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INTERNATIONAL MONETARY FUND

Treasurer's Department

The Private SDR: An Assessment of its Risk and Return

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1. Introduction

The SDR was created by the International Monetary Fund as an international reserve asset which is allocated to its members as a supplement to existing reserve assets. Moreover, it is the unit of account for all the transactions and operations of the Fund. The SDR is currently defined as the sum of US$0.54, DM 0.46, F 0.74, £0.071, and ¥ 34.0.

Parallel to the development of the Fund's, or "official," SDR, international organizations, borrowers, and investors looking for a hedge against the considerable volatility and uncertainty in interest rates and exchange rate developments have started to use the same unit of account, thereby creating the "commercial" or "private" SDR. The value of private SDRs is determined on the basis of the same basket of currencies as the IMF's official SDR. But private SDRs are subject to the conventions of the market place and not constrained by the rules governing the uses of official SDRs. 2/ The simplification of the SDR basket in 1981 enhanced the attractiveness of the SDR in international financial markets and the SDR is now used to denominate a wide range of private financial instruments and obligations, such as commercial bank current accounts and deposits, syndicated credits, fixed and floating rate certificates of deposit, floating rate notes, and Eurobonds.

The growth of private SDRs has been in response to the need to find a more stable unit of account for organizations exposed to the high volatility in exchange and interest rates seen in recent years. In fully arbitraged foreign exchange and capital markets, the ex-ante

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1/ The author is indebted to his colleagues in the Treasurer's Department for their useful comments.

2/ See Warren L. Coats, Jr., "The SDR as a Means of Payment," IMF, Staff Papers, Vol. 29, No. 3 (September 1982), p. 428.

total return, interest income plus currency appreciation or depreciation, expected from investments in otherwise comparable instruments are equal for all currencies, putting aside legal constraints and factors of convenience and political risk. If expectations were always realized, any one such investment (properly adjusted by its forward rate against the SDR) would do as well as any other, i.e., there would be no benefit in using a basket. In reality, however, and even more so since the system of floating exchange rates became generalized, currencies tend to appreciate or depreciate in unexpected ways and divergent and frequently revised expectations of inflation rates and real factors lead to sudden and often unpredictable gyrations in exchange and money markets, resulting in the realization of large discrepancies in returns ex-post.

A large and sophisticated organization may wish to devote enough resources to try to monitor these fluctuations or try to hedge itself by constructing a tailor-made basket of currencies. For the smaller or more conservative organization on the other hand, the SDR, which is a standardized basket, or portfolio of currencies, is often a lower cost means of diversifying the risk of being exposed to unexpected returns. When exchange exposure is unavoidable an investment in SDRs is thus intrinsically less risky than an investment in financial instruments denominated in any individual national currency. Moreover, for the smaller organization there may be economies of scale and reductions of transactions costs in doing business in SDRs. 1/

This superior stability encompasses both components of total return, interest income and exchange rate changes. The stability of the exchange rate results from the changes in the exchange value of the currencies in the basket being offset or partially offset by smaller or opposite changes in exchange values of other currencies in the basket. Because the movements of the exchange rates of the different currencies included in the SDR basket are not perfectly correlated, the standard deviation of the SDR's exchange rate in terms of a particular currency will be less than the weighted average of the five individual standard deviations in terms of the same currency.

By the same token the interest rate on the SDR represents a blending of interest returns. But the intrinsic diversification characteristic is somewhat less pronounced than for exchange rate movements, because interest rates in different countries, in addition to movements in relative rates, also respond to common factors affecting the absolute level of yields and thus tend to move in the same direction. The table below demonstrates that the pairwise correlations between the changes

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1/ See Dorothy M. Sobol, "The SDR in Private International Finance," Federal Reserve Bank of New York, Quarterly Review, Winter 1981-82, pp. 29-41.

Table 1. Pairwise Correlation Coefficients of Changes in Nominal Interest Rates, 1977-82

(Monthly changes)

	SDR	U.S. dollar	Deutsche Mark	Pound Sterling	French Franc	Japanese Yen
SDR	1.00					
U.S. dollar	0.94	1.00				
Deutsche mark	0.93	0.83	1.00			
Pound sterling	0.71	0.63	0.63	1.00		
French franc	0.64	0.48	0.58	0.18	1.00	
Japanese yen	0.69	0.52	0.70	0.69	0.28	1.00

in nominal interest rates on the SDR and its component currencies are consistently positive and often high for the period studied. The stability of the SDR interest rate lies thus predominantly in the fact that it averages various absolute magnitudes of interest rates, rather than offsetting contradictory movements, as is the case for exchange rate changes.

This paper tries to measure the relative attractiveness, in terms of both total return and risk, of SDR-denominated investments. It simulates investments using sequentially each of the component currencies and the SDR itself as a base currency and investing alternatively in the native base currency, in the four other component currencies, and in SDRs.

It is interesting to examine the picture for each currency in turn for two reasons. First, it permits an examination sequentially of the return obtained and risk incurred by residents in each of the five countries whose currencies compose the SDR who invest solely in instruments denominated in their native currency and who therefore, ex-ante, avoid any foreign exchange risk, but which will experience different inflation rates.

Second, both ex-post nominal and real returns differ in each country. When investing any one currency in instruments denominated in the same or other currencies, interest returns corrected for forward foreign exchange premiums or discounts result in a parity of yields, because of the effect of covered interest arbitrage on forward premiums or discounts. Unadjusted nominal interest rate differentials, though for a large part reflecting different expectations of inflation rates,

are also heavily influenced by other (i.e. real) factors, the principal of which are the stances of monetary and fiscal policy pursued in each country. Because of these latter factors, combined with imprecision in and frequent revisions of forecasts, the ex-post changes in exchange rates do not always reflect actual inflation differentials, thereby invalidating strict purchasing power parity and interest rate parity across countries. Consequently, the covered return obtained in any currency by a resident of one country is different from the covered return on the same currency obtained by an investor in another country and from the uncovered ex-post return from another currency.

While the emphasis of the study lies on a comparison of total returns (interest income plus exchange rate changes) and variability of these returns, a separate examination of both interest income and exchange gains or losses is warranted for analytical purposes and because differing tax treatment of the two components of total return can have different implications for the after tax yield.

2. Working assumptions

The main assumption embodied in the paper is that the SDR basket existed in its present five currency form as of January 1, 1977. The exchange rates used for the five constituent currencies are the monthly averages of the daily noon midrates in London, with the exception of the period January 1977 through April 1977, where the monthly averages of the daily representative rates, as published in IFS, are used because the London noon rates are only available from May 1977 on. 1/ The interest rates used are the one-month Eurodeposit rates for each of the constituent currencies. The SDR interest rate is the weighted sum of the interest rates on the component currencies, whereby the weights equal the percentage share of each currency's spot value in the basket. 2/

1/ In the case of the German mark and French franc the differences between these two rates (which are taken from close to the same time of the day) are very small. However, the differences have been significant at times for the Japanese yen because of important time differences. In 1981, for example, the average absolute deviation between the London noon rates and the representative rates were 0.05 percent for the Deutsche mark, 0.12 percent for the French franc, and 0.30 percent for the Japanese yen.

2/ A more precise way to calculate the SDR interest rate is the covered interest rate calculation (also known as the "Morgan formula"), whereby the forward exchange rates of the same maturity rather than the spot exchange rates on each of the currencies are used to derive the weights. The spot exchange rates are used here because of their immediate availability and because the forward rates are not readily available on the Fund's data bank. Moreover, given the range of interest rates under consideration, the difference between the two methods of calculation is small.

The paper simulates an investment in January 1977 rolled over each month through December 1982. Interest income is not reinvested in order to compensate for the fact that the spot exchange rates are used to derive the weights attributed to the currencies. If interest income were reinvested at the prevailing rate, currencies which on average have proportionally high nominal interest rates would obtain a higher weight in the basket at the end of each investment period and currencies with proportionally low nominal interest rates would have a reduced share in the basket at the end of each investment period. Consequently, the composition of currencies at the end of the investment period no longer reflects their original weights in the SDR. The use of forward exchange rates moderates the effect of high interest rates on currencies which are expected to depreciate in the future and augments the yield of currencies bearing low interest rates which are expected to appreciate in the future, thereby resulting in a more exact calculation. The fact that interest incomes are not reinvested at the end of each month, combined with the fact that the value of the SDR is recalculated each month, likewise offsets the opposite bias of using the spot exchange rates to calculate the weights.

The interest and exchange rate returns for each of the currencies and the SDR are calculated monthly at an annual rate, and the month-to-month standard deviations in interest and exchange rate returns are computed. The total yield, being the sum of the interest and exchange rate returns, and its standard deviation, are then computed. Also, the real total yield is assessed by deflating the nominal total yield for each base currency by the annualized monthly changes in the retail price index in the native country of that base currency. It has been demonstrated above that, because the forward premium or discount does not equal the expected exchange rate change, ex-post real total returns differ from one country to the next. Consequently, past behaviour of and expectations about real total returns play a role in influencing decisions concerning foreign exchange exposure.

For the calculation of the SDR's real total yield, the weighted average of the changes in retail price indexes in the five countries is deducted from the nominal total yield obtained when the SDR is used as a base currency. It has been argued that the use of the consumer price index (CPI) does not reflect the true price changes, because of the different methods for deriving it in the various countries, but it is used here because it is the index on which financial markets tend to focus the most. The whole exercise is repeated sequentially considering each of the constituent currencies and the SDR itself as base currency.

With all of the above, the risk-return relationship of the SDR and of each of the base currencies is assessed and compared. For this purpose, total return is measured as above as the sum of the interest income and the exchange rate gain or loss and risk is defined as the

total variability, as measured by the standard deviation of this total return. Moreover, a study of the volatility of the total return on individual currencies, defined as that part of total variability of the returns which is the result of changes in the return of the SDR, is undertaken. Changes in the total return of a currency are broken down into two causes: first, an evolution common to all currencies, defined in the model as the movement of the SDR; secondly, factors which are specific for that currency. Volatility, which is measured by a simple statistic called the beta coefficient, isolates how much of the change in the total return on an individual currency is the result of movements in the value of the basket rather than isolated changes in the value of that currency. A beta coefficient value of one is given to the SDR and the beta coefficients for each of the currencies is calculated. If the beta coefficient of a currency is also equal to one, the yield on that currency varies proportionally with the return of the SDR. A beta coefficient higher than one means that the currency's return varies more than proportionally with the return of the SDR, and conversely for a beta coefficient lower than one. Given a linear risk return relationship, the greater the beta of a currency, the greater the risk and the greater the expected return that is required to compensate risk averse investors. By the same token, the lower the beta, the lower the risk and the lower the expected return that is required. Finally, the paper discusses some features to enhance the attractiveness of the use of the SDR in international financial markets.

As indicated above, the period covered is January 1977 to December 1982. Two subperiods are also considered: in the first subperiod the investment is rolled over from January 1977 to December 1979, and in the second from January 1980 to December 1982. The rationale for choosing the subperiods is the evolution of the exchange rate of the U.S. dollar, given the pre-eminent weight of the U.S. dollar in the SDR basket, as shown in Table 2.

As can be readily seen in the table, the first subperiod, from January 1977 to December 1979, can roughly be earmarked as a period of decline in the exchange value of the U.S. dollar; the second one, covering the period from January 1980 to December 1982, on average experienced a strengthening of the U.S. dollar. For the period as a whole, as shown by the point-to-point exchange rate changes in the last column of Table 1, the U.S. dollar was on average fairly stable against the deutsche mark, the pound sterling, and the SDR; it appreciated markedly against the French franc and depreciated against the Japanese yen.

3. Interest return

In this section the first component of total return, interest income on each of the constituent currencies and on SDR deposits, is examined separately. While interest returns are available in each of the constituent currencies held by potential investors, it is evident

Table 2. Annual Increase (+) or Decrease (-) of Nominal Exchange Rates Against the U.S. Dollar and Average Weight of the U.S. Dollar in the SDR Basket
(In per cent)

Currency	1977	1978	1979	1980	1981	1982	1977-82 Overall change
Deutsche mark	9.76	12.56	7.91	-13.73	-14.58	-7.16	-1.47
Pound sterling	9.60	6.46	9.84	6.09	-22.92	-17.68	-3.56
French franc	3.92	9.77	6.03	-12.32	-25.18	-19.96	-37.43
Japanese yen	18.23	18.60	-22.43	12.75	-4.41	-10.72	17.80
SDR	5.85	7.52	1.23	-1.66	-7.92	-6.07	-2.00
Average weight of U.S. dollar in the SDR	47.38	43.82	42.47	42.04	45.83	48.93	--

that differences in these returns cannot be exploited without incurring exchange rate exposure. As mentioned above, though, interest rates prevailing in a country reflect both expectations of inflation rates and real factors such as the monetary and fiscal policy pursued in that country, so that a study of their evolution has its own merit. Moreover, in most countries, interest income is taxed as current income while exchange rate gains are taxed as capital gains, which normally entails a much lower rate of taxation. Consequently, the allocation of investments will also be influenced by the prevailing level of nominal interest rates. A separate study of interest incomes also permits detection of the degree of risk reduction of interest rates on SDR-denominated deposits. Table 3 displays the nominal and real interest returns, the standard deviation of these returns, and the coefficient of variation for the whole period and for the two subperiods. Chart 1 compares the nominal interest rates simulated for the SDR with the rates on its component currencies for the selected period.

The standard deviations of the interest returns reveal that the nominal interest rate of the SDR has not systematically been the most stable rate. For both subperiods and for the whole period, the deutsche mark interest rates are more stable than the SDR interest

Table 3. Interest Return, Standard Deviation in the Returns, and the Coefficient of Variation

(In per cent)

	Whole period			Subperiod 1			Subperiod 2		
	Interest Return	Standard Deviation Interest Return	Coefficient of Variation Interest Return	Interest Return	Standard Deviation Interest Return	Coefficient of Variation Interest Return	Interest Return	Standard Deviation Interest Return	Coefficient of Variation Interest Return
				(1. Nominal interest rates)					
U.S. dollar	11.51	4.12	0.358	8.68	2.82	0.325	14.34	3.17	0.221
Deutsche mark	7.09	3.16	0.445	4.49	1.70	0.378	9.69	1.85	0.191
Pound sterling	12.59	3.29	0.262	10.84	3.14	0.290	14.33	2.41	0.168
French franc	13.61	5.72	0.420	10.26	2.02	0.197	16.97	6.26	0.369
Japanese yen	6.01	3.44	0.572	3.60	2.49	0.692	8.43	2.40	0.285
SDR	10.34	3.29	0.318	7.68	2.01	0.261	13.00	1.86	0.143
				(2. Real interest rates)					
U.S. dollar	2.85	5.23	1.837	-0.59	2.97	-5.056	6.21	4.73	0.753
Deutsche mark	2.57	3.79	1.474	0.74	3.30	4.438	4.40	3.38	0.767
Pound sterling	1.48	9.07	6.141	-1.06	8.82	-8.323	4.01	8.70	2.169
French franc	2.86	6.40	2.236	0.54	3.99	7.346	5.18	7.49	1.446
Japanese yen	1.49	8.82	5.935	-1.04	8.77	-8.425	4.01	8.24	2.052
SDR	2.46	4.37	1.776	-0.31	3.00	-9.620	5.24	3.73	0.712

rates, which in turn are more stable than the remaining interest rates. When the coefficient of variation, which measures the relative spread of the distribution around its mean and thus has the advantage of being a comparable measure, is used, the interest return on the pound sterling turns out to be the most stable for the period 1977-82, followed closely by the SDR interest returns. During the 1977-79 subperiod, only the French franc had more stable interest rates than the SDR, while in the subperiod, 1980-82 all five constituent currencies had more volatile interest rates than the SDR.

In order to also assess the real interest returns, the nominal interest rates for each component currency have been deflated by the changes in the retail prices in their respective countries and the nominal SDR interest rates have been deflated by the weighted average of the changes in retail price indexes in the five countries.

The results are displayed at the bottom of Table 3 and illustrated in Chart 2.

Interestingly, the first subperiod (1977-79) is characterized by very low or negative real interest rates, while during the second subperiod (1980-82) relatively high real interest rates prevailed.

Both during the whole period 1977-82 and during the two subperiods, the level of the SDR real interest rate remains above the average. During the 1977-79 subperiod, the U.S. dollar and SDR real interest rates are the most stable when measured by the standard deviation. During the subperiod 1980-82, the deutsche mark real interest rate is marginally more stable than the SDR as measured by the standard deviation, but the SDR real interest rate displays the lowest total variability when measured by the coefficient of variation. As it was the case for the nominal interest rates, the deutsche mark has the lowest variability in interest rate returns for the period 1977-82. But the SDR real interest return is higher, while being only marginally more variable than the deutsche mark return.

4. Exchange rate changes

In order to make the various national interest rates described above comparable, they must be adjusted by exchange rate changes experienced in moving from one currency to the other. In this section, exchange rate returns between pairs of currencies are examined separately and the exchange risk reduction obtained when investing in SDR denominated assets is assessed. This is of interest in that it shows the relative gain or loss and stability of exchange rate changes if currency (rather than interest bearing assets) is held. In order to capture the fluctuations of all the currencies included in the SDR basket, the pairwise correlation coefficients of changes in exchange rates using the SDR as a unit of account are given below:

Table 4. Pairwise Correlation Coefficients of Changes in Exchange Rates expressed in terms of SDRs

(1977-82--monthly changes)

	U.S. Dollar	Deutsche Mark	Pound Sterling	French Franc	Japanese Yen
U.S. dollar	1.00				
Deutsche mark	-0.76	1.00			
Pound sterling	-0.29	0.03	1.00		
French franc	-0.75	0.71	-0.03	1.00	
Japanese yen	-0.52	0.02	-0.12	0.18	1.00

Table 4 shows that the exchange rate movements of the U.S. dollar have a negative correlation with the exchange rate changes of the four other currencies included in the SDR basket. This is not surprising, because, given the importance of the U.S. economy and of the U.S. dollar in the world financial system, the evolution of the rate of the U.S. dollar is principally influenced by domestic U.S. events, resulting in quite independent movements of the currency. By definition, other currencies move in the opposite direction than the evolution of the U.S. dollar, but the degree of negative correlation is markedly different from one currency to the other. It is very pronounced for the deutsche mark and the French franc, less for the Japanese yen and even less for the pound sterling. The small correlation coefficient between the U.S. dollar and the pound sterling is due to a marked independent appreciation of the pound sterling in 1979 and 1980 because of the emergence of the United Kingdom as a major oil producer and the implementation of a stringent monetary and fiscal policy in that country.

Tables 1 and 4 reveal a strong positive correlation between the deutsche mark and the French franc, evidently because both currencies are members of the European Monetary System (EMS) which contains exchange rate changes within narrow limits. As the correlation coefficient measures the togetherness of the exchange rate fluctuations in each of the months under study, it is not influenced significantly by periodic revaluations or devaluations. Even more so, normal depreciations before a formal devaluation or conversely, normal appreciations preceding a formal revaluation, are artificially constrained by the mechanism of the EMS, and thereby masking the true measurement of the movements of the French franc vis-a-vis the Deutsche mark.

The relatively high correlation between the French franc and the Japanese yen cannot be explained by any institutional setup and must therefore be considered as accidental. The relatively high correlation between the pound sterling and both the French franc and the deutsche mark when the U.S. dollar is used as a base currency disappears completely when the SDR is used as the numeraire. Consequently, the former is mainly due to the simultaneous fluctuations of these three currencies against the U.S. dollar rather than to the synchronous movements among themselves.

The exchange rate developments described above are illustrated in Charts 3 and 4: in Chart 3, the U.S. dollar is taken as the numeraire, while Chart 4 displays the exchange rate movements when the SDR is used as the base currency.

5. Total return

In this section the total return opportunities, defined as the sum of interest income and exchange rate gain or loss, available to an investor in each base country investing either in his native currency or in each of the other component currencies and in the SDR itself are examined in sequence. As different results are obtained depending on the base currency used, because, as mentioned above, actual total returns do not coincide with expected returns, a stepwise analysis is undertaken. The results are shown in Tables 5-10 and illustrated in Charts 5 and 6.

a. Investment return if the base currency is the U.S. dollar (Table 5 and Chart 5)

Because currencies tend to move in the opposite direction than the evolution of the U.S. dollar, a U.S. dollar-based investor could have used any non-dollar currency in the SDR basket or the SDR itself as a hedge against the fluctuations of its own currency. As the U.S. dollar constituted on average 45 per cent of the SDR in the period under study, the movements of the exchange rate of the SDR encompassed a high degree of autocorrelation of the U.S. dollar, with the result that investments in SDRs were prima facie less risky for a U.S. dollar-based investor than investments in the other non-dollar currencies. Moreover, movements of one of the non-dollar currencies tend to be partially offset by smaller or divergent movements in the other non-dollar currencies. As a matter of fact, the exchange rate variation incurred by investing in one of the four non-dollar currencies would have been on average more than twice the exchange variability of the SDR, as shown by the standard deviations of the exchange rate movements for the whole study period and for both subperiods.

Table 5. Simulation of Investment in SDR Basket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: U.S. Dollar

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	0.00	11.51	4.12	0.00	4.12	0.368
Deutsche mark	7.09	-0.67	6.41	3.16	32.34	31.24	4.869
U.K. pound	12.59	-0.92	11.67	3.29	28.69	28.89	2.477
French franc	13.61	-5.73	7.88	5.72	32.33	32.35	4.106
Japanese yen	6.01	2.65	8.66	3.44	38.31	38.15	4.404
SDR	10.34	-0.43	9.91	3.29	15.36	14.22	1.435
Subperiod 1977-79							
U.S. dollar	8.68	0.00	8.68	2.82	0.00	2.82	0.325
Deutsche mark	4.49	10.39	14.88	1.70	22.44	22.38	1.504
U.K. pound	10.84	8.77	19.61	3.14	24.00	24.18	1.233
French franc	10.26	6.67	16.92	2.02	18.67	18.84	1.113
Japanese yen	3.60	6.25	9.85	2.49	36.62	35.77	3.631
SDR	7.68	4.66	12.34	2.01	11.32	11.09	0.899
Subperiod 1980-82							
U.S. dollar	14.34	0.00	14.34	3.17	0.00	3.17	0.221
Deutsche mark	9.69	-11.74	-2.05	1.85	36.96	36.50	-17.831
U.K. pound	14.33	-10.61	3.72	2.41	30.00	31.28	8.415
French franc	16.97	-18.14	-1.17	6.26	38.15	40.00	-34.274
Japanese yen	8.43	-0.95	7.47	2.40	40.13	40.87	5.468
SDR	13.00	-5.52	7.47	1.86	17.24	16.58	2.219

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.00					
$	-0.33	1.00				
DM	0.91	-0.38	1.00			
£	0.72	-0.36	0.58	1.00		
FF	0.90	-0.39	0.89	0.52	1.00	
¥	0.76	-0.34	0.53	0.43	0.59	1.00

During the period 1977-82, a U.S. dollar holder investing in foreign currencies would have obtained the highest total return by investing in pound sterling and the second highest total return by investing in SDRs. However, the coefficients of variation reveal that the average SDR return would have been nearly twice as stable as the total yield on pound sterling and three times more stable than investments in the other currencies. This is clearly illustrated at the top of Chart 5.

b. Investment return if the base currency is the deutsche mark (Table 6 and Chart 5)

During the period 1977-79, the highest return that a deutsche mark-based investor could have obtained is by investing in pound sterling, but at a relatively high risk. The lowest risk, as measured by the standard deviation of the total returns, would have been realized by an investment in SDRs, closely followed by the low risk on an investment in French francs, given the efficacy of the EMS. But when the coefficient of variation is used to measure the variability of returns, the French franc investment is more stable than the investment in SDRs, because of the low total yield obtained on SDRs during that period. This low yield on the SDR, incidentally, is somewhat distorting the relevance of the coefficient of variation.

During the second subperiod (1980-82), an investment in U.S. dollars would have yielded the highest return, but also the highest standard deviation. In the low-risk category, the opposite scenario from the one in the former period is apparent: when measured by the standard deviations of the returns, the French franc investment is slightly less volatile than the SDR investment, while when the coefficient of variation is used the opposite holds.

For the whole period under study, the investment in French francs turns out to be slightly less volatile than an investment in SDRs, but the total yield obtained is lower. This unexpected behavior is accounted for by the participation of both the deutsche mark and the French franc in the EMS.

c. Investment return if the base currency is the U.K. pound (Table 7 and Chart 5)

For the three periods under consideration, a sterling-based investor would have obtained the greatest stability in foreign investments by investing in SDRs when measured by the standard deviations of the total returns. Moreover, he would have obtained an above-average total yield. When the coefficient of variation is used to measure risk, an investment either in deutsche mark or in French francs would turn out to be more stable than the SDR investment in the period 1977-79, but the most risky in the period 1980-82. For the whole period, the SDR investment is the most stable, whichever measure is used.

Table 6. Simulation of Investment in SDR Basket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: Deutsche Mark

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	-0.19	11.32	4.12	32.35	34.35	3.034
Deutsche mark	7.09	0.00	7.09	3.16	0.00	3.16	0.445
U.K. pound	12.59	-0.64	11.94	3.29	27.24	28.12	2.354
French franc	13.61	-5.15	8.45	5.72	14.74	15.10	1.786
Japanese yen	6.01	3.03	9.04	3.44	33.92	34.71	3.837
SDR	10.34	-0.24	10.10	3.29	19.20	20.39	2.020
Subperiod 1977-79							
U.S. dollar	8.68	-10.90	-2.22	2.82	23.02	23.08	-10.375
Deutsche mark	4.49	0.00	4.49	1.70	0.00	1.70	0.378
U.K. pound	10.84	-1.83	9.01	3.14	23.81	24.37	2.705
French franc	10.26	-3.93	6.33	2.02	16.00	15.62	2.467
Japanese yen	3.60	-4.27	-0.67	2.49	32.77	32.09	-48.073
SDR	7.68	-6.02	1.66	2.01	14.32	14.17	8.543
Subperiod 1980-82							
U.S. dollar	14.34	10.53	24.87	3.17	36.84	38.52	1.549
Deutsche mark	9.69	0.00	9.69	1.85	0.00	1.85	0.191
U.K. pound	14.33	0.55	14.88	2.41	30.59	31.50	2.117
French franc	16.97	-6.38	10.59	6.26	13.47	14.47	1.367
Japanese yen	8.43	10.33	18.76	2.40	33.92	34.92	1.862
SDR	13.00	5.54	18.54	1.86	21.78	22.28	1.202

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.00					
$	0.96	1.00				
DM	0.43	0.46	1.00			
£	0.66	0.54	0.09	1.00		
FF	0.38	0.26	0.16	0.12	1.00	
¥	0.55	0.33	0.12	0.32	0.36	1.00

Table 7. Simulation of Investment in SDR Basket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: U.K. Pound

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	0.25	11.76	4.12	28.64	30.63	2.606
Deutsche mark	7.09	0.04	7.13	3.16	26.85	26.97	3.783
U.K. pound	12.59	0.00	12.59	3.29	0.00	3.29	0.262
French franc	13.61	-5.04	8.57	5.72	27.42	29.50	3.440
Japanese yen	6.01	3.31	9.32	3.44	35.84	36.10	3.873
SDR	10.34	0.08	10.42	3.29	19.82	20.89	2.089
Subperiod 1977-79							
U.S. dollar	8.68	-9.32	-0.64	2.82	24.63	24.96	-39.052
Deutsche mark	4.49	1.37	5.86	1.70	23.65	23.72	4.046
U.K. pound	10.84	0.00	10.84	3.14	0.00	3.14	0.290
French franc	10.26	-2.45	7.81	2.02	23.96	23.95	3.068
Japanese yen	3.60	-2.79	0.81	2.49	37.42	36.68	45.529
SDR	7.68	-4.48	3.20	2.01	19.08	19.08	5.954
Subperiod 1980-82							
U.S. dollar	14.34	9.81	24.15	3.17	29.48	31.05	1.286
Deutsche mark	9.69	-1.29	8.40	1.85	30.00	30.17	3.592
U.K. pound	14.33	0.00	14.33	2.41	0.00	2.41	0.169
French franc	16.97	-7.62	9.35	6.26	30.61	34.51	3.691
Japanese yen	8.43	9.41	17.84	2.40	33.60	33.91	1.901
SDR	13.00	4.65	17.65	1.86	19.75	20.35	1.153

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.80					
$	0.87	1.00				
DM	0.71	0.36	1.00			
£	-0.00	0.08	-0.14	1.00		
FF	0.73	0.37	0.87	-0.09	1.00	
¥	0.60	0.30	0.43	-0.12	0.53	1.00

d. Investment return if the base currency is the French franc (Table 8 and Chart 6)

The conclusions obtained when looking at the deutsche mark-based investor are equally valid for the French franc holder. Because both currencies' membership of the EMS and the narrow margins of exchange rate fluctuations permitted under the system (except for occasional realignments of the EMS currencies), the total risk for a French franc-based resident investing in deutsche mark was somewhat lower than when investing in SDRs during the period under review. But, in both cases, the total yield obtained by holding SDRs was superior to the return realized by holding the other currency.

e. Investment return if the base currency is the Japanese yen (Table 9 and Chart 6)

The interest and exchange rate movements of the Japanese yen over the study period were more influenced by domestic monetary and fiscal policies than was the case for the other nondollar currencies. The correlations of the total return of the yen versus the other currencies are therefore extremely low. But the Japanese yen-based investor would nonetheless have enjoyed the most stable return by investing in SDRs, when considering the standard deviations of the returns. But, unlike the other currencies, the difference between the standard deviations are small. When the coefficient of variation is used as a measure of risk, an investment in U.K. pounds turns out to be fractionally more stable than on an investment in SDRs for the period 1977-82, only due to the high yield performance of that currency.

f. Investment return if the base currency is the SDR (Table 10 and Chart 6)

This last case is somewhat unusual. The starting point is a "world resident" in a low-risk situation who is acquiring more risky assets in order to try to ameliorate his return performance. The first column of the pairwise correlation table at the bottom of Table 10 shows that only the U.S. dollar returns have a positive correlation with the SDR returns (and given the pre-eminent weight of the U.S. dollar in the basket, a large part of this positive correlation is autocorrelation of the U.S. dollar). The returns on the nondollar currencies move modestly in the opposite direction and are thus potentially more risky. For the period studied, the standard deviations of the total returns have a nearly even score, except for the Japanese yen which is more volatile. But only two currencies produce a total yield superior to the SDR return: the U.S. dollar and the U.K. pound.

Table 8. Simulation of Investment in SDR Basket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: French Franc

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	4.87	16.38	4.12	31.65	33.77	2.062
Deutsche mark	7.09	4.96	12.05	3.16	14.41	14.95	1.241
U.K. pound	12.59	4.39	16.98	3.29	27.67	28.30	1.666
French franc	13.61	0.00	13.61	5.72	0.00	5.72	0.420
Japanese yen	6.01	8.13	14.14	3.44	31.13	31.84	2.251
SDR	10.34	4.81	15.15	3.29	18.65	19.96	1.318
Subperiod 1977-79							
U.S. dollar	8.68	-6.99	1.69	2.82	18.84	18.87	11.174
Deutsche mark	4.49	3.71	8.20	1.70	15.73	15.62	1.905
U.K. pound	10.84	1.98	12.82	3.14	24.25	24.37	1.902
French franc	10.26	0.00	10.26	2.02	0.00	2.02	0.197
Japanese yen	3.60	-0.37	3.23	2.49	29.77	28.89	8.938
SDR	7.68	-2.16	5.52	2.01	10.91	10.56	1.913
Subperiod 1980-82							
U.S. dollar	14.34	16.73	31.07	3.17	37.25	38.90	1.252
Deutsche mark	9.69	6.21	15.90	1.85	13.05	13.38	0.841
U.K. pound	14.33	6.81	21.14	2.41	30.86	31.53	1.491
French franc	16.97	0.00	16.97	6.26	0.00	6.26	0.369
Japanese yen	8.43	16.63	25.06	2.40	30.52	31.25	1.247
SDR	13.00	11.78	24.78	1.86	22.06	22.50	0.908

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.00					
$	0.95	1.00				
DM	0.44	0.29	1.00			
£	0.66	0.53	0.29	1.00		
FF	0.12	0.13	0.25	-0.25	1.00	
¥	0.45	0.26	0.06	0.25	0.00	1.00

Table 9. Simulation of Investment in SDR BAsket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: Japanese Yen

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	-3.89	7.62	4.12	39.17	40.93	5.374
Deutsche mark	7.09	-3.99	3.10	3.16	34.11	34.07	10.995
U.K. pound	12.59	-4.40	8.19	3.29	36.49	37.25	4.547
French franc	13.61	-9.00	4.61	5.72	31.43	32.11	6.961
Japanese yen	6.01	0.00	6.01	3.44	0.00	3.44	0.572
SDR	10.34	-3.94	6.40	3.29	28.64	29.45	4.602
Subperiod 1977-79							
U.S. dollar	8.68	-7.39	1.29	2.82	37.08	38.54	29.928
Deutsche mark	4.49	3.39	7.88	1.70	32.64	33.39	4.240
U.K. pound	10.84	1.65	12.49	3.14	37.45	38.89	3.113
French franc	10.26	-0.35	9.91	2.02	29.50	29.87	3.014
Japanese yen	3.60	0.00	3.60	2.49	0.00	2.49	0.692
SDR	7.68	-2.44	5.25	2.01	28.78	30.00	5.720
Subperiod 1980-82							
U.S. dollar	14.34	-0.39	13.95	3.17	41.39	42.79	3.068
Deutsche mark	9.69	-11.37	-1.68	1.85	34.40	34.53	-20.577
U.K. pound	14.33	-10.44	3.89	2.41	34.97	35.55	9.146
French franc	16.97	-17.65	-0.68	6.26	31.31	33.79	-49.407
Japanese yen	8.43	0.00	8.43	2.40	0.00	2.40	0.285
SDR	13.00	-5.44	7.55	1.86	28.82	29.27	3.875

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.00					
$	0.95	1.00				
DM	0.83	0.62	1.00			
£	0.82	0.70	0.69	1.00		
FF	0.78	0.59	0.90	0.62	1.00	
¥	0.06	0.14	-0.12	0.04	-0.11	1.00

Table 10. Simulation of Investment in SDR Basket Currencies and in SDRs Without Reinvestment of Interest Returns

Base Currency: SDR

(In per cent, except for standard deviations and correlations)

Period 1977-82	Interest Return	Exchange Rate Return	Total Yield	Standard Deviation Interest Return	Standard Deviation Exchange Rate	Standard Deviation Total Yield	Coefficient of Variation Total Yield
U.S. dollar	11.51	0.24	11.75	4.12	15.34	17.78	1.513
Deutsche mark	7.09	-0.06	7.03	3.16	19.10	18.36	2.611
U.K. pound	12.59	-0.41	12.18	3.29	19.87	20.54	1.686
French franc	13.61	-5.12	8.49	5.72	18.98	19.65	2.314
Japanese yen	6.01	3.27	9.28	3.44	28.20	28.45	3.066
SDR	10.34	0.00	10.34	3.29	0.00	3.29	0.318
Subperiod 1977-79							
U.S. dollar	8.68	-4.78	3.90	2.82	11.42	12.21	3.130
Deutsche mark	4.49	5.83	10.32	1.70	14.06	14.23	1.378
U.K. pound	10.84	4.17	15.01	3.14	18.88	19.48	1.298
French franc	10.26	2.06	13.32	2.02	10.91	11.08	0.899
Japanese yen	3.60	1.77	5.37	2.49	28.65	27.80	5.180
SDR	7.68	0.00	7.68	2.01	0.00	2.01	0.261
Subperiod 1980-82							
U.S. dollar	14.34	5.26	19.60	3.17	17.18	19.11	0.975
Deutsche mark	9.69	-5.95	3.74	1.85	21.70	21.44	5.725
U.K. pound	14.33	-4.99	9.34	2.41	20.04	21.43	2.294
French franc	16.97	-12.30	4.67	6.26	22.48	25.11	5.377
Japanese yen	8.43	4.77	13.20	2.40	28.07	28.95	2.194
SDR	13.00	0.00	13.00	1.86	0.00	1.86	0.143

Pairwise Correlations of Total Returns (TYM) (1977-1982)

	SDR	$	DM	£	FF	¥
SDR	1.00					
$	0.59	1.00				
DM	-0.15	-0.67	1.00			
£	-0.13	-0.27	-0.02	1.00		
FF	-0.14	-0.65	0.70	-0.13	1.00	
¥	-0.11	-0.46	-0.03	-0.10	0.13	1.00

g. Reward-to-variability ratio 1/

At this stage it can be concluded that, during the period under review, the SDR has produced above average total returns and, except for the close relationship between the deutsche mark and the French franc, has been more stable than any of its components. Though acknowledging that certain investors are prepared to face exchange rate risks and adopt a strategy of frequently switching among currencies in order to try to earn a higher return than yielded by a prepackaged portfolio such as the SDR, it must be recognized that most investors faced with a world of widespread floating are concerned about the variability of rates of return and prefer a conservative portfolio management strategy. For the latter category, one useful way to rank investments is the reward-to-variability ratio, defined as the ratio of the total return to the standard deviation. By giving a ranking of the rate of return per unit of risk obtained on previous investments, it has predictive ability in enabling the investment manager to take better decisions concerning future investments. The results for investments in SDRs or its component currencies for the period 1977-82 are as follows:

Table 11. Reward-to-Variability Ratio (1977-82)

	Base Currency					
	U.S. Dollar	Deutsche Mark	Pound Sterling	French Franc	Japanese Yen	SDR
U.S. dollar	2.79	0.33	0.38	0.49	0.19	0.66
Deutsche mark	0.21	2.24	0.26	0.81	0.08	0.38
Pound sterling	0.40	0.42	3.83	0.60	0.22	0.59
French franc	0.24	0.56	0.29	2.38	0.14	0.43
Japanese yen	0.23	0.26	0.26	0.44	1.75	0.33
SDR	0.70	0.50	0.50	0.76	0.22	3.14

It is evident from the table that if an investor invests in other currencies than its own and with the exception of the special relationship between the Deutsche mark and the French franc, the SDR is a superior investment for a conservative investor, because it provides a higher return for the same variability.

6. Real total return

The real total returns from investing in each currency of the SDR basket are calculated by deflating the nominal total returns obtained

1/ See William F. Sharpe, Mutual Fund Performance, Journal of Business, "Security Prices: A Supplement," Vol. 39, No. 1, Part 2 (January 1966), pp. 119-38

for each base currency by the annualized monthly changes in the retail price index in the country issuing that base currency. For the calculation of the SDR real total yield, the weighted average of the changes in retail price indexes are deducted from the total returns obtained when the SDR is used as a base currency. The results are displayed in Table 12 and illustrated in Charts 7 and 8. The conclusions on total variability reached in the previous sections remain roughly untouched except when the SDR is used as a base currency.

During the subperiod 1977-79, the British pound and the French franc have the highest nominal as well as real yields, whichever currency is used as a base. The SDR does not display a very high real yield because of the high negative returns on the U.S. dollar in that period, but nevertheless had systematically higher returns than the Japanese yen and the U.S. dollar. When the SDR is used as a base currency, the yen replaces the U.S. dollar as the currency bearing the lowest yield.

During the subperiod 1980-82, the U.S. dollar enjoyed the highest returns both in nominal and in real terms, whichever currency is used as a base. The close race for second best return in nominal terms between the SDR and the Japanese yen was won by the yen in real terms, because of the lower inflation rate prevailing in Japan than in the "world" during the period.

For the period 1977-82 as a whole, the British pound experienced the highest nominal total yield, whichever currency is used as a unit of account. The same is true in real terms, except when the SDR is used as a base currency, for which case the U.S. dollar has the highest yield. Otherwise, the U.S. dollar has the second highest return, followed by the SDR, which systematically stands in third place whichever currency is used as a base.

In summary, an above average total yield is attached to SDR investments when the total returns are deflated by the consumer prices in each base currency. Moreover, the SDR's intrinsic stability is untouched by this process.

7. Volatility

So far, the total risk, defined as exposure to interest and exchange rate changes, and measured by the standard deviation, has been assessed for each of the component currencies of the SDR basket and for the SDR itself. In this section, this total risk is broken down into two parts--a systematic component and an unsystematic component--in order to shed some light on the risk reduction conveyed by the SDR. More precisely, it studies whether the balance of currencies in the SDR is appropriate, especially given the preeminent weight carried by the U.S. dollar.

Table 12. Simulation of Investment in SDR Basket Currencies and in SDRs: Total Yield Deflated by Changes in Consumer Price Index in Native Country of Base Currency

Period 1977-82	Base currency: US Dollar			Base currency: DM			Base currency: £		
	Real Total Yield	Standard Deviation	Coefficient of Variation	Real Total Yield	Standard Deviation	Coefficient of Variation	Real Total Yield	Standard Deviation	Coefficient of Variation
U.S. dollar	2.85	5.23	1.84	6.81	33.70	4.95	0.65	34.01	52.71
Deutsche mark	-2.25	32.46	-14.46	2.57	3.79	1.47	-3.98	30.56	-7.68
U.K. pound	3.00	28.90	9.62	7.43	27.36	3.68	1.48	9.07	6.14
French franc	-0.78	33.35	-42.58	3.94	15.48	3.93	-2.53	32.37	-12.78
Japanese yen	0.00	38.98	0.00	4.53	35.11	7.76	-1.79	39.55	-22.14
SDR	1.25	15.39	12.35	5.58	19.91	3.57	-0.68	25.22	-36.89
Subperiod 1977-79									
U.S. dollar	-0.59	2.97	-5.06	-5.97	22.87	-3.83	-12.54	29.61	-2.36
Deutsche mark	5.61	23.04	4.11	0.74	3.30	4.44	-6.04	28.43	-4.71
U.K. pound	10.34	24.38	2.36	5.26	23.42	4.45	-1.06	8.82	-8.32
French franc	7.66	19.10	2.49	2.59	15.67	6.06	-4.09	27.81	-6.79
Japanese yen	0.58	36.72	62.79	-4.41	33.09	-7.50	-11.09	40.50	-3.65
SDR	3.07	11.77	3.83	-2.09	14.20	-6.81	-8.70	24.30	-2.79
Subperiod 1980-82									
U.S. dollar	6.28	4.73	0.75	19.58	38.01	1.94	13.83	33.35	2.41
Deutsche mark	-10.10	38.47	-3.81	4.40	3.38	0.77	-1.92	32.82	-17.09
U.K. pound	-4.34	31.45	-7.25	9.59	30.99	3.23	4.01	8.70	2.17
French franc	-9.22	41.77	-4.53	5.30	15.39	2.90	-0.97	36.71	-37.81
Japanese yen	-0.58	41.64	-71.72	13.47	35.23	2.62	7.52	36.81	4.89
SDR	-0.58	18.30	-31.54	13.25	21.95	1.66	7.33	23.82	3.25

Table 12. (Contd.) Simulation of Investment in SDR Basket Currencies and in SDRs: Total Yield Deflated by Changes in Consumer Price Index in Native Country of Base Currency

Period 1977-82	Base currency: French Franc			Base currency: Yen			Base currency: SDR		
	Real Total Yield	Standard Deviation	Coefficient of Variation	Real Total Yield	Standard Deviation	Coefficient of Variation	Real Total Yield	Standard Deviation	Coefficient of Variation
U.S. dollar	5.63	33.87	6.01	3.09	42.04	13.60	7.91	17.48	2.21
Deutsche mark	1.30	15.86	12.18	-1.43	34.56	-24.20	2.37	19.03	8.04
U.K. pound	6.24	29.00	4.65	3.66	37.32	10.19	6.20	19.82	3.20
French franc	2.87	6.41	2.23	0.09	32.22	371.41	1.15	20.20	17.52
Japanese yen	3.40	32.25	9.48	1.49	8.82	5.94	1.40	29.16	20.79
SDR	4.40	20.39	4.63	1.87	30.42	16.24	2.46	4.37	1.78
Subperiod 1977-79									
U.S. dollar	-8.03	19.66	-2.45	-3.35	38.87	-11.60	-0.19	11.92	-63.06
Deutsche mark	-1.52	16.63	-10.97	3.24	34.06	10.52	5.53	14.51	2.62
U.K. pound	3.10	25.37	8.18	7.86	39.56	5.04	8.87	18.76	2.12
French franc	0.54	3.99	7.35	5.27	29.98	5.69	4.87	10.83	2.23
Japanese yen	-6.48	29.21	-4.51	-1.04	8.77	-8.42	-2.63	28.68	-10.90
SDR	-4.19	11.81	-2.82	0.61	30.56	50.45	-0.31	3.00	-9.62
Subperiod 1980-82									
U.S. dollar	19.29	39.46	2.05	9.53	44.60	4.68	16.02	18.51	1.16
Deutsche mark	4.12	14.74	3.58	-6.09	34.90	-5.73	-0.79	22.44	-28.26
U.K. pound	9.37	32.29	3.45	-0.53	35.00	-66.39	3.53	20.75	5.88
French franc	5.19	7.50	1.45	-5.10	33.94	-6.66	-2.56	26.11	-10.20
Japanese yen	13.29	32.50	2.45	4.01	8.24	2.05	5.44	29.49	5.42
SDR	13.00	23.49	1.81	3.14	30.65	9.76	5.24	3.73	0.71

Variations in interest and exchange rates of a particular currency are caused by a blend of two factors, an evolution common to all the currencies in a basket and factors specific for each currency. It has been demonstrated that the riskiness conferred by the second factor can be reduced by diversification, one option of which is by investing in SDRs. If the diversification is efficient, this unique risk attached to each of the currencies can even be eliminated and the investor remains solely with the much lower riskiness attached to the efficiently diversified currency basket.

If an efficiently diversified currency basket existed, it would be preferred by risk averse investors above any other form of diversification, such as adding one or more other currencies to the basket. The intrinsic riskiness of such a basket is the unavoidable risk that any one investing in foreign currencies is exposed to as it cannot be further diversified away. This nondiversifiable risk is called systematic risk or volatility. The difference between systematic risk and the total risk incurred by holding individual currencies is called unsystematic risk. In other words, that part of the riskiness attached to the expected return of a currency which could not be eliminated by combining that currency with others so as to hold the efficiently diversified basket, is the systematic risk of the currency. The rest of that currency's total risk is the unsystematic risk attached to the currency.

The riskiness of the efficiently diversified currency basket (systematic risk), as measured by its standard deviation, is calculated as the weighted average of the standard deviations of the component currencies multiplied by the correlation coefficients between these currencies and the basket, whereby the weights reflect the importance of each of the currencies in the basket. If the correlation coefficients between the total return of the constituent currencies and the total return of the basket are lower than one, the standard deviation of the basket will be less than the weighted average of the standard deviations of the individual currencies of which it consists.

If all currencies were perfectly correlated with the basket, the basket would be as risky as any individual currency in it, i.e., diversification would be superfluous, and only systematic risk would exist. 1/ For the SDR basket most of the currencies are not perfectly correlated with the basket, so that a certain degree of unsystematic risk is present for each of the five currencies in the basket. By diversifying, this unsystematic risk can be reduced; and if the diversification is efficient, the unsystematic risk can be completely eliminated so that only systematic risk remains. If so, the important

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1/ See J. Lorie and M. Hamilton, The Stock Market, Theories and Evidence, Homewood, Ill., 1973, pp. 203-207.

risk of a currency becomes the unavoidable or systematic risk, because any unsystematic risk will be eliminated by the risk averse investor. Thus, if the possibility for efficient diversification exists, the relevant risk for the individual currency is not the standard deviation of the yield for the currency (total risk), but the marginal effect the currency has on the standard deviation of the efficiently diversified currency basket (systematic risk). 1/ In short, the risk premium in a currency's expected return should be related to its degree of systematic risk, not to its degree of total risk.

An investor will either hold the efficiently diversified basket or incur a higher degree of systematic risk, depending on his risk preference. If the investor chooses to hold a more risky combination of instruments than the efficiently diversified basket, his expected return should exceed the return of the basket only to the extent of the extra systematic risk incurred. The total increase in risk, i.e., systematic and unsystematic, need not be compensated for by the risk premium because that part of the risk that could have been diversified away, i.e., the unsystematic risk was willingly accepted by such an investor.

This implies that if a particular currency's return is uncorrelated with the return on the currency basket, i.e., that it has zero systematic risk, the expected return on that currency will contain no risk premium even though the currency might have a significant amount of total risk. The question here is whether the SDR, given its currency composition, conveys the efficient diversification characteristics described above. If the returns on the currencies included in the SDR are fairly uncorrelated with the return on the basket, a large part of the variability in returns on the component currencies can be diversified away by combining them into the basket.

The contribution of each currency to the riskiness of the SDR--its systematic risk or volatility--which, as mentioned above, is equal to the product of the standard deviation of the total return on the currency and the correlation coefficient between that currency and the basket, is measured by a simple statistic, the beta coefficient 2/, which by the same token indicates the sensitivity of the currency's total return to movements of the basket. In this study, the beta coefficient of the SDR is defined to equal one. If the beta coefficient of a currency is also equal to one, it means that the returns for that currency vary proportionally with the returns of the SDR. In other words, that currency has the same unavoidable risk as the SDR. A beta coefficient higher than one means that the currency's

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1/ See James Van Horne, Financial Management and Policy, Fourth Edition, London, 1977, pp. 57-65.

2/ Sharpe, William F., "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk," Journal of Finance, Vol. 19, No. 3 (September 1964), pp. 425-442.

return varies more than proportionally with the return of the SDR. A beta coefficient lower than one means that the currency has less unavoidable or systematic risk than the SDR. Entities operating in the base currency in question will incur less systematic risk by holding a currency whose beta is less than one, than by "diversifying" into the SDR. If both that currency and the SDR are held, the yield on the SDR would need to be higher in compensation (i.e., carry a risk premium). It should be noted that the total risk of such an individual currency might still be greater than that of the SDR, therefore holding the SDR might still be an attractive form of diversification, but as this example shows, that would not necessarily justify a lower interest rate on the SDR.

The greater the beta of a currency, the greater the systematic risk and the greater the expected return that is required. By the same token, the lower the beta, the lower the systematic risk and the lower the expected return that is required. The relationship between the beta coefficient of a currency and its correlation with the SDR is as follows:

$$\beta_{iSDR} = \frac{\rho_{iSDR}\sigma_i\sigma_{SDR}}{\sigma_{SDR}^2}$$

where β_{iSDR} is the beta coefficient between currency i and the SDR; ρ_{iSDR} is the correlation coefficient between the total return on currency i and the total return on the SDR; σ_i is the standard deviation of the total return on currency i; and σ^2_{SDR} is the variance of the total return on the SDR. The equation makes it clear that the beta coefficient of the SDR is equal to 1.

The beta coefficients for the period 1977-82 are as follows:

Table 12. Beta Coefficients, 1977-82

	Base Currency				
	U.S. dollar	deutsche mark	Pound sterling	French franc	Japanese yen
U.S. dollar	--	1.61	1.28	1.61	1.31
Deutsche mark	2.01	--	0.92	0.33	0.96
Pound sterling	1.45	0.91	--	0.94	1.04
French franc	2.05	0.28	1.03	--	0.85
Japanese yen	2.04	0.93	1.03	0.71	--
SDR 1/	1.00	1.00	1.00	1.00	1.00

1/ By definition.

If changes in the total return of all currencies included in the SDR basket were perfectly correlated with the total return on SDR, the beta coefficient of each would be simply the ratio of the standard deviation of the individual currency to the standard deviation of the SDR. And because it has been demonstrated that, except for the French franc/deutsche mark relationship, the standard deviations of the individual currencies are higher than the standard deviations of the SDR (see Tables 5-9), one would expect all beta coefficients to be above unity, again with the exception of the French franc/deutsche mark beta coefficients. Consequently, the expected returns on investments in each individual currency should be above the returns obtained on investments in SDRs, because investments in individual currencies would command a risk premium.

Because there is a high correlation between the U.S. dollar and the SDR--about half of which is autocorrelation of the dollar--the outcome meets the expectations when the U.S. dollar is used as base currency: the volatility of the nondollar currencies is relatively high. For the same reason, the volatility of the U.S. dollar is relatively high when the nondollar currencies are used as a base. But the beta coefficient of the nondollar currencies when the nondollar currencies are used as the unit of account are on average below unity, resulting principally from the lower correlation between the nondollar currencies and the SDR, as illustrated in the first column of the correlation matrix at the bottom of Tables 5-9.

Because of the low correlation between the returns on the non-dollar currencies and the yield on the SDR, a large part of the variability in returns on these currencies is unsystematic and thus does not command a risk premium. The study of the beta coefficients demonstrates clearly that the risk reduction offered by the SDR is not efficient for the non-dollar currencies. The reason for this is that the SDR does not offer enough diversification for the non-dollar based investors because it either does not include enough currencies or because the U.S. dollar whose return is relatively volatile in terms of the base currencies examined here, is heavily weighted in the basket. 1/

This raises the question if the preponderance of the U.S. dollar in the SDR basket has not been excessive. In other words, a nondollar based organization investing in SDRs automatically acquires a large part the variability of the U.S. dollar, which has been high, especially during the period 1980-82. The study of the beta coefficients tends to demonstrate that if a nondollar resident was not exposed to the U.S. dollar at all, the use of the SDR for an investment or as a unit of account would not have been the optimal solution. The use of

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1/ See Table 2.

a basket with a much lower U.S. dollar content would have greatly increased the correlation between the returns on his native currency and the returns on that basket, thereby more effectively diversifying his total risk. This basket would have been more effective because it coincided more closely with the needs and exposure of that organization. Investments in SDRs, on the other hand, increased systematic risk which indicates the need for a relatively higher return for the SDR.

While there is thus some merit attached to the argument that the weight of the U.S. dollar has been excessive from the point of view of many nondollar based organizations, two arguments nevertheless favor the present composition of the SDR basket. First, the U.S. dollar experienced an unprecedented appreciation during 1981 and 1982 which is more likely to be reversed than to be sustained in the coming years. The value share of the U.S. dollar in the SDR basket should thereby automatically be reduced. Secondly, given the preponderant role of the U.S. dollar in international trade and international financial markets, all international organizations, public or private, are either U.S. dollar based or have a large U.S. dollar exposure anyway, which, of course, is precisely why the U.S. dollar was given such a large weight in the first place. Consequently, the SDR remains attractive as a "world hedge"; moreover, it has a supplementary attraction because the number of currencies in the SDR basket is limited and its constitutents are widely tradeable. Though, concededly, the SDR may be too global a hedge for organizations which are only exposed to a number of regional currencies. This latter phenomenon partly explains the recent success of the European Currency Unit (ECU) in European financial markets.

It has also been argued that because the SDR basket is the blending of five domestic capital markets, the monetary policies in the five countries whose currencies make up the SDR basket have to be harmonized, if not integrated, before the SDR becomes an attractive instrument. The study above shows that this need not be so: the tendency for the exchange rates of the constituent currencies to vary in opposite directions makes the SDR relatively stable. If the monetary policies in these countries were to be harmonized, the amplitude of their divergent movements would be reduced and the natural diversification effect of the SDR would be diminished. The productivity of the SDR resides in its exchange stability relative to that of alternatives, and the expectation that the movement in exchange rates will remain divergent for the foreseeable future make the SDR a particularly attractive unit of account.

8. Conclusion

This paper reviews the performance of the SDR during the last six years. The starting point is that if the correlation coefficients between the returns on the different currencies included in the SDR basket are lower than one, the standard deviation of the SDR will be

less than the weighted average of the individual standard deviations. The outcome fully meets the expectation: the standard deviation of the total return on the SDR is lower than all other standard deviations, whichever currency is used as a base, with the exception of the close relationship between the Deutsche mark and the French franc, because of both currencies' participation in the EMS. The study also demonstrates that an assessment of the volatility of the component currencies, as measured by the beta coefficient, does not provide an adequate measure of riskiness for the nondollar currencies, because of the relatively low correlation between these currencies and the SDR during the study period. Finally, and for whichever currency is used as a unit of account, the SDR had an above average total return during the period studied.

There are often reasons to expect future experience to differ from that in the past. But as far as the turbulence in interest rates and exchange markets is concerned, the SDR produced above average yields and represented a much lower risk than any of the currencies under consideration both in periods of decline and in periods of strength of the U.S. dollar. Given that the gyrations in interest and exchange rates are not expected to abate markedly in the foreseeable future, the use of the SDR as a unit of account should be of paramount interest for any organization exposed to several currencies.

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Morgan Guaranty Trust Co., World Financial Markets.

CHART 1

SDR AND COMPONENT CURRENCIES:

EUROCURRENCY NOMINAL ONE-MONTH DEPOSIT INTEREST RATES
(MONTHLY, 1977-82)

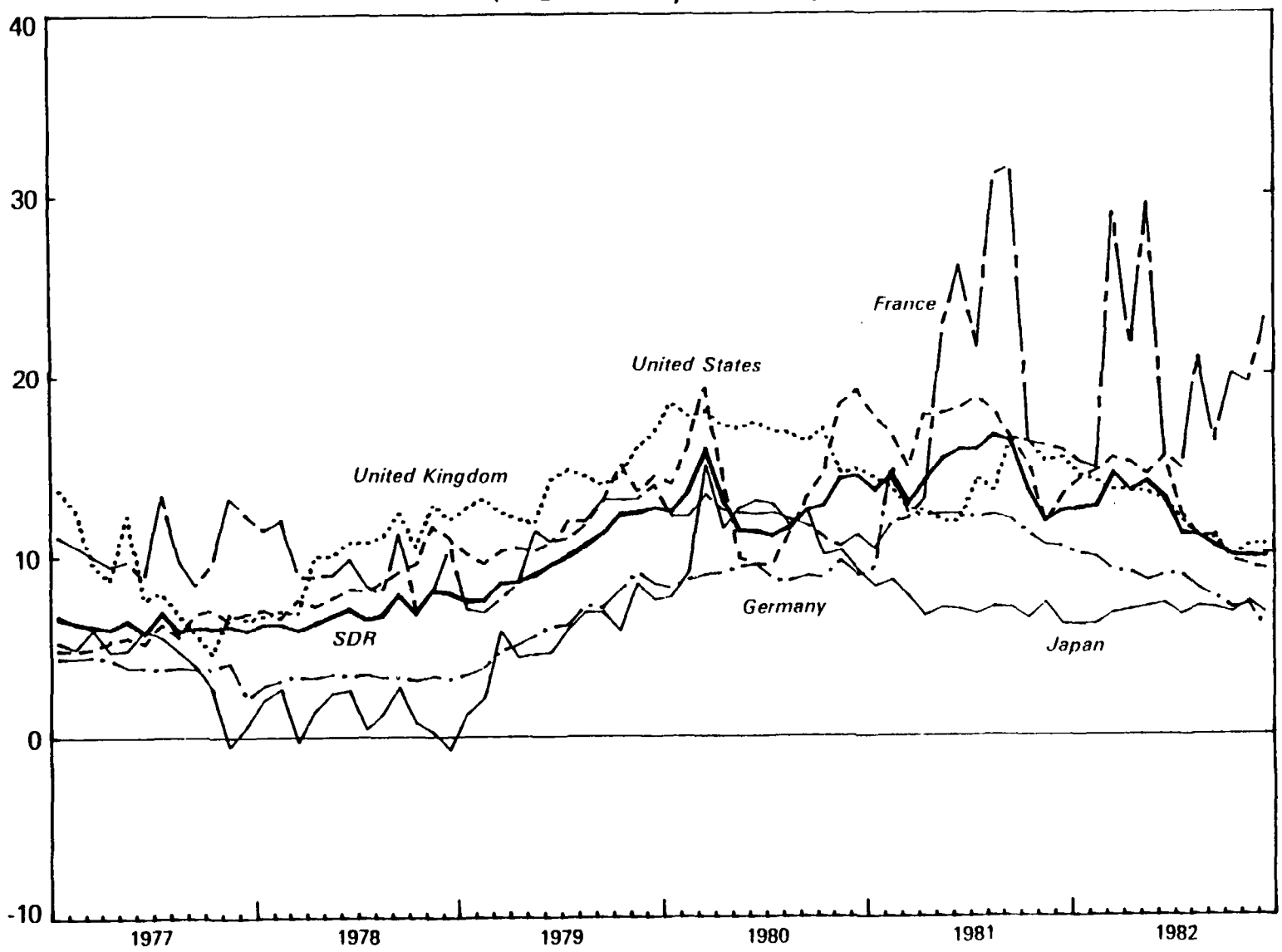

CHART 2

SDR AND COMPONENT CURRENCIES:

EUROCURENCY ONE-MONTH DEPOSIT INTEREST RATES DEFLATED BY CONSUMER PRICE INDEX (MONTHLY, 1977-82)

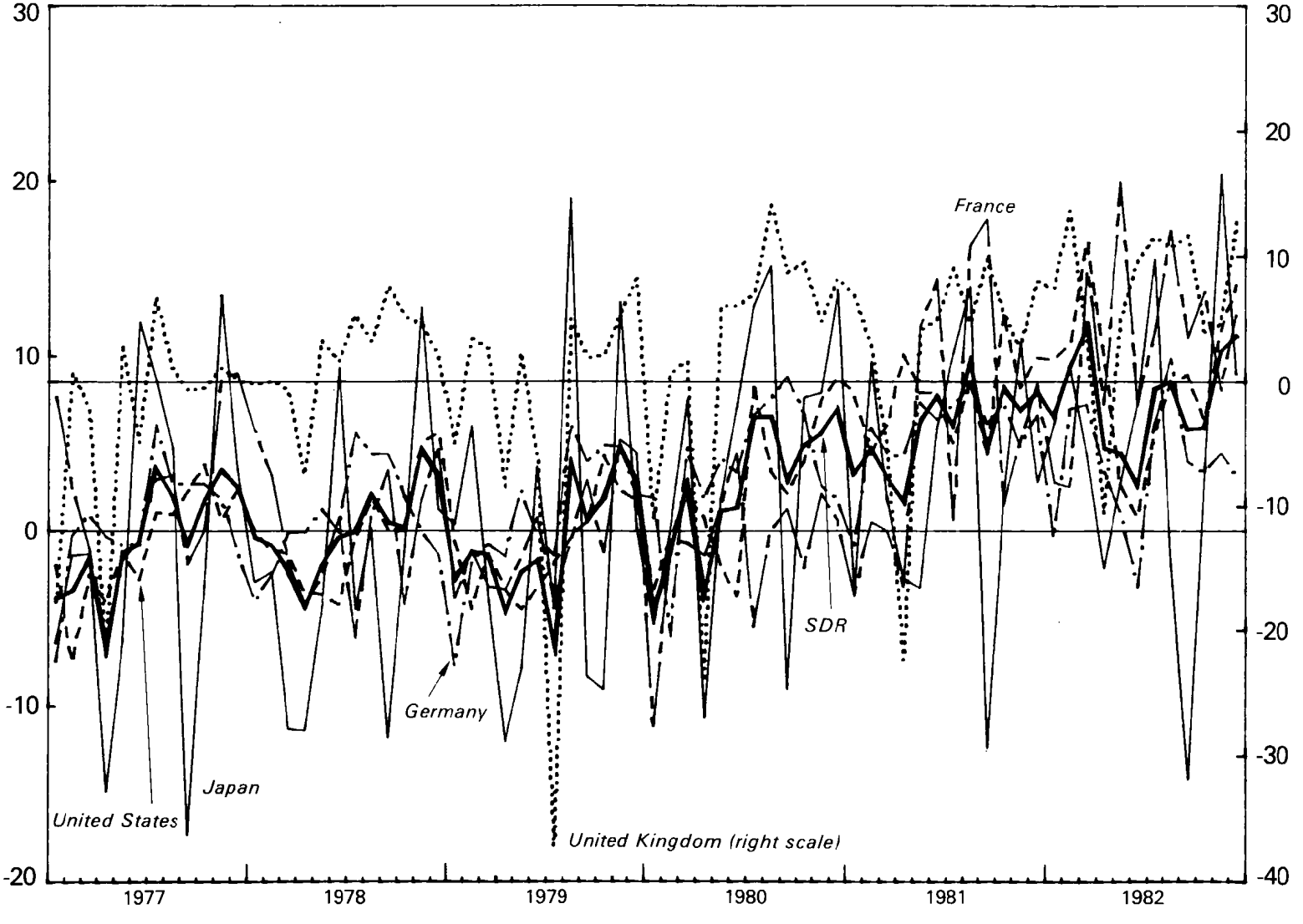

CHART 3

SDR AND COMPONENT CURRENCIES:

FOREIGN EXCHANGE RATE INDICES (MONTHLY, 1977-82)

(In U.S. dollars per foreign currency)

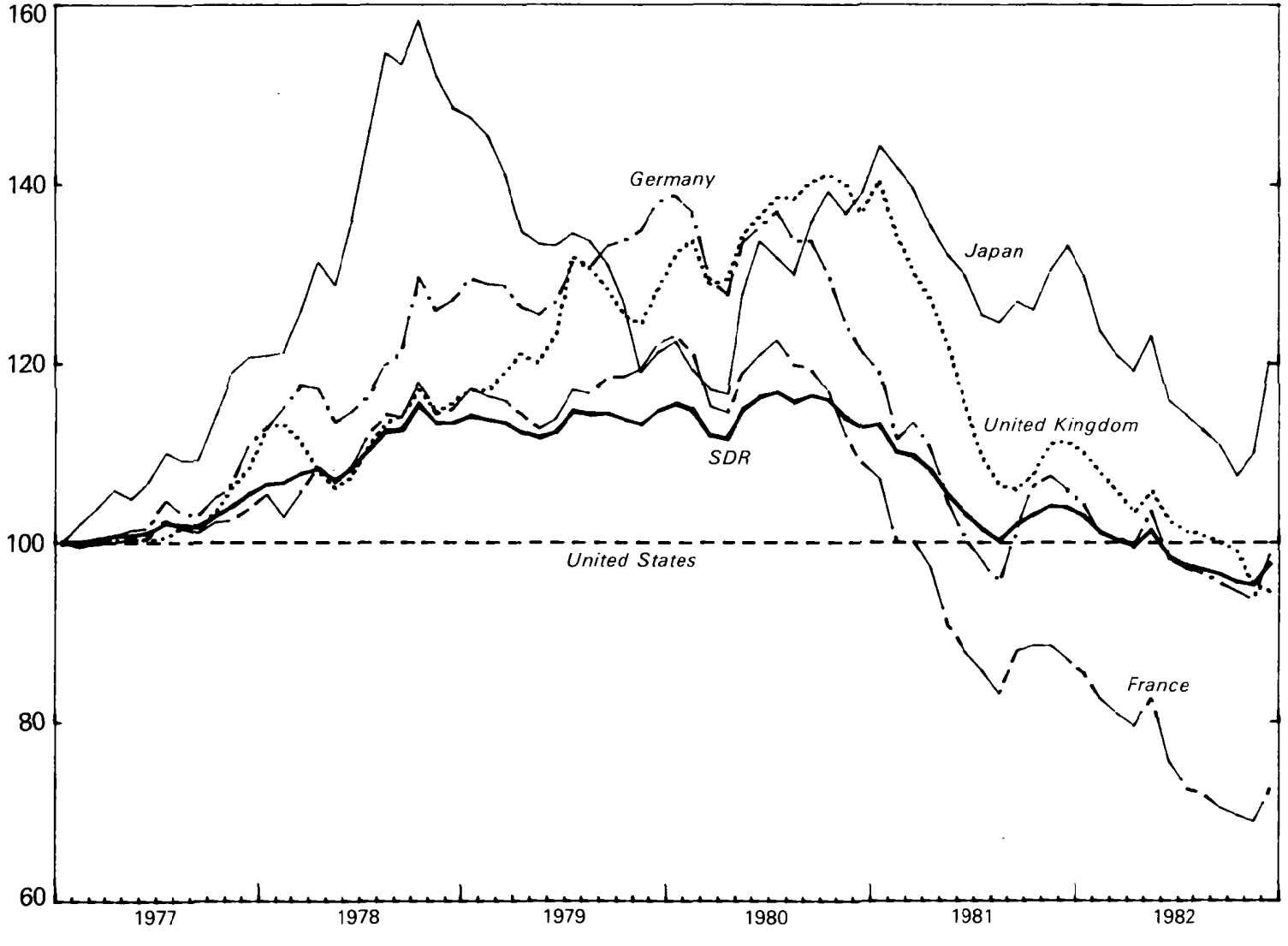

CHART 4

SDR AND COMPONENT CURRENCIES:

FOREIGN EXCHANGE RATE INDICES (MONTHLY, 1977-82)

(In SDR per foreign currency)

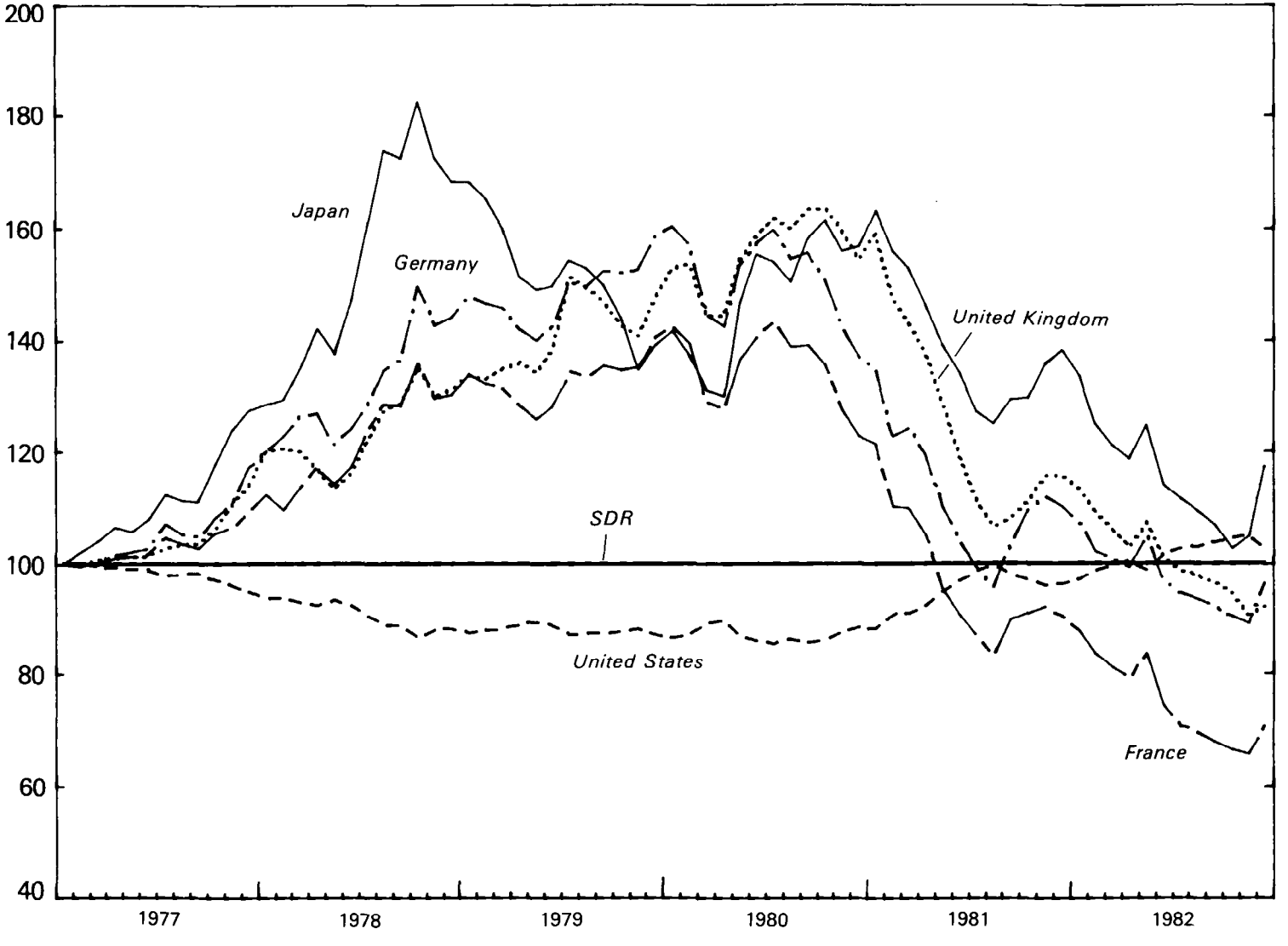

CHART 5

RISK RETURN RELATIONSHIP, 1977-82

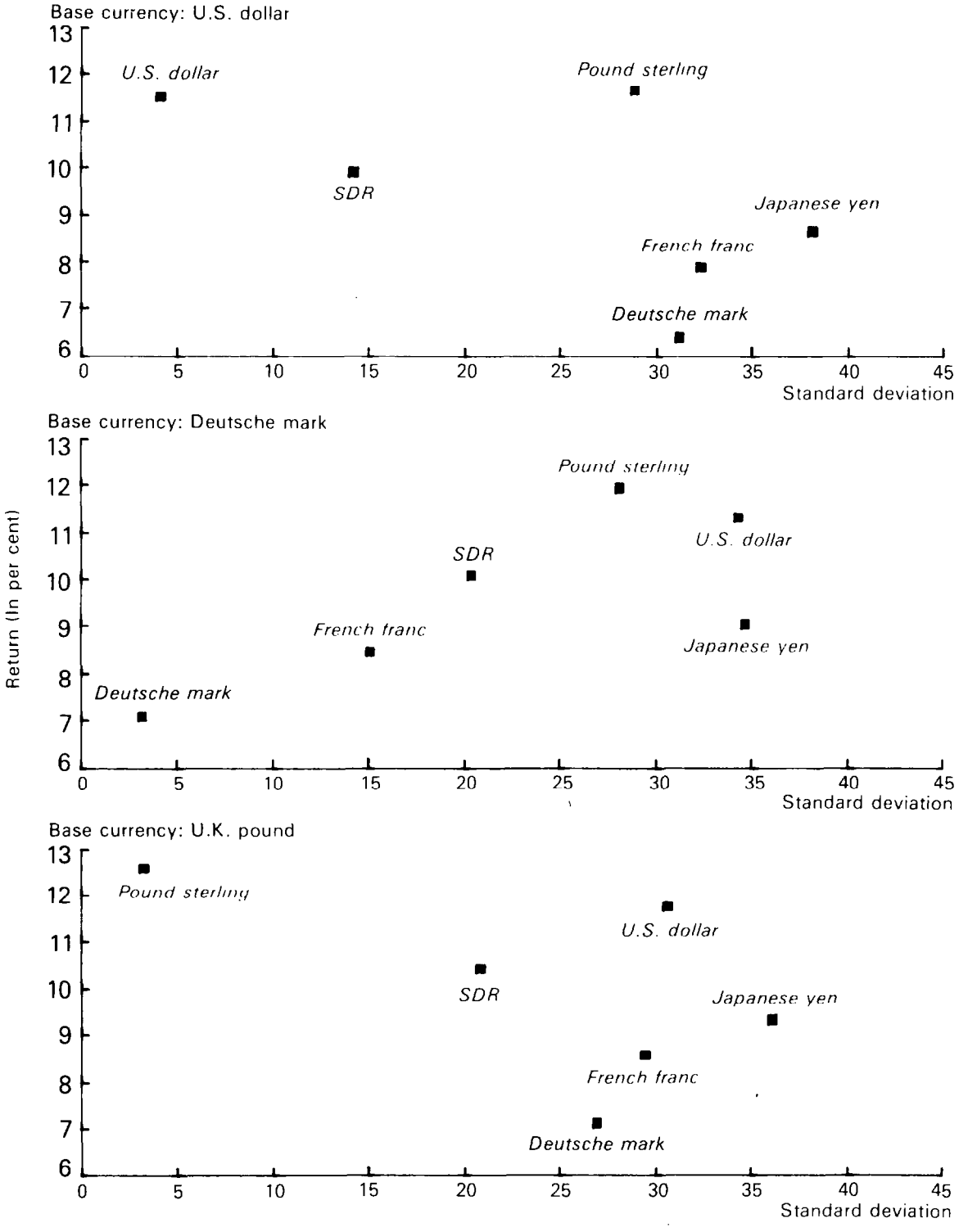

CHART 6

RISK RETURN RELATIONSHIP, 1977-82

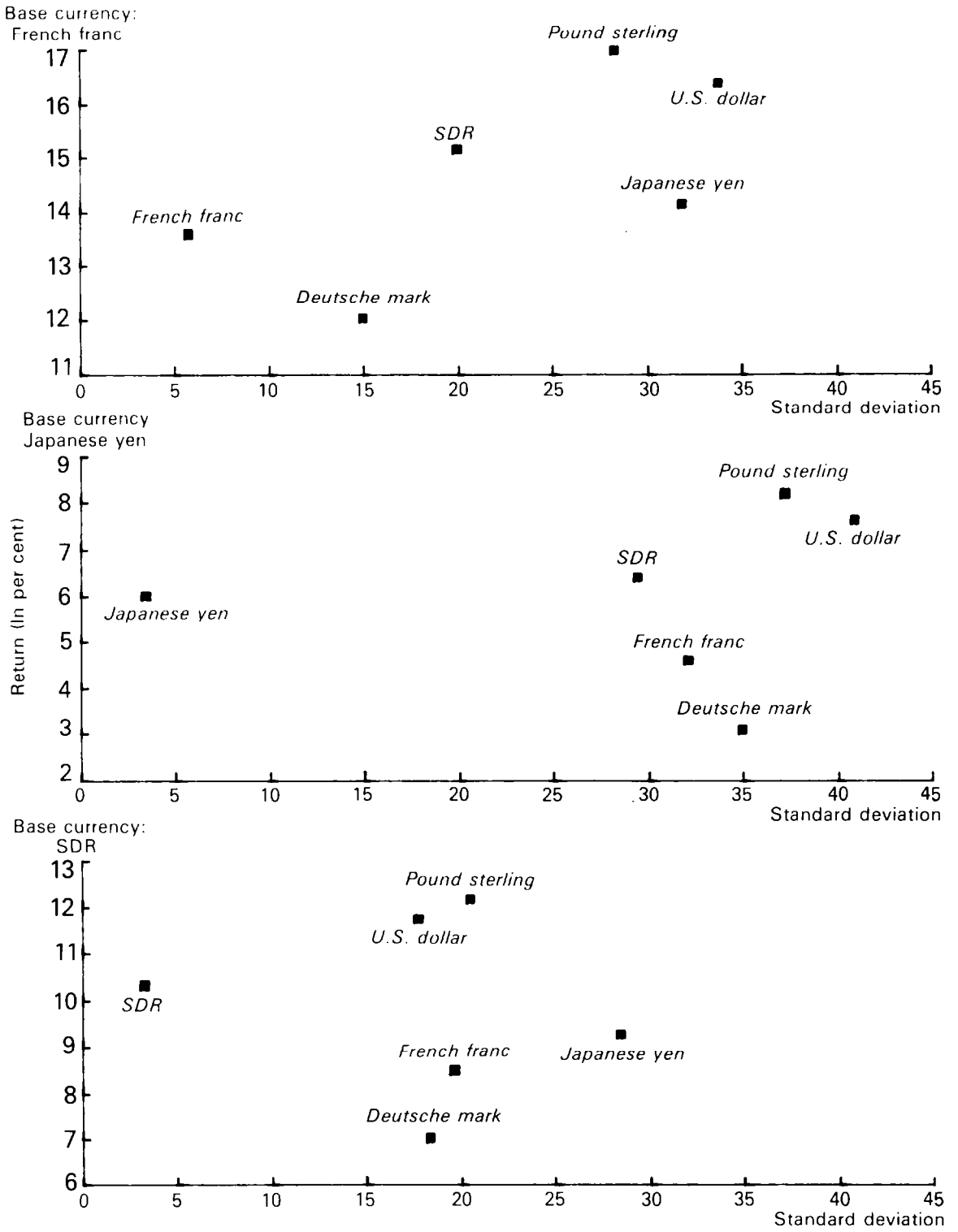

CHART 7

RISK RETURN RELATIONSHIP, 1977-82

RETURNS DEFLATED BY CPI IN NATIVE COUNTRY OF BASE CURRENCY

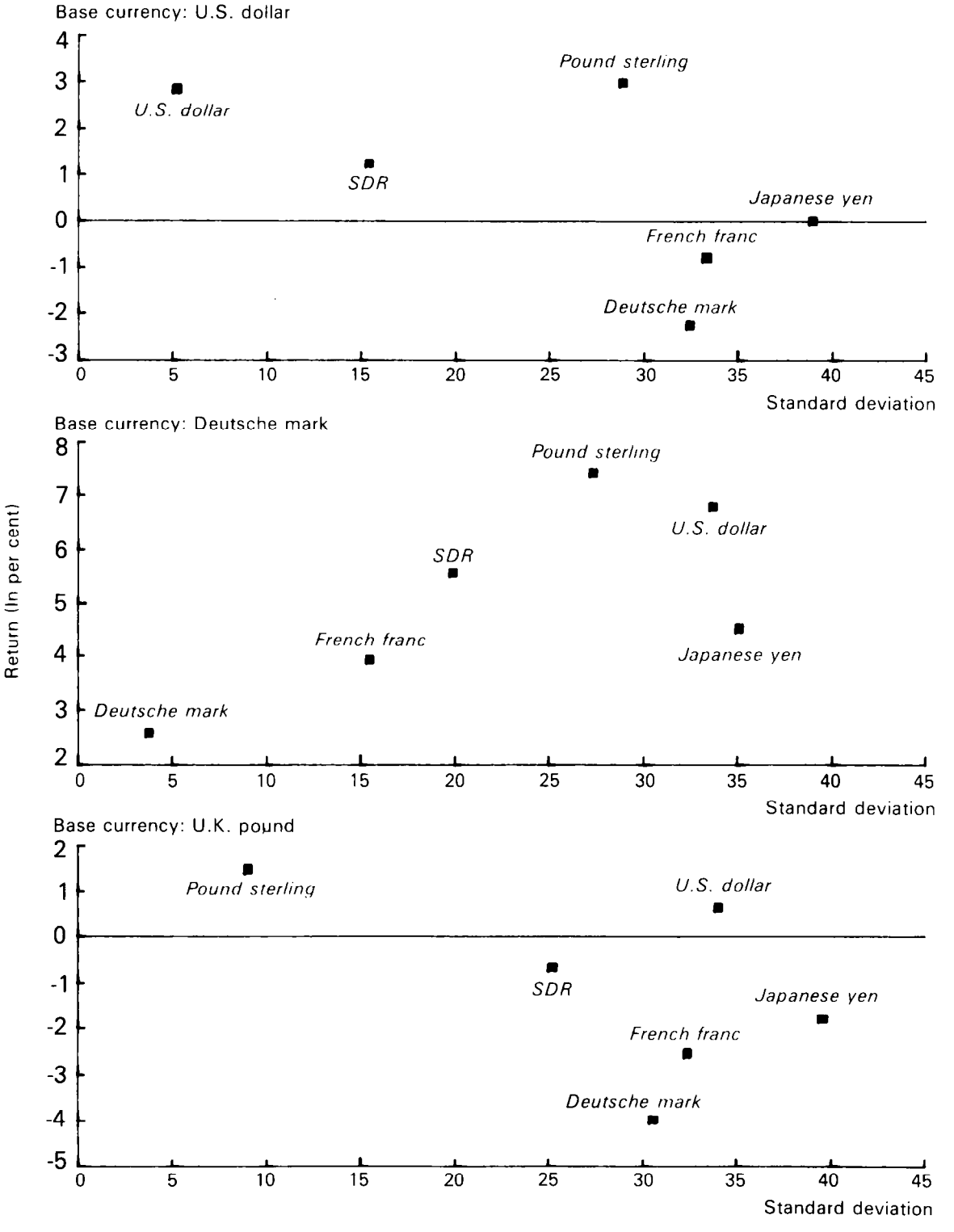

CHART 8

RISK RETURN RELATIONSHIP, 1977-82

RETURN DEFLATED BY CPI IN NATIVE COUNTRY OF BASE CURRENCY