Precautionary Reserve Holdings in Asia: Examining the Case for a Regional Reserve Pool*

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The management of East Asian currencies changed after the regional crisis in 1997. One such change was that the East Asian economies now hold about two-thirds of the world's foreign exchange reserves. This paper examines the precautionary motives behind reserve accumulation. Holding such large volumes of reserves is costly but it also suggests that the regional economies have the capacity to develop a common reserve pool arrangement. The discussion is placed within the context of the ongoing imbalances that plague the global economy.

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INTRODUCTION

There are at least two important dimensions to the current macroeconomic imbalances plaguing the global economy. The first is the rapid stockpiling of reserves by a number of Asian economies since the late 1990s. While Japan and China together account for about half of Asia's reserve holdings (which stood at well over US$2,000 billion), South Korea, Taiwan, Hong Kong, India and Singapore each also hold over US$100 billion of reserves (Kim *et al*. 2005). Secondly, there is the issue of the sustainability of the United States (US) current account deficit and its resulting implications for the US dollar (Bernanke 2005).

There is, in fact, a school of thought that argues that the global macroeconomic situation—whereby the US current account deficit is partly financed by the reserves accumulated by Asian countries that have maintained undervalued exchange rates—is a perfectly normal state of affairs (for instance, see Dooley, Garber & Mathieson 2003, 2004a, 2004b). Proponents of such a view point to the Bretton Woods system of fixed exchange rates, which was initiated in 1944 with an agreement between the war-ravaged Western European countries and the US that the latter would keep its borders open for exports from the former. Thus, while the US acted as the 'importer of last resort', the Western European countries pegged their respective currencies at undervalued levels to the US dollar to remain

cost-competitive. The currency undervaluation and resulting foreign exchange market intervention allowed Western Europe to acquire reserves, which were, in turn, used to finance the US current account deficit at a low cost. There was no immediate or obvious pressure on the US to check its excessive spending. This system of global fixed exchange rates pegged to the US dollar lasted until 1973.

This US–Western Europe axis between 1944 and 1973 (with Japan joining in the 1960s) seems to bear an uncanny resemblance to the current relationship between the US and vendor financing by Asia, leading some to suggest that a New Bretton Woods system has emerged since the 1990s. Proponents of this point of view argue that the current arrangement of international settlements ought to be able to persist for a long time to come, as many developing Asian countries (China in particular, but also others in South-East Asia, India and Korea) are attempting to grow rapidly by exporting to the US through maintaining an undervalued currency. The Asian central banks are, in turn, perfectly happy to hold US sovereign paper as a necessary condition to sustain the export-led growth.

According to proponents of this view, Asia will not stop financing the US on a large scale as that will lead to a marked rise in US long-term interest rates; which, in turn, might trigger a collapse in the US property and equity prices and a concomitant fall in US consumer spending on all goods and services, including those from Asia. According to this logic, the current global macroeconomic imbalances are structural and inherently stable; fears of global instability are grossly overstated.

While the suggestion that a New Bretton Woods system has emerged is rather intriguing, it runs into some major problems when matched against the facts (also see Eichengreen 2004). The rapid build-up in reserves in Asia began in earnest only after the Asian crisis of 1997–98, and escalated from 2000 onwards largely because of capital account surpluses (as foreign investors had been anticipating Asian currency revaluations and resulting capital gains). Pre-1997, many developing countries in Asia actually ran current account deficits. The conventional wisdom then was that Asian economies were growing and industrializing rapidly and needed high levels of foreign capital to spur their development, and that the current account deficits would eventually be self-correcting. This was, after all, the experience of a number of other developed countries in Asia such as Singapore.

Thus, unless there has been a significant and conscious change in the growth strategies in Asia post-crisis, one would be hard-pressed to argue that the ongoing imbalances are part of some sort of grand bargain or implicit global understanding which can persist *ad infinitum*. More likely, at least in the case of South-East Asia and Korea, the current account adjustments (from deficit to surplus) were forced on the region by the crisis and this situation has persisted partly because domestic demand—investment demand in particular—has not fully recovered from the shock of 1997–98. Thus, while many South-East Asian countries continue to be high savers, they no longer maintain such high investment rates as they did in the 1980s and 1990s. The resulting surpluses in the private sector financial balances in Asia have, in turn, been recycled to the US to finance that country's national dis-savings.

In addition, while the official sector dominated capital flows in the pre-1970s period, international private portfolio flows are much more significant nowadays. Thus, even if there were some grand Bretton Woods-type bargain between the US and Asian central banks, there is no reason to expect the

private sector's assessment of the relative attractiveness of US assets would be influenced by any such global understanding among national governments.

Having argued against the New Bretton Woods thesis, this paper focuses on one aspect of the global macroeconomic imbalance, *viz*. reserve management in Asia. While others have discussed the mercantilist rationale and consequences of such reserve stockpiling (for instance, see Rajan 2004; and Dean & Rajan 2004, in the case of China), this paper focuses on the precautionary demand for reserves in Asia in the broader context of monetary cooperation in East Asia.[1] 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. Then the paper goes onto investigate the gains, if any, to be reaped if East Asian economies were to pool their reserves. Finally, the conclusion provides a summary and brief discussion of how the proposed reserve pool would fit into the larger context of evolving East Asian monetary regionalism.[2]

COST-BENEFIT CALCULUS DETERMINING OPTIMAL RESERVE HOLDINGS

Some Analytical Background

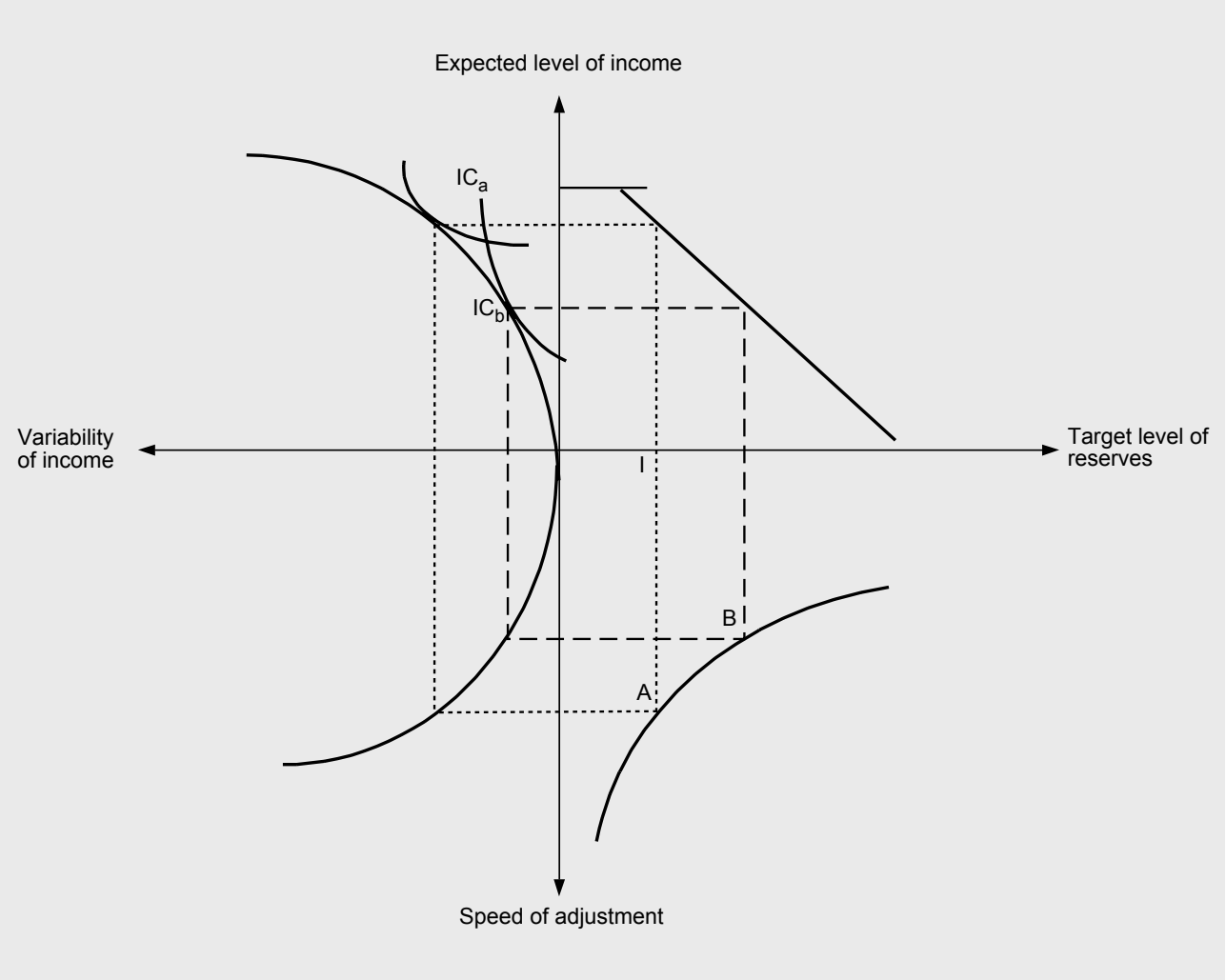
Reserves are held because they act as a buffer against a balance of payments shock. Owned reserves represent a guaranteed and an unconditional source of liquidity. However, there is a significant opportunity cost of stockpiling reserves as the country effectively swaps high-yielding domestic assets for lower-yielding foreign ones.[3] A simple theory of the demand for international reserves based on a cost-benefit calculus is outlined below (Bird 1978).

The bottom-right quadrant of Figure 1 (p. 24) illustrates a negative relationship between the quantity of reserves held and the speed of adjustment. In other words, the fewer reserves held, the faster the speed of adjustment that is needed to adjust to a balance of payments shock. The bottom-left quadrant illustrates a positive association between the speed of adjustment to a balance of payments shock and the variability of income. The quicker the adjustment, the more variable is the income. The top-left quadrant reveals a negative nexus between (expected) income levels and the quantity of reserves held. This essentially represents the opportunity costs of holding reserves; that is, the larger the reserves held, the lower is the amount of capital investment that may be undertaken.[4] Putting these three quadrants together derives the top-right quadrant, which shows a positive association between expected income levels and the variability of income. Thus, other things being equal, the greater the demand for reserves, the slower is the speed of adjustment and the lower is the variability of income, though this benefit comes at a cost of lower income levels. 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).

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, the Frenkel-Jovanovic model derives the optimal reserve holdings to be as follows:

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

FIGURE 1
Determining the optimal reserve holdings



(Source: Adapted from Clark 1970)

where R_0 = desired reserves, c = country-specific nominal constant, σ = standard deviation of reserve movements, and r = opportunity cost of holding reserves. Equation (1) reveals desired reserve holdings to be a positive function of volatility and a negative function of the opportunity costs of maintaining reserves.

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:

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

where R is actual holdings of reserves minus gold (millions of US dollars deflated by the US Gross Domestic Product (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.

Aizenman and Marion (2003) 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 Aizenman and Marion's (2003) priors noted above. 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.[5] 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, Aizenman and Marion (2003: 11) 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'. In terms of the general framework outlined in the previous section, this implies that the more risk averse a country's monetary authorities, the steeper is its indifference curve, and therefore the greater the desired reserve holdings (Point B in Figure 1, p. 24).[6]

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 retaining the option of a slower speed of adjustment should the balance of payments position weaken and external assistance be found inadequate. In other words, holding reserves may be considered a form of insurance premium ('precautionary motive').[7] This comes at a price, however, 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

TABLE 1
Reserves as proportion of imports (months), GDP (%) and average amount (US$ million) (1992–2004)

Country	1992	1995	1998	2001	2004
Indonesia					
Imports[a]	3.0	2.7	7.1	9.6	11.9
GDP	8	7	15.9	17.2	13.9
Average[b]	10376.7	13022.5	19020.8	27863.5	34523.9
Malaysia					
Imports[a]	4.2	3.0	5.1	4.6	n/a
GDP	30	27	34	35	46.7
Average[b]	15082.8	25063.0	21441.8	28071.3	55017.6
Philippines					
Imports[a]	2.8	2.1	3.6	4.8	3.5
GDP	8	9	13	19	15.5
Average[b]	3941.9	6199.4	8771.2	12771.5	13068.97
Singapore					
Imports[a]	5.7	5.7	7.3	7.8	9.1
GDP	82	82	90	91	92.9
Average[b]	38028.3	65798.9	73170.9	75687.8	102704.7
Thailand					
Imports[a]	4.9	4.9	6.2	6.4	6.1
GDP	18	22	23	28	25.7
Average[b]	19574.5	33455.7	27020.1	31734.4	43355.9
Hong Kong					
Imports[a]	3.0	3.1	6.1	6.8	5.4
GDP	35	40	55	66	74.1
Average[b]	n/a	53283.5	92826.8	113307	121103.3
China					
Imports[a]	3.1	5.9	9.5	9.0	n/a
GDP	4.6	10.7	15.5	15.9	30
Average[b]	33875.2	67595.4	145535.8	194410.2	494608.2
Korea					
Imports[a]	2.2	2.5	5.6	8.5	9.4
GDP	5.0	4.0	5.0	20.6	22.9
Average[b]	15365.3	29679.9	42351.3	97834.1	171948.0
Japan					
Imports[a]	2.1	3.9	10.2	14.3	23.8
GDP	2.0	4.0	5.0	8.5	16.6
Average[b]	71408.6	166451.2	213459.8	374028.8	806165

(a) Ratio to average monthly imports of merchandise goods.
(b) Monthly average of total foreign exchange reserves minus gold.

(Source: IFS-CD ROM and ADB Database)

derive the benefits of scale economies. But how might one judge the potential size of benefits from reserve pooling? Before attempting to estimate such gains (or lack thereof), it is necessary first to estimate the level of reserves that members would have to hold independently.

ASSESSING THE SIZE AND BENEFITS OF A RESERVE POOL

Reserves-to-Imports Ratio Revisited

Assume reserve pooling is undertaken as part of a broader policy of economic integration including trade integration.[8] In such a case, part of what was formerly external trade will become intra-regional. Insofar as the reserves-to-imports (R:M) ratio is considered a reasonable, albeit highly imperfect, yardstick of reserve adequacy (Bird & Rajan 2003; and Table 1, p. 26), 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?[9]

To ascertain the gains from reserve pooling, first the international reserves-to-imports ratio is computed for the individual country (3) and for the overall group (4).

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

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

where R_i and $\sum_i R_i$ are the average level of reserves held by the individual country (i) and by the group of countries during a specified period of time, respectively. M_i and $\sum_i M_i$ 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 a broader goal of trade integration, the arrangement implies that reserves will not be needed to cover the imports from other member countries.[10] 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:

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

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

where s is the share of intra-regional imports.

The next step is to compute the 'hypothetical reserve level'; that is, 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 as it would have under the pooling arrangement.

$$HR(i) = Ratiopol(i) * M_i \tag{7}$$

$$HR = Ratiopol * \sum_i M_i, \forall i = 1,\ldots,n \tag{8}$$

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

$$ER(i) = HR(i) - R_i \tag{9}$$

$$ER = HR - \sum_i R_i \tag{10}$$

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

Tables 2a and 2b (pp. 29–30) report the findings for the ASEAN-5 (the group of five Association of South-East Asian Nations members—Indonesia, Malaysia, Philippines, Thailand and Singapore) plus China, Korea and Japan—commonly referred to as ASEAN+3—as well as Hong Kong, for the pre-crisis and the crisis period of 1990–98.[11] The foreign exchange reserve data are obtained from the International Financial Statistics (IFS) CD-ROM of the International Monetary Fund (IMF).

The findings of this computation show that the average share of intra-regional imports in the overall imports of the individual country ranges from 28% for Japan to a high of 66% for Hong Kong. For the ASEAN-5 the range is narrower, between 43% and about 52%. As for the overall group of the economies, the average *s* is found to equal 0.45 for that group of East Asian economies during the specified period.

Based on the available information, $Ratiopol(i)$ and $Ratiopol$ are then calculated. The results show that the number of months of import coverage for the ASEAN-5 should increase by as little as two months for the Philippines and as much as seven months for Singapore (Table 2a, p. 29). As for the rest of the East Asian countries, Korea will gain the smallest increase in the import coverage, by less than two months; while Hong Kong will gain the most (an extra coverage of eight months of import). Lastly, the East Asian countries as a group should enjoy an extra coverage of four months of import by committing themselves to the regional pooling.

Reflecting the variations in the reserves-to-imports ratio, the average 'excess' reserves from pooling for each individual are also very diverse (Table 2b, p. 30). 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, it follows that one would ask: What are the fiscal costs of failing to derive the reserve benefits from integration?

The fiscal costs (FC) are computed as follows:

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

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

where $FC(i)$ and FC are the estimated fiscal cost for the individual country and for the group; int^{EA} is the average annual interest rate of the 3–6 month time deposit offered by East Asian commercial banks; and int^{USA} is the equivalent average deposit rate offered by US commercial banks. Interest rate data are obtained from the IFS CD-ROM produced by the IMF.[13]

The average interest rate in East Asia shows a 3.3% 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% higher than the US rate. The Philippines' and Thailand's commercial deposit rates were also significantly well above the US rates by about 7% and 5%, 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), the fiscal cost of holding excess reserves is derived to be well over US$10 billion for the period at hand for the group. China and Indonesia suffered the highest fiscal costs (about US$1.7 billion and US$1.5 billion, respectively). Malaysia and the Philippines incurred average fiscal costs of around US$320–70

TABLE 2a
Reserves-to-imports ratio with and without pooling
ASEAN-5 + Korea + China + Hong Kong + Japan
(1990–98)

Country	*s* (Share of intra-regional imports in %)[a]	Average reserves-to-imports ratio without pooling (months of imports)	Average reserves-to-imports 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

(a) Raw data are obtained from ICSEAD 2000, *East Asian Economic Perspectives*, 11 (Feb.).

million, while those of Thailand and Korea were US$1.2 billion and US$670 million, 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 (p. 30) are likely to underestimate the full fiscal cost of reserve hoarding, as the cost of 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).

TABLE 2b
Actual reserves, hypothetical reserves and fiscal cost
(1990–98)

Country	Average actual reserves (US$ million) (A)	Average hypothetical reserves with pooling (US$ million) (B)	Excess reserves (US$ million) (B–A)	Fiscal cost (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

(a) Positive number implies cost.

Variability of Reserves: Coverage Index

While the preceding measure of reserve gains from integration are 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 (Fischer 2001; Bird & Rajan 2002; 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: 6)

Second, the foregoing analysis assumes that reserve pooling is carried out in tandem with intensified trade and possibly even monetary integration. What if the region does not opt for economic integration? Is there any way of gauging the gains from reserve pooling? Since international reserve holdings have been found to be a theoretically and statistically significant determinant of creditworthiness (see De Beaufort Wijnholds & Kapteyn 2001; Bird & Rajan 2003, and references cited within the respective publications), 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.

In view of the foregoing, there seems to be a sound rationale for minimizing the variability of reserve holdings. How is this related to a reserve pool? Medhora (1992a) 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 (Medhora 1992a, 1992b; Williams, Pollius & Hazel 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.[14]

The coverage index in country i is defined as:

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

where PR is the average level of reserve holdings (or access to reserves); that is, effective reserves during a particular time period; and $Var(PR)$ is the variability of reserves 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 (13) and (14), 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

TABLE 3
Average and variability of the foreign exchange reserves[a]
(1993: Q4 – 2002: Q1)

	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

(a) Variability computed using standard deviations.

(Source: Computed from IFS-CD ROM and ADB database)

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 1992a: 217).

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

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

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, the coverage

TABLE 4
Coverage with and without pooling for ASEAN-5, Korea, Japan, China and Hong Kong
(1993: Q4 – 2002: Q1)[b]

	0%[b]	1%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
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

(a) Data for the foreign exchange reserve of Hong Kong from the IFS, CD ROM is available only from 1993: Q1.
(b) Without pooling

index is computed first without pooling (0%) and then the country's coverage index is simulated by imposing additional 10% increments in the level of pooling commitment (from 10% pooling to 100% 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. The coverage index is then simulated *for every 10%* increment in pooling commitments. The highest overall average for the coverage index with pooling is found to be at a 10% commitment; it implies a significant gain from pooling. The coverage index is estimated for *every 1% from 0 to 10% and then from 10% to 20%* to locate the level of pooling that will most benefit the East Asian economies as a group. The results are again summarized in Table 4.

Several key findings emerge. Based on the highest overall average of coverage index, the results suggest that, as a group, the economies stand to benefit most by committing to a 1% 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% pooling, while the other two ASEAN economies (the Philippines and Singapore) and Hong Kong enjoy the highest coverage index by pooling a mere 1% share of their respective reserves.[17] As for the

TABLE 5
Reserve gains and losses with the pooling scheme
(1993: Q4 – 2002: Q1)

	Actual average reserves (PR) (US$ million)	Hypothetical reserves (HR) (US$ million)	Gain / loss in reserves (HR–PR) (US$ million)	Fiscal cost [d] (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

(a) With 20% pooling.
(b) With 1% pooling.
(c) With 100% 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).

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 (p. 33) were computed on the assumption that all countries in the group contribute an identical proportion of their reserves to the regional pool. A 20% share may no longer be optimal for Indonesia when other countries are not pooling the same share of their own reserves. Second, it is assumed that Malaysia and Thailand participate at a 1% share (given the other benefits from being part of a regional reserve arrangement).

Keeping these caveats in mind, it is found 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) is about US$1 billion, with significant variations between individual countries. The fiscal costs for Malaysia and Thailand are negative, though relatively negligible since the 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 the present calculations 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.

The coverage ratio estimated above is one of 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; that is, 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. This analysis suggests that there are greater benefits to be had from *partial* as opposed to *complete* pooling.

CONCLUDING REMARKS

The fact that the Asian economies maintain about two-thirds of the world's foreign exchange reserves suggests, first, that there is potential resource misallocation with significant opportunity costs; and, second, that the region has sufficient aggregate reserves to develop a large and credible common reserve pool arrangement. The reserves are reasonably evenly distributed across many strong currency countries including Japan, China, Korea and Singapore. This is important because if the region has a balance of 'weak currency' countries, creating sustainability by means of a common reserve pool would be difficult. It is highly unlikely that 'strong currency' countries would allow their reserves to be constantly compromised by weaker currency countries.

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% 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, Pollius & Hazel 2001: 7).

The third tier would be conventional IMF lending which, in turn, ought to be sub-divided into 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 that operate 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 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. For the CMI 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).[19]

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 & 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 intra-regional security and reduces some of these intra-regional geopolitical considerations, the region's aggregate demand for reserves may decline over time. The analysis in this paper suggests that while reserve accumulation in Asia may be understandable, following the need to borrow from the IMF in 1997–98, it may not be the best policy. There is a significant fiscal cost, and the precautionary benefits may be better provided by an expanded system of partial reserve pooling. The selection of individual reserve accumulation therefore hints at the significant resistance to the dilution of national sovereignty to which reserve pooling would give rise, and the political constraints on regional monetary cooperation.

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ENDNOTES

1. See Aizenman and Lee (2005) for an initial attempt to differentiate between the precautionary and mercantilist motives for reserve build-up in Asia.

2. Admittedly, it is not clear at this stage whether East Asia is necessarily the appropriate focal point of Asian regionalism. For instance, there is a strong case to be made for the inclusion of India, Australia and New Zealand as well, in an initial core group (for instance, see Rajan 2005; Rajan & Rongala 2005). However, this paper focuses on a sub-set of East Asian economies (see under subheading Assessing the Size and Benefits of a Reserve Pool).

3. 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).

4. 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. This possible effect is ignored in the analysis in this paper.

5. 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.

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

7. Apart from concerns about conditional access to fickle global capital markets (discussed in Bird & 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.

8. See under Concluding Remarks for a discussion of reserve pooling in the presence of regional exchange rate coordination.

9. This was one of the questions asked during the advent of the euro.

10. In other words, members can gain by economizing on reserve holdings (*à la* the European Union).

11. The shares of intra-regional imports (*s*) are based on data from the *East Asian Economic Perspectives* of the International Centre for the Study of East Asian Development (ICSEAD 2000).

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. For simplicity, it is assumed that the bulk of East Asian reserves is held in US dollars. This is probably not too far from reality. In 1999, 78% of global international reserves was in US dollars (D'Arista 2000). Eichengreen and Mathieson (2000) offer a recent discussion on the currency composition of international reserves.

14. See Medhora (1992a) for a discussion about concerns relating to reserve variability.

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

16. The initial period of 1993:Q4 was selected due to the availability of the foreign exchange reserve holding data from the IFS CD-ROM, IMF.

17. While not shown in Table 4, other shares such as 5% and 15% were tried but the conclusions are unaltered.

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 Communaute Financiere Africaine (CFA) franc zone (Williams, Pollius & Hazel 2001 discuss the institutional arrangements of these institutions).

19. There are hopeful signs that this may be happening. See the Joint ministerial Statement of the ASEAN+3 Ministers (4 May2005) <http://www.mof.go.jp/english/if/as3_050504.htm>.

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 intra-regionally.

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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