

## **International Reserves and Liquidity: A Reassessment**

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### **I. Introduction**

The problem of international liquidity received dominant attention throughout the debate on the functioning of the international monetary system in the 1960s, as reflected in numerous reviews (see International Monetary Fund, 1970; Kelly, 1970; Grubel, 1971; Williamson, 1973, 1994; Cohen, 1975; Willett, 1980; Guth, 1985). As originally interpreted, the liquidity problem was the need to ensure sufficient quantity of global reserves to meet global demand consistent with non-inflationary world growth. Concern with adequacy of global liquidity arose because of the system's dependence on a growing U.S. balance-of-payments deficit to satisfy increasing demand: a situation that could be resolved only by undermining confidence in the U.S. ability to maintain a fixed price of gold in terms of dollars. The policy solution was the creation of a new, externally controlled reserve asset, Special Drawing Rights in 1970.

The shift to flexible exchange rates by the main industrial countries and growth of global capital markets has led many of the leading contributors to the earlier debate to reassess whether and why the question of international liquidity remains of global relevance. For example, Guth (1985) argues that despite these institutional developments, the question of adequacy retains its significance in the present international monetary system owing to continued official demand for international reserves. In addition, Guth (1985) and Buirra (1995) note an emerging problem of inequitable distribution of international reserves and access to global capital markets. The majority view expressed at a 1994 conference on the international monetary system is to declare the irrelevance of the problem of international liquidity (Williamson, 1994). However, a notable

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dissenter is Mundell (1994) who argues that the core of the international liquidity problem, namely defining and measuring the subset of assets that make up international liquidity remains unresolved. Surprisingly, the well-developed approaches to domestic monetary aggregation have never been employed for the aggregation of international assets.

The purpose of this paper is to re-examine the literature on international reserves and liquidity from the dual perspectives of micro financial aggregation theory and recent international financial developments. Specifically, it addresses the following questions: Why and for whom is aggregation of international reserves and liquidity a useful research question? What can be done with the aggregated numbers? Does the exchange rate regime matter for aggregation? What is the appropriate definition to be used in estimating demand for international reserves? Is the issue of global liquidity adequacy still relevant? What are the perceived or actual deficiencies in the present international liquidity system and how might correct measurement of international liquidity strengthen global policy?

The paper is organised as follows. Section II discusses the relevance of aggregation for international reserves and liquidity. Section III examines the stylised facts based upon international reserves as traditionally defined; movements in reserve stocks across and within major country groups, reserve-to-import ratios and changes in the composition of reserves. Section IV contrasts traditional approaches to defining and measuring international liquidity with new theoretical approaches to financial aggregation and discusses their implications for empirical studies of demand for international liquidity and policy issues. Section V discusses global liquidity issues and the relevance of aggregation for helping resolve these concerns within the context of recent reform proposals. The final section brings together the main conclusions and suggestions for further research.

## **II. Aggregation of International Reserves and Liquidity**

This section begins with the fundamental question: why and for whom is aggregation of international reserves and liquidity a useful research question? It also discusses potential users of the aggregated numbers. Two further issues are also raised: first, the implications of the exchange regime for aggregation and, second, the relevance of both aggregation and exchange rate regime for “new” problems of international liquidity,

namely unequal distribution of reserve assets and access to global capital markets across countries.

*Why and for whom is aggregation of international reserves and liquidity a useful research question?*

In answering this question, it is useful to ask the same question in regard to domestic money. There exists a large literature on domestic monetary aggregation: see, for example, Chetty (1969), Horne et al. (1986), Barnett (1980), Nahm (1995), and references quoted therein. The premise underpinning this literature is that correct measurement of domestic money matters for effective conduct of monetary policy, whether necessitated by a predictable relationship between a chosen monetary aggregate and nominal income as under a regime of monetary targeting or, more generally as an unambiguous indicator of movements in liquidity to private agents in their formation of exchange rate and price expectations.

The various approaches introduced in the above literature highlight the inadequacy of traditional simple-sum or unweighted aggregates of monetary assets. A simple-sum aggregate implicitly assumes each included asset is a perfect substitute for each other while having zero substitutability with excluded assets. An example shows why this assumption may result in a misleading measure of the quantity of money. Suppose in a given period, the economy holds \$1 million of cash and \$2 million of interest-earning term deposits. The total quantity of money as measured by a simple-sum aggregate is \$3 million. Suppose next period agents substitute \$1 million from term deposits towards currency. The simple sum would record an unchanged quantity of money. But the quantity of money has altered because the two assets have different degrees of liquidity, that is, liquidity has risen.

In the above example, only the liquidity consumption characteristic of money was considered. More generally, methods of aggregation developed by Barnett (1980) and others include a range of monetary services derived from money viewed as a durable good. For a given simple aggregate, any shift within the aggregate towards assets with a relatively higher opportunity or user cost of money services (relative to a benchmark asset) implies an increase in the total monetary services provided by the aggregate.

Consider now international reserves, traditionally defined and measured as a simple-sum aggregate of convertible assets; foreign exchange,

gold, SDRs, and net IMF position. These assets are assumed to be perfect substitutes for official holders as well as having zero substitutability with borrowed reserves. However, a cursory inspection shows different properties, for example, SDRs and foreign exchange yield market rates of return whereas gold and net IMF reserves do not. Suppose there is a shift from gold to foreign exchange. The simple-sum aggregate would remain unchanged but if gold has a relatively higher user cost than exchange holdings, reflecting a higher degree of reserve services including safe-haven property, the total services provided by the international reserve assets have fallen. The above example may help explain a puzzle as to why gold continues to be held by central banks (see Section III). It also suggests that the distinction adopted in the literature between international reserves and liquidity (see Section IV) is artificial and unnecessary within an aggregation framework.

It may be argued that even if a strong theoretical and empirical case may be made for economic monetary aggregates, central banks' reluctance to adopt weighted domestic monetary aggregates will also carry over to international reserves. There are various reasons for this failure, including the demise of monetary targeting in the 1980s (linked primarily to the breakdown of simple-sum aggregates under deregulation and shifts in asset substitutability). However, the main obstacle for aggregation in both areas is the additional data requirements and computation required, for example, an index number system needs calculation of user costs. The specific data requirements to calculate an economic aggregate of international reserve assets are discussed in Section IV. Nevertheless, an enduring influence of aggregation research is that more attention is now paid by central banks to individual components of traditional aggregates where each component is a simple-sum of close substitutes or to the economic aggregate if the components are not closely substitutable.

#### *What can be done with the aggregated numbers?*

In the case of domestic financial aggregates, the user is the central bank as well as the private sector insofar as movements in money influence price expectations. In the case of international reserves and liquidity, the national and global dimensions of liquidity issues and related problems of adjustment and confidence become relevant in identifying end-users.

For an individual country, correct measurement and interpretation of movements in international reserves matters in the context of the

national liquidity problem, defined as the need to finance a balance-of-payments deficit. This definition, it is noted, assumes a regime of fixed exchange rates, an issue taken up below. There is also a linkage between the national liquidity, adjustment and confidence problems. For example, the greater the amount of reserves, the greater the room for policy manoeuvre to adopt appropriate adjustment measures to reduce an external imbalance. In addition, the perceived amount of international reserves will influence private sector expectations of the ability of the central bank to defend an exchange rate under pressure, thereby affecting the timing of a forced policy switch.

Benefits from correctly measured international liquidity also lie at the global level, especially in the area of international surveillance by organisations such as the IMF. As discussed in Section V, the problem of global liquidity adequacy under Bretton-Woods and the linked issue of confidence in the ability of the United States to maintain a fixed dollar-gold price are no longer relevant. However, these problems have been replaced by concerns with unequal reserve distribution and access to borrowing by central banks from global capital markets for low-income developing countries. As such, there is a need to monitor the distribution of global liquidity and identify gaps of estimated regional demand relative to regional and global liquidity supply.

### *Role of exchange rate regime*

Countries are now free to choose their own exchange rate regime with the main industrial countries opting for flexible exchange rates. If the only motive for holding international reserves was precautionary, that is, for intervention purposes, the issue of aggregation of international reserves for countries under flexible exchange rates is irrelevant since no reserves would be held. However, a major finding of the demand literature reviewed in Section IV is that countries continue to hold international reserves even under flexible exchange rates. This finding is viewed as a puzzle with various ad hoc explanations advanced. An aggregation approach would help provide a theoretical and empirical explanation since the correct measure of international liquidity would include a full set of reserve asset services.

*Distribution of reserves*

As noted above, the issue of unequal distribution of international reserves and assets has replaced the earlier problem of global liquidity adequacy. In order to argue a case for correct measurement of international liquidity, a prior argument needs to be made as to how and why distribution issues matter. The majority of developing countries are on some form of fixed exchange rates (although there is evidence of a shift towards flexible exchange rates in the past decade). A subset of this group...low-income developing countries...face both restricted reserves and little or no access to global capital markets. As a result, these countries are forced to compress imports to their existing level of exports. Their economies also become more vulnerable to speculative attacks on foreign reserves and their exchange rate in the face of adverse term-of-trade shifts. Even if the reserve constraint were lifted with a shift to flexible exchange rates, inability to borrow abroad will prevent this group of countries from obtaining the dynamic welfare gains of running a current account deficit through financing the excess of national investment over national saving. Correct measures of international reserves and liquidity held by individual countries would provide a correct picture of the distribution of international reserves across countries.

### III. Stylised Facts

This section examines the pattern of foreign reserves, as traditionally defined, to assess any changes in observed behaviour that has been identified in earlier studies (IMF, 1970; Guth, 1985; Buira, 1995).

*Earlier studies*

Earlier studies (IMF, 1970; Guth, 1985; Buira, 1995) focused on three issues: the pattern of overall foreign reserves across and within major country groups, stability and size of the reserve-to-import ratio and stability of reserve components. The first issue has relevance for the question of the influence of exchange rate regime on reserve holdings as well as the implications of reserve distribution for global reserve management. The second issue – stability and magnitude of the reserve-to-import ratio – is at the core of both specification of demand functions for reserves as well as the usefulness of the ratio for assessing global adequacy of reserves. The third issue of stability of reserve components is

central to the question of the degree of substitutability between various reserve assets and the question of confidence in reserve media.

### *Stock of foreign reserves*

As traditionally defined (and measured in International Financial Statistics), official foreign reserves are made up of gold, SDRs, IMF net position, and convertible currencies. By definition, the outstanding global reserve stock is the aggregated (across countries) cumulated balance of payments position of each country. Thus, we would expect the reserve pattern to reflect specific institutional features of the international monetary system, in particular, Bretton-Woods exchange rules and its subsequent breakdown in 1971/72 as well as country-specific factors such as stabilisation policies, external balance targets and access to global capital markets. The implications of Bretton-Woods and its particular functioning through the U.S. dollar as the key or n-th currency for the behaviour of foreign reserves is well documented (see IMF, 1970). The global stock or supply of foreign reserves was driven by the U.S. overall balance-of-payments, itself demand-driven by other (n-1) countries' portfolios.

Earlier data collected in the IMF (1970) study are consistent with this institutional feature. Over the period 1952-64, the main source of global liquidity outside the United States (excluding additions to gold holdings) was the U.S. overall balance of payments deficit. Within this period, three sub-period patterns are observed: 1952-57, characterised by moderate U.S. deficits, offset by surpluses of other industrial countries; 1958-60, years of very large deficits in the U.S. balance of payments and corresponding surpluses of other industrial countries; and 1961-64 with progress towards more balanced transactions, a moderation in the U.S. deficit, and fall in industrial countries' surpluses and rise in surpluses of developing countries. The overall picture is of dominant but falling U.S. reserves with rising reserves of other industrial countries and stable reserves of developing countries.

The impact of the post-Bretton Woods set of hybrid exchange rate rules on reserve patterns is less clear-cut. In principle, a switch from fixed to flexible exchange rates, for example, by the United States implies a zero balance-of-payments and hence zero change in foreign reserves by an individual country. However, as various observers have noted (for example, Flood and others, 1989; Grimes, 1993), the choice of exchange rate regime and degree of intervention is endogenously deter-

mined, in particular being influenced by a changing stochastic environment and the perceived relative importance of real and monetary shocks.

Table 1 reveals two striking features of post-Bretton Woods holdings of official reserves. First, there has been a significant change within the G-7 group, in particular a dramatic fall in the U.S. reserve share, partially offset by a rise in that of Japan. Second, the overall share of the G-7 has fallen, being offset by a rise in that of developing countries.

In regard to reserve holdings by G-7 countries, the U.S. share of total G-7 reserves has fallen dramatically from 48.9 percent (1960) to 13.7 percent (1997). At the same time, Japan has increased its share from 4.8 percent in 1960 to 42.3 percent in 1997. Over the same period, the G-7 share of global reserves fell from 66 percent (1960) to 54.4 percent (1970) and to its present (end-1997) share of 30 percent. The sizeable fall in G-7 share reflects the relatively greater share of U.S. reserves (compared to Japan) in global reserves in the 1960s and 1970s. Since the share of global reserves of non-G7 industrial countries has remained stable at around 17 percent, the main offset has come from a sharp rise in the share of developing countries from 15.9 percent (1960) to 53 percent

*Table 1*  
**Distribution of Total Reserves**  
(In percent of total)

	1960	1970	1980	1990	1997
Industrial Countries	83.9	77.9	60.5	64.2	47.0
G7	66.0	54.4	41.7	40.9	30.0
(United States)	32.3	15.5	6.1	8.7	4.1
(Japan)	3.2	5.2	5.7	8.1	12.7
(Germany)	11.7	14.6	11.7	7.4	4.7
Other	17.9	23.4	18.8	23.4	17.0
Developing Countries	15.9	22.1	39.5	35.8	53.0
Asia	5.2	6.2	8.7	21.2	29.9
Africa	3.0	3.8	4.4	1.8	2.3
Middle East	2.4	4.9	15.9	5.5	5.3
Europe	0.5	1.1	1.5	2.3	5.7
Western Hemisphere	4.7	5.9	8.9	5.0	9.8
All Countries (m SDRs)	59,981	93,244	354,718	688,025	1,284,046

Source: International Financial Statistics on CD-ROM, December 1998  
Gold is evaluated at SDR 35 per ounce.

(1997). Within developing countries, this increase has been concentrated within Asia. The Asian countries' share of total developing countries' reserves has increased from 32.7 percent (1960) to 56.4 percent (1997), which is equivalent to 30 percent of total global reserves.

Despite the increase in developing countries' share of total reserves during the period 1960–1997, the distribution of international reserves remains very uneven. The uneven distribution reflects the systematic nature of the sources of growth in primary liquidity which is driven by payments disequilibria of the world's major economies. An earlier study by Buira (1995) showed that, in 1993, 22 industrial countries and 18 developing countries with access to international capital markets control more than 89 percent of global reserves. In addition, of 138 developing countries without voluntary access to global capital markets, Buira estimates that 110 developing countries (about 25 percent of global population) hold only 11 percent of total international reserves. Data presented in Table 1 show that these trends have continued. Industrial countries (47 percent) together with Western Hemisphere (9.8 percent) and Asian developing countries (29.9 percent) retain the dominant share of total reserves.

Although gold has been evaluated at SDR 35 per ounce in constructing Table 1, evaluating gold at market prices does not result in a significant change in the overall picture. With gold evaluated at market prices, the industrial countries' share of global reserves increases only slightly (from 47 percent to 51 percent in 1997), offset by the corresponding decrease in the developing countries' share. The increase in the industrial countries' share is due to their large share of total gold reserves (82 percent of the total 890 million ounces in 1997). However, the increase is insignificant since the share of gold, evaluated at market prices, as a component of total global reserves is only 13 percent (in 1997).

### *Reserve-to-import ratio*

The premise of a stable relationship between international reserves and a group of measurable variables including the volume of gross international transactions is relevant for both analytical and policy issues. Although there is no theoretical basis for assuming a fixed proportional relationship between trade volume and foreign reserves, earlier data (1952–64) suggest that such a fixed relationship holds. This feature does not seem to have continued in the post-Bretton Woods period. Table 2 shows that the reserve-to-import ratio for industrial countries has

decreased from 58 percent in 1960 to 22 percent in 1997 while the ratio for developing countries has increased from 22 percent to 48 percent. The most dramatic change has occurred in the U.S. ratio. Its 1960 ratio of 118 percent had fallen to 8 percent by 1997. Over the same period, Germany's ratio also decreased from 69 percent to 18 percent. Japan's ratio has been stable at around 25 percent, apart from a few irregular hikes, until the recent ascent to 65 percent. This feature highlights the importance of factors other than trade volumes as explanatory variables in the reserve demand functions. Such factors include the ability to have access to international credit markets and position as a reserve-currency country. A large part of the dramatic fall in the U.S. and Germany's ratio could be explained by such factors. Another noticeable feature from Table 2 is that even a reserve-to-import ratio close to 50 percent ... more than double that of the average of the industrial countries ... could not prevent the recent Asian crisis.

### *Reserve components*

Earlier data assembled in Buirra (1995) covering the period 1970–93 revealed a distinct pattern of changing shares within the reserve aggregate. A similar pattern is shown in Table 3. The importance of foreign exchange within international reserves became overwhelming in the 1990s, while that of gold and SDR has significantly diminished. The share of gold fell dramatically from 63.2 percent in 1960 to 2.4 percent in 1997 when evaluated at SDR 35 per ounce. (When gold is evaluated at market prices, the share falls from 63.8 percent to 13.3 percent in 1997.) SDR's share halved from 3.4 percent in 1970 to 1.6 percent in 1997 while that of foreign exchange rose from 30.5 percent in 1960 to 92.3 percent in 1997.

In summary, a satisfactory theory of demand for international liquidity and policy focus needs to address and explain so-called paradoxes in the stylised facts. Our review reveals three such paradoxes.

1. The global stock of reserves has shown continued growth and is spread unevenly among different country groups, for example, industrial and low-income developing countries. The latter hold proportionately more reserves in terms of imports. This observation suggests that factors other than trade exert a significant influence on reserve holdings, for example, access to capital markets and status as reserve currencies.

*Table 2*  
**Reserve-to-Import Ratio**  
(In percent)

	1960	1970	1980	1990	1997
Industrial Countries	57.6	31.2	19.5	24.4	22.4
G7	64.7	31.4	18.9	21.5	19.4
(United States)	118.2	34.2	10.7	16.5	7.9
(Japan)	43.4	25.6	18.2	33.9	65.2
(Germany)	69.1	45.4	28.1	21.0	18.4
Other	40.9	30.8	21.2	32.1	30.9
Developing Countries	22.4	25.3	29.6	38.2	47.6
Asia	23.8	26.7	21.8	44.1	48.9
Africa	24.2	27.8	24.8	23.4	37.5
Middle East	37.3	50.6	62.7	46.9	52.1*
Europe	—	—	—	—	31.5
Western Hemisphere	29.1	31.4	34.3	43.7	57.9
All Countries	46.1	29.7	22.6	28.0	31.2

Source: Source: International Financial Statistics on CD-ROM, December 1998  
Gold is evaluated at SDR 35 per ounce.

\* 1996 figure

*Table 3*  
**Share of Foreign Reserves**  
(In percent of total)

	1960	1970	1980	1990	1997
Gold	63.2	39.8	9.4	4.8	2.4
SDRs	0.0	3.4	3.3	3.0	1.6
Reserve position in Fund	6.0	8.3	4.7	3.5	3.7
Foreign Exchange	30.5	48.4	82.5	88.8	92.3

Source: International Financial Statistics on CD-ROM, December 1998

Gold is evaluated at SDR 35 per ounce.

2. A related point is that since the breakdown of Bretton-Woods, the reserve-to-import ratio has exhibited instability, especially for developing countries but also for G-7 countries. The apparent instability in the ratio calls into question the twin premises that underpin the hypothesis of a stable ratio as well as its usefulness as an indicator of liquidity adequacy; (a) countries hold reserves to act as a buffer to offset the impact of variability in the balance of payments on the domestic economy and

Table 4  
Summary Table: Foreign Reserves

	Total		G-7		Other Industrial		Developing	
	US\$b	Share %	US\$b	Share %	US\$b	Share %	US\$b	Share %
Reserves, year-end average								
1960-69	70		42	59.73	16	22.34	12	17.91
1970-79	237		102	43.25	49	20.63	86	36.12
1980-89	552		229	41.57	114	20.65	208	37.78
1990-97	1303		428	32.88	260	19.98	614	47.15
Average annual rate of growth of reserves	(percent per annum)							
1961-69	3.08		0.74		6.28		7.68	
1970-79	14.80		12.19		12.88		22.30	
1980-89	7.58		8.38		9.31		5.94	
1990-97	9.50		4.72		5.98		15.62	
Reserve-imports ratio*	(percent)							
1960-69	39.32		48.23		39.35		24.32	
1970-79	30.18		27.10		30.28		35.25	
1980-89	24.66		19.62		26.69		32.38	
1990-97	29.53		19.61		32.66		43.24	

Source: International Financial Statistics on CD-ROM, December 1998

\* Ratio of year-end reserves to actual imports during year.

(b) balance-of-payments variability moves in proportion to the value of trade (imports). The explanation may well lie in similar factors to that above, including borrowed reserves but this variable is assumed implicitly to have zero substitutability with reserves.

3. While the share of convertible currencies in reserves has risen to over 90 percent, gold continues to be held by central banks. Since gold does not yield a return, its continuing role as a reserve currency needs explanation.

#### IV. Traditional and New Approaches

International reserves are widely defined as “all the assets of monetary authorities that can be used, directly or through assured convertibility into other assets, to support its rate of exchange when its external payments are in deficit” (Group of Ten, 1965, p.11). The corresponding measurement of international reserves is foreign exchange, gold, SDRs and net IMF position. In contrast, there is much less agreement on the meaning, definition and measurement of international liquidity. After three decades of discussion, the latter concept remains “surprisingly ill-defined” (Kane, 1965).

##### *International reserves*

There are two distinctive features of the above definition of international reserves; convertibility and intervention by official users. The rationale for the first function derives from the liquidity property: reserves need to be assets that can be converted into foreign exchange with certainty and rapidity. The rationale for the second feature stems from the requirement that central banks intervene in the foreign exchange market under fixed exchange rates. Included convertible assets are assumed to be perfect substitutes for official holders (central banks, treasuries) with an implicit elasticity of substitution of infinity. However, a cursory inspection of the set of reserve assets demonstrates different store-of-value and liquidity properties. For example, while SDRs and foreign exchange holdings yield market rates of return (the latter invested in short-term bonds to maintain high liquidity), IMF net reserve position and gold do not offer yields. Further, the purchasing power of SDRs (the weighted average of the five currencies that make up the SDR basket) has fallen in real terms since their inception (see Thakur, 1994).

No empirical study has attempted to estimate the degree of liquidity of the various asset components although many observers would agree with Mundell's qualitative ranking of; (in increasing order of "liquidity") conditional IMF loans, gold, IMF drawing rights, SDRs, foreign exchange (Mundell, 1994, p.77).<sup>1</sup> These assets make up only a very small proportion of national financial wealth and, as in domestic monetary theory, there remains the issue of determining the degree of liquidity of selected assets.

As conventionally measured, international reserves exclude borrowed reserves, that is, lines of credit with other central banks, swap facilities and direct official borrowing from capital markets. At a practical policy level, borrowed reserves play a key role in intervention operations (see Williams, 1994). Hence, the assumption of zero substitutability between borrowed and unborrowed reserves is problematic.

### *International liquidity*

In earlier policy discussion, official reserves are assumed to be synonymous with international liquidity, as reflected in the agreement to use only SDRs by government institutions. With the exception of Mckinnon (1969), the problem of private international money or liquidity is ignored in the earlier policy and academic debate. One consequence of this dichotomy in thinking is the belief that a switch to flexible exchange rates would eliminate aggregate demand for international money. But as noted in Mckinnon, reserve currencies such as the U.S. dollar serve simultaneously as vehicle or intervention currencies and for private transactions. While official demand for reserve assets may fall with the adoption of flexible exchange rates, private demand need not. The net impact on total liquidity, interpreted in Mckinnon in terms of the liquidity definition of the U.S. balance of payments deficit (increase in short-term dollar claims held by private and official foreigners plus losses in monetary gold) is uncertain. Thus, the liquidity "problem" as originally

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<sup>1</sup> Mundell includes IMF conditional lending in his definition. A recent analysis of Fund-created reserve assets (SDRs and reserve position in the Fund, reserve tranche [creditor] position and loan claims on the IMF) by Fawzi (1992) concludes that changes in net reserves created by the Fund were negatively correlated with changes in other international reserves for most of the 1980s. The negative correlation is interpreted by Fawzi as reflecting the role of IMF reserves as a shock stabilizer: demand for these reserves falling (rising) during periods of perceived liquidity abundance (scarcity) and thereby acting as a close substitute for other reserve components.

interpreted, is neither solved nor eliminated under flexible exchange rates.

The degree of substitutability between private and official international money is one aspect of the concept of international liquidity. However, from the perspective of global and national reserve management, the appropriate focus is on official use in view of the inability of central banks to commandeer private agents for intervention operations. Even if the concept of international liquidity is restricted to official use, there remains the issue of substitutability between borrowed and unborrowed reserves. Traditional approaches to defining international liquidity attempt to address this issue by adopting one of two extreme positions. One approach defines international liquidity as “any official assets that can be liquidated on short notice and can be used with virtual certainty to finance deficits in international payments” (Cooper, 1970). For the purposes of measurement, this definition reduces to that of unborrowed reserves. Hence, it fails to address the significance of private capital markets for official financing.

At the other extreme, official international liquidity may be defined to include all borrowings abroad by official institutions to supplement reserve holdings. The difficulty with the second definition is that, for measurement purposes, the ability to borrow depends upon market conditions and lenders’ perceptions of sovereign creditworthiness. The latter may alter unexpectedly and sharply, as illustrated by the recent Asian crisis.

At a more fundamental level, the concept of international liquidity is difficult to define because it contains a subjective component, arising from the close linkage between the liquidity and adjustment problems. The greater the amount of international reserves, the greater the flexibility enjoyed by policymakers in terms of the form, scope and timing of adjustment measures. The significance for global reserve management (as distinct from central bank portfolio asset management) arises from the need to satisfy the global adding-up constraint. This constraint will always be met *ex-post* but *ex-ante* policy inconsistencies may arise, for example, if all countries perceive a liquidity shortage and attempt to increase foreign reserves by adopting restrictive macro and/or trade policies.

Reflecting the above concerns, Williamson (1973) defines international liquidity as “a country’s ability to finance a payment deficit without taking ‘undesirable’ adjustment measures.” This property of liquidity underpins Kane’s earlier attempt to construct a liquidity index reflecting

a country's ability and willingness to activate other credit instruments, measuring "a nation's international liquidity ... as a probabilistically weighted sum of its various foreign assets, liabilities and commitments" (Kane, 1965).

The potential significance of the Kane index to the debate on measuring international liquidity adequacy is recognised in two major literature surveys (Williamson, 1973, 1994). In both cases, it is noted that Kane's contribution has failed to be developed by other researchers. Why? There are several reasons, related to its theoretical properties and operational usefulness. First, Kane's index is not derived from aggregation theory: the weights reflect an ad hoc collection of variables affecting official borrowing capabilities. Second, movements in the index and official reserves may not be positively correlated. This property is not a weakness but may deter policymakers who wish to signal their intentions to the market. Third, because the weights reflect borrowing capacity, the index is in part endogenously determined, being dependent on market perceptions of creditworthiness. This property is both a strength and a weakness: a strength if the index is seen as a market indicator of liquidity adequacy and a weakness because policymakers lack control over the reserve instrument. Finally, the index fall short of being operational, that is, it is difficult to construct the weights easily from readily available data. For all the above reasons, Kane's index has not been developed further: its relevance for recent research on financial aggregation is discussed in the next section.

### *Empirical analysis of demand for international reserves*

Since the breakdown of Bretton-Woods, a considerable research effort has been directed towards identifying the main factors influencing demand for international reserves and their stability. Of particular interest is the question of whether and why countries continue to hold international reserves under flexible exchange rates. More broadly, empirical analysis of demand for international reserves and liquidity is relevant to the debate on international liquidity in three ways: first, it offers an alternative methodology to single, model-free reserve-import ratios for assessing global adequacy of liquidity; second, the existence of a stable, well-defined demand function for liquidity is necessary for a causal linkage under fixed exchange rates to operate between growth in world reserves and global inflation; and third, estimates of demand provide a

measure of optimality of reserves, conditional on specification of the adjustment process.

Under a regime of fixed exchange rates, there exists a trade-off between drawing down reserves or allowing the economy to bear the burden of adjustment to external shocks through accompanying greater income fluctuations. Reflecting this emphasis on the key role of the adjustment-reserves trade-off, the demand for international reserves is assumed to be a stable function of a few variables while the supply is exogenous. Thus, by manipulating the supply of reserves, policymakers may allow flexibility in the adjustment process in individual countries. The major focus of earlier studies is to identify the variables that have significant effects on the demand for international reserves; see, for example, Kelly (1970) and Clark (1970). The dependent variable is defined and measured using the traditional definition of foreign reserves.

Under the Bretton-Woods system of fixed but adjustable exchange rates, reserves are held primarily for precautionary purposes with a transactions demand entering indirectly through the inclusion of a scale (trade) variable. However, with the switch to flexible exchange rates by the main industrial countries (and other countries), an alternative adjustment mechanism becomes available which does not require the holding of reserves for precautionary purposes. Under a flexible exchange rate regime, current account imbalances are financed by capital flows via flexible adjustment in the real exchange rate. Against theory and initial expectations, however, the levels of international reserves held by most countries have increased substantially since the collapse of the Bretton-Woods system in the early 1970s; see Table 4 and Miller (1995).<sup>2</sup>

Various ad hoc attempts have been made in the literature to explain the above “puzzle”. For example, Grimes (1993) attempts to explain the apparent “paradox” of reserve holding under flexible exchange rates by specifying a theoretical model for the demand for reserves, which is an extension of earlier work by Claassen (1975). His model is based on the assumption that at any given point in time there is target exchange rate that the government wishes to maintain. Miller (1995) offers several alternative explanations for this paradox, including the operation of the J-curve phenomenon together with the Harrod Effect, namely, the proposition that flexible exchange rates will decrease the amount of stabilising

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<sup>2</sup> Earlier work on the stability of demand for international reserves in the post-Bretton-Woods period shows evidence of a structural break (see Heller and Khan, 1978).

speculation because of the higher risk associated with speculative activity under the flexible exchange rate regime, requiring central banks to engage in potentially large amounts of stabilising foreign-exchange market intervention.

There may be a further source of instability of demand arising from financial integration. The ability of central banks to borrow on the global capital market may be expected to lower official transactions demand for international reserves but not necessarily precautionary demand. Consistent with this hypothesis, non-reserve, developing countries tend to have higher elasticities of demand for international reserves compared to industrial countries (see Edwards, 1975; Buirra, 1995). A recent theoretical analysis by Anayiotos (1992) develops a linkage between private capital flows and optimal reserve holdings through two channels; reducing the costs of policy adjustment and increasing the speed of reserve adjustment. An empirical study of demand for international reserves by Israel (an indebted country) over the period, 1964–1988, by Ben-Bassat and Gottlieb (1992) shows that sovereign borrowers with high debt are more vulnerable to reserve depletion and thereby face higher adjustment costs than countries with unrestricted access to external borrowing.<sup>3</sup>

#### *Aggregation of international reserves: a new approach*

As noted above, traditional approaches to reserve-demand analysis are usually based upon a framework where demand for international reserves, defined as the sum of the values of various reserve assets, is determined by a few variables that are more or less arbitrarily chosen.

In these approaches, it is assumed implicitly that various types of international reserves are perfectly substitutable for one another. However, a country's international reserves consist invariably of various assets with different degrees of liquidity and other reserve services like store of value and safe haven-in-crisis. Hence, they are not perfect sub-

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<sup>3</sup> The assumption of demand-driven reserves (exogenous supply) is tested in Bahmani-Oskooee (1995) who estimates a simultaneously-determined demand and supply of international reserves. Supply is assumed to be a positive function of gold prices as well as U.S. relative prices (*vis-à-vis* its trading partners) and income. His findings support the interpretation of exogenously-determined supply that underpins the demand studies. It is also noted that the incorporation of the new statistical concept of cointegration leaves the earlier findings unaltered (see Ford and Huang, 1994; Huang, 1995; Jung, 1995).

stitutes for one another. This, in turn, implies that adding the face values of different reserve assets results in a misleading measure of total reserves held by a country. This is the case because the simple sum is a valid aggregate of different components only if all the components are perfect substitutes.

A simple model for the demand for international reserves is developed in the appendix incorporating aggregation theory. In the model, each reserve asset is assumed to provide to the central bank various reserve services, such as liquidity, including flexibility in exchange policy implementation, store of value and safe haven-in-crisis. The central bank, in turn, bears “user cost” for holding each unit of the reserve asset, defined as the yield forgone by holding that specific asset rather than investing in capital. The user cost is typically a function of own yield and a benchmark yield on capital. Since the central bank derives utility from holding a positive quantity of each reserve asset, the arguments of its utility function include the quantities of international reserve assets held by the bank.<sup>4</sup>

According to aggregation theory, in order for a meaningful aggregate of reserve assets to exist, the holdings of reserve assets must be separable from the other arguments in the central bank’s utility function. The aggregate of the reserve assets held by the central bank at a point in time is the scalar value by which the quantity of each reserve asset should be deflated or inflated in order to achieve a reference utility level (referred to as the economic aggregate).<sup>5</sup> Hence, the economic aggregate of international reserves will double if the central bank doubles the quantity of every reserve asset it holds. This is one of the essential properties for a meaningful aggregate, which is even satisfied by the simple-sum aggregate. Unlike the simple-sum aggregate, however, the economic aggregate allows for less-than-perfect substitutability among reserve assets. Hence, substituting one type of asset for another without changing the simple-sum aggregate will usually alter the economic aggregate as it incorporates the central bank’s behaviour, aimed at minimising the cost to achieve a certain level of utility. This property has special relevance in the compositional distribution of reserve assets.

A drawback of the above approach is that the parameters of the utility function need to be estimated in order to compute the aggregate. How-

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<sup>4</sup> It is usually assumed that the amount of services provided by an asset is proportional to the quantity of the asset held.

<sup>5</sup> Such scalar value is called the “distance” of the quantity vector with reference to the given utility level.

ever, this problem may be easily overcome by using an appropriate index number formula which is free of unknown parameters. Certain group of index number formulae such as the discrete-time Divisia index and the Fisher Ideal index provide a close approximation to the true economic index, which is the economic aggregate at a point in time in comparison with the economic aggregate at a base point in time.<sup>6</sup> (See the Appendix for the formal definition of the economic quantity index.)

### *An illustration*

The effects of different aggregation methods are illustrated using the data provided in Table 5. The amounts of individual component assets are obtained by multiplying the average end-of-year reserve holdings of all countries in the 1970s, 1980s and 1990s (from Table 4) by the corresponding shares in 1970, 1980, and 1990 (from Table 3), respectively. The user costs and weights are hypothetical values, while the budget share of, say, asset  $h$  ( $S_h$ ) is computed by

$$S_h = \frac{R_h \pi_h}{\sum_k R_k \pi_k}$$

where  $R_h$  is the amount of asset  $h$  held by the central bank, and  $\pi_h$  is its user cost.

The user costs are the forgone yields for holding reserve assets rather than investing in productive capital. Hence, the user costs are proportional to the difference between a benchmark rate and the own yields of individual reserve assets. For instance, in Barnett's (1978, 1980) user-cost formula, which is based on a rigorous theoretical foundation in the context of domestic monetary aggregation, the user costs are proportional to the discounted difference between a benchmark rate and individual asset's own yield; see the Appendix. In practice, one needs to find relevant own yields and a benchmark rate to compute the user costs. The most appropriate benchmark rate in the context of reserve aggregation would be the rate of return from productive capital. As mentioned earlier, SDRs and foreign exchange yield positive rates of return while gold and IMF net position have a zero yield. Various IMF surveys publish SDR rates that are appropriate as the own rate for SDR holdings. For-

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<sup>6</sup> An index number formula that provides a second-order Taylor series approximation to an arbitrary economic index is called a "superlative" index; see Diewert (1976).

foreign exchange holdings are usually invested in short-term bonds. Thus, a representative rate for short-term bonds would be appropriate for the own yield for foreign exchange holdings. As gold and SDRs have the same user cost for every period, they belong to a Hicksian composite commodity.

The simple-sum quantity indices of the 1980s and the 1990s in comparison with the 1970s are simply the ratios of the sum of the book values of all component assets in the 1980s and the sum in the 1990s to the sum in the 1970s, respectively. The simple sums for the three decades are provided in the third last column of Table 5, and the quantity indices based on those sums are shown in the first column of Table 6.

The weighted-sum indices in the second column of Table 6 are the ratios between the weighted sums of the values in the two compared decades which are shown in the second last column of Table 5.

The economic quantity indices are based a Cobb-Douglas utility function:

$$U(R) = \prod_k R_k^{\beta_k} \quad \text{for } k = \text{gold, SDRs, IMF position, and forex.}$$

It is well known that the  $\beta$ 's in the above function are fixed budget shares. In the present illustration,  $\beta$ 's are approximated by the average budget shares over the three decades (shown in the last row of Table 5). The economic indices are provided in the third column of Table 6.

Diewert (1976) shows that the following discrete-time Divisia index provides a very close approximation to an arbitrary economic index.

$$Q_D^{t,0} = \prod_k \left( \frac{R_k^t}{R_k^0} \right)^{0.5 (s_k^0 + s_k^t)}$$

In the above definition, the superscripts denote periods and the subscripts denote individual component assets. The Divisia indices are shown in the last column of Table 6. An important advantage of using an index number formula, such as the above, is that we only need observable values, namely, prices (provided user costs are correctly estimated) and quantities, to compute indices; and hence, unlike the economic index we do not have to estimate unknown parameters.

In summary, this section has shown how various international reserves with different characteristics may be aggregated in a way that is consistent with aggregation theory. A quantity aggregate so measured is the

Table 5  
Illustrative Data

	Gold	SDRs	IMF Pos	Forex	Simple Sum	Wt Sum	U(R)
Base 1970s	R (US\$b)	94.3	8.2	19.7	114.8	61.8	89.1
	$\pi$ (user cost)	1.0	0.7	0.8	0.9		
	S (budget share)	0.43	0.03	0.07	0.47	1.00	
1980s	R (US\$b)	52.0	18.3	26.2	455.5	198.1	202.9
	$\pi$ (user cost)	1.2	0.8	0.9	0.6		
	S (budget share)	0.17	0.04	0.06	0.73	1.00	
1990s	R (US\$b)	62.0	39.0	45.0	1157.0	489.7	417.9
	$\pi$ (user cost)	1.3	0.8	0.9	0.5		
	S (budget share)	0.11	0.04	0.06	0.79	1.00	
Weight	0.1	0.3	0.2	0.4	1.00		
Av. B. Share ( $\beta$ )	0.24	0.04	0.06	0.66	1.00		

*Table 6*  
**Quantity Indices**

	Sum	Wt Sum	Economic	Divisia
80/70	2.33	3.21	2.28	2.01
90/70	5.50	7.93	4.69	4.27

true “economic” aggregate of international reserves in the utility function of a central bank. In this setting, the reason why a central bank holds positive balances of international reserves, even under flexible exchange rates, is because they provide not only a service as the medium for transactions but also other services such as store of value and as a precautionary measure for a crisis.

Well-developed index number theory enables economists to compute good approximations of the true economic aggregates using a simple and mechanical method without the need to specify and estimate underlying preferences of a central bank. However, while the above exercise illustrates how various types of indices are constructed, the indices so obtained do not have any practical implications since the values used for weights and user costs are hypothetical. What is important from the perspective of aggregation and index number theories is that different index number formulas imply different utility functions. Thus, some index number formulas may imply too restrictive and unrealistic preference ordering. For example, a weighted-sum or simple-sum aggregate implies all components are perfect substitutes.

## V. Policy Issues

The specific question addressed is the following: does a global (or regional) liquidity problem remain in the post-Bretton-Woods system (or non-system) and how satisfactorily do recent reform proposals address perceived weaknesses?

### *Background and earlier debate*

A recurrent theme of the policy debate throughout the late 1950s and 1960s was concern about the global adequacy of liquidity on account of the system’s dependence on the U.S. balance of payments deficit. The

close linkage between the global liquidity and confidence problems is highlighted in the “Triffin” dilemma (see Triffin, 1960): a perceived liquidity shortage could only be solved through a confidence crisis.<sup>7</sup> The Bretton-Woods gold exchange system suffered a fundamental weakness: demand for reserves would grow faster than supply unless the United States ran a continuing payments deficit. But a growing deficit would eventually undermine confidence in the ability of the U.S. to maintain a fixed price between the dollar and gold.

The fundamental difficulty for global reserve management is that a global liquidity problem is an indirect outcome, arising from individual country responses to perceived liquidity shortages or abundance, as well recognised in the debate preceding the introduction of SDRs (see International Monetary Fund, 1970). Notwithstanding this ambiguity, early reform proposals emphasised the necessity of control over international reserves and liquidity to avoid either a liquidity shortage and world deflation or excess liquidity and world inflation. In this framework, SDRs were viewed as an instrument directed to an intermediate target such as the world money supply and inflation aimed at maximising global welfare subject to constraints, including policy reaction functions of individual countries.

### *Present relevance of adequacy*

To what extent does the global liquidity problem remain? Three major institutional changes in the international monetary system have since occurred over the past three decades; the shift from a par-based Bretton-Woods set of exchange rate rules (with the U.S. dollar as the key currency) to the present hybrid exchange rate arrangements and adoption of flexible exchange rates by the main industrial countries; the introduction of an externally-generated source of international reserves through SDRs and the growth of global, private capital markets that enable current account deficits to be financed without drawing down foreign reserves. As noted in Section III, SDRs are a small and falling share of total foreign reserves. A major consequence of the first and third developments is that the U.S. payments deficit is no longer the main source of

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<sup>7</sup> As noted in Cohen (1975) and Williamson (1994), the problem of adequacy of international liquidity has a long history, extending back to bimetallism in the 19<sup>th</sup> century (with France as the reserve centre) as well as the Genoa Conference in 1922 (gold and dollar shortage). Triffin (1960) only revived an earlier debate rather than activating a new one.

global liquidity. The sources of primary liquidity remain largely endogenously driven through payments imbalances of industrial countries which in turn reflect divergences in macro policies. The asymmetrical role of the U.S. balance-of-payments in the international monetary and liquidity system has been replaced by that of G-3 countries.

The issue of global adequacy of liquidity or more precisely excess rather than scarcity received a resurgence of attention in the early 1970s triggered by the dual phenomena of a rapid expansion in global reserves and world inflation. However, the existence and strength of any causal linkage may be refuted on both analytical and empirical grounds. Analytically, under flexible exchange rates, movements in international reserves are divorced from movements in the national money supplies with each country free to determine its own inflation rate. Even if central banks engage in managed floating, the net impact of intervention operations on global money supply and inflation is ambiguous, depending upon the extent to which intervention is sterilised or not and, more broadly, the central bank reaction function of reserve countries to different shocks, real and monetary.<sup>8</sup>

The post-1980s period has been characterised by low world inflation: this observation, combined with the adoption of flexible exchange rates by the main industrial countries and growth of private international credit markets has led many commentators to conclude that the concept of international liquidity has lost its strategic role (see Willett, 1980; Williamson, 1994). As a consequence of the two developments, the external constraint on macro policy ... the key linkage with the liquidity problem ... is no longer unborrowed foreign reserves but a country's ability to borrow, that is, sovereign creditworthiness. A liquidity constraint may prevent some countries from accessing international credit markets. But the latter problem is viewed as one of inequitable distribution, quite separate from that of global adequacy.

One dissenter from the majority view is Mundell (1994). Mundell argues that the above reasoning is flawed on two counts. First, even under flexible exchange rates, liquidity is still of concern as long as groups of countries belong to currency unions.<sup>9</sup> The global issue of adequacy becomes a regional one. Second, even under perfect capital mar-

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<sup>8</sup> The linkage assumes a stable liquidity demand function and no shifts in reserve composition.

<sup>9</sup> Transition of EMS to EMU and a predicted fall in their demand for reserves excludes European Union countries from this group but other currency unions, existing and potential are relevant in the present international monetary system.

kets, countries are constrained by their intertemporal budget constraints. A liquidity constraint still exists as long as financially traded assets are not perfect substitutes. Thus, different forms of liquidity available to official users matter since central banks cannot commandeer liquidity from the private sector for exchange market support. The essence of the international liquidity problem then arises from the existence of uncertainty and transactions costs, implying that assets have different degrees of liquidity that need not be distributed equitably or in proportion to country wealth.

### *Reform proposals*

There is an emerging consensus that the growth of private credit markets has shifted concerns from fears of a global liquidity shortage to regional shortage and unequal distribution as well as the effective functioning of international credit markets (see Guth, 1985; Buirá, 1995; Goldstein and others, 1992). However, proposed global policy response and the role of the International Monetary Fund differ widely, especially when considered within the broader context of proposals for reform of the international monetary system, for example, Davidson (1992–93), as discussed below.

Three proposals for liquidity reform are discussed below; the first by Buirá (1995) addresses the question of unequal liquidity distribution; the second by Goldstein and others (1992) addresses the functioning of international capital markets and the third by Davidson (1992–93) proposes a ‘rules based’ strengthening of the international monetary system that ensures a redistribution of liquidity from surplus to deficit countries. Notably, none of the proposals address directly the issue of composition of international reserves.<sup>10</sup>

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<sup>10</sup> Literature on reserve asset composition of central banks and the role of gold is excluded in this paper (see Gill, 1994); its relevance relates to the continuing presence of gold as an international reserve asset (see Section II) and stability of the composition of reserves. Gold is an anomaly insofar as it offers no rate of return (although it may be leased out to commercial banks); it is still held by central banks because it offers high liquidity, that is, reserves available at short notice when needed. The apparent stability of the share of gold in global reserves in recent decades is masked by individual country sales in the 1990s, including that by Belgium, Canada, the Netherlands and Australia. In almost all cases, sales have been motivated by a perceived too high weight attached to gold in terms of willingness to sacrifice return for liquidity. In regard to SDRs, it is sufficient to note that earlier research focused upon the issue of avoiding a confidence problem through, for example, proposals for a substitution account for U.S. dollars. More

## (i) Buira proposal

Buira (1995) focuses upon the issue of unequal distribution of reserves and liquidity, arguing that the present global liquidity problem ... deficiency in creating and distributing international liquidity ... may be attributed largely to the absence of any institution which assesses world liquidity requirements and implements measures to meet requirements. He proposes that the International Monetary Fund conduct an annual liquidity surveillance exercise: to assess global liquidity requirements, including access of countries to sources of liquidity and to consider appropriate measures to adjust supply. Thus far, the IMF has not undertaken this role nor expressed an interest to do so in the future.

The rationale behind Buira's reform plan and emphasis on IMF responsibility is based upon the first Amendment to the Articles of Agreement undertaken when SDRs were introduced in 1971. This amendment augments IMF responsibilities to include international liquidity creation, that is, to increase the supply of reserve assets in a timely manner whenever the need arises. The SDR is intended to serve multiple objectives beyond liquidity creation, including expansion of trade, promotion of the multilateral payments system, promotion of exchange rate stability and correction of payments disequilibrium.

The operational robustness of the IMF commitment to supply SDRs "in a timely manner whenever the need arises" is weak, as demonstrated by the debate on a new SDR allocation at the 1994 Madrid Interim Meeting. The debate ... a proposal by developing countries for a new SDR allocation and its subsequent rejection by the G-7 ... highlights the continuing lack of agreement on an appropriate methodology for assessing liquidity adequacy as well as the ineffectiveness of the present external mechanism for satisfying liquidity requirements.<sup>11</sup>

The second component of Buira's reform proposal involves international surveillance of liquidity by the IMF and requires an agreed set of global liquidity indicators. Buira assumes that this exercise is a robust undertaking, based upon estimated reserve demand functions for various country groupings (reserve-currency countries, other industrial coun-

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recent studies focus on redefining SDRs from a basket of five inflating currencies to a stable purchasing power unit.

<sup>11</sup> Under the Articles of Agreement, an overall SDR allocation requires an 85 percent majority vote. The precise proposals varied but one proposal was for an SDR allocation equivalent to 10 percent of IMF quotas (1994) or 14.5 billion SDRs (see Buira, 1995).

tries). Notably, he does not suggest a return to model-free indicators such as reserve-to-import ratios that are already reported for various country classifications in the biannual World Economic Outlook exercise. The main message of the present paper is to argue that specification and estimation of demand for reserves, as currently being undertaken is incorrect and not robust.

(ii) Goldstein proposal

In response to the Asian crisis, new initiatives have been undertaken to help strengthen the resilience of the international and national financial systems to external shocks (see Group of Twenty-two, 1998). The issue of the market's ability to assess sovereign creditworthiness as distinct from the ability and capacity of banks to lend is examined in Goldstein and others (1992).<sup>12</sup>

Goldstein and others (1992) do not offer a concrete reform proposal but instead seek to determine the existence of market failures in the present system for pricing risk and access to international liquidity. Two factors suggest market failures; contagion effects and policy spillovers. Contagion effects arise when credit access for one country is curtailed as a result of external developments, as demonstrated in the recent Asian crisis. One explanation is that lending and borrowing decisions are being undertaken in an environment that underestimates risk owing to lack of country-specific information. If this is the case, the appropriate policy response is to make transparent information more available to investors as well as strengthen corporate and public sector governance as is presently underway in East Asian reform programs.

A second source of market failure in global credit markets is policy spillovers arising from structural and other interdependencies between integrated, open economies. Such externalities, for example positive global spillovers from stronger growth in developing countries are unlikely to be captured in evaluating creditworthiness of sovereign borrowers. As a result, the total amount of liquidity from private sources will be below that of the social optimum. In the second case, targeted tax incentives through subsidies to credit may be appropriate, provided benefits are weighed against political economy costs, including incentives for rent-seeking.

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<sup>12</sup> A recent analysis by Dziobek and others (2000) provides a framework for assessing the adequacy of arrangements for systemic liquidity.

## (iii) Davidson proposal

A third proposal for liquidity reform comes from Davidson (1992–93) in the context of an overall restructuring of the international payments system and exchange rate arrangements. The distinguishing feature of the Davidson plan is that it is “rules-based”, proposing a specific set of rules to create and redistribute international liquidity from surplus to deficit countries. The rules are intended to: (a) prevent countries from building up excess reserves (or the reverse); (b) shift the burden of adjustment from deficit to surplus countries; (c) provide a means of monitoring capital flows and (d) provide for global liquidity expansion through the creation of a new reserve asset (IMCU). In common with the SDR, the IMCU would be held only by central banks. But unlike the present hybrid exchange rate arrangements, Davidson’s plan requires that the IMCU have a fixed rate to each country’s domestic currency.

Setting aside the issue of exchange rate regime, the innovative feature of Davidson’s plan is that it attempts to address directly equity issues of unequal burden of adjustment and access to liquidity.<sup>13</sup> A trigger mechanism is proposed whenever creditor countries spend in excess of agreed credit balances from past current account surpluses. This excess is then eliminated either through unilateral transfers to deficit countries, by direct spending on goods produced by deficit countries, by foreign investment or by financing the adjustment of deficit countries. Whatever means is employed, the outcome is to shift the burden of adjustment from deficit to surplus countries and thereby alleviate national liquidity problems.

Not surprisingly, the Davidson plan has failed to receive serious attention, in part because of its core component is a return to fixed exchange rates. However, the plan does revive the long-standing liquidity debate on whether reliance on market mechanisms through adjustment of reserve-currency countries rather than explicit rules are sufficient to ensure liquidity requirements of developing countries are met. The Davidson rules have weak operational content. But it is also apparent that reliance upon existing private credit market mechanisms to ensure equitable liquidity distribution is inadequate.

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<sup>13</sup> The proposal for a return to some form of fixed exchange rates for the world is the common element linking the Davidson plan with target zone proposals of McKinnon (1992–93) and Williamson (1992–93). However, the latter two plans ignore the question of distribution and liquidity.

Several proposals (for example, Williamson, 1994) attempt to address the distribution issue by linking future SDR allocations with development aid. As noted in Mundell (1994), these proposals are weak since they link liquidity with poverty issues and may give wrong or inappropriate signals to developing countries.

## VI. Concluding Comments

In order to bring together the main arguments and conclusions, we return to the six issues raised in the Introduction.

*Why and for whom is aggregation of international reserves and liquidity a useful research question?*

As discussed, the traditional approach to this question is to ignore it through the assumption of a simple-sum unweighted aggregate in which included assets (foreign exchange, gold, SDRs, net IMF position) are perfect substitutes for each other but imperfect substitutes for excluded assets. This assumption means that movements in international reserves will fail to measure correctly the value of total reserve services when shifts occur within the aggregate between assets with different consumption characteristics. Whether or not this assumption is justified is an empirical question. But the observed unexplained paradoxes in the stylised facts, empirical studies of demand for international reserves and unresolved issue of measuring adequacy of international liquidity suggest that, as in domestic money, aggregation of international reserves matters.

An alternative method of aggregating international assets was proposed in the paper which demonstrates how the true economic aggregates may be computed in a way that is consistent with aggregation theory. The aggregation model specified in the present paper produces an answer to the paradox of why central banks hold international reserves under flexible exchange rates. It is also argued that the alternative method is operational by using an appropriate index number formula.

*What can be done with the aggregated numbers?*

In contrast to domestic money, potential users of aggregated international reserves and liquidity have a national and global dimension. At the national level, the users are central banks as well as private agents.

At the global level, users are international organisations such as the IMF as part of its surveillance function and responsibility to provide SDRs to meet global liquidity requirements.

*Does the exchange rate regime matter for aggregation?*

An aggregation approach helps resolve the puzzle of why countries continue to hold reserves under flexible exchange rates. Reserve assets provide various services to central banks such as liquidity, including flexibility in exchange policy implementation, store of value and safety in crisis.

*What is the appropriate definition to be used in estimating demand for international reserves?*

Again, the traditional approach to this question uses the simple-sum aggregate as the dependent variable in empirical estimates of demand for international reserves. As in domestic money-demand estimation, this approach may not present major difficulties provided the composition of the aggregate is stable. Financial deregulation in the international economy is a form of financial innovation affecting official transactions demand for international reserves. Hence the explicit incorporation of borrowed reserves into an economic aggregate may enhance the explanatory power of reserve demand functions. When theory does not provide a clear guideline, selection of the components of the economic aggregate may be based on an empirical separability test.

*Does the problem of liquidity adequacy remain of relevance in the present international monetary system?*

Contrary to the majority view, it is argued that the issue of liquidity adequacy retains its relevance in a regional context for countries joined in currency unions even in the altered post Bretton-Woods environment. But there is no satisfactory methodology for assessing liquidity gaps as a basis for global or regional policy. However, when attention is drawn to the alternative aggregates of international reserves, as suggested in the present paper, the issue becomes broader than liquidity adequacy because the economic aggregates are an aggregate of other reserve services as well as liquidity. The economic aggregates also implicitly incorporate the compositional distribution of reserve assets in contrast to

simple-sum aggregates in which changing the distribution of components leaves the aggregate unaltered.

*What are the weaknesses of the present international liquidity mechanism and role for policy?*

Recent policy focus has shifted away from the question of liquidity adequacy to that of unequal reserve distribution facing low-income developing countries that also lack access to global capital markets. The recent East-Asian crisis has highlighted the weaknesses in the functioning of international credit markets even for countries perceived as creditworthy and with “adequate” reserves. However, there is no agreement on how to address the problem of inequitable reserve distribution nor on means of strengthening the functioning of international credit markets.

The broad conclusion reached from this reassessment of international liquidity issues is that the newer approach to defining and measuring international “liquidity” offers potentially significant benefits for theoretical and empirical work as well as practical policy concerns. In order to avoid the “Kane trap”, it is suggested that this research proceed from first principles, namely aggregation theory as set out in the present paper.

## Appendix

### Model

Consider a central bank’s sub-utility function on international reserves in a specific period that is given by

$$(1) \quad u = U(R)$$

where  $R$  is a  $K \times 1$  vector of real quantities of various reserve assets,  $u$  is the utility level, and  $U(\cdot)$  is the utility function satisfying the usual regularity conditions.<sup>14</sup> Each reserve asset provides various services including international liquidity services, such as flexibility in exchange policy implementation, and store-of-value services, to the central bank. Hence,

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<sup>14</sup> To simplify the analysis, the utility function is assumed to be (weakly) directly intertemporally separable. Selection of the components of  $R$  could be based on a statistical separability test if economic theory is not helpful in deciding what assets should be included. See Berndt and Christensen (1973a, 1973b) and Denny and Fuss (1977) for separability tests.

$U(\cdot)$  is an increasing and concave function of each argument. The optimal  $R$  is determined by maximising the above utility function subject to the budget constraint

$$(2) \quad R'\pi = X$$

where  $\pi$  is a  $K \times 1$  vector of the user costs of holding  $K$  reserve assets and  $X$  is the total budget allocated to reserve holdings in the higher-stage optimisation process.<sup>15</sup> There are many variants of the user cost formula, but the formula derived by Barnett (1978, 1980) appears to have the strongest theoretical foundation:

$$(3) \quad \pi_k = p(q - r_k)/(1 + q)$$

where  $\pi_k$  is the  $k$ -th element of  $\pi$ ,  $p$  is the implicit price deflator of imports,  $q$  is the benchmark yield on capital, and  $r_k$  is the yield on holding a unit of  $R_k$ , the  $k$ -th element of  $R$ .

This optimisation is assumed to be the second-stage budgeting procedure in two-stage budgeting; see Strotz (1957, 1959) and Gorman (1959) for two-stage budgeting procedure. That is, the budget on international reserve holdings,  $X$ , is assumed to be optimally allocated in the first-stage budgeting. For the solution from a two-stage budgeting procedure to be identical to the solution from a single-step overall optimisation, the utility function should satisfy certain conditions. For this reason, we further assume that the upper-level utility function is (weakly) directly separable in the reserve holdings and the lower-level (sub-)utility function,  $U(\cdot)$ , is homothetic. Under these assumptions, the above optimisation problem can be separately solved without concerning about any other arguments in the upper-level utility function.

Solving the above constrained optimisation problem with respect to  $R$  yields optimal demands for reserve assets:

$$(4) \quad R_k = M_k(X, \pi) \quad \text{for } k = 1, \dots, K$$

where  $M_k(\cdot)$  is *Marshallian* demand function.

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<sup>15</sup> Notice that  $X$  is not the sum of all reserve holdings. It is the total opportunity cost of holding various types of international reserves.

*Quantity Index*

When the utility function is homothetically separable, as assumed above, the true *Malmquist* economic quantity index is independent of reference utility. So, the economic quantity index of the total international reserve holdings in period  $t$  compared with that in period  $0$  is given by

$$(5) \quad Q_M^{t,0} = U(R^t)/U(R^0)$$

where  $R^t$  is the  $K \times 1$  vector of international reserve holdings in period  $t$  and  $R^0$  in the base period. It would be unreasonable to assign cardinal values for this index since the utility function is related only to ordinal values. The index only measures relative quantities in comparison with the quantity in a base period.

In analysing a country's demand for aggregate quantity of international reserves, the above index should provide a much more appropriate measure of total reserve than does the traditional simple-sum aggregate. Hence, in a structural model that incorporates aggregate demand for international reserves, the equation representing reserve demand could be specified as

$$(6) \quad Q_M^{t,0} = f(y^t, x^t)$$

where  $y^t$  and  $x^t$  are vectors containing the endogenous and the exogenous variables in the model, respectively.

Index number theory shows that a close (second-order Taylor series) approximation of the quantity index  $Q_M^{t,0}$  can be obtained only by using the observed values of  $R$  and  $\pi$  for an arbitrary functional form of  $U(\cdot)$ ; see Diewert (1976) for the introduction of the concept and a proof.

If an identical utility function is assumed for all countries, a similar procedure can be applied to measuring cross-country quantity indices.

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## Summary

### International Reserves and Liquidity: A Reassessment

This paper reassesses the literature on international reserves and liquidity from the dual perspectives of micro financial aggregation theory and recent international financial developments. The traditional simple-sum aggregates approach to defining, measuring and estimating demand for international reserves is contrasted with more recent research derived from financial aggregation theory. As in domestic monetary theory, it is argued that aggregation theory is necessary to identify reserve assets with different degrees of liquidity and other reserve services. The main conclusion reached is that the financial aggregation approach is warranted on theoretical, empirical and practical policy grounds because the

liquidity problem of adequacy and distribution remains relevant even in the altered international environment of flexible exchange rates and growth of private capital markets. (JEL F33, C43)

## **Zusammenfassung**

### **Internationale Reserve- und Liquiditätshaltung: Eine Neubewertung**

Dieser Artikel enthält eine Neubewertung der Literatur auf dem Gebiet der internationalen Währungsreserve- und Liquiditätshaltung in der doppelten Perspektive der mikroökonomischen Finanzaggregationstheorie und der Finanzentwicklungen der jüngeren Vergangenheit. Der Ansatz der einfachen Summenaggregation zur Definition, Messung und Schätzung der Nachfrage nach internationalen Reservemitteln wird in einen Gegensatz gesetzt zu jüngeren von der Finanzaggregationstheorie abgeleiteten Forschungstätigkeiten. Wie bei der Geldmengensteuerung wird argumentiert, daß die Aggregationstheorie für die Identifizierung von Reservemitteln bei unterschiedlichen Liquiditätsgraden und sonstigen Reservedienstleistungen erforderlich ist. Die wichtigste Schlußfolgerung besteht darin, daß der Finanzaggregationsansatz aus theoretischen, empirischen und praktischen Gründen in politischer Hinsicht gerechtfertigt ist, weil das Liquiditätsproblem der Adäquanz und Verteilung auch in einem geänderten internationalen Umfeld von flexiblen Wechselkursen und eines wachsenden privaten Kapitalmarktes seine Relevanz behält.

## **Résumé**

### **Réserves internationales et liquidité: une réexamination**

Cet article réexamine la littérature sur les réserves internationales et la liquidité sous deux perspectives: celle de la théorie de l'agrégation micro-financière et celle des récents développements financiers internationaux. L'approche traditionnelle de la simple somme des agrégats pour définir, mesurer et estimer la demande de réserves internationales est mise en contraste avec les recherches plus récentes dérivées de la théorie financière de l'agrégation. Comme dans la théorie nationale monétaire, les auteurs argumentent que la théorie de l'agrégation est nécessaire pour identifier les réserves avec différents degrés de liquidité et d'autres fonctions. La conclusion principale obtenue est que l'approche d'agrégation financière est justifiée théoriquement, empiriquement et pratiquement parce que le problème de liquidité de l'adéquation et de la distribution reste significatif même dans l'environnement international modifié de taux de change flexibles et de croissance des marchés des capitaux privés.