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SM/85/320
Supplement 2

December 19, 1985

To: Members of the Executive Board
From: The Acting Secretary
Subject: SDR Valuation Basket - Further Trial Calculations

The attached supplement on the rounding procedures for the revised SDR basket containing the further calculations requested by Executive Directors at Executive Board Meeting 85/182 (12/16/85) is scheduled for discussion on Monday, December 23, 1985.

Mr. Roncesvalles (ext. 7807) or Mr. Kawakami (ext. 7812) is available to answer technical or factual questions relating to this paper prior to the Board discussion.

Att: (1)

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Department Heads



INTERNATIONAL MONETARY FUND

SDR Valuation Basket--Further Trial Calculations

Prepared by the Treasurer's Department

Approved by W. O. Habermeier

December 19, 1985

As requested at EBM/85/182 (12/16/85), the staff has undertaken further trial calculations of the amounts of currency units in the revised SDR valuation basket which comes into effect at the beginning of 1986. The further calculations requested by the Board are shown in Table 1, together with comparable calculations given in SM/85/320, Sup. 1 (12/13/85). The following notes describe briefly the various calculations summarized in the table:

1. The two approaches discussed at EBM/85/182 and previously presented in SM/85/320 and in SM/85/320, Supplement 1, are reproduced as Calculations I and II, respectively.

2. The calculation shown in line III was requested by an Executive Director at EBM/85/182 and may be referred to as the constrained approach. This calculation is a variant of Calculation I and has been made as follows: in the event it was not possible to express the currency amounts in the revised SDR basket uniformly in two significant digits, consideration was given to calculate currency amounts in combinations of two and three significant digits, in an iterative manner similar to the calculations made in connection with the 1980 revision, but which also takes into account the numerical size of the rounded currency amounts so as to minimize the ratio between the highest and lowest of these currency amounts without regard to decimal places. For example, if one currency amount were to have three significant digits and the rest were to have two significant digits, the constrained approach would choose the one currency with three significant digits to be either the French franc, if its currency amount were rounded to a number greater than F 1, or the Japanese yen, if the French franc amount were rounded to below F 1. The progression of the search procedure under Calculation III is shown in Table 2. From the table, it can be seen that the constrained approach limits the search to three-digit amounts for a certain combination of currencies at various levels of the search process. In contrast, the minimum digits approach considers all possible baskets for a given combination of two and three significant digits.

3. As also suggested at EBM/85/182, Calculation IV of Table 1 has been based on a tolerance limit from the agreed weights for the revised basket of one percentage point, instead of a tolerance limit of one half percentage point as indicated in the 1980 guidelines. This approach is otherwise the same as under the minimum digits approach but has the potential to raise considerably the likelihood of obtaining solutions expressed uniformly in two significant digits.

4. The range of probable solutions under the four approaches described above can be roughly gauged on the basis of the number of potential baskets tested for solutions and from the staff's experience with trial calculations in 1980 and this year. Table 3 shows the approximate number of baskets that are tested for equality with the transition exchange rate for the SDR under the successive rounds of the search procedure for each of the four types of calculations. 1/

Solutions can be expected to be found with a very high probability whenever the potential number of baskets are at least in the high tens of thousands (e.g., 7×10^4). The probability is significantly lower when the potential number of baskets is in the low tens of thousands or fewer. For example, widening the tolerance limit to one percentage point (Calculation IV) produces about 20,000 potential two-digit baskets, compared with 3,000 potential baskets with a half percentage point tolerance limit. Approach IV thus raises the probability, but does not assure, that the currency amounts in the revised basket would continue to be expressed in only two significant digits. As shown in Table 3, the minimum digits approach with a tolerance limit of one half of one percent or one percentage point (Calculations I and IV) is highly likely to produce solutions with one currency in three digits and the remaining four in two digits, but also will give some chance of producing a uniform two-digit result. As indicated in SM/85/320, the uniform significant digits approach (Calculation II) is likely to result in a basket expressed uniformly in three significant digits. The so-called constrained approach (Calculation III) is likely to produce solutions with two currencies expressed in three significant digits.

5. The alternative forms of calculations are essentially a matter of presentation, as indicated in SM/85/320. All solutions are mathematically acceptable. Other considerations may be listed, in summary form, as follows:

(a) Simplicity and convenience, as represented by the number of digits;

(b) Presentational elegance, as indicated by the arithmetic relationships among the amounts of currency units;

1/ It may be recalled that the potential range of baskets is determined for each currency amount by the allowable deviation from the unrounded calculation.

(c) Adherence to the agreed weights, as reflected in the tolerance limit and the use of the minimum average (root-mean-squared) deviation criterion; and

(d) Continuity with past procedures.

As indicated in SM/85/320, a uniform two-digit result within the constraint of a tolerance limit of one half of one percent would be the most preferred solution. In the event that such a two-digit solution were not obtained, the staff feels that the minimum digits approach (Calculation I in Tables 1 and 3) would reflect a reasonable balance among the various considerations listed above, though Calculation IV provides added flexibility at some expense of (c) in the search for a set of currency amounts expressed uniformly to two digits. The uniform significant digits approach (II) is likely to yield closer adherence to the agreed weights than the other approaches but it is likely to result in a relatively large number of digits. The constrained approach (III) gives results that fall between Calculations I and II.

Table 1. Trial Calculation of Amounts of Currency Units in the Revised SDR Valuation Basket

	U.S. dollar (1)	Deutsche mark (2)	Japanese yen (3)	French franc (4)	Pound sterling (5)	Total number of significant digits (6a)	Currency units with three significant digits (6b)
	Currency units						
<u>Present basket</u>	0.54	0.46	34	0.74	0.071	10	none
<u>Trial baskets calculated using Oct. 1-Dec. 13 as base period</u>							
<u>Unrounded amounts in the revised basket</u>	0.450699	0.530545	33.5524	1.02179	0.0896105	--	--
<u>Rounded results</u>							
I. Under the minimum digits approach (line a of Table 2 of SM/85/320, Sup. 1)	0.447	0.54	34	1.0	0.090	11	U.S.\$
II. Under the uniform digits approach (line b of Table 2 of SM/85/320, Sup. 1)	0.452	0.530	33.5	1.02	0.0892	15	all
III. Under a constrained approach: combinations of two and three significant digits	0.45	0.53	33.7	1.03	0.089	12	FF, yen
IV. Under the minimum digits approach with tolerance limit on agreed weights of one percentage point	0.45	0.52	35	1.0	0.090	10	none

Table 2. Illustrative Comparison of the Search Procedure Under the Minimum Digits Approach and Under the Constrained Approach

Round	Number of significant digits	Total number of significant digits	Currencies with three significant digits	
			Minimum digits approach	Constrained approach
1	2 for all currencies	10	none	none
2	2 for 4 currencies 3 for 1 currency	11	any one	FF or yen
3	2 for 3 currencies 3 for 2 currencies	12	any two	FF and yen or \$ and yen
4	2 for 2 currencies 3 for 3 currencies	13	any three	FF, yen, \$ or DM, yen, \$
5	2 for 1 currency 3 for 4 currencies	14	any four	FF, yen, \$, DM or £, yen, \$, DM
6	3 for all currencies	15	all	all

Table 3. Range of Potential Solutions Under Alternative Approaches to Rounding the Currency Units in the Revised SDR Basket

Round	Number of significant digits	Total number of significant digits	Approximate number of potential baskets to be tested for equality of value with the SDR on the transition date 1/			
			Minimum digits approach (I)	Uniform digits approach (II)	Constrained approach (III)	Minimum digits approach with full percentage tolerance limit (IV)
1	2 for all currencies	10	3×10^3	3×10^3	3×10^3	2×10^4
2	2 for 4 currencies 3 for 1 currency	11	1×10^5	--	2×10^4	8×10^5
3	2 for 3 currencies 3 for 2 currencies	12	2×10^6	--	1×10^5	2×10^7
4	2 for 2 currencies 3 for 3 currencies	13	2×10^7	--	1×10^6	1×10^8
5	2 for 1 currency 3 for 4 currencies	14	7×10^7	--	1×10^7	6×10^8
6	3 for all currencies	15	1×10^8	1×10^8	1×10^8	1×10^9

Most likely solution

In number of significant digits	2 for 4 currencies 3 for 1 currency	3 for all currencies	2 for 3 currencies 3 for 2 currencies	2 for 4 currencies 3 for 1 currency
In total number of significant digits	11	15	12	11

1/ The four alternative approaches (I-IV) correspond with those similarly numbered in Table 1. The potential baskets are also tested against the tolerance limit on the percentage weights of the currencies using average exchange rates over the base period.