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## EXAMINING THE CASE FOR RESERVE POOLING IN EAST ASIA: EMPIRICAL ANALYSIS

### Ramkishen S. Rajan, Reza Siregar and Graham Bird

**Ramkishen S. Rajan**

Institute of Policy Studies and School of Economics, University of Adelaide

e-mail: ramkishen.rajan@adelaide.edu.au


**Reza Siregar**

School of Economics, University of Adelaide

e-mail: reza.siregar@adelaide.edu.au


**Graham Bird**

Surrey Centre for International Economic Studies, University of Surrey

e-mail: g.bird@surrey.ac.uk

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## ABSTRACT

Two features of East Asia's recovery from the financial turmoil of 1997-98 appear to be rather paradoxical. First, the regional economies (except Hong Kong, China and Malaysia) have allowed a relatively greater albeit modest degree of variability of their currencies according to market conditions. Second, the regional monetary authorities have simultaneously appeared keen on bolstering reserves to historically high levels. This paper examines the subject of reserve management in the broader context of monetary cooperation in East Asia. The paper briefly reviews the factors that go into the determination of "optimal reserves" in general, and specifically in the case of East Asia. It then goes on to investigate the gains, if any, to be reaped if the East Asian economies were to pool their reserves.

## 1.    Introduction[1]

Two features of East Asia's recovery from the financial turmoil of 1997-98 appear to be rather paradoxical. <u>First</u>, the regional economies (except Hong Kong, China and Malaysia) have allowed a relatively greater albeit modest degree of variability of their currencies according to market conditions (Hernandez and Montiel, 2003, Rajan, 2002 and Rajan, et al., 2002). <u>Second</u>, the regional monetary authorities have simultaneously appeared keen on bolstering reserves to historically high levels[2].

A policy of stockpiling reserves has clearly been embraced by East Asia, which has the world's largest holdings of foreign reserves in aggregate. To emphasize this point, global international reserves (minus gold) stood at US$ 2,223 billion in May 2002, a near doubling in nominal terms since early 1994. Developing countries hold around two-thirds of the world's international reserves, with developing East Asia alone holding 38 percent of the global share in May 2002, up from 30.5 percent in 1994 (Aizenman and Marion, 2003). Among the crisis-affected economies, Korea stands out as having amassed reserves particularly aggressively between 1992 and 2001 <u>(Table 1)</u>[3]. Japan, China, Taiwan, Hong Kong, Korea and Singapore

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[1] This paper was completed while the the first author was a Visiting Freeman Foundation Scholar at the Department of Economics, Claremont McKenna College. The author is grateful for the generous support provided by the Freeman Foundation as well as for the excellent research facilities made available to him at the Lowe Institute of Political Economy. Research assistance by Yuan-Feng Ouyang is also gratefully acknowledged. The usual disclaimer applies.

[2] Of course, the impact of exchange rate flexibility on reserve holdings runs both ways. On the one hand, with flexible regimes, the exchange rate acts as a safety valve in response to balance of payments disequilibria. On the other hand, past exchange rate changes may be an indication of the extent of variability of and susceptibility to external shocks. Insofar as central banks need to hold reserves to counter these external shocks, this suggests the need to hold larger quantities of reserves.

[3] This desire by regional monetary authorities to accumulate reserves well beyond levels that would be deemed adequate by cost-benefit calculations is not a new phenomenon. In what became known as "Mrs Machlup's Wardrobe Theory", Machlup (1966) suggested that the acquisitive characteristics of monetary authorities in terms of adding to their reserves resembled those of his wife in terms of clothes. He argued that monetary authorities essentially looked to maximize their reserves. As such, the demand for reserves in any period could, according to Machlup, be characterized simply as being equal to the level of reserves

rank as the largest holders of international reserves in the world (Aizenman and Marion, 2003). The whole of East Asia (i.e. inclusive of Japan) accounts for over half global international reserve holdings.

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in the previous period plus some growth factor no matter what the level of imports or any other underlying economic variable.

**TABLE 1**
**RESERVES AS PROPORTION OF IMPORTS (MONTHS),**
**GDP (IN PERCENT) AND AVERAGE AMOUNT (IN US$ MILLIONS)**
**(1992 - 2001)**

| COUNTRY | 1992 | 1995 | 1998 | 2001 |
|---|---|---|---|---|
| INDONESIA IMPORTS[A] GDP AVERAGE[B] | 3.0 8 10376.7 | 2.7 7 13022.5 | 5.1 19 19020.8 | 11.0 21.1 27863.5 |
| MALAYSIA IMPORTS[A] GDP AVERAGE[B] | 4.2 30 15082.8 | 3.0 27 25063.0 | 5.1 34 21441.8 | 4.6 35 28071.3 |
| PHILIPPINES IMPORTS[A] GDP AVERAGE[B] | 2.8 8 3941.9 | 2.1 9 6199.4 | 2.6 13 8771.2 | 5.3 19 12771.5 |
| SINGAPORE IMPORTS[A] GDP AVERAGE[B] | 5.7 82 38028.3 | 5.7 82 65798.9 | 7.3 90 73170.9 | 7.8 91 75687.8 |
| THAILAND IMPORTS[A] GDP AVERAGE[B] | 4.9 18 19574.5 | 4.9 22 33455.7 | 6.2 23 27020.1 | 6.4 28 31734.4 |
| HONG KONG IMPORTS[A] GDP AVERAGE[B] | 3.0 35 N/A | 3.1 40 53283.5 | 4.8 55 92826.8 | 6.8 66 113307 |
| CHINA IMPORTS[A] GDP AVERAGE[B] | 3.1 4.6 33875.2 | 5.9 10.7 67595.4 | 9.5 15.5 145535.8 | 9.0 15.9 194410.2 |
| KOREA IMPORTS[A] GDP AVERAGE[B] | 2.2 5.0 15365.3 | 2.5 4.0 29679.9 | 5.1 5.0 42351.3 | 8.2 4.0 97834.1 |
| JAPAN IMPORTS[A] GDP AVERAGE[B] | 2.1 2.0 71408.6 | 3.9 4.0 166451.2 | 5.0 5.0 213459.8 | N/A 8.5 374028.8 |

Notes:    a) Ratio to average monthly imports of Merchandise goods.
              b) Average of total foreign exchange reserves minus gold.
SOURCE:  IFS-CD ROM AND ADB DATABASE.

While interest in ensuring "reserve adequacy" diminished markedly following the collapse of the Bretton Woods, it has re-emerged as an issue of more general interest as a series of currency crises afflicted many developing economies worldwide in the 1990s and early 2000. Fischer (2001c) nicely summarizes the importance of reserves in an era of capital mobility as follows.

> Reserves matter because they are a key determinant of a country's ability to avoid economic and financial crisis. This is true of all countries, but especially of emerging markets open to volatile international capital flows…The availability of capital flows to offset current account shocks should, on the face of it, reduce the amount of reserves a country needs. But access to private capital is often uncertain, and inflows are subject to rapid reversals, as we have seen all too often in recent years. We have also seen in the recent crises that countries that had big reserves by and large did better in withstanding contagion than those with smaller reserves.. (pp.1-3)

This paper examines the subject of reserve management in the broader context of monetary cooperation in East Asia. The next Section briefly reviews the factors that go into the determination of "optimal reserves" in general, and specifically in the case of East Asia. Section 3 investigates the gains, if any, to be reaped if East Asian economies were to pool their reserves. Section 4 explores how the proposed reserve pool would fit into the larger context of the evolving East Asian monetary regionalism (Bird and Rajan. 2002). The final section offers a few concluding remarks.

## 2. Cost-Benefit Calculus Determining Optimal Reserve Holdings

### 2.1 Some Analytical Background

Reserves are held because they act as a buffer against a balance of payments (bop) shock. Owned reserves represent a guaranteed and unconditional source of liquidity. However, there is a significant opportunity cost of stockpiling reserves as the country effectively swaps high yielding domestic assets for lower

yielding foreign ones[4]. We briefly outline below a simple theory of the demand for international reserves based on a cost-benefit calculus (Clark, 1970).

The bottom-right quadrant of <u>Figure 1</u> illustrates a negative relationship between the quantity of reserves held and the speed of adjustment. In other words, the lower the reserve holdings, the greater the speed of adjustment needed to adjust to a balance of payments shock. The bottom-left quadrant illustrates a positive association between the speed of adjustment to a BOP shock and the variability of income. The quicker is the adjustment, the more variable is income. The top left quadrant reveals a negative nexus between (expected) income levels and the quantity of reserves held. This is essentially a representation of the opportunity costs of holding reserves, i.e. the larger the reserves held, the lower the amount of capital investment that may be undertaken[5]. Putting these three quadrants together derives the top-left quadrant which shows a positive association between expected income levels and the variability of income. Thus, other things equal, the greater the demand for reserves, the slower the speed of adjustment and the lower the variability of income, though this benefit comes at a cost of lower income levels.

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[4] Conversely, reserve holdings confer a benefit to nations that supply the reserve currency as they are effectively obtaining low interest loans (with no currency risk).

[5] Of course, to the extent that reserve holdings are seen as a sign of strength, a larger level of reserves may encourage greater capital inflows. We ignore this possible complementary effect in the analysis in this paper.

**Figure 1**
**Determining the Optimal Reserve Holdings**



Figure 1
Determining the Optimal Reserve Holdings
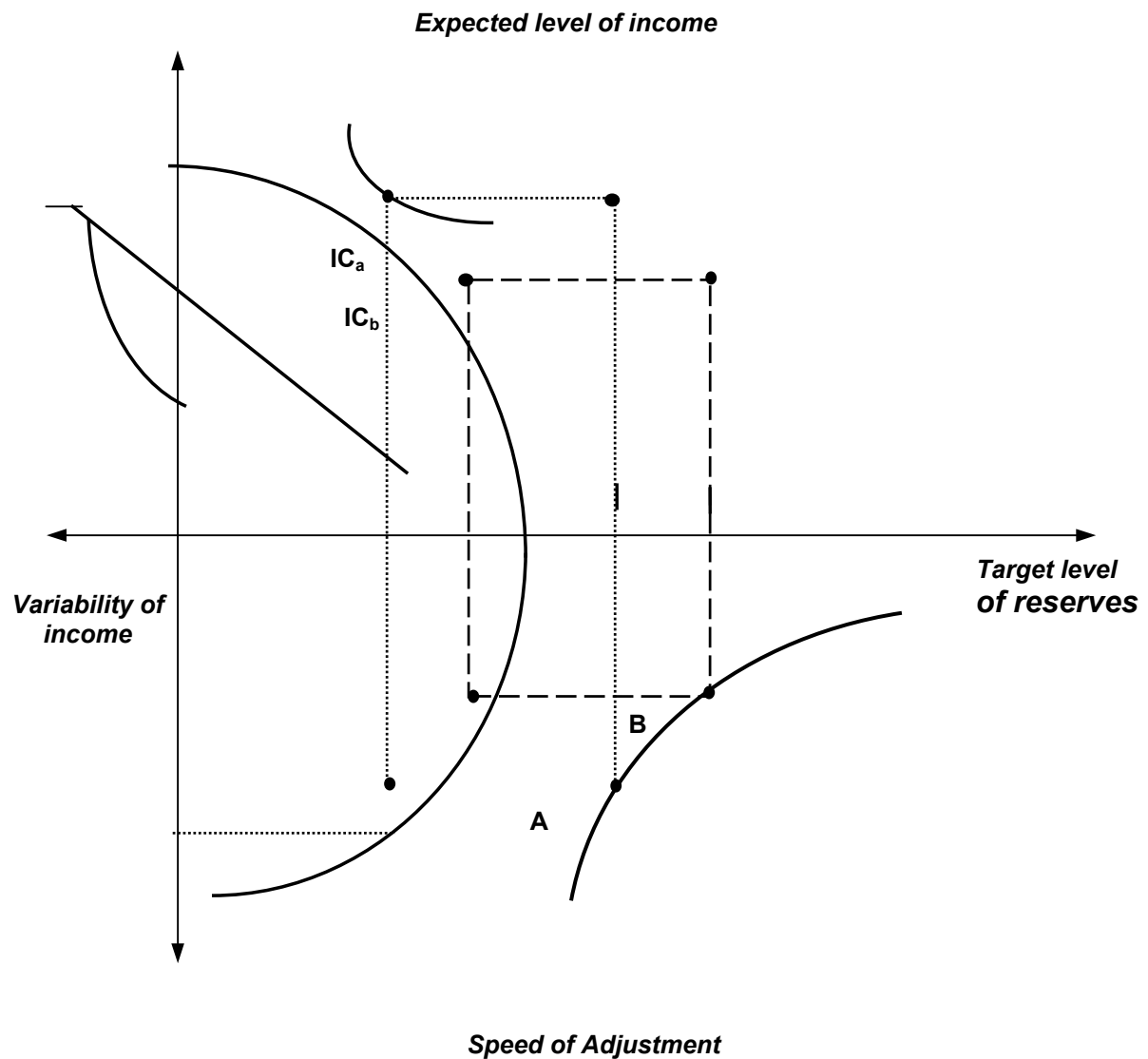
SOURCE: CLARK (1970)

The demand for reserves will be determined at the point of tangency between the central bank's indifference curve ($IC_A$) and the curve showing the trade-off between expected income and variability of income (point A). Note that the more risk averse the central bank, the more steeply sloped the indifference curve ($IC_B$) and therefore the greater the desired reserve holdings (point B).

The preceding framework can be thought of as a generalization and graphical representation of the buffer stock model developed by Frenkel and Jovanovic (1981). Under certain assumptions, Frenkel-Jovanovic derive the optimal reserve holdings to be as follows:

$$R_0 = (c\sigma/r^{0.5})^{1/2}$$

*where* $R_0$ = desired reserves, c = country-specific nominal constant; $\sigma$ = standard deviation of reserve movements; and r = opportunity cost of holding reserves. Equation I reveals desired reserve holdings to be a positive function of volatility and a negative function of the opportunity costs of maintaining reserves.

## 2.2    Reserve Holdings in East Asia: Are they Optimal?

While Flood and Marion (2001) discuss how the Frenkel-Jovanovic model has performed empirically and proceed to outline useful theoretical and empirical extensions to it, Aizenman and Marion (2003) have recently estimated the following generalized reserve equation using a panel of 122 developing countries over the period 1980-96:

$$\ln(R_{it}/P_{it}) = \alpha_0 + \alpha_1\ln(pop_{it}) + \alpha_2\ln(gpc_{it}) + \alpha_3\ln(exa_{it}) + \alpha_4\ln(imy_{it}) + \alpha_5\ln(neer_{it}) + \varepsilon_t \qquad (2)$$

*where*: *R* is actual holdings of reserves minus gold (millions of US dollars deflated by the US GDP deflator, *P*); *pop* is the total population of the country; *gpc* is real GDP per capita; *exa* is the volatility of real export receipts; *imy* is the share of imports of goods and services in GDP; and *neer* is the volatility of the nominal effective exchange rate.

The authors explain the choice of dependent variables as follows:
Real reserve holdings should increase with the size of international transactions, so we would expect reserve holdings to be positively correlated with the country's population and standard of living.

> Reserve holdings should increase with the volatility of international receipts and payments if they are intended to help cushion the economy, so we would expect reserve holdings to be positively correlated with the volatility of a country's export receipts. Reserve holdings should also increase with the vulnerability to external shocks. We therefore expect reserve holdings to be positively correlated with the average propensity to import, a measure of the economy's openness and vulnerability to external shocks. Finally, since greater exchange-rate flexibility should reduce the demand for reserves because central banks no longer need a large reserve stockpile to manage a fixed exchange rate, reserve holdings should be negatively correlated with exchange-rate volatility (p.6).

In the case of East Asia, in-sample results largely confirm the authors' priors. Indeed, if anything, the estimated reserve equations systematically *over-predicted* reserve holdings (between one and two standard deviations from the average). This would be expected *a priori* as their estimating equation excludes any measure of the opportunity cost of holding reserves[6]. However, out-of-sample results for the crisis period in East Asia in 1997-99 reveal a systematic *under-prediction* of reserves in most of the East Asian countries (except Malaysia). Incorporating political variables does not alter these conclusions. Thus, the authors conclude that "behavior has changed since the Asian financial crisis", and go on to suggest that the "recent build-up of large international reserve holdings in a number of Asian emerging markets may represent precautionary holdings" (p.11). In terms of the general framework outlined in Section 2.1, this implies that the more risk averse a country's monetary authorities, the steeper is the indifference curve, and therefore the greater the desired reserve holdings[7].

Stockpiling reserves by the East Asian economies implies more generally that, at the margin, the benefits of extra reserves are perceived as exceeding the costs. There may be a political premium placed on avoiding future crises and

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[6] Aizenman and Marion (2003) exclude the opportunity cost variable as they argue that it is not a significant explanatory factor, but more so because of the difficulty of obtaining consistent data series on interest rates for developing countries.

[7] Unlike the more general framework, the Frenkel-Jovanovic model does not explicitly capture changes in loss aversion.

retaining the option of a slower speed of adjustment should the balance of payments position weaken and external assistance be found wanting. In other words, holding reserves may be considered a form of insurance premium ("precautionary motive")[8]. However, this comes at a price given the opportunity cost of holding reserves. Is there any way in which the liquidity yield from holding reserves may be generated without the need for individual countries to continually accumulate them? One way may be for regional economies to pool their reserves and derive the benefits of scale economies. But how might one judge the potential size of benefits from reserve pooling? Before doing this, we first need to estimate the level of reserves that members would have to hold independently.

## 3.  Assessing the Size and Benefits of a Reserve Pool

### 3.1  Reserve-to-Imports Ratio Revisited

Assume reserve pooling is undertaken as part of broader policy of economic integration including trade and monetary integration[9]. In such a case, some formerly external trade will become intra-regional. Insofar as the reserve to imports (R/M) ratio is considered a reasonable - albeit highly imperfect - yardstick of reserve adequacy (Bird and Rajan, 2003), the reclassification of a large part of formerly external trade will now imply that the region will be holding a substantial pool of "excess reserves". In the case of East Asia, how much would this excess be and what would be the gains from reserve pooling?[10]

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[8] Apart from concerns about conditional access to fickle global capital markets (discussed in Bird and Rajan, 2003; also see Willett, 2001), Aizenman and Marion (2003) also suggest that this precautionary motive may arise from costly domestic tax collection and inelastic fiscal liabilities.

[9] See Section 4 for a discussion of reserve pooling in the presence of regional exchange rate coordination.

[10] This was one of the questions asked during the advent of the euro.

To ascertain the gains from reserve pooling we first compute the international reserves to imports ratio for the individual country (equation 3) and for the overall group (equation 4).

$$Ratio\ (i) = \frac{R_i}{M_i} \tag{3}$$

$$Ratio\ = \frac{\sum_i R_i}{\sum_i M_i}, \forall i = 1,...., n \tag{4}$$

where: $R_i$ and $\left(\sum R_i\right)$ are the average levels of reserves held by the individual country (*i*) and by the group countries during a specified period of time, respectively. $M_i$ and $\left(\sum M_i\right)$ are the average monthly level of imports for each country (*i*) and the group, respectively. *(n)* is the total number of countries joining the group.

If reserve pooling among the East Asian economies is part of broader goal of trade integration, the arrangement implies that no reserves will be needed to cover the imports other member countries. Consequently, the same average level of individual country reserve holdings will correspond to a higher number of monthly import coverage. Conversely, to maintain the same import coverage, each member country and the region need only hold a lower amount of reserves. This may be formally stated as follows:

$$Ratiopol(i) = \frac{R_i}{M_i - s.M_i} \tag{5}$$

$$Ratiopol = \frac{\sum_i R_i}{\sum_i (M_i - s.M_i)}, \forall i = 1,...,n \tag{6}$$

where: *(s)* is the share of intraregional imports.

We now compute the "hypothetical reserve level"; *the level of total international reserves that the individual country* $(HR(i))$ *and the non-pooling group* $(HR)$ *would have to hold to have the same months of import coverage that it would have under the pooling arrangement.*

$$HR(i) = Ratiopol(i) * M_i \qquad (7)$$

$$HR = Ratiopol * \sum_i M_i, \forall i = 1,...,n \qquad (8)$$

The average excess gains from joining the pooling for each individual member (equation 9) and for the group (equation 10) are:

$$ER(i) = HR(i) - R_i \qquad (9)$$

$$ER = HR - \sum_i R_i \qquad (10)$$

*where*: *(ER)* is the excess reserve level during the specified period.

Tables 2a and 2b report the findings for the ASEAN-5 (Indonesia, Malaysia, Philippines, Thailand and Singapore) plus China, Korea and Japan – commonly referred to as ASEAN plus Three (APT) – as well as Hong Kong, for the pre-crisis and the crisis period of 1990-1998.[11] We obtain the foreign exchange reserve data from the IFS CD-ROM of the International Monetary Fund (IMF).

From our computation, we find the average share of intraregional imports in the overall imports of the individual country range from a low of 28 percent for Japan and a high of 66 percent for Hong Kong. For the ASEAN-5, the range is narrower between 43 percent to about 52 percent. As for the overall group of the economies,

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[11] The shares of intra-regional imports *(s)* are based on data from The East Asian Economic Perspectives of ICSEAD (2000).

we find that the average *(s)* equals 0.45 for that group of East Asian economies during the specified period.

Based on the available information we calculate $(Ratiopol(i))$ and $(Ratiopol)$. The results show that the number of months of import coverage for the ASEAN-5 should increase by as little as 2 months for the Philippines and as much as 7 months for Singapore (Table 2a). As for the rest of the East Asian countries, Korea will gain the smallest increase in the import coverage by less than 2 months, while Hong Kong will gain the most (an extra coverage of 8 months of import). Lastly, the East Asian countries as a group should enjoy an extra coverage of 4 months of import by committing themselves to the regional pooling.

**Table 2a**
**Reserve-Import Ratio With and Without Pooling**
**(ASEAN-5) + Korea + China + Hong Kong + Japan**
**(1990-1998)**

| Country | *s* (Share of intra-regional imports in percent)[a] | Average Reserve-Import Ratio without Pooling (months of imports) | Average Reserve-Import Ratio with Pooling (months of imports) |
|---|---|---|---|
| Indonesia | 43.2% | 5.08 | 8.94 |
| Malaysia | 52.9% | 4.47 | 9.49 |
| Philippines | 43.8% | 2.89 | 5.15 |
| Thailand | 47.8% | 6.11 | 11.70 |
| Singapore | 52.3% | 6.85 | 14.36 |
| Korea | 37.1% | 2.93 | 4.67 |
| China | 45.6% | 7.96 | 14.62 |
| Hong Kong | 66.4% | 4.16 | 12.39 |
| Japan | 28.2% | 6.63 | 9.23 |
| Total of ASEAN-5 + Korea + China + Hong Kong + Japan | 45.0% | 5.62 | 10.10 |

Notes:  a) Raw data are obtained from ICSEAD (2000).

Reflecting the variations in the reserve-import ratio, the average "excess" reserves from pooling for each individual are also very diverse (Table 2b). Korea appears to gain the least amount of excess reserves (US$15 billion), while Hong Kong stands to gain the most (US$105 billion). As a whole, East Asia stands to reap around US$330 billion of excess reserves for the period between 1990 and 1998[12]. This being the case, a logical question would be to ask what are the fiscal costs of failing to derive the reserve benefits from integration?

We compute the fiscal costs (FC) as follows:

$$FC(i) = \left(\text{int}^i - \text{int}^{USA}\right) * ER(i) \tag{11}$$

$$FC = \left(\text{int}^{EA} - \text{int}^{USA}\right) * ER \tag{12}$$

where: $(FC(i))$ and $(FC)$ are the estimated fiscal costs for the individual country and for the group. $(\text{int}^i)$ is the average annually of 3 to 6 months time deposit rate offered by the commercial banks of the individual East Asian country. $(\text{int}^{EA})$ is the average annual interest rate on the 3 to 6 months time deposit offered by East Asian commercial banks; and $(\text{int}^{USA})$ is the equivalent average deposit rate offered by US commercial banks. We obtain interest rate data from the IMF's IFS CD-ROM[13].

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[12] Another way of seeing the gains from integration is to note that if the region wanted to maintain the same average import coverage without pooling (i.e. 5.6 months), the amount of reserves saved would be about US$ 185 billion.

[13] We assume for simplicity that the bulk of East Asian reserves are held in US short-term assets. This is probably not too far from reality. In 1999, 78 percent of global international reserves were in US dollars (D'Arista, 2000). Eichengreen and Mathieson (2000) offer a recent discussion on the currency composition of international reserves.

**Table 2b**
**Actual Reserve, Hypothetical Reserve and Fiscal Cost**
**(1990-1998)**

| Country | Average Actual Reserve (in US$ million) (A) | Average Hypothetical Reserve With Pooling (in US$ million) (B) | Excess Reserve (in US$ million) (B-A) | Fiscal Cost (in US$ million)[a] |
|---|---|---|---|---|
| Indonesia | 13535.60 | 23832.25 | 10296.65 | 1518.75 |
| Malaysia | 20852.30 | 44241.72 | 23389.42 | 376.57 |
| Philippines | 5795.63 | 10303.50 | 4507.87 | 326.82 |
| Thailand | 25967.09 | 49738.46 | 23771.37 | 1243.24 |
| Singapore | 55562.61 | 116478.26 | 60915.65 | -1041.66 |
| Korea | 25615.49 | 40760.83 | 15145.34 | 666.39 |
| China | 71505.29 | 131410.40 | 59905.11 | 1713.29 |
| Hong Kong | 53605.23 | 159584.19 | 105978.96 | -476.90 |
| Japan | 142398.20 | 198281.90 | 55883.70 | -1832.99 |
| Total of ASEAN-5 + Korea+China + Hong Kong + Japan | 414837.40 | 745074.98 | 330237.58 | 10831.79 |

Notes:    a) Positive number implies cost.

The average interest rate in East Asia shows a 3.3 percent premium over the equivalent US rate, although there are significant variations within East Asia. For the specified period, the commercial bank deposit rate in Indonesia averaged close to 15 percent higher than the US rate. The Philippines' and Thailand's commercial deposit rates were also significantly well above the US rates by about 7 percent and 5 percent, respectively. In contrast, the commercial banks in Singapore, Hong Kong and Japan offered lower deposit rates than the commercial banks in the US. From equations 11 and 12 we derive the fiscal costs of holding excess reserves to be well

over US$ 10 billion for the period at hand for the group. China and Indonesia experienced highest fiscal costs (about US$1.7 billion and US$ 1.5 billion, respectively). Malaysia and Philippines incurred "moderate" fiscal costs of around US$320-US$370 million, while those of Thailand and Korea were US$1.2 billion and US$670, respectively. Due to the negative interest rate spreads, Singapore, Hong Kong and Japan actually benefited from holding their excess reserves denominated in US dollars. The foregoing notwithstanding, it is important to note that the results highlighted in Table 2b are likely to underestimate the full fiscal cost of reserve hoarding as the cost of the financial capital in East Asia (reflected by the deposit interest rate) is likely to be far lower than the marginal cost of capital (which is the true opportunity cost of reserves).

## 3.2 Variability of Reserves: Coverage Index

While the preceding measure of reserve gains from integration intuitive, there are at least two problems with it.

First, there are limitations in using imports as a scaling factor for determining reserve adequacy. Crises during the 1990s and beyond have predominantly been crises of the capital account. Reserve adequacy benchmarks accordingly need to be modified to allow for both imports and capital outflows as potential drains on reserves (Bird and Rajan, 2002a, Fischer, 2001c and Reddy, 2002). For instance, the Reserve Bank of India (RBI) states:

> (W)ith the changing profile of capital flows, the traditional approach of assessing reserve adequacy in terms of import cover has been broadened to include a number of parameters which take into account the size, composition, and risk profiles of various types of capital flows as well as the types of external shocks to which the economy is vulnerable (Reddy, 2002, p.6).

Second, the foregoing analysis assumes that reserve pooling is carried out in tandem with intensified trade and monetary integration. What if the region does not

opt for economic integration form?[14] Is there any way of gauging the gains from

reserve policy? Since international reserve holdings have been found to be a

theoretically and statistically significant determinant of creditworthiness (see Bird and

Rajan, 2003 and Wijnholds and Kapteyn, 2001 and references cited within), depleting

them may induce capital outflows. If capital outflows reflect a perception within

private capital markets that a country is illiquid, reducing international reserves is

unlikely to be an effective strategy. The reversibility that makes reserve depletion

credible in the context of trade deficits is often absent in the context of capital

outflows (Bird and Rajan, 2002a).

In view of the foregoing, there seems to be a sound rationale for minimising

the variability of reserve holdings. How is this related to a reserve pool? Medhora

(1992b) observes:

> By belonging to the reserve pool, the member countries have…access
> to the others' reserves during times of need. At the same time, by
> pooling, each country is taking on the variability of the entire pool,
> rather than just the variability of its own reserves (p.213).

It has been argued that a more appropriate way of measuring international

reserve adequacy is to compare average reserve holdings with their variability

(Dodsworth, 1978, Medhora, 1992a,b and Williams et al., 2001). This so-called

"reserve coverage index" encompasses two potential sources of gain from reserve

pooling, viz. an increase in average effective holdings and a decrease in their

variability.

We define the coverage index in country $i$ as:

$$C_i = \frac{PR}{Var(PR)} \qquad (13)$$

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[14] This is an important point -- while the ASEAN and China are planning on forming an FTA
over the next decade or so, Japan and Korea are not (yet) part of this policy initiative.

*where*: $PR$ is the average level of reserve holdings (or access to reserves), i.e. effective reserves during a particular time period and $Var(PR)$ is the variability these during the same period[15].

Each individual country may also consider a partial pool, whereby each can access its own reserves as well as the partially pooled reserves of all the other members. The coverage index for the partial pool is computed as follows:

$$C_i = \frac{R_i + \sum_{j \neq i} p.R_j}{Var \left[ R_i + \sum_{j \neq i} p.R_j \right]} \tag{14}$$

*where*: p is the degree of pooling (0 < p < 1) and $R_i$ and $R_j$ are the total reserves of country $i$ and $j$ (assumed to be the members of the pool).

From equations 9 and 10, the coverage under reserve pooling will be higher than in the independent situation if the variability of the pool is lower than that of each country's reserves separately, or if the increased access to the larger pool of reserves outweighs the higher variability of the pooled reserves.

The formulation of the pooled-coverage index assumes that each country has unrestricted access to the pool. If one country draws on the pool it reduces coverage for the other member countries. Hence, the pooled system is a zero sum game. The effects of pooling can be quantified by examining the hypothetical scenario in which "each country had wanted to maintain the level of coverage that it actually enjoyed, but did not belong to the pool" (Medhora, 1992b, p.217).

This hypothetical reserve level is calculated by using the following equation.

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[15] Variability of PR is represented by the standard deviation of the reserve during a specified time period.

$$HR_i = C_i * Var(R_i) \tag{15}$$

$HR_i$ is the hypothetical reserve -- the level of reserves that each country would have had to hold had it not belonged to the pool, but still wanted to maintain the same coverage afforded by the pool. $C_i$ is the coverage index of country $i$ under pooling, and $Var(R_i)$ is the variability of country $i$'s own reserves. The gains/losses from reserve pooling may be measured as follows:

$$G/L = HR - PR \tag{16}$$

where: $(G/L)$ is the gain (+) or loss (-) in international reserve levels and *HR* and *PR* are the hypothetical and actual average foreign exchange reserves, respectively.

Table 3 reports the average quarterly reserve holdings for each country and their variability from the last quarter of 1993 to the first quarter of 2002[16]. Based on this data, and for each country, we first compute the coverage index without pooling (0 percent) and then simulate the country's coverage index by imposing additional 10 percent increments in the level of pooling commitment (from 10 percent pooling to 100 percent pooling) (Table 4). The overall coverage index without pooling for the selected East Asian economies is well above 4. However, the range runs from 1.76 for Korea to 8.02 for Thailand. We then simulate the coverage index *for every 10 percent* increment in pooling commitments. The highest overall average for the coverage index with pooling is found to be at a 10 percent commitment; it implies a significant gain from pooling. We estimate the coverage index for *every 1 percent from 0 to 10 percent and then from 10 to 20 percent* to locate the level of pooling that

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[16] The initial period of last quarter 1993 was selected due to the availability of the foreign exchange reserve holding data from the IMF's IFS CD-ROM.

will most benefit the East Asian economies as a group. The results are again summarized in Table 4.

**Table 3**
**Average and Variability of the Foreign Exchange Reserves[a]**
**(Q4: 1993 – Q1: 2002)**

|  | Average Reserve (US$ million) | Variability of Reserve (US$ million) |
|---|---|---|
| **Indonesia** | 20089.50 | 6544.70 |
| **Malaysia** | 27279.30 | 4044.4 |
| **Philippines** | 9730.20 | 3007.50 |
| **Singapore** | 68708.62 | 11907.80 |
| **Thailand** | 31356.30 | 3908.80 |
| **Korea** | 52018.60 | 29593 |
| **China** | 123447.80 | 55142.30 |
| **Hong Kong** | 79172.80 | 24171.50 |
| **Japan** | 237171.90 | 86988.50 |

Notes:   a) Variability computed using standard deviations.
Source:  Computed from IFS-CD ROM and ADB database.

**TABLE 4**
**COVERAGE WITH AND WITHOUT POOLING FOR ASEAN-5, KOREA, JAPAN, CHINA AND HONG KONG**
(QUARTER 4, 1993 – QUARTER 1, 2002)[B]

| | 0 percent[a] | 1 percent | 10 percent | 20 percent | 30 percent | 40 percent | 50 percent | 60 percent | 70 percent | 80 percent | 90 percent | 100 percent |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Indonesia** | 3.07 | 3.128 | 3.150 | 3.152 | 3.148 | 3.147 | 3.146 | 3.145 | 3.144 | 3.144 | 3.143 | 3.143 |
| **Malaysia** | 6.75 | 6.741 | 4.080 | 3.585 | 3.406 | 3.313 | 3.257 | 3.219 | 3.192 | 3.172 | 3.156 | 3.143 |
| **Philippines** | 3.24 | 3.261 | 3.176 | 3.159 | 3.153 | 3.149 | 3.147 | 3.146 | 3.144 | 3.144 | 3.143 | 3.143 |
| **Singapore** | 6.19 | 7.559 | 4.752 | 3.982 | 3.661 | 3.486 | 3.376 | 3.300 | 3.245 | 3.203 | 3.169 | 3.143 |
| **Thailand** | 8.02 | 8.010 | 4.319 | 3.690 | 3.466 | 3.352 | 3.283 | 3.236 | 3.203 | 3.178 | 3.159 | 3.143 |
| **Korea** | 1.76 | 1.856 | 2.399 | 2.677 | 2.828 | 2.924 | 2.989 | 3.037 | 3.073 | 3.101 | 3.124 | 3.143 |
| **Japan** | 2.73 | 2.746 | 2.818 | 2.889 | 2.945 | 2.989 | 3.027 | 3.057 | 3.084 | 3.106 | 3.126 | 3.143 |
| **China** | 2.24 | 2.275 | 2.520 | 2.699 | 2.818 | 2.905 | 2.969 | 3.019 | 3.059 | 3.093 | 3.119 | 3.143 |
| **Hong Kong** | 3.28 | 3.281 | 3.264 | 3.231 | 3.207 | 3.189 | 3.176 | 3.166 | 3.159 | 3.152 | 3.147 | 3.143 |
| | | | | | | | | | | | | |
| **Average** | **4.142** | **4.317** | **3.386** | **3.229** | **3.181** | **3.164** | **3.153** | **3.147** | **3.145** | **3.144** | **3.143** | **3.143** |

Notes:   a) Without pooling; [b]/ Data for the foreign exchange reserve of Hong Kong from the IFS, CD ROM is available only from quarter 1, 1993.

Several key findings emerge. Based on the highest overall average of coverage index, our results suggest that as a group the economies stand to benefit most by committing to a one percent pooling arrangement. However, looking at the individual countries, the pooling arrangement will not benefit all members equally; the optimal shares to be pooled may be different across countries. For instance, Indonesia will benefit most from 20 percent pooling, while the other two ASEAN economies (Philippines and Singapore) and Hong Kong enjoy the highest coverage index by pooling a mere 1 percent share of their respective reserves[17]. As for the larger North Asian economies, Japan, Korea and China gain most by committing all their respective reserves. Malaysia and Thailand are the only two countries that do not benefit by any level of pooling commitment.

Table 5 (Column 2) shows the hypothetical reserves within a pool, assuming each country participates according to its optimal shares as previously calculated. Two caveats need to be noted before proceeding. First, the optimal shares in Table 4 were computed on the assumption that all countries in the group contribute an identical proportion of their reserves to the regional pool. A 20 percent share may no longer be optimal for Indonesia when other countries are not pooling the same share of their own reserves. Second, we assume that Malaysia and Thailand participate at a 1 percent share (given the other benefits from being part of a regional reserve arrangement).

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[17] While not shown in Table 4, we tried other shares like 5 percent and 15 percent but the conclusions are unaltered.

**Table 5**
**Reserve Gains and Losses with the Pooling Scheme**
**(Quarter 4, 1993 – Quarter 1, 2002)**

| | Actual Average Reserves (PR) (US$ million) | Hypothetical Reserves (HR) (US$ million) | Gain / Loss in Reserves (HR-PR) (in US$ million) | Fiscal Cost [d] (in US$ million) |
|---|---|---|---|---|
| Indonesia | 20089.50 | 20628.89 [a] | 539.40 | 76.81 |
| Malaysia | 27279.30 | 27263.30 [b] | -16.00 | - 0.098 |
| Philippines | 9730.20 | 9807.45 [b] | 77.26 | 3.44 |
| Singapore | 68708.62 | 90011.06 [b] | 21302.4 | -483.60 [e] |
| Thailand | 31356.30 | 31309.49 [b] | -46.80 | -1.30 |
| Korea | 52018.60 | 93010.8 [c] | 40992.20 | 1524.9 |
| China | 123447.80 | 173312.24 [c] | 49864.44 | 605.4 |
| Hong Kong | 79172.80 | 79306.69 [b] | 133.89 | -0.522 [e] |
| Japan | 237171.90 | 273404.85 [c] | 26232.95 | -1062.4 [e] |
| Total | 651067.50 | 894404.26 [b] | 243336.76 | 1028.10 |

Notes: a ) with 20 percent pooling; b ) with 1 percent pooling; c) with 100 percent pooling; d) derived using interest rate differentials of average time deposit of 3-6 months for 1993-2001; e) the negative fiscal costs for Singapore, Hong Kong and Japan are due to the negative interest rate spread (the US time deposit rate is higher than the domestic rates in these countries).

Keeping these caveats in mind, we find that for the group as a whole, the aggregate reserve savings (i.e. hypothetical less actual reserves) is over US$240 billion. The corresponding fiscal gains to the region from pooling (or fiscal costs from not pooling) are about US$ 1 billion; with significant variations between individual countries. The fiscal costs for Malaysia and Thailand are negative though relatively negligible since our calculations suggest that any pooling is sub-optimal for them. Those for Japan and Singapore are negative as their respective interest rates are less than the US interest rates of an equivalent maturity. However, as noted, if we were to use the differential between the marginal cost of capital in these two

countries and the US interest rate, the fiscal costs to these two countries are likely to be positive.

**3.3     Caveats Regarding the Coverage Ratio**

The coverage ratio estimated above is among the first formal attempts to quantify the costs and benefits of regional reserve pooling. This said, its use as a measure of assessing the adequacy of reserve holdings is not without its limitations. Key among these is the fact that it is probably a more appropriate measure of the benefits from diversification. Reserve pooling in the Asian context largely focuses on the "insurance" motive, i.e. access to a liquidity pool at times of crisis in international capital markets. In relation to this, the very presence of a large shared liquidity pool of reserves may, *ceteris paribus*, reduce the probability of a crisis. Our analysis suggests that there are greater benefits to be had from *partial* as opposed to *complete* pooling.

**4.     Some Further Implications**

With memories of crisis in 1997-98 still reasonably fresh, it is perhaps unsurprising that East Asian countries have exhibited a desire to stockpile reserves to finance international transactions, meet unexpected difficulties in their balance of payments, and provide an insurance or a "war chest" against future crises. However, an important limitation of such a reserve-hoarding policy is that it carries potentially large implicit fiscal costs as the country effectively swaps high yielding domestic assets for lower yielding foreign ones. Assume that countries want to retain a relatively open capital account, is there any way in which the liquidity yield from holding reserves may be generated without the need for individual countries to continue to accumulate them?

From a systemic and individual country perspective it may be desirable to have "tiers of liquidity" (or concentric defence lines). The top tier would be owned

reserves. From a government's perception, an advantage associated with these is that they may be used quickly and without conditions. The second tier could take the form of regional liquidity arrangements. This tier could take the form of a regional reserve pool. In the West African Economic and Monetary Union (WAEMU)[18],

> each central bank is obliged to maintain 65 percent of its official reserves in the operations account. In the first instance, each country draws down on its own account of pooled and unpooled reserves. Once these are fully drawn down, the other countries' pooled reserves may be used. In essence, there is no statutory limit on a member country's use of reserves. A crisis management scheme takes over when..(aggregate)..reserves fall below the prescribed threshold, not when the reserves of individual countries are exhausted (Williams et al., 2001, p.7).

East Asia could consider a similar arrangement.

The third tier would be conventional IMF lending which in turn ought to be sub-divided into CCL/liquidity-based lending and more conventional structural adjustment based lending. In the case of the former, it would be appropriate for the conditionality linked to liquidity-based lending to be closely aligned with financial and macro conditionality determined by the regional monetary facility (in conjunction with the IMF). All in all, with such a tiered structure, the degree of liquidity could be inversely related to the degree of conditionality.

In the case of the second tier and a regional reserve pool in East Asia (a natural starting point would be the Chiang Mai Initiative (CMI) which is essentially a network of bilateral currency swaps and repurchase agreements as a "firewall" against future financial crises. In broad terms, the CMI is aimed at providing countries facing the possibility of a liquidity shortage with additional short-term hard currencies. While the CMI is undoubtedly an important first step towards intensified monetary cooperation, on its own, and given the manner in which it is presently structured, its

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[18] The WAEMU, established in 1994, consists of eight countries (Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo. The WAEMU has a common central bank (BCEAO) and shares some other institutions. The WAEMU and the Central African Economic and Monetary Community (CAEMC) together comprise the CFA franc zone (Williams et al., 2001 discuss the institutional arrangements of these institutions).

effectiveness is questionable. It is, after all, still an uncoordinated and decentralized swap arrangement.

An important next step would therefore be to reinforce and augment the existing bilateral currency swap arrangements (BSAs) under CMI if it is to be made a credible and effective financing mechanism. The size of currency swaps, though large in comparison to some countries' quotas in the IMF (Henning, 2002), remains small in absolute terms. Currently, the total amount of BSAs covering all 13 East Asian countries is estimated at around US$20 billion, with the maximum amount of money that any individual country can draw varying significantly. Nonetheless, the US$ 20 billion that is available in aggregate is comparable to the US$ 17.2 billion that was granted to Thailand on its own as part of the IMF program in 1997-98 (Chang and Rajan, 2001). If the aim of liquidity arrangements is to ensure the availability of large-scale liquidity in crisis periods, the current size and manner in which the CMI is structured needs to be reformed.[19]

If the CMI is to be built upon as a way of providing short-term liquidity at the regional level, the facility needs to be extended to establish a fully-fledged regional reserve pooling mechanism or liquidity support program (Henning, 2002). Indeed, if the hitherto decentralized and bilateral swap arrangements are activated collectively, the CMI will go a long way to being a *de facto* regional pooling arrangement.

## 5.    Concluding Remarks

The fact that the Asian economies maintain about 50 percent of the world's foreign exchange reserves suggests that first there is a potential resource misallocation with significant opportunity costs and second the region has sufficient aggregate reserves to develop a large and credible common reserve pool

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[19] Henning (2002), Park (2001) and Wang (2001) provide comprehensive descriptions of the CMI and offer useful suggestions on how it may be built upon while still maintaining its credit line character.

arrangement. The reserves are reasonably evenly distributed across many strong currency countries including Japan, China, Korea and Singapore. This is important since if the region have a balance of "weak currency countries", the sustenance if not creation of a common reserve pool would be a problem. It is highly unlikely that strong currency countries would allow their reserves to be constantly compromised by weaker currency countries. Conversely, if reserves are evenly distributed among a number of "strong currency" countries, they will be able to work together and to encourage the weak currency ones to implement necessary macroeconomic and structural reforms in order to remain eligible to draw upon the common pool when needed.

Member countries with somewhat smaller reserves or limited technical capacities may stand to gain further by participating in a centralized reserve pooling mechanism since their capital contributions might be more efficiently managed.

If the CMI does evolve into a regional liquidity facility, it would be natural to ask whether effective financial cooperation can be pursued without regional exchange rate coordination. Certainly, any explicit form of exchange rate coordination would be helped by a reserve pooling arrangement. But it would also require the closer coordination of regional macroeconomic policies, which in turn may require some sort of constraining arrangement to ensure policy compliance and avoid moral hazard. Asia, in contrast, does not currently have the consensus or political will necessary to consider establishing a coordinated exchange rate regime (Eichengreen and Bayoumi, 1999). Indeed, small but strong currency countries like Singapore are unlikely to be willing to forsake the discretion they have over their own macro policy and subordinate this to a regional monetary alliance that is untested and where their voice would be small.

Greater exchange rate coordination facilitates intra-regional trade and the optimal size of reserve holdings of the region as a whole might decline as intra

regional trade replaces external trade[20]. In addition to this, the reduced need to stabilize intra-regional exchange rates also implies a lower precautionary demand for reserves[21]. Furthermore, countries hold reserves as a war chest against adverse geopolitical developments and other "non-market considerations" (Reddy, 2002). To the extent that closer monetary integration enhances intraregional security and reduces some of these intraregional geopolitical considerations, the region's aggregate demand for reserves may decline.

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[20] Frankel and Rose (2002), Glick and Rose (2002) and Rose (2000) estimate gravity models using both cross-sectional and time series data and conclude that a common currency is especially trade stimulating intraregionally.

[21] Offsetting these effects, with a full-fledged currency union, there will be an automatic decline in "international reserves" with the re-definition of regional currencies. However, this is of less relevance for Asia (compared to Europe, for instance) as the US dollar is the most important reserve asset in Asia.

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