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SM/83/164
Correction 1

August 15, 1983

To: Members of the Executive Board

From: The Acting Secretary

Subject: Interest Rate Differentials and the Exchange Rate of the Yen

The attached pages 8 and 9 of SM/83/164 (8/1/83) are being reissued to correct a few typographical errors in the equations.

Att: (2)

Other Distribution:
Department Heads

of the yen during much of 1982, despite a substantial movement of the interest differential in favor of Japan, may also have been the result of a series of changes in public perceptions about the strength of the Japanese economy and related uncertainty about the future course of the economic policies and financial market conditions.

A Simple Attempt at Quantification

While explanatory equations for exchange rates are notoriously poor at explaining short-run variations and subject to all the caveats mentioned above concerning the difficulty of measuring expectations, they are useful in indicating the relative importance of various factors affecting exchange rates. The equation reported in this appendix is not an attempt to produce an exhaustive description of the determinants of the dollar/yen exchange rate, but rather an attempt to relate the real dollar/yen exchange rate (S) to the major quantifiable explanatory variables described in the preceding pages--the real short-term interest differential between Japan and the United States (RJ-RUS), lagged unexpected developments in the Japanese and U.S. current account balances (DCA), and last period's value of the real exchange rate (S_{t-1}).

More concretely, the specification of the equation is based on the interest parity condition.

$$(1) \quad x_t - x_t^e = i_j - i_{us}$$

where x is the nominal dollar/yen exchange rate, i indicates a nominal interest rate and superscript e indicates expected levels of the attached variable. Lower case letters indicate logarithms of variables except for nominal interest rates. Tautologically,

$$(2) \quad x^e = p_{us}^e - p_j^e + s^e$$

$$(3) \quad s^e = p_j^e - p_{us}^e + x^e$$

where p is the price level of the indicated country and s is the real dollar/yen exchange rate. Expectations of future relative prices and the future real exchange rate are assumed to be determined as follows:

$$(4) \quad p_{us}^e - p_j^e = p_{(us)t} + \pi_{us}^e - p_{(j)t} - \pi_j^e$$

$$(5) \quad s_t^e - s_{t-1} = \lambda(s_t^* - s_{t-1})$$

$$(6) \quad s_t^* = a \Sigma(DCAS)_{t-1}$$

where π indicates the rate of change of prices and DCAS is unexpected changes in the difference between the current account in Japan and that in the United States, which are assumed to indicate changes in the equilibrium exchange rate, S^* . Combining (1) - (6) gives the estimation equation:

$$\begin{aligned} \ln(S)_t &= (i_j - \pi_j^e) - (i_{us} - \pi_{us}^e) + \lambda a \Sigma(DCAS)_{t-1} \\ &= (1 - \lambda) [(i_j - \pi_j^e)_{t-1} - (i_{us} - \pi_{us}^e)_{t-1}] \\ &\quad + (1 - \lambda) \ln(S)_{t-1} \end{aligned}$$

The equation is estimated with data from the first quarter of 1978 to the first quarter of 1983. ^{1/}

$$\ln(S) = -0.582 + 0.019 (RJ-RUS) + 0.017 DCA (-1) - 0.008 (RJ-RUS)_{t-1} \\ (1.15) \quad (3.53) \quad (2.98) \quad (7.97) \\ + 0.844 \ln (S(-1)) \\ (7.97)$$

$$\bar{R}^2 = .8462 \quad H = 1.452 \quad SEE = 0.056$$

The results of the equation suggest the following conclusions:

1. There is a positive and empirically significant relationship between the real short-term interest rate differential and the exchange rate. A 1 percentage point increase in real interest rates in Japan relative to those in the United States leads, on average, to a 1.9 per cent appreciation of the yen vis-a-vis the U.S. dollar. ^{2/}

^{1/} The real exchange rate and the real interest differential are defined in footnotes 1 and 2 of Chart 2. The variable DCA represents cumulated unexpected changes in the difference between the current account balances of Japan and the United States. A slightly more sophisticated measure of these unexpected changes than used in Chart 3 is calculated for the equation. Specifically, the expected difference between the current account balance in Japan and in the United States is estimated by regressing the actual difference on its lagged values and on lagged values of the real exchange rate. The variable DCA is the cumulated divergence of the actual from the expected difference between the Japanese and U.S. current account balances. That is:

$$DCA = \Sigma(DCAS) \\ \text{where } DCAS = DCA^e - DCAB \\ \text{and } DCA^e = \text{expected divergence between the current account} \\ \quad \text{balances of Japan and the United States} \\ DCAB = \text{actual divergence between the current account} \\ \quad \text{balances of Japan and the United States.}$$

The variable is lagged because it is assumed that market participants receive current account data with a one-period lag. Numbers in parentheses below coefficients are t-statistics. H is Durbin's statistic to test for first order serial correlation in the presence of lagged dependent variables. It indicates that the hypothesis that there is no first order autocorrelation cannot be rejected at a high level of confidence. In an effort to avoid multicollinearity, the coefficient on the lagged real interest rate differential was constrained to be equivalent to that on the lagged real exchange rate as indicated in the theoretical specification.

^{2/} The magnitude of this effect is consistent with results obtained in a similar equation of the real effective value of the dollar as reported in SM/83/152.

2. The current account variable also bears a positive and empirically significant relationship to the value of the yen. An unexpected 1 billion dollar increase in the difference between the current account surplus in Japan and the United States leads on average to a 1.7 per cent appreciation of the yen.

3. The coefficient on the lagged exchange rate (0.844) is quite robust statistically. This is consistent with many other equations explaining exchange rates between major currencies and the dollar and may be interpreted as indicating the importance of past values of the exchange rate in expectations of future exchange rates.

4. Although the relationship of the exchange rate to both the interest rate differential and current account developments is statistically robust, the behavior of these two explanatory variables alone cannot fully explain the recent weakness of the yen. For example, during the period of very rapid depreciation of the yen, between the first quarter of 1981 and the second quarter of 1982, movements in the real interest differential and in current account developments account for only about 10 per cent of the approximately 22.5 per cent depreciation of the real exchange rate. Clearly, therefore, there are other variables of importance that have affected the exchange rate during the recent period.