



STAFF NOTE FOR THE G20

THE ROLE OF THE SDR—INITIAL CONSIDERATIONS

July 15, 2016

EXECUTIVE SUMMARY

Following the recent diagnostic of the international monetary system (IMS), the IMF will explore whether a broader role for the SDR could contribute to its smooth functioning. The economic rationale for or against broader use of the SDR will be examined, focusing in particular on identifying any gaps and market failures the SDR could help address in light of the increasingly multi-polar nature of the global economy and growing financial interconnectedness.

This note sets out some initial considerations on this matter. The note sketches some key issues bearing on the role of the SDR in each of three concepts: (i) the official SDR, or "O-SDR", the composite reserve asset issued and administered by the IMF; (ii) SDR-denominated financial market instruments, or "M-SDRs," which could be both issued and held by any parties; and (iii) the SDR as a unit of account.

M-SDRs reduce foreign exchange and interest rate risk relative to single-currency instruments, but there are some drawbacks and challenges. The basket nature of M-SDRs would allow the volatility of returns to be lower than for a similar single-currency instrument. However, the SDR only represents one of many possible sets of portfolio weights, and issuers or investors could use existing instruments to replicate their preferred weights at a relatively low cost. There are also challenges to market development, including settling and clearing of M-SDR transactions, dealing with potential basket redefinition, and fostering secondary market trading in order to generate liquidity and market depth.

There are potential benefits to using the SDR as a unit of account, which have to be weighed against other considerations. Publishing economic statistics and financial statements in SDR terms could help users identify valuation changes. Statistical authorities would need to invest in communicating the rationale for any change in practices.

While the official SDR under its current framework is not playing a significant role in the IMS, a re-examination of its role is expected to inform whether any specific reform options should be pursued. The evolution of the IMS has given rise to an active debate on how much concern is posed by high rates of reserve accumulation, global imbalances, and rising claims on reserve issuers, and on whether the O-SDR could contribute to addressing these issues.

CONTENTS

INTRODUCTION	3
SDR-DENOMINATED FINANCIAL INSTRUMENTS (THE “M-SDR”)	4
A. Diversification Properties of the SDR Basket	4
B. Other Potential Advantages	8
C. Potential Disadvantages	9
D. Market Development Issues	9
SDR AS A UNIT OF ACCOUNT	12
ROLE OF THE OFFICIAL SDR (THE “O-SDR”)	14
BOXES	
1. Historical Experience with SDR- and ECU-denominated Instruments	5
2. Technical Aspects of the Official SDR	15
FIGURES	
1. Development of M-SDR and US Dollar/SDR Exchange Rate	6
2. Indices of Primary Commodity Prices	12
3. Indices SDR Basket Changes and U.S. Dollar-SDR Exchange Rate	13
TABLES	
1. SDR Currency Basket and Interest Rate Instruments	6
2. Correlation Coefficients, 2005–15	7
References	17
ANNEX	
I. Diversification Properties of the SDR Basket	19

INTRODUCTION¹

1. Following the recent diagnostic of the international monetary system (IMS), the IMF will explore whether a broader role for the SDR could contribute to its smooth functioning (IMF, 2016a). In particular, it aims to identify any gaps and market failures the SDR could help address in light of the increasingly multi-polar nature of the global economy and growing financial interconnectedness. Unlike the most recent discussion on the role of the SDR in 2011 which focused on reform options (IMF, 2011a, 2011b), the economic rationale for or against broader use of the SDR will be examined.²

2. This note distinguishes between the role of the SDR in its three concepts. These are:

- The official SDR, hereafter referred to as the “O-SDR.” This is the reserve asset defined by the IMF’s Articles of Agreement and administered by the IMF; most of the SDR 204.1 billion stock outstanding was allocated in 2009 in the aftermath of the global financial crisis.
- SDR-denominated financial instruments, which could be both issued and held by any parties, hereafter referred to as “M-SDRs,” for market-based SDRs.³ M-SDRs emerged in the 1970s and early 1980s before the market faded, but there has been renewed interest recently.
- The SDR as a unit of account, for such uses as reporting economic statistics and financial statements, and pricing transactions—examples of the latter include Suez Canal fees and the Montreal Convention on damages, such as lost baggage, incurred by air carriers.

This note sets out some initial considerations on market incentives for M-SDRs, aspects of developing such markets, and reporting statistics in SDR terms. The note also sketches some key issues that would factor into an examination of the economic rationale for or against a broader role of the O-SDR.

¹ The note was prepared by an IMF staff team from the Strategy, Policy, and Review; Finance; and Monetary and Capital Markets Departments, in consultation with the Legal and Statistics Departments. The team was led by Kristina Kostial and comprised Wojciech Maliszewski, Neil Meads, Hui Miao, Andrew Swiston, Camilo Tovar, and Frank Wallace, under the overall guidance of Alfred Kammer.

² In their discussion of *The Case for a General Allocation of SDRs During the Eleventh Basic Period* (IMF, 2016b), Executive Directors generally concurred that it would be premature to bring a proposal for an SDR allocation or cancellation to the Board of Governors, pending further work on, among other things, the role of the SDR (see IMF, 2016c).

³ Previous analysis has used the phrase “private SDR” instead of “market SDR.” The M-SDR terminology is used since both private and official sector entities could issue or hold such instruments.

SDR-DENOMINATED FINANCIAL INSTRUMENTS (THE “M-SDR”)

3. This section examines the incentives for market participants to deal in M-SDRs and discusses some considerations for development of M-SDR markets. The current legal framework for SDRs under the IMF’s Articles of Agreement does not preclude any market participant from issuing or holding M-SDRs.⁴ Some M-SDRs were issued in the 1970s and 1980s, but activity has since been dormant, unlike markets for the European Currency Unit (ECU), which developed throughout the 1980s (see Box 1). While the ECU benefitted from the movement toward European monetary integration, other factors are explored in more detail in this section, with a view to assessing constraints on activity in M-SDRs. A further avenue for research could include assessment of the potential systemic contribution of the M-SDR should deep, liquid markets develop.

A. Diversification Properties of the SDR Basket

4. M-SDRs should reduce foreign exchange and interest rate risk relative to single-currency instruments by inheriting some of the diversification properties of the O-SDR. The SDR valuation method aims at ensuring a stable value of the SDR in terms of the major currencies of the world—a key consideration in switching its valuation to a basket of currencies in 1974 (IMF, 2015a and Polak, 1979). With the basket weights reflecting the importance of the currencies in the world’s trading and financial system, this also helps limit the influence of a particular currency or group of currencies on the value of the SDR (Table 1).⁵

- **The weighted returns on the instruments in the SDR basket have been less volatile than the returns of the individual components.** The value of the SDR has been more stable than the value of the individual currencies, as their fluctuations have displayed low or negative correlations, buffering the impact of exchange rate movements on the value of the SDR (Table 2).⁶ Similarly, the SDR interest rate has been less volatile than its individual components, as the component rates have been positively correlated, but to a low enough degree that the basket provides some diversification relative to the individual components (Table 2).⁷

⁴ With market forces determining the interest rates on M-SDRs (which could vary by instrument), the M-SDR market could develop independent from the O-SDR.

⁵ The currencies included in the basket are also widely traded in foreign exchange markets, so are less likely to experience large fluctuations due to market illiquidity. Furthermore, the currencies in the basket are those of the largest exporters. Owing to their economic size, their exchange rates are less likely to encounter variability due to idiosyncratic shocks.

⁶ The highest correlation is for the Chinese renminbi-U.S. dollar currency pair, reflecting in part that the renminbi was managed against the dollar during some of the sample period.

⁷ The SDR interest rate is determined by market rates on representative three-month instruments in the currencies that comprise the SDR currency basket, using the same weights (Table 1). These instruments have a credit profile of the highest quality, fully comparable to that of government paper available in the market or, in the absence of appropriate official paper, comparable to the credit risk of prime financial instruments (IMF, 2015b). The SDR interest rate has been set at a weekly frequency since 1983.

Box 1. Historical Experience with SDR- and ECU-denominated Instruments

While SDR-denominated assets have been issued previously, a deep, liquid market did not develop. This box contrasts experience with SDR-denominated assets with the development of private markets for the European Currency Unit (ECU).

SDR-denominated assets were first issued in 1975 and reached a peak in the early 1980s. By end-1981 it was estimated that up to 50 banks were prepared to accept and manage SDR deposits, such deposits amounted to SDR 5–7 billion, while SDR 563 million in SDR-denominated bonds had been issued, and five syndicated bank loans worth SDR 908 million had been extended (IMF, 1987). However, the SDR market quickly dried up—no SDR bonds or credits have been issued since 1981 and bank deposits declined. By contrast, the market for ECU-denominated assets became well-developed: The basket currency was created in 1979 as part of the European Monetary System (EMS), and by 1990, the ECU ranked as the sixth most-used currency in terms of outstanding international bonds.

Development of SDR and ECU markets reflected, in part, ready-made diversification benefits of basket currencies, especially for retail investors. In the lead-up to the end of the Bretton-Woods system, the U.S. dollar devalued by around 17 percent, and the U.S. dollar depreciated further in the late 1970s (Figure 1). In this environment, SDR-denominated assets offered investors and bond issuers stability, in the absence of alternative hedging instruments. However, the U.S. dollar strengthened substantially in the early 1980s, reducing the appetite of many investors for such diversification. By the mid-1980s, a further round of U.S. dollar depreciation did not result in a revival of the SDR market—possibly in part because of financial liberalization (easing restrictions on investing in component currencies—see below) and innovation, with currency swaps allowing the transformation of liabilities from one currency into another.¹ The ECU also offered diversification, but benefitted from relative stability of currencies within the basket, and from being reflective of a growing range of commercial and financial dealings (at least within Europe) for a number of increasingly integrated economies.

The ECU's initial market development may have benefitted from opportunities for regulatory arbitrage. The use of basket currencies allowed markets to by-pass restrictions on the use of the Deutsche mark to denominate bonds for non-residents (Dammers and McCauley, 2006). As such, when investor demand in the Deutsche mark rose and demand for the U.S. dollar fell, demand for the ECU increased since it acted as a Deutsche mark proxy given the mark's high weight in the ECU basket. Restrictions on the under-writing of Deutsche mark bonds were eventually lifted, however, and internationalization of the Deutsche mark increased as financial liberalization required under the single market proceeded. Demand was also supported by yield differentials amidst relative stability of currencies within the basket (IMF, 2011). Given the presumption of continued stability, issuers from countries with relatively higher interest rates and investors from countries with relatively lower interest rates could both gain by issuing/investing in ECU rather than their respective national currencies.

The private ECU market was bolstered by official sector interest and support. For example, several European institutions issued bonds in ECUs and the EC—through publicly favoring expansion of private use of the ECU—was seen as committed to the ECU during the transition to the Euro. As the private ECU market expanded, European central banks also started holding private ECU as part of reserves to use for market intervention (Allen, 1993). Although the private ECU market declined following the ERM crisis, the market recovered as the introduction of the Euro approached and reflected the EC's commitment to convert one ECU for one euro (Dammers and McCauley, 2006). Private sector market development was also facilitated by the BIS helping to develop an ECU clearing system.

¹ The first currency swap occurred in 1981 between the World Bank and IBM. The estimated principal amount of outstanding currency swap contracts is estimated to have increased from just \$2-3 billion in 1982 to around \$80-100 billion by end-1986. See Hammond (1987) for more details on swap market developments.

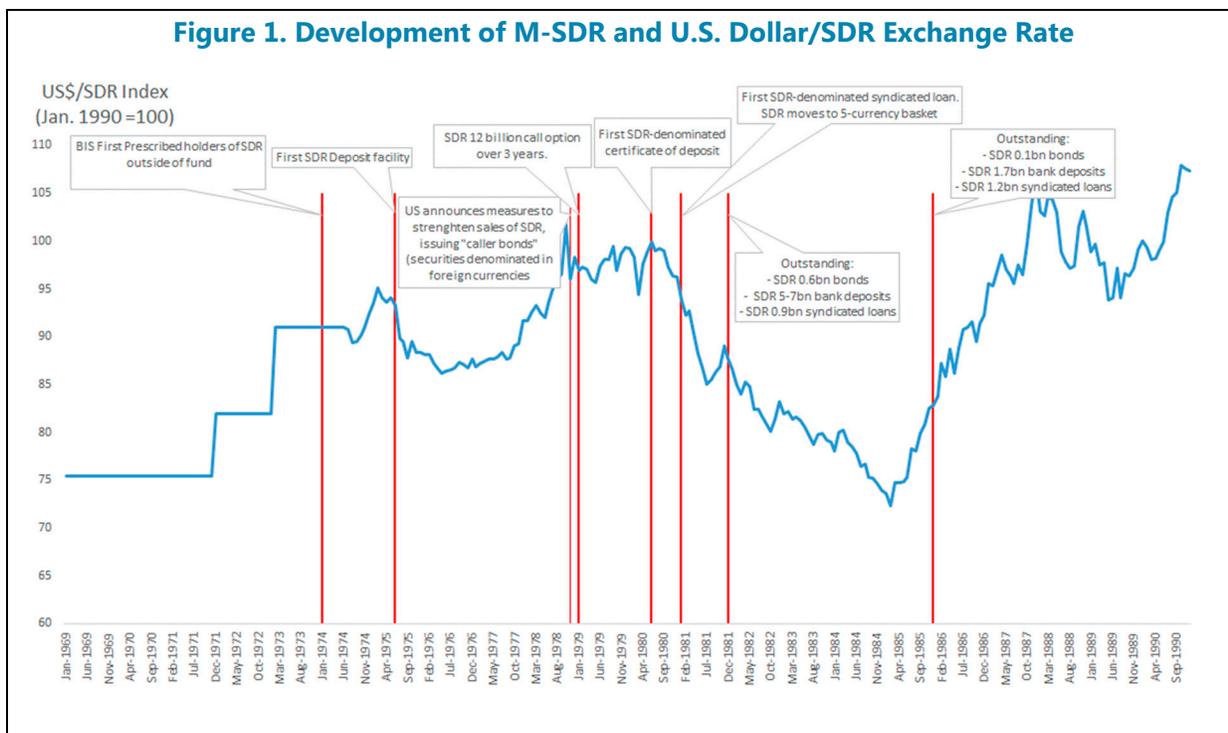


Table 1. SDR Currency Basket and Interest Rate Instruments

	Basket weights		Interest rate 1/ (3-month instrument)
	Current	As of October 1, 2016	
Dollar	41.9	41.73	U.S. Treasury Bill.
Euro	37.4	30.93	Central government bonds with AA rating and above. 2/
Pound	11.3	8.09	U.K. Treasury Bill.
Yen	9.4	8.33	Japanese Treasury Discount Bills.
Renminbi		10.92	Benchmark yield for China Treasury bonds. 3/

1/ On October 24, 2014, the Executive Board of the International Monetary Fund amended the rule for setting the SDR interest rate by introducing a floor of 0.050 percent (5 basis points) and changing the rounding convention for calculating the SDR interest rate from two to three decimal places.

2/ Published by the European Central Bank.

3/ Published by China Central Depository and Clearing Co., Ltd.

**Table 2. Correlation Coefficients, 2005–15
(Monthly Changes)**

	Currencies					Interest Rates				
	Dollar	Euro	Pound	Yen	Renminbi	Dollar	Euro	Pound	Yen	Renminbi
Dollar	1.00					1.00				
Euro	-0.87	1.00				0.19	1.00			
Pound	-0.24	0.14	1.00			0.40	0.79	1.00		
Yen	0.22	-0.52	-0.38	1.00		0.05	0.34	0.42	1.00	
Renminbi	0.91	-0.80	-0.20	0.16	1.00	0.01	0.50	0.48	0.38	1.00

Source: IMF staff calculations.

Notes: For exchange rates, correlations are against the SDR. See Table 1 for a description of the interest rate instruments. The renminbi is shown since it will be included in the SDR basket effective October 1, 2016.

- **Risk-adjusted returns also would have typically outperformed the risk-adjusted returns of investments in single-foreign currency securities.** Annex I compares the risk-return properties of a synthetic SDR bond with those of three-month Treasury bills in each of the component currencies, plus the Chinese renminbi (RMB) since it will be included in the SDR basket effective October 1, 2016.⁸ For investments outside the investor's own currency, the synthetic SDR bond earned higher returns per unit of risk, as measured by Sharpe ratios (average return, divided by the standard deviation of returns) than for most single-currency instruments, with the exception of returns on RMB-denominated instruments.⁹ The high risk-adjusted returns of the synthetic SDR bond were driven by its low exchange rate volatility.¹⁰
- **Returns on M-SDRs would be expected to reflect uncovered interest parity of the currencies in the SDR basket plus premiums associated with the credit characteristics of the issuer.** Holding constant the latter, an M-SDR should have a return with a lower variance than that of a comparable instrument denominated in one of the component currencies (van den Boogaerde, 1984; Hoguet and Tadessee, 2011; Dammers and McCauley, 2006).

5. M-SDRs could therefore be attractive to investors and issuers by offering a pre-packaged diversification option. The above discussion applies to the weighted returns on the instruments in the SDR basket vis-à-vis the individual components, which are short-term Treasury securities in the component currencies. Ultimately the underlying risk of the M-SDR will not move solely with these rates, but will depend on other factors such as the term premium and the

⁸ The synthetic SDR bond consists of the instruments in the SDR basket, but the return differs from that on the O-SDR in that the floor of five basis points on the O-SDR interest rate (in effect since 2014) is not applied.

⁹ Investments in the investor's own currency typically display the highest risk-adjusted returns by construction, since returns are measured in the investor's own currency. This eliminates foreign exchange risk on the home currency instrument, which is the largest source of risk.

¹⁰ The high risk-adjusted returns in RMB were driven by its appreciation over the sample period, which outweighed its volatility.

creditworthiness of the issuer, which will be reflected in the demand and pricing of the instrument.¹¹ This could blunt the diversification properties for M-SDRs, though divergences should be bounded by arbitrage. The costs would also need to be weighed against those of alternative instruments that provide similar diversification benefits, as discussed later in this section. The diversification aspect may be particularly attractive to retail investors (Dammers and McCauley, 2006), or official investors (e.g., central bank reserve managers, treasury operations of international organizations) with portfolios benchmarked to the SDR or with SDR-denominated liabilities.

B. Other Potential Advantages

6. Both issuers and investors could reap gains from M-SDRs by consolidating the number of denominations in which they operate. This was a factor supporting private activity in the ECU (Allen, 1990; Tosolini, 2014). While the costs of operating in multiple currencies may have declined as financial market infrastructure has developed, and the M-SDR is settled in a smaller number of currencies than the private ECU was, there could still be scope for savings. For investors with portfolios benchmarked to the O-SDR, M-SDRs could reduce the need for portfolio rebalancing compared to investing in single-currency bonds. Further analysis of the typical transactions costs for issuance of and investment in foreign currency securities (including the foreign exchange leg of the transaction) could help identify the potential magnitude of reduced costs.

7. Gaining exposure to a currency subject to capital controls could be another advantage, though the potential pickup in RMB exposure is limited. A driver of the private ECU market was the combination of restrictions on issuance of instruments denominated in Deutsche mark with the close relationship of the value of the ECU to the mark (Box 1). Effective October 2016, M-SDRs could offer similar exposure to the RMB. While there could be unsatisfied demand for RMB exposure among international investors, M-SDR activity associated with this would be limited by the fact that the RMB exposure embodied in the O-SDR (just over 10 percent) is small in comparison to the weight of the mark in the ECU (over 30 percent).¹² Activity would be further limited by the existence of an active offshore RMB market (see PBC, 2015 and IMF, 2015a), which already provides a channel for exposure to the RMB.¹³

8. M-SDR activity has also been suggested as a potential channel for domestic investors subject to controls on capital outflows to gain exposure to reserve currencies.¹⁴ For example in

¹¹ However, this would also apply when comparing single-currency instruments with risk-free, short-term instruments in that currency.

¹² In addition, given the European Monetary Union convergence criteria, the currencies in the ECU basket were expected to remain within a certain range of the central parity, which limited expected fluctuations against the mark.

¹³ Reserves managers also already have unrestricted access to onshore RMB markets.

¹⁴ In the presence of capital controls, issuance would likely be onshore and settlement carried out in the domestic currency. This would make such activity similar to some existing and historical examples of instruments indexed to a foreign currency but payable in the domestic currency. These instruments have tended to be more attractive when domestic investors attach a high risk to depreciation of the domestic currency, underscoring the store... (continued)

China, there may be untapped demand among domestic investors for exposure to reserve currencies as capital controls are gradually lifted. From this perspective, M-SDRs issued in the onshore market could potentially reduce demand for foreign currency and reduce capital outflows by allowing domestic market participants to diversify their foreign exchange risk. From the perspective of issuers of M-SDRs in the onshore China market, they would in essence be assuming foreign exchange risk by indexing their liabilities to a foreign currency instead of issuing directly in RMB.¹⁵ Those issuers with needs for foreign exchange may instead find it more attractive to tap international markets, if they have access.

C. Potential Disadvantages

9. The main disadvantage of M-SDRs is that with fixed currency amounts, the basket represents only one of many potential sets of portfolio weights. With M-SDRs, investors and issuers would take as given the currency weights of the SDR basket.¹⁶ Given the existence of deep and liquid markets in each of the component currencies, as well as alternative instruments such as foreign exchange and interest rate derivatives, a key question is whether investors or issuers find that the benefits of the pre-packaged diversification discussed above outweigh those of constructing a customized portfolio with their preferred currency weights. In practice, entities that may not find it feasible to invest or issue in a number of currencies may find M-SDRs a more attractive diversification option than entities with access to a wide array of markets and risk management products would.

10. The complexity of M-SDRs may pose a hurdle to some issuers and investors. In the early stages of market development, and in the absence of a well-defined yield curve, market participants would need to price the instrument referring to yield curves in each currency in addition to pricing the credit risk of the issuer. This challenge in pricing M-SDRs may constrain demand and secondary market trading. The basket nature of M-SDRs also signifies that an issuer or investor engaging in an M-SDR transaction is taking on an asset or liability exposure in five currencies. This could require, for regulatory purposes, parallel transactions on the other side of the balance sheet, or hedging the individual currency exposures. Similar such complexities weighed on the development of the private ECU market (Tosolini, 2014).

D. Market Development Issues

11. Settlement and clearing of M-SDR transactions is a critical aspect of market development. Once an M-SDR market developed and accounts denominated in M-SDR were widespread, such accounts could be used for settling coupon and redemption payments, which

...of value properties of the reserve currency exposure. In some jurisdictions, onshore issuance could carry higher transfer risk than comparable issuance in the international capital markets.

¹⁵ For a potential issuer such as the People's Bank of China, such issuance would reduce its sizable long position in foreign currency.

¹⁶ The effective weights in the basket also fluctuate on a daily basis with exchange rates.

would be greatly facilitated by having an M-SDR clearing facility.¹⁷ However, until these conditions are in place, transactions would need to be settled in one or more of the component currencies.¹⁸ The issuance terms of individual instruments could specify who would elect the currency of settlement and when. Whether this could inhibit secondary market trading, or if standardization of such terms would help, could be discussed with market participants. For the private ECU, the BIS provided clearing services for commercial banks, and further examining this experience could provide valuable lessons. Another point for dialogue with market participants and financial intermediaries is whether there would be a need to adjust their infrastructure or information technology systems to facilitate M-SDR activity.

12. If M-SDRs were primarily accumulated by buy-and-hold retail investors, they could be less liquid than comparable single currency claims. As noted above, with the pre-packaged diversification of M-SDRs more likely to appeal to small-scale investors, their liquidity may be lower than comparable single-currency instruments subject to frequent trading by institutional investors, which could lead to an interest rate premium on issuance that may be sizable until a deep and liquid market develops. IMF (2011a) examined various studies of other financial markets and suggested the liquidity premium could lie within a wide range, from 25 to 150 basis points, postulating a central tendency of 80 to 100 basis points. The premium would be expected to decline as issuance increased, but the market would face a first-mover problem—issuers could be dissuaded from entering the market until it developed enough to reduce the premium. The degree to which the low initial supply and buy-and-hold behavior would affect market liquidity is subject to a wide range of uncertainty and could be refined through further research.¹⁹

13. While M-SDRs may initially attract more activity in short-maturity instruments, a fully liquid M-SDR yield curve would facilitate market development. A curve specific to M-SDR instruments would facilitate pricing and secondary market trading. Initially, M-SDRs could be priced off the swap curves in the component currencies, though a substitute for the RMB such as the Treasury yield curve may need to be used since a liquid swap curve has not yet developed. Short-dated claims would help reduce the uncertainties related to the SDR basket review cycle, and could be easier to market to buy-and-hold investors. As with a number of examples in developing local currency bond markets, the maturity of instruments could be lengthened once the market gained experience at the short end of the curve.

14. Market participants would need to resolve how to deal with potential revisions to the SDR basket at the time of quinquennial SDR reviews. An “open basket” approach would specify that the instrument would be indexed to the official basket definition at the time, which exposes

¹⁷ Tosolini (2014) describes the evolution of this process for the private ECU. M-SDR clearing and settlement may require amendment to legal and regulatory frameworks governing clearing and settlement.

¹⁸ The national regulations governing clearing and settlement in each component currency would apply.

¹⁹ For some countries, M-SDR activity could also adversely affect the turnover and liquidity of their local currency market by segmenting the market. For emerging and developing markets, official sector issuers may thus face a tradeoff with the objective of developing local currency bond markets.

participants to redefinition risk. Alternatively, the “closed basket” approach maintains the basket definition in effect upon entering into the contract, which limits risks but can lead to non-standardized instruments.²⁰ M-SDRs would also grapple with this issue, given that the SDR currency basket is reviewed by the IMF every five years.²¹ Uncertainty surrounding basket redefinition could adversely affect demand, the maturity of new issuance, and trading in the secondary market, but given the broad stability in the composition of the SDR basket, the magnitude of this risk should not be overstated.²² Experience with the private ECU suggests that the “open basket” approach is preferable.²³ This would preserve a unified definition of the M-SDR, facilitating development of market conventions, dealer arrangements, regular issuance, and support for repos and forwards, which would help boost liquidity and thus support secondary market trading.

15. Other market development issues include:

- **Official involvement.** Since a number of supranational issuers denominate their balance sheet in SDRs they may be attracted to issue M-SDRs to minimize currency mismatch and invest in M-SDRs to reduce portfolio adjustments and lower trading costs, subject to the existence of a liquid market. Experience with the Asian bond fund initiative may provide some guidance on where official sector involvement could support market development. In order to promote local bond markets, in 2005 Asian central banks pooled reserves to establish the Asian bond fund to invest in local currency bond markets. The Asian bond fund is managed independently, enlarged the professional investor base, and helped develop yield curves in the local bond markets.
- **Foreign exchange markets.** Liquid foreign exchange markets with trading in forward contracts typically facilitate activity in fixed-income instruments, as occurred with the ECU. However, foreign exchange trading in basket instruments is currently rare, and with this less of an immediate precursor than a subsequent milestone for market development, this issue will be left for future work.
- **Investor indices.** Inclusion in major bond indices or creation of an M-SDR index could help enlarge the investor base by facilitating the participation of institutional investors. The M-SDR would first need to attain a certain minimum issuance scale. Other considerations will be explored further.

²⁰ Under this approach, contracts for M-SDRs would need to specify the source of exchange rate quotations for each currency in the basket, in order to allow instruments to be valued against the old, closed basket in case a currency subsequently drops out of the official basket.

²¹ The SDR valuation review typically evaluates the currency selection criteria, the selection of currencies, the weighting methodology, and the composition of the SDR basket. The last SDR valuation review was conducted in 2015 (IMF, 2015a, 2015b).

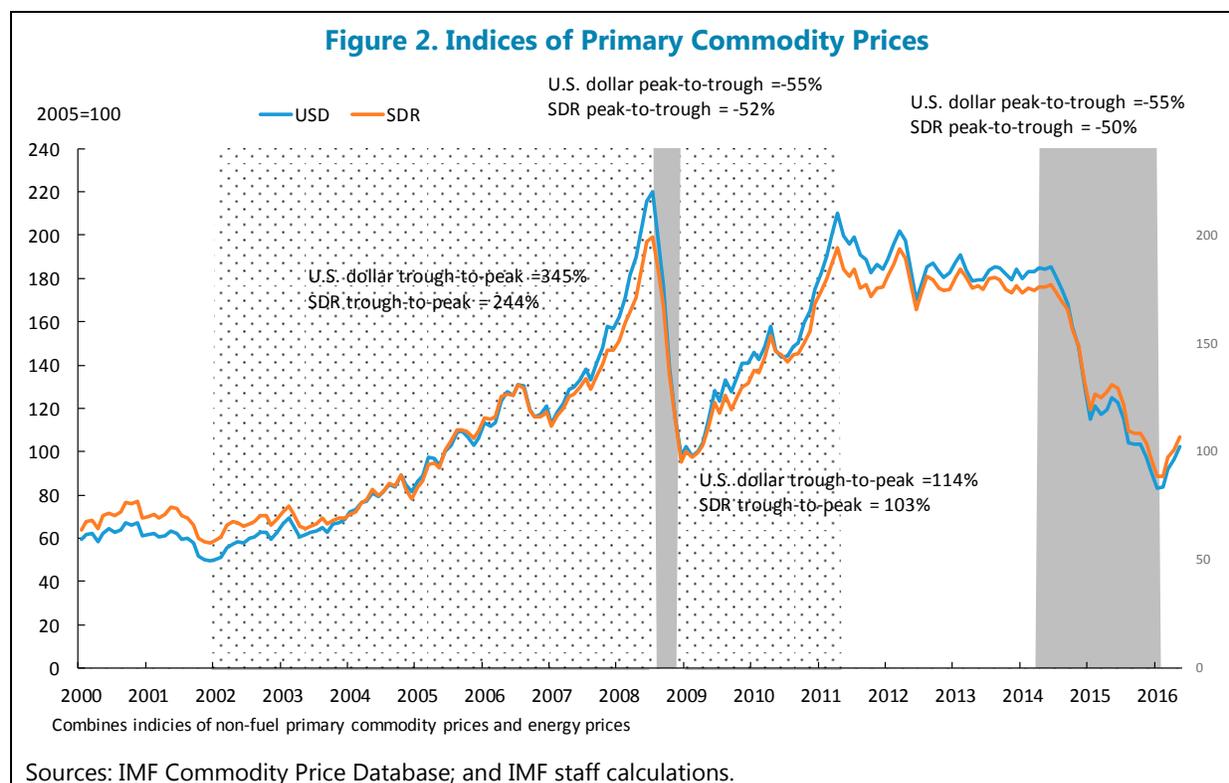
²² For previous basket redefinitions, the BIS, which offers deposit facilities to its central bank clients, has engaged in compensatory payments to adjust for the changing basket in terms of the principal and interest rate. The amount has been small as the adjustment of basket weights has not been significant. The market could potentially adopt similar arrangements as a convention to deal with basket redefinitions.

²³ Tosolini (2014) notes that this contributed to the development of the private ECU market.

SDR AS A UNIT OF ACCOUNT

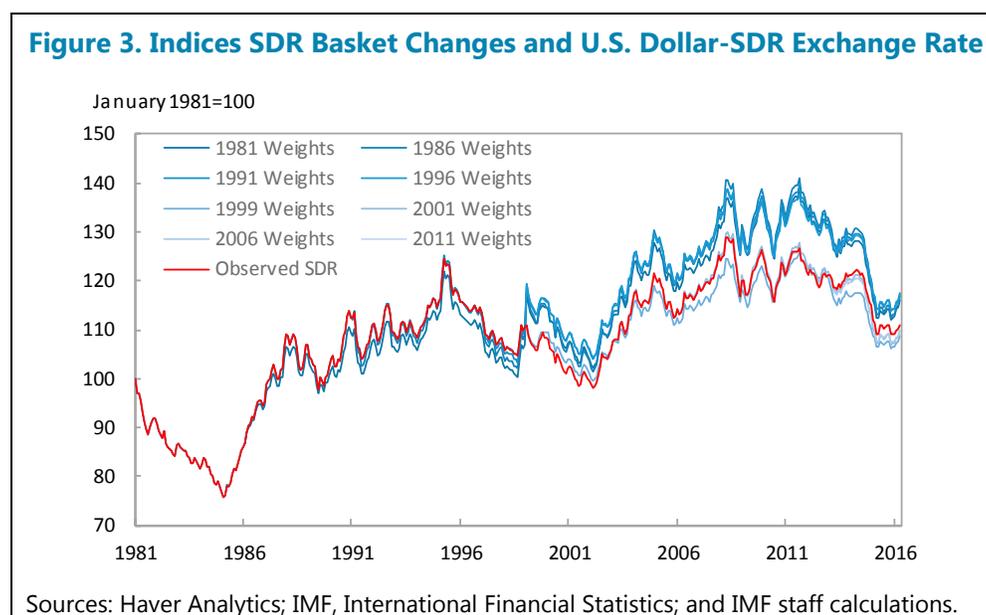
16. The SDR is used in a handful of instances as a unit of account for economic statistics, financial statements, and pricing of transactions. International reserves data is published in SDR terms by China and in *International Financial Statistics*, a number of international and regional institutions use the SDR as a unit of account for their balance sheets, and the lending of some multilateral development banks is denominated in SDR. The SDR is also used to price some transactions with a multinational character—Suez Canal fees and damages, such as lost baggage claims, incurred by air carriers under the Montreal Convention. Overall, though, uptake of the SDR as a unit of account has been low.

17. There are some potential benefits to such uses. The diversification properties of the SDR basket noted above imply that presenting data or pricing transactions in SDR terms would smooth out valuation changes from fluctuations among major currencies. For commodity prices, for example, price fluctuations are often in the opposite direction as fluctuations in the value of the U.S. dollar. For this reason, observed commodity price volatility is lower in SDR terms than in terms of U.S. dollars (Figure 2). From the perspective of a commodity exporter, pricing commodities in SDR terms could thus stabilize receipts in terms of the domestic currency (IMF, 2011a). Whether there would also potentially be complementarities between SDR commodity pricing and M-SDR development could be examined further.



18. Basket redefinition presents one potential drawback. Uncertainty on the outcome of quinquennial SDR reviews—either through inclusion of new currencies or through adjustments in the weights of currencies in the basket—could in theory affect the attractiveness of the SDR as a unit of account by reducing its ability to act as a common, stable (over time) base for prices. For example, Figure 3 highlights that the observed U.S. dollar-SDR exchange rate differs from that implied by some earlier constructs of the SDR basket. Thus, there is some redefinition risk, but this should not be overstated as Figure 3 also shows that near-term fluctuations in the value of the SDR would have been broadly similar even if the weights had not changed. Furthermore, the observed basket has displayed a lower long-term variance than if the weights had been fixed over time, suggesting that, abstracting from the relatively small redefinition risk, the changes in weights have made the SDR a more stable anchor of value.

19. Statistical authorities considering publishing statistics in SDR will need to weigh a number of other considerations. These include: (i) while end-users could in principle perform their own conversions, offering the data pre-packaged in SDR terms could increase uptake and familiarity with it; (ii) authorities would need to be prepared to publish in both SDR and U.S. dollar terms for those users who continue to demand the latter; (iii) improvements in technology may be lowering the cost of disseminating statistics online in more than one currency; and (iv) any change in reporting practices should be clearly communicated to data users and markets to avoid confusion over its rationale. The IMF is exploring the feasibility of publishing online also in SDR terms statistics on the balance of payments and international investment position, and the COFER survey on official holdings of foreign exchange reserves.²⁴



²⁴ Conversions would be performed by the IMF using the exchange rates it already disseminates, to keep from expanding the reporting burden.

ROLE OF THE OFFICIAL SDR (THE “O-SDR”)

20. The O-SDR is a unique instrument among international reserve assets in two key respects. First, it is allocated according to IMF quotas rather than accumulated through a balance of payments surplus. Second, it is not the direct liability of any single economy but represents a potential claim on the freely usable currencies of other participants in the SDR Department (Box 2). These characteristics also signify that quota-based O-SDR allocations are not targeted to match the liquidity needs of individual countries, and larger allocations would raise the potential claims of members using O-SDRs on other members’ freely usable currencies.²⁵

21. While the O-SDR under its current framework is not playing a significant role in the IMS, a broader re-examination is expected to inform whether any specific reform options should be pursued. Larger allocations and other options for reform have been discussed extensively in the past, but those most likely to have a systemic impact have failed to achieve the high degree of consensus among the membership necessary for implementation—including, in some cases, amending the IMF’s Articles of Agreement. As such, a first step could be to examine, in light of the evolution of the IMS and its current features, why the O-SDR has played only a minor role in the IMS and the economic rationale for or against a broader role, before going into how this could be accomplished.

22. The evolution of the IMS has given rise to changing perspectives on the role the O-SDR should play. The O-SDR was created as a supplement to reserve assets in the late 1960s under the Bretton Woods system of fixed but adjustable exchange rates, amid concerns over the sustainability of continued accumulation of claims on the United States—the “Triffin dilemma” (Triffin, 1961). While such concerns persisted after the move to a system of floating exchange rates, the O-SDR played only a minor role in the IMS, and despite the aims of the Second Amendment of the Articles of Agreement to make the O-SDR “the principal reserve asset of the IMS” (Article VIII, Section 7 and Article XXII), consensus was never reached on the more far-reaching reform proposals discussed at the time (see Boughton, 2001 and McCauley and Schenk, 2015). Significant reserve accumulation in recent decades and the resulting capital flows from emerging to advanced economies, along with the rising public debt of reserve currency issuers, have spurred renewed discussion on whether the O-SDR has a broader role to play as a reserve asset, with the general lines of the debate as follows:

- Some argue that the O-SDR could mitigate the effects of the existence of a modern form of the Triffin dilemma (see Ocampo, 2010 and Zhou, 2009). According to this view, with the large magnitude and volatility of capital flows, and no mechanism for symmetric adjustment of surplus and deficit countries, the incentives are in place for: (i) excessive reserve accumulation and uphill capital flows as non-reserve-issuing countries attempt to avoid

²⁵ With O-SDR use not subject to conditions, and currently no safeguards to ensure that holdings are reconstituted over time, O-SDRs can in principle be used for long-term financing rather than short-term liquidity needs.

balance of payments deficits and build precautionary liquidity buffers;²⁶ and (ii) undermining policy discipline in reserve currency issuers, manifested in current account and/or fiscal deficits. In such an environment external balances can become unanchored from fundamentals, or disinflationary pressures can emerge as all countries cannot simultaneously improve their balance of payments. The O-SDR could help reduce these incentives by providing access to international liquidity.

Box 2. Technical Aspects of the Official SDR

The official SDR, hereafter O-SDR, is the reserve asset created in 1969 and defined under the IMF's Articles of Agreement. The O-SDR is not a currency, but a potential claim on the holdings of freely usable currencies of participants in the SDR Department (currently all IMF members). Furthermore, it is allocated by the IMF to these participants according to their quotas. Allocations are not targeted based on need or any other consideration, but aiming to supplement existing reserve assets. These characteristics imply that it is neither a direct liability of any single economy nor accumulated through a balance of payments surplus.

The O-SDR can be held on the balance sheets of participants or used unconditionally to obtain a freely usable currency to meet a balance of payments need (or for other reserves management purposes). Originally, participants who used a large share of their holdings were required to reconstitute them over time, but this requirement has been suspended since 1981. Transactions and holdings are limited to participants in the SDR Department, the General Resources Account within the General Department of the IMF (as a result of transactions between participants and the IMF), and prescribed holders (some international financial institutions and regional central banks; prescribed holders can hold O-SDRs but do not receive allocations).

O-SDRs are primarily exchanged for freely usable currencies through voluntary exchanges between members, typically mediated by the IMF through the system of Voluntary Trading Arrangements (VTAs). The designation mechanism remains as a backstop by ensuring that participants with a balance of payments need can exchange on demand their O-SDRs with participants with a strong external position (such participants cannot be obligated to increase their holdings of O-SDRs to more than twice their cumulative allocation), but this mechanism has not been used since 1987.

Since 1974 the O-SDR has been valued based on a basket of currencies, which currently includes the U.S. dollar, euro, Japanese yen, and pound sterling. The basket will be expanded effective October 1, 2016 to include the Chinese renminbi, reflecting its rising international use and trading. The O-SDR carries an interest rate determined by the yields on three-month treasury bills of the component currencies, making its return comparable to that of an asset of the highest credit quality.

The O-SDR mechanism is self-financing and levies charges on allocations, which are then used to pay interest on O-SDR holdings. If the O-SDR holdings of a participant are equal to its allocation, the charges are equal to the interest received. If a participant's holdings rise above its allocation, it effectively earns interest on the excess. Conversely, if it holds fewer O-SDRs than allocated, it pays interest on the shortfall.

²⁶ Obstfeld (2011a) sketches a mechanism through which this could occur.

- Others argue that the globalization of finance has weakened the link between the macroeconomic policies of reserve currency issuers and the currency denomination of reserve assets, allowing the creation of sufficient liquidity in reserve currencies that is independent of the policies of reserve issuers. According to this view, the importance of external imbalances and the precautionary motive in the growth of reserves are both overstated. Proponents of this view see little impact from broader use of the O-SDR.²⁷

23. In the current context, some questions to look into as part of this work include:

- Impact on reserve accumulation, global imbalances, or external adjustment: By raising effective liquidity buffers, how much would a higher stock or greater usability of the O-SDR reduce accumulation of reserves through balance of payments surpluses? Would broader use of the O-SDR affect external adjustment in deficit countries and in reserve currency issuers?²⁸ Would it have an inflationary impact, or help avert potential risks of global deflation? Further examination of the effects of the 2009 allocations could provide evidence on some of these questions.
- Is the O-SDR serving as a truly liquid and usable reserve asset? How does its status as a call on other reserves affect its attractiveness relative to other reserve assets?
- As a departure from the unconditional use of the O-SDR as conceived under the current framework, O-SDRs (whether the existing stock, or new issuance) could be used as a means to finance crisis prevention instruments such as precautionary liquidity facilities, or augment the resources available via conditional lending. Such uses could provide access to liquidity without a permanent commitment of freely usable currency.²⁹ A key open question is, would this reduce self-insurance or improve incentives for policy adjustment (see Obstfeld, 2011b)? Furthermore, would such objectives be best achieved by the O-SDR as defined in the Articles of Agreement, or by an alternative asset or funding vehicle? Conditional use of the O-SDR would also be related to issues such as the IMF's lending toolkit and the size of IMF resources, so further analysis would need to be coordinated with ongoing work in those areas.

²⁷ See, for example, Farhi and others (2011), and Borio (2013, 2016).

²⁸ Note that these potential channels for the SDR to contribute to IMS stability are different from that of diversification of international currency use. Given the characteristic of the O-SDR as a claim on existing freely usable currency, diversification is more of a consideration in the context of reducing volatility through increased use of the M-SDR.

²⁹ The impact on those who could potentially be called upon to provide freely usable currency under such facilities would also need to be taken into account.

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Annex I. Diversification Properties of the SDR Basket

The risk-return properties of a synthetic SDR bond are compared with those of three-month Treasury bills in each of the component currencies, plus the Chinese renminbi (RMB) since it will be included in the SDR basket effective October 1, 2016.³⁰ The metrics analyzed include the standard deviation of returns and the Sharpe ratio—the average return, divided by the standard deviation of returns—which provides a measure of risk-adjusted returns.³¹ The returns are also decomposed into the portions attributable to foreign exchange fluctuations and to interest income.

Returns are calculated from the perspective of investors in each of the component currencies of the SDR basket. Each investor evaluates the returns in terms of her own currency. Following Shimizu and Ogawa (2005), the returns are calculated as follows: The investor exchanges her *base* currency into a *target* currency (which can include the SDR basket), at a price in terms of the *target* currency. The *target* currency is then used to purchase a three-month Treasury security of one of the other currencies in the SDR basket (or a hypothetical synthetic SDR bond whose yield is). She holds the security for one or three months, sells it, and exchanges the revenue from the *target* currency to the *base* currency. The formula for calculating the return, in terms of the *base* currency, is:

$$\begin{aligned} \text{Bond value}_t(\text{Base currency equivalent}) &= \frac{100E_t(1 + Y_t)}{E_{t+k}} \\ &= 100 + \left(\frac{100E_t Y_t}{E_{t+k}}\right) + \left(\frac{100E_t}{E_{t+k}} - 100\right) \\ &= \text{principal} + \text{interest rate return} + \text{foreign exchange return} \end{aligned}$$

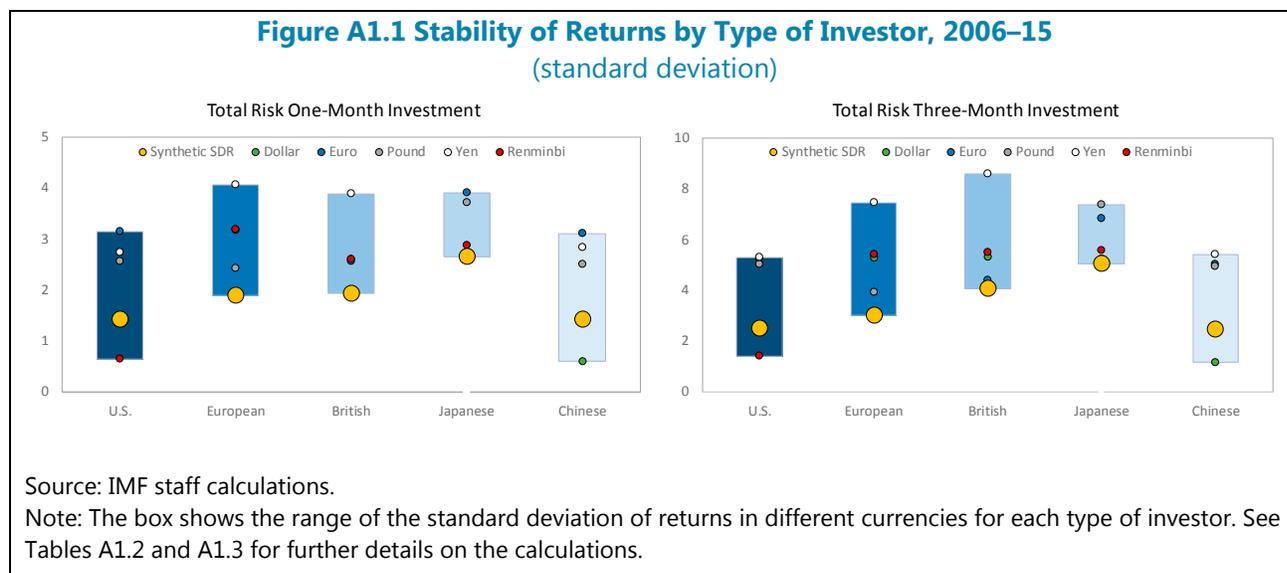
where E_t is the closing rate of the *target* currency against the *base* currency at month t , Y_t is the closing rate of bond yields on a monthly basis at month t , and $k = 1, 3$ is the investment time horizon of one or three months. The interest rate returns are calculated from the instruments described in Table A1.1, and foreign exchange returns are calculated from *ex post* returns realized when the bonds are converted to the base currency at the end of the month, and assuming the transactions are not hedged. Reported annual bond yields are converted to monthly and quarterly compounded rates. The data used for the analysis covers the period January 2005 through December 2015.

The characteristics of the SDR basket have allowed returns on the synthetic SDR bond to be more stable than those of the underlying instruments. Figure A1.1 compares the standard deviation of one-month and three-month returns of a synthetic SDR bond with those of three-

³⁰ The synthetic SDR bond is a hypothetical instrument whose currency composition is equivalent to that of the O-SDR, and whose yield is equivalent to a weighted average of the yields on the securities in the SDR interest rate basket. The synthetic SDR bond is not subject to the interest rate floor of five basis points that has been applied to the O-SDR since 2014.

³¹ Similar metrics are constructed in earlier studies (van den Boogaerde, 1984; Medeiros and Nocera, 1988; and Hoguet and Tadessee, 2011).

month Treasury bills in each of the component currencies, plus the RMB. The returns on the synthetic SDR bond have been consistently more stable than the single-foreign currency returns.³² This has been driven principally by lower fluctuations in the value of the SDR basket (Tables A1.2 and A1.3). The only exception would have been the U.S. dollar-RMB rate, since this currency pair experienced low exchange rate volatility as a result of the latter being managed against the former during much of the sample period. The synthetic SDR bond also would have lowered interest rate risk, though with only a small contribution since the global crisis due to the stability of most component interest rates near zero (Tables A1.2 and A1.3).

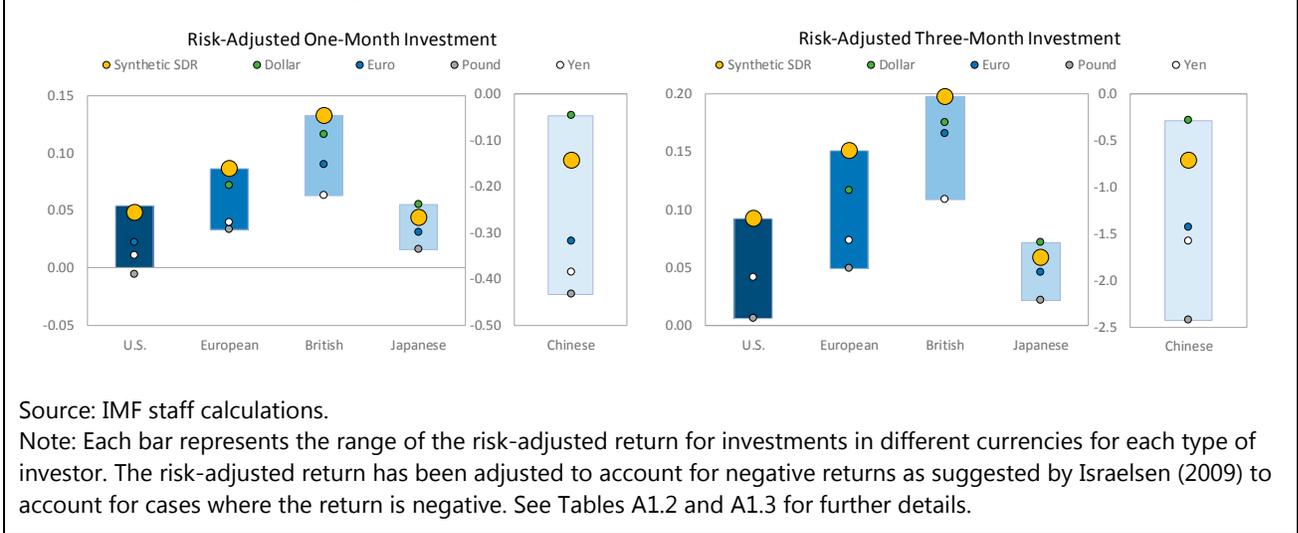


Risk-adjusted returns also would have typically outperformed the risk-adjusted returns of investments in single-foreign currency securities. The synthetic SDR bond earned higher returns per unit of risk, as measured by Sharpe ratios (average return, divided by the standard deviation of returns) than for most single-currency instruments (Figure A1.2; Tables A1.2 and A1.3).³³ This is a key consideration for investors such as reserve managers who might prefer a conservative portfolio management strategy.

³² Returns on the instrument denominated in the investor’s base currency are always the most stable, since there is no contribution to returns of currency fluctuations.

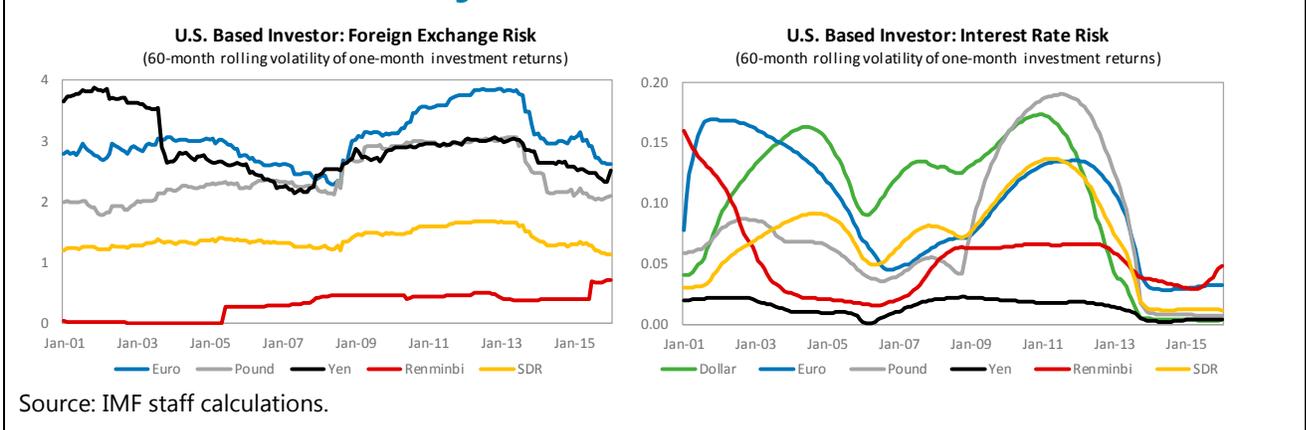
³³ The main exception is that risk-adjusted returns on RMB-denominated securities have been higher for all investors over this sample period. This is due to the appreciation of the RMB, which has outweighed its volatility (for European, Japanese, and British investors). For this reason, RMB-denominated returns are not included in Figure A1.3.

Figure A1.2 Total Risk-Adjusted Returns, 2006–15



The stability of SDR returns has been robust over time. To illustrate, Figure A1.3 displays the volatility of foreign exchange and interest rate risk for one-month investments since 2001 for a U.S.-based investor. It shows that foreign exchange risk of the SDR basket has been consistently lower than for the individual component currencies.³⁴ Interest rate risk has also generally been lower, except for Japan where rates were near zero through most of the period, and China where reserve requirements have been heavily relied upon as an instrument of monetary policy. Other studies have found similar stability in earlier periods (van den Boogaerde, 1984; Medeiros and Nocera, 1988; and Hoguet and Tadessee, 2011).

Figure A1.3 SDR Returns, 2001–15



³⁴ As previously noted, the RMB has displayed lower volatility against the U.S. dollar, but it has been more volatile than the SDR against the euro, yen, and pound.

Returns on the SDR basket have also displayed lower systematic risk. So far, the total risk—i.e., the exposure to interest rate and exchange rate changes—has been assessed for each component currency of the SDR basket and for a synthetic SDR bond. Fluctuations can reflect either a common shock to all currencies, or idiosyncratic variation of an individual currency. The latter can be mitigated through diversification—such as investing in the synthetic SDR bond—while retaining the risk attached to the efficiently diversified currency basket (i.e., systematic risk). If such a currency basket existed, it would be preferred by risk-averse investors over alternative diversification instruments. So it is natural to ask whether the synthetic SDR bond offers these efficient diversification benefits. The beta coefficient, which captures the sensitivity of the currency’s total return to movements of the basket (i.e., systematic risk) shows that the risk reduction offered by the SDR is efficient in many instances, but not always (Table A1.1).³⁵ For instance, U.S.-based investors could reduce systemic risk further by investing in Asian currencies rather than in a synthetic SDR-denominated instrument, or Chinese-based investors could do so by investing in dollars instead of the synthetic SDR (a result driven by the RMB’s peg to the dollar). In these instances, for an investor to hold the synthetic SDR, she would have to be compensated with a higher yield.

Table A1.1 Beta Coefficients, 2005–15

Currencies												
Investor Type	One-month return						Three-month return					
	SDR	Dollar	Euro	Pound	Yen	Renminbi	SDR	Dollar	Euro	Pound	Yen	Renminbi
U.S.	1.00		2.13	1.28	0.61	0.10	1.00		2.01	1.45	0.64	0.15
European	1.00	1.65		0.84	1.79	1.62	1.00	1.73		0.58	1.98	1.72
British	1.00	1.15	0.90		1.54	1.12	1.00	1.17	0.81		1.80	1.19
Japanese	1.00	0.90	1.35	1.24		0.94	1.00	0.93	1.26	1.33		0.98
Chinese	1.00	0.11	2.04	1.20	0.73		1.00	0.16	1.91	1.42	0.77	

Source: IMF staff calculations.

Note: The beta coefficient measures the sensitivity of the currencies return to movements in the SDR basket. That is, it is a measure of systematic risk. A beta equal to one suggest the currency carries the same risk as the synthetic SDR. A beta below one suggest a risk and return below the synthetic SDR. A beta above one suggest a risk and return above the SDR.

³⁵ The beta coefficient is calculated as; $\beta_{i,SDR} = \frac{\rho_{iSDR}\sigma_i\sigma_{SDR}}{\sigma_{SDR}^2}$, where i is the corresponding currency, ρ_{iSDR} the correlation coefficient, and σ_i the standard deviation. The beta coefficient for the synthetic SDR is therefore set equal to one. If the beta coefficient of a currency is equal to one, the return on that currency varies proportionally with the return on the SDR, and therefore that currency would have the same systematic (or unavoidable) risk than the synthetic SDR. A beta greater than one implies that the currency return varies more than proportionally with the return on the SDR. A beta coefficient less than one implies that the currency has less systematic risk than the synthetic SDR and therefore investors would incur less risk by holding that currency.

Table A1.2 One-Month Bond Value of Investments in SDR or SDR-Basket Currencies, 2005–15

Investor perspective	Bond Value						Interest rate return						Foreign Exchange Return					
	SDR	Dollar	Euro	Pound	Yen	Renminbi	SDR	Dollar	Euro	Pound	Yen	Renminbi	SDR	Dollar	Euro	Pound	Yen	Renminbi
	Return (μ-100)/100 (%)						Average (μ)						Average (μ)					
U.S.	0.068	0.091	0.068	-0.002	0.030	0.659	0.096	0.091	0.106	0.143	0.016	0.487	-0.029	...	-0.038	-0.145	0.014	0.172
European	0.162	0.226	0.105	0.081	0.159	0.793	0.096	0.090	0.105	0.143	0.016	0.488	0.066	0.136	...	-0.061	0.143	0.305
British	0.254	0.302	0.228	0.143	0.244	0.869	0.096	0.090	0.106	0.143	0.016	0.489	0.158	0.212	0.122	...	0.227	0.381
Japanese	0.116	0.150	0.118	0.057	0.016	0.720	0.096	0.090	0.105	0.142	0.016	0.487	0.020	0.060	0.013	-0.085	...	0.233
Chinese	-0.102	-0.078	-0.103	-0.173	-0.137	0.486	0.096	0.090	0.105	0.142	0.016	0.486	-0.198	-0.168	-0.208	-0.316	-0.153	...
	Standard deviation (σ)						Standard deviation (σ)						Standard deviation (σ)					
U.S.	1.410	0.150	3.143	2.558	2.730	0.646	0.128	0.150	0.133	0.171	0.018	0.057	1.389	...	3.130	2.558	2.725	0.616
European	1.878	3.172	0.133	2.414	4.061	3.167	0.127	0.149	0.133	0.171	0.018	0.060	1.882	3.188	...	2.431	4.058	3.144
British	1.921	2.597	2.552	0.172	3.872	2.593	0.128	0.149	0.134	0.172	0.018	0.061	1.904	2.606	2.525	...	3.867	2.563
Japanese	2.647	2.742	3.895	3.709	0.017	2.859	0.127	0.150	0.132	0.170	0.017	0.057	2.655	2.751	3.902	3.725	...	2.844
Chinese	1.415	0.603	3.090	2.500	2.815	0.056	0.127	0.149	0.132	0.170	0.017	0.056	1.414	0.626	3.088	2.514	2.813	...
	Adjusted Return (μ)/σ 1/						Adjusted μ/σ 1/						Adjusted μ/σ 1/					
U.S.	0.048	0.604	0.022	-0.006	0.011	1.020	0.754	0.604	0.795	0.834	0.927	8.495	-0.040	...	-0.118	-0.371	0.005	0.279
European	0.086	0.071	0.794	0.034	0.039	0.250	0.756	0.605	0.794	0.836	0.925	8.105	0.035	0.043	...	-0.149	0.035	0.097
British	0.132	0.116	0.089	0.835	0.063	0.335	0.756	0.606	0.792	0.835	0.919	7.953	0.083	0.081	0.048	...	0.059	0.148
Japanese	0.044	0.055	0.030	0.015	0.932	0.252	0.753	0.603	0.796	0.836	0.932	8.492	0.007	0.022	0.003	-0.316	...	0.082
Chinese	-0.144	-0.047	-0.319	-0.433	-0.385	8.703	0.754	0.604	0.796	0.836	0.928	8.703	-0.280	-0.105	-0.643	-0.793	-0.430	...

Source: IMF staff calculations.

Note: Bond value for 1-month is starting from 100 at the beginning of the month. Then it is invested into every currency for 1 month and converted into the investor based currency using the local currency against the base currency. Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns, which are uncovered by forward transactions at the beginning of period and realized when the bond value is converted to the base currency at the end of period. Shade areas correspond to return values for each investor type ranging between the 33rd and 66th percentiles, and to standard deviations for each investor type below the 33rd percentile.

1/ The risk-adjusted return has been adjusted as suggested by Israelsen (2009) to properly account for cases where the return is negative.

Table A1.3 Three-Month Bond Value of Investments in SDR or SDR-Basket Currencies, 2005–15

Investor perspective	Bond Value						Interest rate return						Foreign Exchange Return					
	SDR	Dollar	Euro	Pound	Yen	Renminbi	SDR	Dollar	Euro	Pound	Yen	Renminbi	SDR	Dollar	Euro	Pound	Yen	Renminbi
	Return (μ-100)/100 (%)						Average (μ)						Average (μ)					
U.S.	0.230	0.272	0.243	0.031	0.219	2.004	0.291	0.272	0.319	0.427	0.049	1.475	-0.060	...	-0.076	-0.396	0.170	0.530
European	0.454	0.616	0.317	0.190	0.548	2.346	0.288	0.268	0.317	0.424	0.049	1.481	0.166	0.349	...	-0.234	0.499	0.865
British	0.806	0.934	0.725	0.431	0.936	2.673	0.293	0.271	0.324	0.431	0.050	1.487	0.513	0.663	0.401	...	0.886	1.186
Japanese	0.295	0.374	0.313	0.159	0.048	2.111	0.286	0.269	0.313	0.421	0.048	1.476	0.009	0.105	0.000	-0.262	...	0.635
Chinese	-0.290	-0.242	-0.286	-0.492	-0.293	1.466	0.287	0.269	0.315	0.421	0.049	1.466	-0.577	-0.510	-0.601	-0.913	-0.342	...
	Standard deviation (σ)						Standard deviation (σ)						Standard deviation (σ)					
U.S.	2.500	0.451	5.204	5.024	5.297	1.403	0.387	0.451	0.402	0.512	0.054	0.181	2.391	...	5.129	5.023	5.278	1.285
European	3.001	5.299	0.400	3.900	7.453	5.394	0.380	0.440	0.400	0.505	0.054	0.209	3.027	5.379	...	4.011	7.439	5.263
British	4.077	5.325	4.376	0.517	8.579	5.486	0.388	0.444	0.413	0.517	0.057	0.225	3.976	5.349	4.209	...	8.553	5.323
Japanese	5.041	5.240	6.811	7.354	0.052	5.545	0.381	0.449	0.392	0.503	0.052	0.188	5.072	5.282	6.830	7.414	...	5.454
Chinese	2.452	1.180	5.003	4.934	5.409	0.169	0.381	0.445	0.395	0.503	0.053	0.169	2.443	1.285	4.984	4.994	5.397	...
	Adjusted Return/σ 1/						Adjusted μ/σ 1/						Adjusted μ/σ 1/					
U.S.	0.092	0.604	0.047	0.006	0.041	1.429	0.751	0.604	0.794	0.834	0.912	8.143	-0.144	...	-0.389	-1.987	0.032	0.412
European	0.151	0.116	0.794	0.049	0.074	0.435	0.757	0.607	0.794	0.840	0.905	7.093	0.055	0.065	...	-0.937	0.067	0.164
British	0.198	0.175	0.166	0.834	0.109	0.487	0.755	0.611	0.784	0.834	0.883	6.615	0.129	0.124	0.095	...	0.104	0.223
Japanese	0.059	0.071	0.046	0.022	0.932	0.381	0.751	0.600	0.798	0.837	0.932	7.867	0.002	0.020	-0.001	-1.943	...	0.116
Chinese	-0.712	-0.285	-1.431	-2.425	-1.586	8.660	0.753	0.604	0.796	0.838	0.916	8.660	-1.410	-0.656	-2.993	-4.560	-1.845	...

Source: IMF staff calculations.

Note: The Bond value is 100 at the beginning of the 3-month period. Then it is invested into every currency for 3 months and converted into the investor based currency using the local currency against the base currency. Interest returns are calculated by every bond yield. Foreign exchange returns are the actual ex-post foreign exchange related returns, which are uncovered by forward transactions at the beginning of period and realized when the bond value is converted to the base currency at the end of period. Shade areas correspond to return values for each investor type ranging between the 33rd and 66th percentiles, and to standard deviations for each investor type below the 33rd percentile.

1/ The risk-adjusted return has been adjusted as suggested by Israelsen (2009) to account for cases where the return is negative.