," pp.124-155, Reserve Bank of Australia.

Table I. Quantities of Component Currencies in Asymmetric Basket[35]

	Trade volume* %	GDP measured at PPP** %	Weights % (a)	Benchmark exchange rate*** (b)	Quantities (a)/(b)
Brunei	0.41	0.41	0.41	0.5912	0.0069
Cambodia	0.19	0.21	0.20	0.0003	7.4235
China	21.65	47.93	34.79	0.1256	2.7711
Indonesia	4.67	5.56	5.12	0.0001	452.7871
Japan	27.31	28.30	27.80	0.0091	30.5681
South Korea	12.86	6.65	9.76	0.0009	113.1459
Laos	0.09	0.08	0.08	0.0001	5.9500
Malaysia	8.85	1.83	5.34	0.2735	0.1953
Myanmar	0.38	0.38	0.38	0.1598	0.0239
Philippines	3.12	2.74	2.93	0.0220	1.3347
Singapore	11.90	0.81	6.36	0.5912	0.1075
Thailand	6.60	3.56	5.08	0.0246	2.0630
Vietnam	1.96	1.53	1.74	0.0001	243.0432

* : The trade volume is calculated as the average of total export and import volumes in 2001, 2002 and 2003 taken from DOTS (IMF).
**: GDP measured at PPP is the average of GDP measured at PPP in 2001, 2002 and 2003 taken from the World Development Report, World Bank. For Brunei and Myanmar, we again use the same share of trade volume since no GDP data are available for these countries.
*** : The Benchmark exchange rate ($-euro/Currency) is the average of the daily exchange rate in terms of US$-euro in 2000 and 2001.

[35] Source: Table 2 of Ogawa and Shimizu (2006a) with only slight modifications.

Figure I: Value of Component Currencies in terms of US dollar

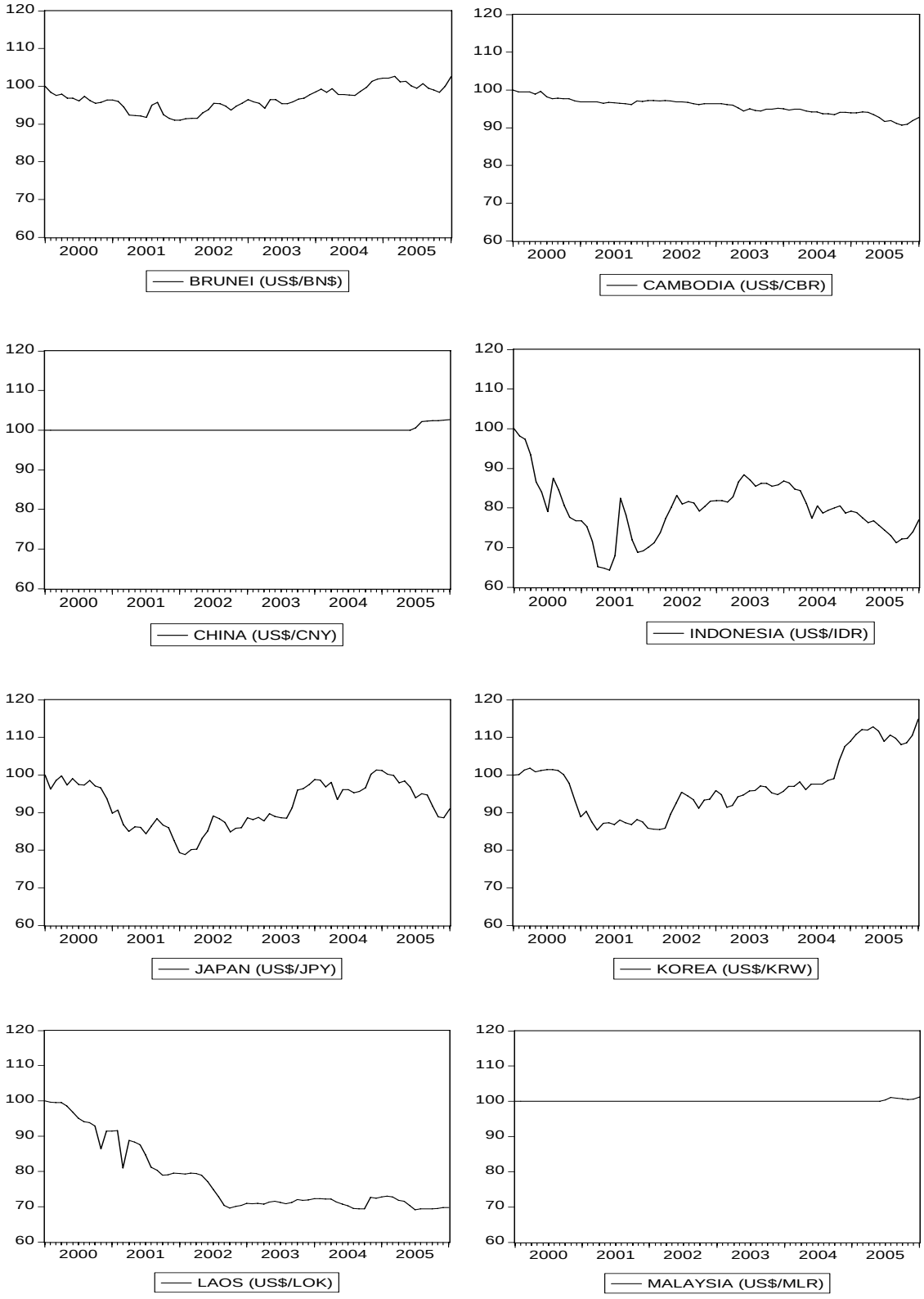


Figure I (cont'd)

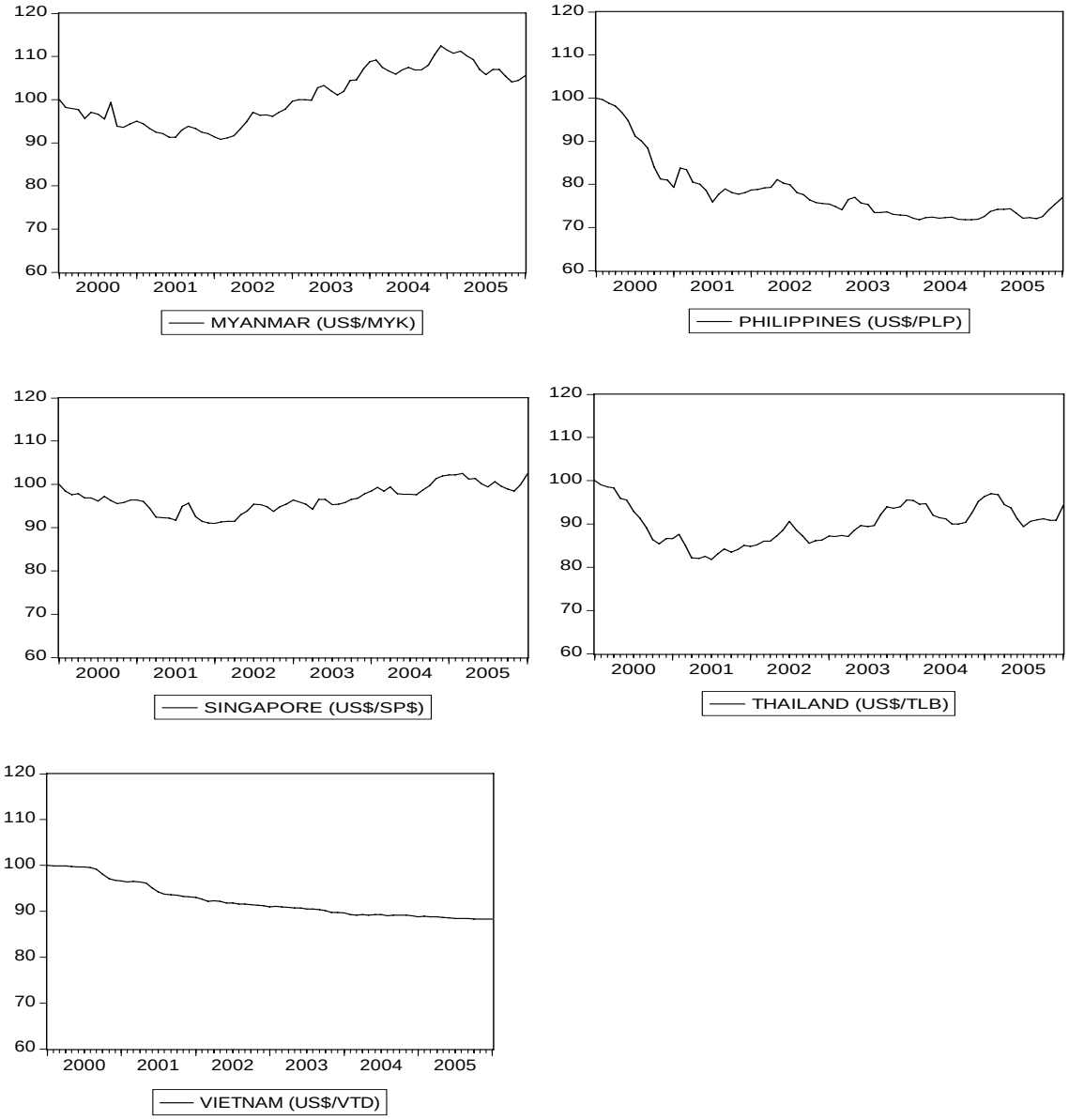


Figure II: Value of ACU in terms of US dollar for Asymmetric and Symmetric Baskets

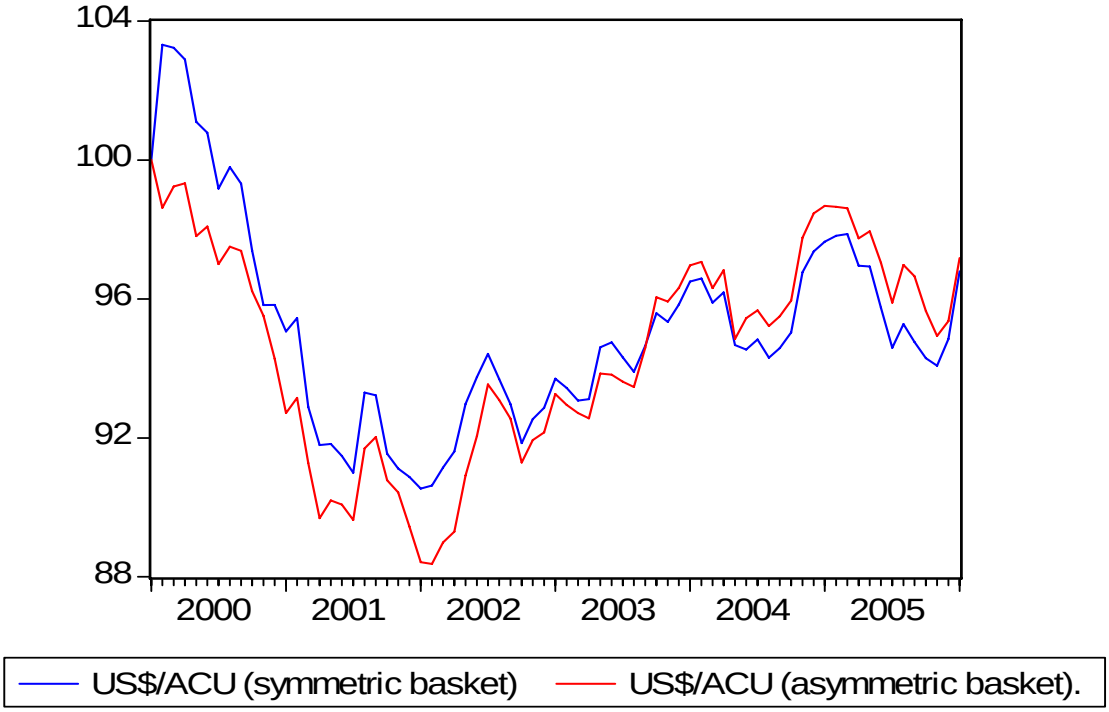
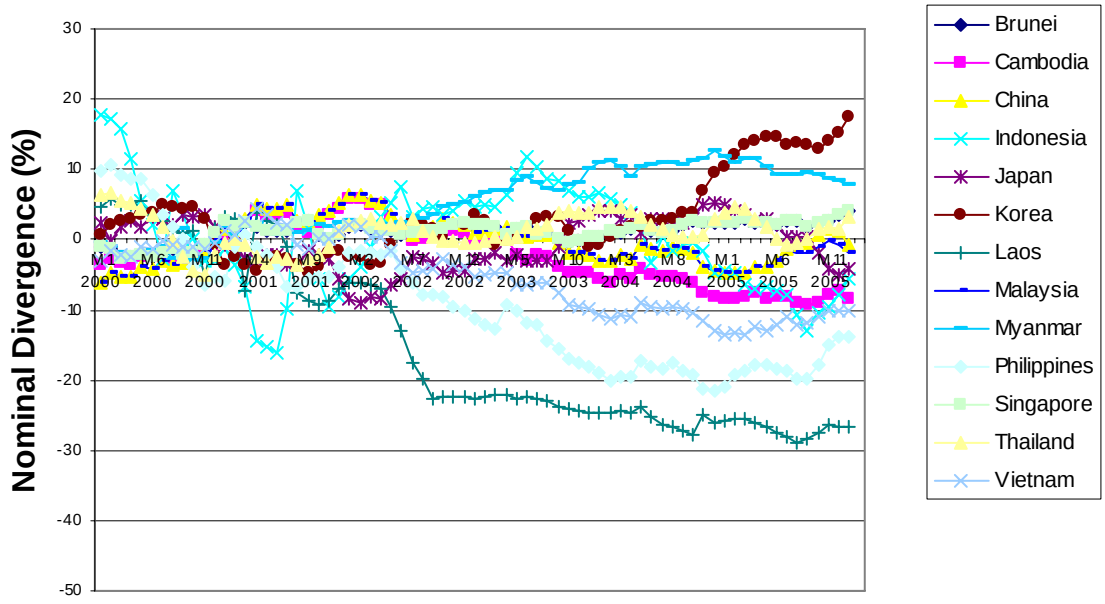
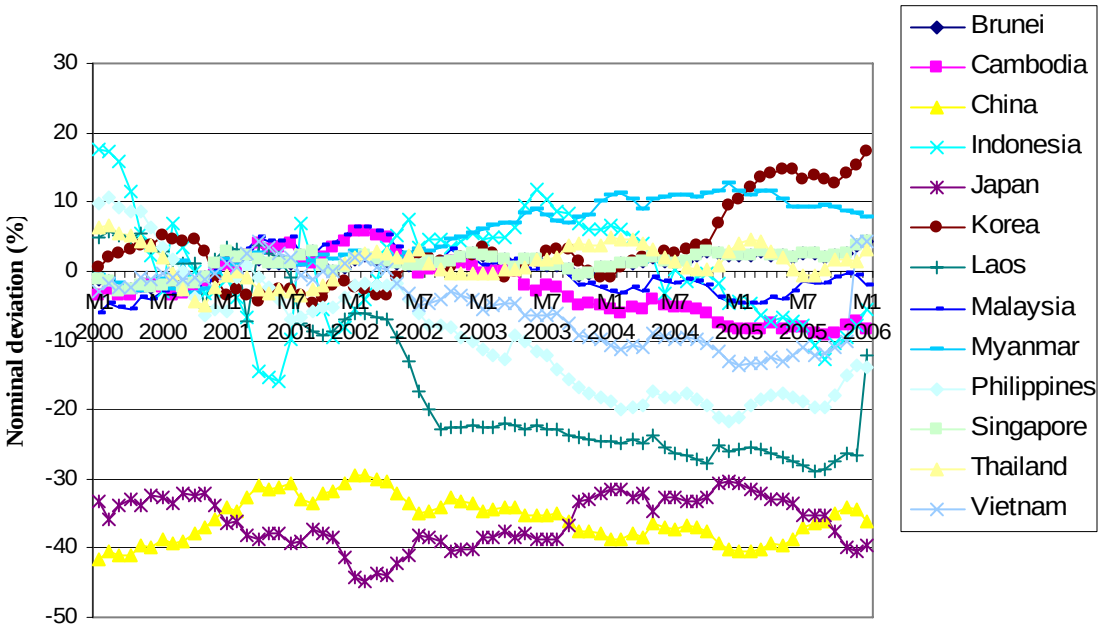


Figure III: Divergence Indicators

(a) Asymmetric Basket-based Divergence Indicators (Backward reference)



(b) Asymmetric Basket-based Divergence Indicators (Forward Reference)



(c) Symmetric Basket-based Divergence Indicators (Forward Reference)

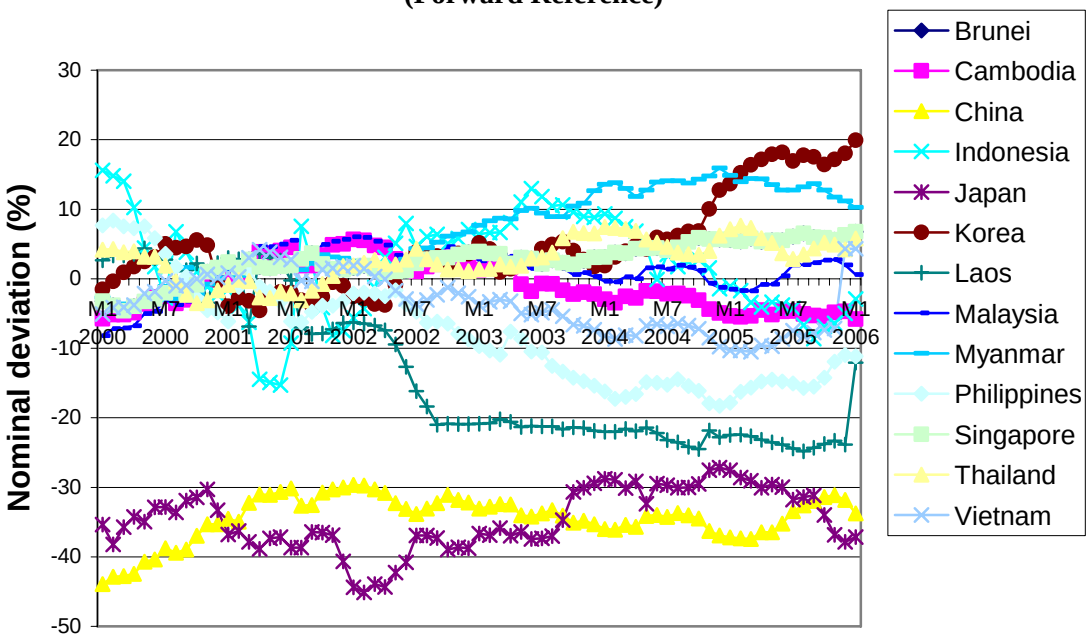


Table II. Asian Currency Basket and Deviation Indicators Under Alternative Scenarios

(Percentage Point Deviations From Baseline)

	Scenario IA		Scenario IB		Scenario II		Scenario III	
Basket Type	*Asymmetric*	*Symmetric*	*Asymmetric*	*Symmetric*	*Asymmetric*	*Symmetric*	*Asymmetric*	*Symmetric*
	-0.52	-0.77	-2.78	-0.77	19.50	20	26.93	21.54
Basket Deviation Indicators								
Brunei	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Cambodia	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
China	0.52	0.77	2.78	0.77	0	0	13.07	18.46
Indonesia	-9.49	-9.23	2.78	0.77	0	0	-6.93	-1.54
Japan	0.52	0.77	-7.22	-9.23	0	0	-6.93	-1.54
Korea	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Laos	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Malaysia	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Myanmar	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Philippines	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Singapore	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Thailand	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Vietnam	0.52	0.77	2.78	0.77	0	0	-6.93	-1.54
Bilateral Deviation Indicators								
Brunei	10		10		0		0	
Cambodia	10		10		0		0	
China	10		10		0		20	
Indonesia	0		10		0		0	
Japan	10		0		0		0	
Korea	10		10		0		0	
Laos	10		10		0		0	
Malaysia	10		10		0		0	
Myanmar	10		10		0		0	
Philippines	10		10		0		0	
Singapore	10		10		0		0	
Thailand	10		10		0		0	
Vietnam	10		10		0		0	

Table II (cont'd)

	Scenario IV		Scenario VA		Scenario VB	
Basket Type	*Asymmetric*	*Symmetric*	*Asymmetric*	*Symmetric*	*Asymmetric*	*Symmetric*
ACU	-12.52	-6.93	5.55	6.16	-4.45	-3.85
Basket Deviation Indicators						
Brunei	12.52	6.93	-0.55	-1.16	-0.55	-1.16
Cambodia	12.52	6.93	-0.55	-1.16	-0.55	-1.16
China	12.52	6.93	-5.55	-6.16	-5.55	-6.16
Indonesia	12.52	6.93	4.45	3.85	4.45	3.85
Japan	-17.48	-23.07	4.45	3.85	4.45	3.85
Korea	-17.48	-23.07	4.45	3.85	4.45	3.85
Laos	12.52	6.93	-0.55	-1.16	-0.55	-1.16
Malaysia	12.52	6.93	-5.55	-6.16	-5.55	-6.16
Myanmar	12.52	6.93	-0.55	-1.16	-0.55	-1.16
Philippines	-2.48	-8.07	4.45	3.85	4.45	3.85
Singapore	12.52	6.93	-0.55	-1.16	-0.55	-1.16
Thailand	-2.48	-8.07	4.45	3.85	4.45	3.85
Vietnam	12.52	6.93	-0.55	-1.16	-0.55	-1.16
Bilateral Deviation Indicators						
Brunei	30		5		5	
Cambodia	30		5		5	
China	30		0		0	
Indonesia	30		10		10	
Japan	0		10		10	
Korea	0		10		10	
Laos	30		5		5	
Malaysia	30		0		0	
Myanmar	30		5		5	
Philippines	15		10		10	
Singapore	30		5		5	
Thailand	15		10		10	
Vietnam	30		5		5	