

International Reserves and Liquidity: A Reassessment

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Abstract

This paper reassesses the literature on international reserves and liquidity from the dual perspectives of financial aggregation theory and recent international financial developments. 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.

Key words : international reserves, international liquidity, aggregation, quantity index, index numbers

JEL Classifications : F33, C43

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INTERNATIONAL RESERVES AND LIQUIDITY: A REASSESSMENT

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; Cohen, 1975; Willett, 1980). 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 US balance-of-payments deficit to satisfy increasing demand: a situation that could be resolved only by undermining confidence in the US 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. However, it is not SDRs but rather the shift to flexible exchange rates by the main industrial countries and growth of capital markets that has led many of the leading contributors to the debate to declare the irrelevance of the liquidity problem for the present international monetary system (see Williamson, 1994).

The purpose of this paper is to re-examine the literature on international reserves and liquidity from the dual perspectives of financial aggregation theory and recent international financial developments. Specifically, it addresses the following questions: What is the appropriate method of aggregating international reserve assets with different characteristics and does this matter for global reserve management? What is the appropriate definition to be used in estimating demand for international reserves? Does the issue of adequacy of international reserves remain of relevance in the altered global environment of global financial integration and hybrid set of exchange rate rules? What are the perceived or actual deficiencies in the present international liquidity system and what is the role for global policy?

Why the need for yet a further review? There are two main reasons, one driven by analytical concerns and the other by recent international financial developments. First, on analytical grounds, a striking feature of the review literature is the absence of a unified, theoretical framework that attempts to define and measure international reserves from first principles, namely aggregation theory. The core of the concept of international liquidity lies in the different degrees of liquidity offered by different reserve assets that make up only a small proportion of a country's total wealth.¹ Given the differences in the characteristics of reserve assets, it is likely that an analysis of the demand for the simple-sum aggregate of various reserve assets would result in misleading conclusions. It is surprising that the well-developed approaches to domestic monetary aggregation have never been employed for the aggregation of international reserves while the two areas share many similar characteristics.

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.

¹ "The essence of the international monetary problem of liquidity is that assets have different degrees of liquidity and these liquid assets are often distributed unequally among countries in disproportion to wealth differences" (Mundell, 1994).

The approaches introduced in this literature highlight the inadequacy of the traditional simple-sum aggregates of various monetary assets as a measure of the quantity of money in the economy. Although the aggregation methods introduced in the literature have not been directly employed to replace the traditional methods by monetary authorities, the literature has contributed towards a significant change in the view of monetary authorities and other economic agents on simple-sum monetary aggregates. Rather than concentrating on simple-sum aggregates of various-liquidity assets, such as M3 or broad money, more attention is now paid to the individual components of those aggregates, where each component is a simple sum of close substitutes, or to the 'economic aggregates' if the components are not closely substitutable.

A second reason for reassessing the significance of the international liquidity problem arises from the effect on the functioning of the international monetary system of two main developments; the adoption of flexible exchange rates by the main industrial countries and the growth of private capital markets. Both developments have been interpreted as contributing to the demise of the liquidity problem, the first by reducing official demand for international reserves and the second by creating an additional means of financing current account deficits.

Notwithstanding the unresolved issue of the concept and measurement of international liquidity, the above interpretation may be questioned. Despite the growth of private capital markets, there is unequal access for a large group of low-income developing countries. The significance for the international liquidity problem is that many countries within this group also hold a disproportionately small share of global reserves (and frequently operate under a fixed exchange rate regime or are members of a currency union). Even in situations in which countries normally have access to global capital markets and are perceived as creditworthy, sudden and unexpected disruptions to external borrowing may occur, as illustrated by the recent East-Asian crisis.

As a consequence of the above developments, policy attention has shifted from concern with adequacy to equity of distribution of international liquidity and functioning of international credit markets. In particular, in the aftermath of the Asian crisis, the effective functioning of international credit markets has come under scrutiny. However, there is little agreement on the global and regional policy significance of unequal reserve and/or international liquidity distribution and even less on proposed solutions to broaden access or to prevent sudden disruptions to sovereign borrowers.

Section II begins with the stylised facts, focusing on three key aspects of the pattern of 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 III looks at traditional approaches to defining and measuring international liquidity. Section IV contrasts traditional approaches 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 policy issues and the relevance of the liquidity problem for the present international monetary system as well as recent reform proposals. The final section brings together the main conclusions and suggestions for further research.

II. Stylised Facts

This section first 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; Buira, 1995).

Earlier studies

Earlier works (IMF, 1970; 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 determined, in particular being influenced by

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.

a changing stochastic environment and 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 (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) suggests 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 the Table 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 Buira (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 as international reserve has become 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

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.

gold is evaluated at SDR 35 per ounce).² 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.

² When gold is evaluated at market prices, the share decreases from 63.8 percent in 1960 to 13.3 percent in 1997.

Table 4: Summary Table: Foreign Reserves

	Total	G-7		Other Industrial		Developing	
Reserves, year-end average	US\$b	US\$b	Share %	US\$b	Share %	US\$b	Share %
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.

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. While the global stock of reserves 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.
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 (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.

III. Traditional 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).

This section discusses traditional approaches to defining and measuring international reserves and liquidity and the implications for estimation of demand for international reserves and liquidity and policy issues.

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 rapidly. 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 “liquiditiness”) conditional IMF loans, gold, IMF drawing rights, SDRs, foreign exchange (Mundell, 1994, p.77).³ These assets make up only a very small proportion of national financial wealth and hence, 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.

³ 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.

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 US 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 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 is 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 be 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 analyses of the demand for international reserves

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.

The studies undertaken during the Bretton-Woods period are based on the presumption that in eliminating payments imbalances, there exists a trade-off between drawing down reserves and allowing the economy to adjust for the imbalances 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, it is believed that, given demand, by manipulating the supply of reserves, the policy decisions by individual countries may be influenced because the level of reserves is a key element allowing flexibility in the adjustment process for individual countries. The major focus of these 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.

Kelly (1970) builds a model on the assumption that the policymaker maximises its utility subject to the above trade-off and tests the model using a pooled set of data for forty-six countries over the period 1953-65. In his model, the optimum level of reserves varies directly with the variability in exports and the marginal disutility of the degree of income fluctuations. It varies inversely with the marginal disutility of income reduction due to holding assets as reserves, the opportunity cost of reserve holdings, the marginal propensity to import (since the larger the propensity the larger the proportion of the payments deficit that the economy adjusts itself to), and the tolerance level of the probability of reserves falling below certain specified level. When the level of reserves is regressed on the explanatory variables representing the variability in exports, the marginal propensity to import, and the opportunity cost of reserves, using the pooled data, all but

the coefficient for the import-propensity variable have the expected sign. Kelly attributes the wrong sign for import propensity to measurement errors which are suspected because he uses the average propensity to import as proxy for the marginal propensity to import.

Clark (1970) specifies a similar model in which a country maximises its welfare function that is assumed to be a function of the mean and standard deviation of income. In his model, the average level of reserves varies directly with variability in reserves and per capita income; it varies inversely with the marginal propensity to import and opportunity cost. Clark's approach differs from the previous literature in that the two components of a reserve movement, namely, the component representing adjustments, that is, the economy's response to present and past balance-of-payments disturbances and the one representing the true disturbances in reserves, are explicitly distinguished. In his model, actual changes in reserves held by a country over a given period of time are determined by partial adjustment towards a desired level of reserves and a random disturbance. Clark uses this specification to estimate the speed of adjustment and the standard deviation of the payments disturbances for each of thirty eight countries using the respective country's monthly time-series data over nine years. Then, he estimates regression models of the average level of reserves and the speed of adjustment as a function of the marginal propensity to import, income per capita, and the standard deviation of the payments disturbances using the cross-country data. His estimation results show that the speed of adjustment is insignificantly different from zero for seventeen out of thirty eight countries. The hypothesis of an inverse relationship between the speed of adjustment and the standard deviation of the payments disturbances is rejected.⁴ Further, the level of reserve holdings is found to be positively related with the standard deviation of the payments disturbances which is consistent with expectation; while the estimation result confirms the belief that there exists a trade-off between reserves and adjustment, namely, two policy instruments, the speed of adjustment and the stock of reserves, are substitutes.⁵

Under the Bretton-Woods system of fixed but adjustable exchange rates, reserves are held mainly 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 the 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). Earlier work on the stability of demand for international reserves in the post-Bretton-Woods period show evidence of a structural break (see Heller and Khan, 1978).

⁴ The reason for the inverse relationship between the speed of adjustment (γ) and the size of the payments disturbances (σ_ϵ^2) is best explained by equation (9) of Clark (1970,p581), which shows that the variability in income (σ_y^2) is proportional to the product of σ_ϵ^2 and $\gamma/(2-\gamma)$, where $0 \leq \gamma \leq 1$, given the marginal propensity to import. Since $\gamma/(2-\gamma)$ is an increasing function of γ for $0 \leq \gamma \leq 1$, a reaction to an increase in σ_ϵ^2 by increasing γ would exacerbate the increase in σ_y^2 . So, the optimal behaviour to minimise fluctuations in income would be to reduce γ , namely, to adjust slowly to a payments disturbance and hold larger reserves.

⁵ If a country adjusts more quickly to a payments imbalance by adopting appropriate policy measures to induce a balance-of-payments surplus (or deficit), it can reduce the impact of a payments disturbance on the variability in reserves and thereby reduce the probability of running out of reserves. Consequently, the country can economise on reserve holding.

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. The reasons why the demand functions for reserves have not been substantially altered since the end of the Bretton-Woods system include: (i) most of the world has remained on some type of pegged or adjustable pegged exchange rate system; (ii) the J-curve phenomenon together with the Harrod Effect, namely, the proposition that flexible exchange rates will decrease the amount of stabilising 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; (iii) monetary authorities may wish to control current accounts via management of the exchange rate because it will be advantageous to keep the current account positive, or at least to prevent it from randomly deteriorating; and (iv) monetary authorities of the countries which have large capital inflow of easily reversed funds (eg. portfolio investments) will wish to build up international reserves for precautionary reasons.

There may be a further source of instability of demand arising from financial integration. 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. Consistent with this hypothesis, an empirical study of demand for international reserves by Israel (an indebted country) over the period, 1964-1988, by Ben-Bassat and Gottlieb (1992b) 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.⁶

The incorporation of the new statistical concept of cointegration leaves the earlier findings largely unaltered. Ford and Huang (1994) and Huang (1995) incorporate the new statistical concept of cointegration and the corresponding error-correction mechanism into their analysis of the demand for international reserves by the Chinese monetary authority which still maintains pegged-rate system. Jung (1995) applies a continuous-time stochastic inventory control framework to his analysis of the optimal level of international reserves held by monetary authorities.

Summary

Traditional approaches to the definition and measurement of international reserves and liquidity recognise that the two concepts are not identical and the difficulty of defining the latter, owing to its close linkage with adjustment measures and measuring perceived creditworthiness that changes over time. Despite these concerns, the two concepts are

⁶ The assumption of demand-driven reserves (exogenous supply) is tested in Bahmani-Oskooee (1985) 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.

used interchangeably in academic and policy debate as well as empirical estimation of demand curves.

While the above approach offers pragmatic benefits, it suffers from a major weakness: failure to define and measure international liquidity means that little reliance may be placed on empirical estimates of demand for international liquidity. These estimates and their stability are the basis for identifying gaps in global liquidity as well as underpinning policy focus on an exogenously-driven supply of liquidity. A paradox of the research on demand for international reserves in the post-Bretton Woods period is its apparent stability. This finding stands in marked contrast to studies of demand for domestic money. The paradox is not satisfactorily explained in the literature.

IV. Aggregation of International Reserves: A New Approach

As noted in the previous section, traditional approaches to reserve-demand analysis are usually based on a framework where demand for international reserves, which is defined as the sum of the values of various reserve assets, is determined by a few variables that are more or less arbitrarily chosen. For instance, Frenkel (1980) assumes that the demand for international reserves, which is the sum of gold, SDRs, foreign exchange, and reserve position at the IMF, is a function of the variability of reserve holdings, GNP, and the average propensity to import; while Ben-Bassat and Gottlieb (1992a) assume that it is a function of the variability and the opportunity cost of reserve holdings.

In these approaches, it is implicitly assumed 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 substitutes 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.

Kane (1965) and Grimes (1993) explicitly incorporate the concept of different levels of liquidity of different reserve assets into their analyses. Kane as noted above is concerned with the concept of aggregate liquidity, and he defines a country's international liquidity as a weighted sum of various reserve assets, liabilities, commitments, and lines of credits. The weight for a reserve asset in his aggregator function is the expected value of a corresponding weight variable. Each weight variable represents the corresponding reserve asset's level of potential liquidity in meeting a specific degree of pressure against the country's currency. The degree of pressure is assumed to be a random variable having a probability density function (*pdf*), and the expected value of the weight variable is obtained over this *pdf*. Grimes is more specific in defining variables. In his model, the uncertainty a country's monetary authority faces is represented by the *pdf* for the amount of international reserves that is required for the authorities to intervene in the market to maintain a desired level of exchange rate during a specific period of time starting from the beginning of the intervention. At the same time, international reserve assets are classified into different 'tranches' according to the number of days required for an asset to be mobilised for the intervention. In his model, a country's portfolio of international reserve holdings, consisting of various reserve tranches, is determined by the authority's decision to minimise the expected cost of having a shortfall of reserves in any day following the

decision to intervene. The first-order conditions indicate that the optimal holding of reserve assets in a specific tranche is a function of the probability that on a future day the authority will decide to intervene in the market to maintain a certain exchange rate, the authority's preferences towards risk, marginal opportunity costs of holding reserves, how soon new borrowings can be made following the decision to intervene, and the *pdf* for the required amount of foreign reserves for each day. These studies highlight the importance of distinguishing reserve assets with different degrees of liquidity.

Given the differences in the characteristics of reserve assets, it is likely that an analysis of the demand for the simple-sum aggregate of various reserve assets would result in misleading conclusions. It is surprising that the well-developed approaches to domestic monetary aggregation have never been employed for the aggregation of international reserves while the two areas share many similar characteristics.

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 approaches introduced in this literature highlight the inadequacy of the traditional simple-sum aggregates of various monetary assets as a measure of the quantity of money in the economy. Although the aggregation methods introduced in the literature have not been directly employed to replace the traditional methods by monetary authorities, the literature has contributed towards a significant change in the view of monetary authorities and other economic agents on simple-sum monetary aggregates. Rather than concentrating on simple-sum aggregates of various-liquidity assets, such as M3 or broad money, more attention is now paid to the individual components of those aggregates, where each component is a simple sum of close substitutes, or to the 'economic aggregates' if the components are not closely substitutable.

Much the same story will carry over to international reserve issues. In the following we develop a simple model for the demand for international reserves incorporating aggregation theory.

Model

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

$$u = U(R) \tag{1}$$

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.⁷ 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, $U(\cdot)$ 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

$$R'\pi = X \tag{2}$$

⁷ 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.

where π 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.⁸ There are many variants of the user cost formula, but the formula derived by Barnett (1978, 1980) appears to have the strongest theoretical foundation:

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

where π_k is the k -th element of π , p is the implicit price deflator of imports, ρ 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:

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

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

Quantity Index

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

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

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

⁸ Notice that X is not the sum of all reserve holdings. It is the total opportunity cost of holding various types of international reserves.

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

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 π 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.

An Illustration

For an illustration of the effects of different aggregation methods, consider 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

$$S_h = \frac{R_h \pi_h}{\sum_k R_k \pi_k} \quad (7)$$

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	237.0	61.8	89.1
	p (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	552.0	198.1	202.9
	p (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	1303.0	489.7	417.9
	p (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 (b)		0.24	0.04	0.06	0.66	1.00		

Table 6: Quantity Indices

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

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 1980's 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 Malmquist quantity indices are based on (5) where $U(\cdot)$ is assumed to be a Cobb-Douglas function:

$$U(R) = \prod_k R_k^{\beta_k} \quad \text{for } k = \text{gold, SDRs, IMF position, and forex.} \quad (8)$$

It is well known that the β 's in (8) are fixed budget shares. In the present illustration, β 's are approximated by the average budget shares over the three decades (shown in the last row of Table 5). The Malmquist indices are provided in the third column of Table 6.

Diewert (1976) defines a 'superlative' index as an index that can provide a second-order Taylor series approximation to the true Malmquist index that is based on an arbitrary linear-homogeneous function, $U(\cdot)$. He shows that the following discrete-time *Divisia* index belongs to the group of 'superlative' indices.

$$Q_D^{t,0} = \prod_k \left(\frac{R_k^t}{R_k^0} \right)^{0.5(S_k^0 + S_k^t)} \quad (9)$$

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 (9), is that we only need observable values, namely, prices and quantities, to compute indices; and hence, unlike the Malmquist index, (5), we do not have to estimate unknown constants. Yet, a superlative index can provide a good approximation to the Malmquist index.

Summary

This section shows how various international reserves with different characteristics can be aggregated in a way that is consistent with aggregation theory. A quantity aggregate so measured is the 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. It is hypothesised that the demand for this economic aggregate of international reserves is a function of various variables such as overall opportunity cost of holding reserves, the variability in international transactions, variables representing policy changes (or differences), and possibly a dummy variable for the change in the exchange-rate regime.

Well-developed index number theory enables us 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.

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 instance, a weighted-sum or simple-sum aggregate implies all components are perfect substitutes.

V. Policy Issues

This section discusses the relevance of the international liquidity problem in the present international monetary system. It begins with an overview of earlier debate on the problems of the international monetary system and contemporary concern with the issue of adequacy of global liquidity arising from the asymmetric role of the U.S. payments deficit in the Bretton-Woods system. 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 to what extent do recent reform proposals address satisfactorily perceived weaknesses?

Earlier Debate

The problem of international liquidity is closely linked with the problems of adjustment and confidence. As defined in Mundell (1969), the global liquidity problem is the need for long-run adaptation of the quantity of world reserves to non-inflationary world economic growth.⁹ The global confidence problem is the need to prevent speculative worldwide shifts between stocks of different reserve assets from forcing changes in (fixed) relative prices. The global adjustment problem is the need to correct disequilibrium by bringing about equality of world demand and supply of international assets.

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 US 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.¹⁰ 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

⁹ Each problem as defined in Mundell (1969) has a global and national dimension. For example, the liquidity problem at a national level is the need to finance a balance of payments deficit. The confidence problem at a national level is to prevent changes in the status of reserve assets from causing speculative shifts in the composition of stocks of official reserves held by central banks. The adjustment problem from a national perspective is the need to correct a payments deficit or surplus.

¹⁰ 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 19th century (with France as the reserve centre) as well as the Genoa Conference in 1922 (gold and dollar shortage). Triffin only revived an earlier debate rather than activating a new one.

payments deficit. But a growing deficit would eventually undermine confidence in the ability of the US 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.

Analytically, the above argument assumes that (a) international reserves are a determinant of overall economic policy, based upon the reserve-policy flexibility trade-off; (b) reserves are a policy instrument in aggregate demand management and (c) a causal link operates between movements in international reserves, money and inflation as under the automatic adjustment mechanism of fixed exchange rates. At an operational level, there is a further set of assumptions relating to (a) the ability of the IMF to create SDRs at an appropriate rate; (b) ability to assess any gaps in adequacy and (c) ability to prevent instability in reserve asset composition. The linkage with empirical estimates of demand for international reserves discussed earlier is apparent in (b) since estimates of global demand for reserves are required in order to estimate the liquidity gap (the residual gap between projected demand and that met from variables driving reserve growth) to be met from reserves under official control.

An increase in the rate of reserve creation may reduce rather than increase reserve ease, by inducing monetary authorities to inflate, thereby reducing excess reserves by reducing their real rate of return. At a more general level, the complex linkages between individual country responses and global liquidity may also help explain why an external mechanism for increasing the supply of liquidity may be counter-productive even if all the above conditions were met. Increasing the supply of global reserves carries the risk of an asymmetric response by deficit and surplus countries. An expansion of liquidity reduces the willingness of surplus countries to delay (expansionary) adjustment measures while it weakens the resolve of deficit countries to adopt appropriate restrictive measures for external adjustment. The asymmetric response is a factor behind the tendency of surplus countries to resist proposals to expand global liquidity, through for example, additional SDR allocations as evidenced at the 1994 Madrid Interim Meeting and concerns by industrial countries of an inflationary bias. Conversely, such proposals are in the interests of deficit countries and hence supported by them.

Present relevance of adequacy

To what extent does the global liquidity problem remain? Three major institutional changes in the international monetary system have taken place 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 II, 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 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 US 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.¹¹

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.¹² The global issue of adequacy becomes a regional one. Second, even under perfect capital markets, 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 Buira, 1995; Goldstein and others, 1992). However, proposed global policy response and the

¹¹ The linkage assumes a stable liquidity demand function and no shifts in reserve composition.

¹² 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.

role of the International Monetary Fund differ widely. Three proposals for liquidity reform are discussed below; the first by Buira (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 an overall 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.¹³

(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 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. While these objectives tend to be mutually reinforcing, a single instrument cannot meet satisfactory multiple targets – the well-known problem of over-determinacy. In any event, the SDR is a small and falling share of reserve assets, a reflection of both restrictions placed on its use, being held only by central banks and non-use for intervention purposes and continuing dominance of the U.S. dollar in international transactions and as a store of liquidity (see Section II).

The operational robustness of the IMF commitment to supply SDRs “in a timely manner whenever the need arises” is also 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

¹³ 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 US dollars. More recent studies focus on redefining SDRs from a basket of five inflating currencies to a stable purchasing power unit.

liquidity requirements.¹⁴ Support for the proposal was based upon the seemingly plausible grounds of: (a) trade and growth needs of developing and transition economies; (b) need to strengthen the role of the SDR; (c) low risk to world inflation and (d) desire to reduce vulnerability of economies to sudden shifts in market sentiment. Main grounds for rejection of the proposal were: (a) possible inflationary impact, operating via secondary multiplier effects from an injection of primary liquidity and (b) claimed absence of an identified long-term liquidity need.

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

Even if agreement could be reached on an appropriate set of liquidity indicators ... a worthwhile exercise ... there still remains the contentious issue of appropriate policy response and institutional responsibility. It is by no means obvious that responsibility for meeting global liquidity requirements rests solely with the International Monetary Fund. The broader role of the Fund is to help strengthen processes for encouraging macro policy coordination between deficit and surplus countries as well as support reforms such as public sector governance through its conditional lending function. Satisfactory resolution of individual country adjustment problems will also help address an impending global liquidity problem.

(ii) Goldstein proposal

Goldstein and others (1992) do not offer a 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

¹⁴ 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 Buirá, 1995).

to credit may be appropriate, provided benefits are weighed against political economy costs, including incentives for rent-seeking.

(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.¹⁵ 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 not received serious attention, in part because of its core component of 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 are unlikely to be operational. But it is also apparent that reliance upon existing private credit market mechanisms to ensure equitable liquidity distribution is inadequate.

Several proposals (for example, Williamson, 1994) attempt to address this 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.

Summary

The main conclusion reached is that, contrary to the majority view, the question of global or regional liquidity adequacy remains relevant in the present hybrid international monetary system and environment of financial integration. Its relevance arises because of the existence of currency unions and the necessity of choosing only a subset of international liquid assets to meet this regional demand. Two further issues for global liquidity management have also arisen; the problem of unequal access to international

¹⁵ 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 (1992-9) and Williamson (1992-93). However, the latter two plans ignore the question of distribution and liquidity.

reserves and global capital markets for low-income developing countries and the ability of international credit markets to assess sovereign creditworthiness.

Recent reform proposals attempt to address the latter two issues. However, the question of developing indicators of liquidity adequacy for global and regional surveillance and institutional responsibility for monitoring adequacy and distribution remains unresolved.

VI. Concluding Comments

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

What is the appropriate method of aggregating international reserve assets with different characteristics and does it matter?

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. 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 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 and, 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 of 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.

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