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# IS THE ECU AN OPTIMAL CURRENCY BASKET?

by

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## ABSTRACT

Recently the role of the ECU has increased and there has been concern whether it is sustainable. The first part of this paper examines the composition of the ECU and investigates the impact of changes in this composition on the value of the ECU. The results show that when there is little exchange rate variability among the currencies that comprise the ECU or when the changes in composition are small the value of the ECU remains stable. The second part of this paper constructs an alternative, optimal basket of currencies for Germany and compares this basket to the ECU. The path of the optimal basket resembles the ECU path but is dramatically different from the DM/$.

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## I. Introduction

When the European Monetary System (EMS) was launched in March 1979 it was stipulated that in this system the European Currency Unit (the ECU) was to play an important role. Since that time the ECU and the EMS have become closely interwoven. Furthermore, in recent years the ECU has become an important entity on its own. In the wake of the official ECU, a private ECU was developed. Today the private ECU leads a life of its own and is legally independent of the official ECU's function as the European Community's (EC's) unit of account. By 1984, ECU-denominated bonds were the third most important in the Eurobond market. ECU-denominated bank deposits, loans, and bond issues are governed by private contracts which are not guaranteed by the Community or national monetary authorities. However, the official definition of the ECU as laid down by the EC serves as the basis for its private use. Typically financial institutions stipulate in their contracts that the ECU used is that defined by the EC and ensure that any changes in the composition of the ECU basket are allowed for in terms of the contract.[1]

The composition of the ECU might be different for private use than it is for official use. The first purpose of this paper is to examine the composition of the ECU. In order to investigate this issue I shall first review how the current ECU is defined, its role in the EMS, and the method used to update its definition. Alternative methods of defining the ECU are then examined to investigate the impact of the weighting scheme on the value of the ECU. If the currencies involved in the EMS truly remain close to their central rates, then it is not clear that the value of the ECU should be sensitive to changes in its definition. On the other hand, because the EMS is more like a crawling peg than a fixed exchange rate system, the ECU may be highly sensitive to changes in weighting schemes. If the results indicate the ECU is sensitive to changes in weights, then this suggests that studying the question of optimal weights for the ECU is important. This extension is, however, beyond the scope of this paper.

The second purpose of this paper is to investigate the issue of whether Germany would be better off with a differently weighted ECU-type basket. It is assumed that the goal of Germany is to stabilize its exchange rate in terms of a basket of currencies which will minimize the fluctuation in the real exchange rate. This part of the paper follows the standard literature on optimal currency baskets as discussed in Edison and Vardal(1985) and Lipschitz and Sundararajan (1980). The single country optimal basket is compared to the ECU basket.

The paper is organized as follows: Section II presents the main institutional features of the EMS and the definition of the ECU. Section III evaluates the composition of the ECU under various weighting schemes. The results show that under certain circumstances, in particular when there are only small fluctuations from the central rates, the definition of the ECU is of little importance given the entire EMS apparatus. Section IV evaluates the optimal currency basket for Germany, a major country in the EMS, and compares these results with the ECU weights. Section V presents concluding remarks.

## II. The ECU/EMS

At the heart of the EMS is a system of fixed but adjustable exchange rates.[2] For each currency, central rates are expressed in terms of the ECU. A grid of bilateral central rates is calculated from these individual central rates. A band of ± 2.25 per cent (or ± 6.0 per cent for the Italian lira) has been established within which each currency may fluctuate. Theoretically, when the margins are reached the participating central banks are obliged to intervene. On occasion, however, central banks have requested changes in their central rates rather than intervene in the foreign exchange market or change their economic policies. Provisions were made to thwart frequent realignments by requiring approval of all participating countries to these adjustments.

The grid of bilateral central rates and intervention limits is supplemented by the divergence indicators which show the movement of the exchange rate of each EMS currency against the (weighted) average movement of the other EMS currencies. When a currency crosses its "threshold of divergence" it activates an early warning system. A currency is said to have reached its divergence threshold when it reaches 75 per cent of its band (or spread, that is ± 2.25 per cent). There is the presumption that the authorities concerned will correct this divergence by adequate measures. In practice, the divergence indicators have not played as large a role as they were intended since they do not obligate countries to intervene or otherwise to act.

The ECU plays a central role in the EMS. It serves as the numeraire for the exchange rate mechanism and also as a means of settlement and as a reserve asset of EMS central banks.

The ECU is a basket of currencies. It is valued following a standard basket technique. The quantity of each currency in the basket is fixed. Over time the value weight of each component changes as that component's currency market value with respect to the numeraire changes relative to that value of the other currencies. As Polak (1979) has pointed out, this type of basket has not only a spot value in terms of any reference currency, but at least in principle, also a forward rate. These properties permit the ECU to become a market asset.

This important property is not available in baskets constructed differently such as by the asymmetrical or adjustable peg method. Both of these methods also value the basket in terms of a group of currencies. However, in neither method is the quantity of the currencies fixed as in the ECU basket; rather the relative initial values of the currencies are maintained. For example, in a basket constructed by the adjustable peg method, the common way of defining an optimal currency basket for a single country, a change in one country's exchange rate in either direction causes an offsetting adjustment in the quantity of that currency in the basket in order to maintain the currency's initial value weight. The only difference between the asymmetric and the adjustable method is that the former one makes these adjustments only for the devaluing currencies.

Each member of the EC is supposed to have a share in the ECU reflecting its economic strength. The respective shares, or weights, are determined not only by reference to each country's gross national product, but also with reference to its participation in the Community's external trade and its quotas under the short-term monetary support system. Note, however, that the ECU is not completely immutable, its composition can be changed by unanimous consent and by the addition of currencies to the basket as the EC expands.

The calculation of the amount of each currency component within the ECU involves two steps. First, the weights reflecting the currency's importance in the basket are chosen. Second, these weights are converted into actual quantities using the current exchange rate. The actual units of each currency remain constant and are used in the calculation of the daily ECU. In order to prevent a break in the valuation of the ECU, the day the currency components are calculated the previous day's value of the ECU is used. This maintains continuity.

More precisely the components of the basket are based on the following calculation which assumes the value of the ECU at time 0 is known.

(1) $S_i = ECU(0) * (W_i(0) * FX_i(0))$

$S_i$ = quantity of currency i in the ECU

$W_i$ = weights of currency i, expressed as a proportion, determined by political and economic factors.

$FX_i(0)$ = exchange rate for currency i in terms of U.S. dollars.[3]

ECU(0) = dollar/ECU exchange rate at time of change.[4]

Thus, the dollar value of the ECU at time t is given by summing the actual units of each currency which have been converted into dollars (that is, $ECU(t) = \Sigma S_i * 1/FX_i$).

Table 1 presents the components used to calculate the ECU on September 17, 1984, which was the date the EC officially revised the definition of the ECU.[5] Column one gives the country names and column two reports the actual number of units of each currency used in the calculation of ECU's. Column 3 shows the actual exchange rates vis-a-vis the dollar. Column 4 gives the dollar equivalents of currency units appearing in column 2. The sum of the entries in column 4 yields the dollar value of the ECU. Column 5 presents the central bilateral rates in terms of the ECU, while column 6 gives the initial share values, $W_i$.

The composition of the ECU must be distinguished from the weight of each component in the ECU. Although the composition, $s_i$, of the ECU is fixed, the value weight of each component changes as that component's currency market value changes relative to the other currencies in the basket. Thus an appreciation of the DM vis-a-vis the other EMS currencies will increase the DM's value weight.

Furthermore, the distinction between realignments and revisions to the definition of the ECU is important. Realignments occur from time to time and are adjustments to the bilateral central rates. This change in turn affects the bilateral grid and the position of the fluctuation bands. During a realignment the actual definition of the ECU remains unchanged. A revision to the definition, a recomposition of the ECU, alters the actual number of units of each currency.

Revisions to the definition of the ECU have been provided for in the EMS apparatus. A change in the definition of the ECU can be decided by the Council of Ministers of the EC and a decision can be obtained through a unanimous vote of all the member countries. The Council's resolution of December 5, 1978 stipulates "the weights of the currencies in the ECU will be re-examined and if necessary, revised within a period of 6 months of entry into force of the system and thereafter every five years or, on request if the weight of a currency has changed by 25%."[6] A second safeguard was provided: "Revisions have to be mutually accepted; they will by themselves not modify the external value of the ECU."[7] This means that on the day a change in definition of the ECU becomes effective the value of the ECU according to both the old and the new definition will be exactly the same.

## III. The Weighting Scheme of the ECU

This section focuses on the impact of alternative weighting schemes on the currency composition of the ECU and on the dollar value of the ECU. It is important to examine how sensitive the value of the basket is to these changes because of the ECU's increasing importance in financial markets. Moreover, the EC has the opportunity to alter the currency composition of the ECU at least every five years. By 1989 it will be necessary for the EC Commision to redefine the ECU. It is possible that an earlier change may occur if either Spain or Portugal joins the EMS exchange rate system. However, the increase of private use of the ECU in the last two years indicates that the official weights are adequate. On the other hand, private use could increase by even more if the ECU were redefined.

A typical approach in defining weights for a country's basket index has been to derive optimal weights by specifying the policymaker's (or country's) objective function and by minimizing the variance of this function in which the target variable is either the real or nominal exchange rate. However, in the case of the EMS with ten member countries, following this procedure is more difficult, though not impossible. It is not obvious what type of objective function should be used and how the individual members should be considered. A further complication to this problem is to give weight to the ECU's role in the private sector. This addition requires considering the ECU in terms of portfolio decisions.

Rather than derive optimal weights for the ECU, in this paper various weighting schemes with economic justification are devised and are evaluated. If the results show that the value of the ECU is not highly sensitive to changes in its composition then deriving optimal weights is not important. One would expect that the value of the ECU would be sensitive to these changes. This sensitivity is evaluated by comparing mean values of different baskets. Other ways of assessing these differences may be considered at a later date.[8]

At each re-composition of the ECU, the EMS countries must decide and agree on the appropriate weighting scheme. Let us assume that they choose $w_i(0)$ to represent each country's share. This $w_i$ is then used to define the quantity of each member currency, $s_i$, used to create and calculate the ECU basket. Note that these $s_i$'s are fixed and are not changed again until the basket is redefined. To calculate the $s_i$ it is further assumed that the value of the ECU at time 0, ECU(0), and the $i^{th}$ foreign currency exchange rate in terms of a U.S. dollar, $FX_i(0)$, are known. Thus, repeating equation (1),

(2) $$s_i = w_i(0) * ECU(0) * FX_i(0).$$

The value of the ECU in subsequent periods is determined by using the market quoted exchange rates and the $s_i$'s derived in equation (2).

(3) $$ECU(t) = \sum_{i=1}^{n} s_i * \frac{1}{FX_i(t)} .$$

For the purposes of comparison, alternative baskets, referred to as "Pongos" are defined. They are similar to the ECU except that the initial 'economic' weights are $\tilde{w}_i(0)$. Given these weights a new set of currency amounts, $\tilde{s}_i$, are determined

$$(4) \qquad \tilde{s}_i = \tilde{w}_i(0) * ECU(0) * FX_i(0) \quad .$$

These $\tilde{s}_i$ are then used to calculate the value of the Pongo.

$$(5) \qquad Pongo(t) = \sum_{i=1}^{n} \tilde{s}_i * \frac{1}{FX_i(t)} \quad .$$

The construction of the Pongo as shown in (5) is the same as the ECU except that the $s_i$'s are different.

To determine whether the ECU is sensitive to changes in its composition the mean of the ECU is compared with the mean of each Pongo. The dollar value of the ECU and the Pongo are calculated using daily exchange rate data. The null hypothesis of this experiment is that the mean of the Pongo is not significantly different from the ECU. If the null hypothesis is not rejected this suggests that the ECU is invariant to the currency composition.[9]

Table 2 contains the results of this experiment. Column one presents results using data from September 17, 1984 to December 12,1985. September 17th is a natural starting point because it is the day the EC redefined the ECU's composition. Thus in this experiment September 17th is the base date, the date when the Pongo equals the ECU.

The first two rows of Table 2 give the mean (of the Pongo) and the "t" statistic obtained when testing for the difference in mean between the Pongo and the ECU. The mean value of the ECU is reported in the last row of column 1. The mean of the Pongo ought to be approximately the same magnitude as the ECU. The "t" statistic represents the test between means. The null hypothesis is rejected at the 5 percent level if this test is greater than 1.96 or at the one percent significance level at or greater than 2.576. The first four Pongo baskets represent four alternative weighting schemes reflecting each country's share of total EC exports, imports, nominal GNP, real GNP respectively. The test statistics show that the means of these alternative Pongos are not significantly different from the ECU. The failure to reject the null hypothesis may be due to small differences in the Pongo and the ECU or may be due to little exchange rate variability for the currencies that comprise the ECU. These results reported above may be due to small changes in weights between the baskets. Table 3 presents the ECU's and the Pongo's weights ($w_i$'s and $\tilde{w}_i$'s) and currency amounts ($s_i$'s and $\tilde{s}_i$'s). These Pongo shares and amounts are not identical to the actual ECU; however, they are not radically different.

To evaluate these results more fully 11 additional Pongo baskets over the same time period are considered. The first of these additional baskets gives equal weight to the countries. This basket incorporates larger changes in $\tilde{s}_i$ than the first four Pongo baskets and yet still includes the currency of all member countries. The other baskets are designed to represent a single country peg -- a weight of 1 is given to a different country in each successive basket. The design of these baskets goes against the EC's principle that the ECU should represent each member country rather than be a technical unit. These single country baskets are not considered realistic alternatives; they are merely designed to assess the sensitivity of the ECU to weight changes. Recall from (2) that the initial value of the ECU or the

Pongo is the same no matter what the weighting scheme is. This feature forces the currency amounts to alter dramatically when the weights move. For example, in the 'DM peg', 2.51 Deutsche mark defines the Pongo. In the actual ECU basket there are .719 Deutsche marks.

The results in column one of Table 2 show that the mean of the Pongo is not significantly different from the ECU for 9 of the 11 baskets. This result is somewhat surprising. Ex-ante, one would have thought that the value of the Pongo under these single country pegs would not be similar to the ECU because of the diverging strengths and weaknesses of the various currencies. However, when examining the position of various currencies in relation to the EMS bilateral grid over this 308 day period (actual market days), only 9 days are observed to be at either the floor or the ceiling assuming the spread of ± 2.25 per cent (± 6.0 per cent for Italy). Eight of these days occurred immediately prior to the realignment of central rates on July 19, 1985. Note that in total 6,468 bilateral exchange rates are observed. Furthermore, only during 76 days was one or more bilateral exchange rates observed to be greater (less) than 75 per cent over (under) the EMS central rate.[10] In general, there was little tension in the EMS over this period. Charts 1 to 3 show that the ECU and its member currencies all moved more or less uniformly against the U.S. dollar. During this period there was not a great deal of fluctuation among the individual EMS currencies cross rates. Table 4 reports the correlation matrix of EMS currency dollar exchange rates. The correlation amongst the currencies is extremely high -- most correlations are greater than .98. Therefore, defining the Pongo in terms of either the Deutsche mark (one of the EMS strong currencies) or in terms of the French franc (one of the EMS weak currencies) yields the same basket value as the ECU. The failure to reject the null hypothesis in these single country pegged Pongo baskets comes from the lack of exchange rate variability among currencies comprising the EMS rather than small variations in weights.

There are two exceptions to these findings: the Italian lira and the Greek drachma. Both the lira and the drachma dollar exchange rates had a larger variance than the EMS rates. The drachma was first included in the ECU basket in September 17, 1984 when the ECU was redefined. Furthermore, Greece does not participate in the full EMS arrangements nor has it been coordinating its economic policies with the other EC countries. It is not surprising, therefore, that the drachma Pongo basket does not approximate the ECU. The Italian lira, on the other hand, is an active participant of the EMS. However it has been one of the weakest EMS currencies and precipitated the realignment in July 1985. Pegging to the weakest currency yields an average basket value be less than the average for the ECU.

Another noteworthy observation from Table 4 is that the U.K. pound appears to have behaved much like the other EMS currencies. This observation may be consistent with the rumors that Britain may be considering to join the EMS. In general, the results over this time period suggest that if the EMS central rate system is functioning and all currencies stay within their prescribed bands, then it does not matter how the ECU is defined, since it will approximately equal any weighted average basket.

These results may have policy implications. Therefore, three additional episodes are analyzed. The base date for these other baskets including the ECU is shifted back to March 13, 1979 -- the day the ECU was first defined. Column 2 of Table 2 reports the results covering the period March 13, 1979 to December 21, 1982. Because six EMS realignments occurred over this period, a sub-sample of this period which exhibited stability is also examined -- December 2, 1979 to March 20, 1981. Lastly, the period after the 7th EMS realignment -- March 1983 -- until the change in ECU composition, September 17, 1984, is also examined. In each of these episodes the same experiments as described earlier are considered.

As in the first period, the means of the economic weighted Pongos are not significantly different from that of the ECU. This result suggests (at least empirically) that the ECU is not sensitive to small fluctuations in weighting schemes. In contrast to the first period, however, the null hypothesis is rejected in nearly every single country peg and equal weighted basket case. In some instances the Deutsche mark and the Netherlands guilder are exceptions.

Closer examination of the period of December 1979 to March 1981 helps to understand the general results obtained in these additional periods. Note that there are differences in the ECU and Pongo baskets between the first period (September 1984 to December 1985) and the other periods. First, in the additional periods the currency amounts used in the ECU calculation represent those defined in 1979. The initial weighting scheme used to derive these amounts differ slightly between the two periods. This is partly due to the inclusion of the Greek drachma in the latter period and partly due to changes in relative economic importance attributed to the various countries.

Note that this December-March period approximately spans the same interval, 326 days, as that of the first period. Moreover, it is a period between two sets of realignments. Unlike the first period examined, this period is characterized by a weak dollar. However, if the only difference between the periods was the EMS currencies' relationship to the dollar, then one would expect the results obtained in the earlier periods to hold during this period. In addition to the weak dollar, there was considerably more strain on the EMS system. Even though very few days were observed at the actual floor or ceiling, 34 to be precise, more than 52 percent of all bilateral rates were at least 75 percent (± 1.68 per cent -- the divergence indicator band) of the 'legal spread' from the central rate. This condition is dramatically different from the other period where very few bilateral rates fluctuated beyond the divergence band. It appears that the null hypothesis is rejected in this instance because of the divergence in exchange rates between EMS countries. This result is consistent with the earlier observation that if the EMS central rate system is functioning and currencies remain close to the central rates then it does not matter how the ECU is defined.

The observations made from the December-March period extend to the two other periods. During the March 1983 - September 1984 period the strain on the EMS was much greater. Nearly every bilateral exchange rate was at or exceeded the 'divergence band'. In general, the results of the additional periods indicate that the initial weights are important, especially when currencies deviate from the central rate.

A more positive conclusion that can be drawn from this exercise, though tentative, is that if EMS countries continue to follow similar economic paths which eliminate variability in their cross exchange rates as they recently have, then the ECU will not be sensitive to its weighting scheme. This conclusion implies that the EC should be able to sustain the ECU under the weighting scheme they have currently devised.

## IV. Comparison of Single Country Currency Basket Peg and the ECU -- The Case of Germany

This section focuses on analyzing German exchange rate policy assuming its real exchange rate is pegged to a basket other than the ECU.[11] The object of the exercise is to compare the derived optimal basket path with that of the ECU basket path. It is a simple counterfactual experiment, attempting to answer the question: Is the EMS or the ECU basket peg an optimal policy for Germany?

There has been concern about the stability of the EMS. However, if the ECU basket path closely approximates the optimal basket, then this suggests that the Germans may be willing to continue their participation in the EMS rather than opt for some other policy. This result further suggests general stability for the ECU. The experiment could also be considered for any or all of the other EMS countries. However, it is certainly easier to investigate the optimality of a currency basket for an individual country, than it is for ten countries jointly.

The type of exchange rate index considered in this section is similar to the adjustable peg described in section II. The weights are fixed and the amount of each currency adjusts. This is in contrast to the ECU basket, where the currency amounts are fixed and the weights adjust reflecting changes in relative values of the exchange rate. The nominal exchange rate index is denoted as $I^h(t,w)$ where I, h, t, w are the exchange rate index, the reference currency (the home country), time and weights, respectively. The home country's bilateral exchange rate with respect to currency j at time t is written as $E_j^h(t)$. The effective exchange rate index for the home country is defined as a geometric average.

$$(6) \qquad I^h(t, w) = \prod_{j=1}^{N} (E_j^h(t)/E_j(o))^{w_j} .$$

In this basket, there are N currencies with weights $w_j$, j=1....N and the sum of the weights equals one, $\Sigma\, w_j = 1$. When $I^h(t,w)$ is greater than $I^h(o,w)$ this implies a depreciation of the home currency. Equation (6) is rewritten in log form where lower case letters denote logs of variables (with the exception of weights and parameters):

$$(7) \qquad i^h(t, w) = \sum_{j=1}^{N} w_j(e_j^h(t) - e_j^h(o)) .$$

Furthermore, if the home numeraire exchange rate, $e_1^h$, is pegged to a log-linear basket of n currencies with weights, $w_j$, then one can write

$$(8) \qquad e_1^h = - \sum_{2}^{N} w_j\, e_j^1 .$$

For the purpose of this paper, it is assumed that the German policymaker is concerned with minimizing fluctuations in the real exchange rate index at some target $r^*$, and that the weights ($w_j$'s) in the currency basket are policy instruments. The policy problem is to determine the weights at each point in time which minimize the cost of deviations from the policy target. To this end, the policymaker is assumed to possess the following quadratic objective function

(9) $$L = E(r - r^*)^2 \quad .$$

To simplify matters it is further assumed that the target is expected to be achieved, that is $r^* = E(r)$.

Note that the real exchange rate index is defined as

(10) $$r = (e_1^h - p^h) + \sum_{j=1}^{N} \tau_j \, (e_j^1 + p^j) \quad .$$

where

$r$ = real exchange rate

$p^h$ = home country price index

$e_j^1$ = numeraire - $j^{th}$ country exchange rate

$p^j$ = $j^{th}$ country price index

$\tau_j$ = elasticity weights.

It is assumed that the authorities know exactly what these elasticity weights are. They are used to define the real exchange rate index and under certain circumstances the optimal currency basket weights, $w_j$, will equal these elasticity weights.[12]

According to equation (8), basket weights are shown to affect the home numeraire exchange rate. This will in turn affect the real exchange rate. This can be seen by substituting equation (8) into (10) which yields

$$(11) \qquad r(w) = \sum_{1}^{N} \tau_j \, (p^j - p^h) + \sum_{2}^{N} (\tau_j - w_j) e_j^1 \quad .$$

To be consistent with the empirical derivations, the numeraire-home relative price is separated from the numeraire-country j prices by adding and subtracting $p^1$ from the right hand side of (11). This yields

$$(12) \qquad r(w) = (p^1 - p^h) + \sum_{1}^{N} \tau_j \, (p^j - p^1) + \sum_{2}^{N} (\tau_j - w_j) \, e_j^1 \quad .$$

Note that the real exchange is a function of both $\tau_j$'s and $w_j$'s, the elasticity shares and the optimal basket weights. The problem of choosing weights can now be seen as minimizing the objective function with respect to the weights

$$(13) \qquad \underset{\text{W.R.T } (w)}{\text{Min}} \; L = E(r(w) - E(r(w)))^2 \quad ,$$

where r(w) is defined in (12) and the weights satisfying the problem, $w^o = (w_1^o \ldots w_n^o)$, are defined as optimal.

The first-order conditions after minimizing (13) are as follows:

(14) $$\sum_{j=2}^{N} (w_j - \tau_j) \text{ Cov } (e_j^1, e_q^1) - \sum_{2}^{N} \tau_j \text{ Cov } (p^j - p^1, e_q^1)$$

$$- \text{ Cov } (p^1 - p^h, e_q^1) = 0 \text{ for } q = 2,\ldots N \quad .$$

The N-1 equations in (14) are rewritten in matrix and vector notation.

(15) $$\Omega \, (w - \tau) - \pi \, (\tau) - \Gamma = 0 \quad ,$$

where

$\Omega = \text{Cov } (e_j^1 \; e_q^1)$, an (N - 1) by (N - 1) variance-covariance matrix of exchange rates.

$\pi = \text{Cov } (p^j - p^1, e_q^1)$, an (N - 1) by (N - 1) Covariance matrix between the numeraire-country g exchange rates and the relative price of the (N - 1) foreign countries and the numeraire country.

$\Gamma = \text{Cov } (p^1 - p^h, e_q^1)$, an (N - 1) column vector of the covariance between the numeraire-country q exchange rate and the relative price between the numeraire and home country.

From (15), the solution with respect to the optimal weights, $w^o$, can be derived as:

(16) $$w^o = \tau + \Omega^{-1} \pi \;\; \tau + \Omega^{-1} \Gamma \quad .$$

Both Lipschitz and Sundararajan (1980, 1982) and Edison and Vardal (1985) discuss in detail the implications of equation (16) and the various special cases. In this paper the focus is on applying equation (16) to the German situation by comparing the German optimal basket path with the path of the ECU.

The evaluation of the optimal weights is done using monthly data over the period March 1979 to May 1985. German trade shares are used to represent the elasticities, $\tau_j$'s. Some of the smaller EMS countries, Luxembourg and Greece, in particular have been omitted from the calculation. However, Japan, Switzerland and the United States were included. Realistically, if Germany were to create an independent basket, then it seems reasonable that these latter countries would be included. There is at least one caveat to this exercise that needs to be mentioned It is assumed that the German policymakers observe accurate data on prices. In practice, prices are not accurately observed, and this introduces uncertainty into the problem. This uncertainty implies that the weights are not truly optimal.[13]

Chart 4 illustrates the path of the optimal currency basket derived from the formulae in equation (16) and the path of the ECU converted into DM (DM-ECU). The German basket is consistently above the DM-ECU basket. This chart suggests that the DM would have been generally weaker vis-a-vis most currencies if Germany it were to stabilize its real exchange rate index. However, the differences are quite small. Chart 5 depicts the optimal currency basket path and the DM/$ exchange rate indexed also to 100 in March 1979. The paths of these two baskets are dramatically different. The conclusion one draws from this chart is that the optimal exchange rate basket is not very different from the ECU peg but is very different from a DM/$ peg.

## V. Conclusion

During the past year or so there has been a great deal of discussion at the policy-making level and in financial markets about the stability of the ECU. This paper has sought to examine the sensitivity of the ECU to changes in its currency composition and to compare the path of the ECU to that of an optimal basket in the case of Germany. The results derived in this paper suggest that the ECU is stable. The first experiment indicated that when there is little exchange rate variability within the currencies that comprise the ECU the value of the ECU remains invariant to weight changes. The second experiment demonstrated that the optimal basket for German is not unlike the ECU. Both of these results are based on preliminary work and should be interpretated as tentative.

Table 1: Components of the ECU Basket
for September 17, 1984

| Country[a] | $S_i$[b] | $FX_i$[c] | $C_i$[d] | $FXECU_i$[e] | $W_i$[f] |
|---|---|---|---|---|---|
| BF | 3.71 | 61.84 | .059994 | 45.153 | .082165 |
| DK | .219 | 11.112 | .019708 | 8.1135 | .026992 |
| FF | 1.31 | 9.428 | .13895 | 6.8839 | .1903 |
| DM | .719 | 3.073 | .23397 | 2.2438 | .32044 |
| GD | 1.15 | 120.2 | .0095674 | 87.765 | .013103 |
| IL | 140 | 1892 | .073996 | 1381.5 | .10134 |
| IP | .00871 | .99206 | .0087797 | .72436 | .012024 |
| LF | .14 | 61.84 | .0022639 | 45.153 | .0031006 |
| NG | .256 | 3.465 | .073882 | 2.53 | .10119 |
| EP | .0878 | .80515 | .10905 | .58789 | .14935 |
| ECU[g] | | | .73016 | | |

Notes to Table:

a Countries are as follows: Belgium (BF), Denmark (DK), France (FF), Germany (DM), Greece (GD), Italy (IL), Ireland (IP), Luxembourg (LF), Netherlands (NG), and U.K. (EP).

b $S_i$ represent actual currency components in the ECU -- revised on 17 September 1984.

c $FX_i$ - represent the foreign exchange/dollar rate. Data are from the Federal Reserve MDL database -- based on noon New York rates.

d $C_i$ - dollar equivalent of component in ECU.

e $FXECU_i$ - represents the central foreign exchange rates in terms of the ECU.

f $W_i$ - represent initial weights. Note that because I use New York exchange rates rather than the official EC rates these weights are slightly different from official one. However, the currency components correspond exactly with the official numbers.

g ECU - the dollar value of the basket. It is the sum of the $C_i$'s.

Table 2: Mean of the Pongo and ECU Baskets
Tests for Differences in these Mean[a]

| Type of Pongo | Sept. 17, 1984 Dec. 11, 1985 | March 13, 1979 Dec. 31, 1982 | Dec. 2, 1979 March 1981 | March 1983 Sept. 14, 1984 |
|---|---|---|---|---|
| EXP[b] | .74993 | 1.209 | 1.37 | .845 |
| | (.09088) | (.328) | (.631) | (.01) |
| IMP[c] | .7485 | 1.21 | 1.37 | .84 |
| | (.41311) | (.327) | (.813) | (.14) |
| GNPV[d] | .74819 | 1.21 | 1.366 | .84 |
| | (.4917) | (.448) | (1.04) | (1.33) |
| GNP[e] | .74901 | 1.208 | 1.37 | .836 |
| | (.2951) | (.182) | (.735) | (2.36) |
| EQ[f] | .741 | 1.18 | 1.35 | .8 |
| | (1.91) | (2.6)*** | (3.32)*** | (13.6)*** |
| BF[g] | .75363 | 1.1587 | 1.338 | .739 |
| | (.7287) | (5.2737)*** | (4.66)*** | (43.5)*** |
| DK[g] | .75786 | 1.094 | 1.235 | .73 |
| | (1.6724) | (12.894)*** | (23.41)*** | (35.7)*** |
| FF[g] | .7586 | 1.1612 | 1.345 | .712 |
| | (1.7723) | (4.99)*** | (3.625)*** | (42.1)*** |
| DM[g] | .75533 | 1.2217 | 1.361 | .943 |
| | (1.0815) | (1.853) | (.957) | (29.0)*** |
| GD[g] | .6533 | -- | -- | -- |
| | (24.703)*** | | | |
| IL[g] | .72349 | 1.13 | 1.31 | .706 |
| | (7.136)*** | (7.978)*** | (8.74)*** | (42.8)*** |
| IP[g] | .7587 | 1.174 | 1.33 | .771 |
| | (1.84) | (3.8266)*** | (5.04)*** | (22.1)*** |
| NG[g] | .7552 | 1.199 | 1.342 | .905 |
| | (1.04) | (.9617) | (4.2154)*** | (18.0)*** |
| EP[g] | .7486 | 1.362 | 1.533 | .959 |
| | (.3434) | (19.538)*** | (32.81)*** | (32.1)*** |
| Actual ECU | .75034 | 1.2069 | 1.368 | .845 |

Notes to Table:

*** indicates that the mean of the ECU is significantly different from the mean of the Pongo .

a Test Statistic based on Behrens-Fisher Test:
't' = (mean(Pongo)-mean(ECU))/(SQRT((var(Pongo)+var(ECU))/T))

b Exp Pongo Basket -- weights based on export shares:source OECD.

c Imp Pongo Basket -- weights based on import shares:source OECD.

d GNPV Pongo Basket -- weights based on nominal GNP shares:source OECD.

e GNP Pongo Basket -- weights based on real GNP shares:source OECD.

f EQ Pongo Basket -- weights based on equal shares.

g single country peg -- for country mnemonic see note to Table 1.

Table 3: Initial Weights ($W_i$) and Currency Amounts ($S_i$'s) for the ECU and Pongo Baskets September 17, 1984

| | ECU | | EXPORT | | IMPORT | | GNPV | | GNP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $W_i$ | $S_i$ | $W_i$ | $S_i$ | $W_i$ | $S_i$ | $W_i$ | $S_i$ | $W_i$ | $S_i$ |
| BF | .082 | 3.71 | .088 | 3.97 | .093 | 4.19 | .035 | 1.58 | .041 | 1.85 |
| DK | .027 | .219 | .027 | .22 | .028 | .22 | .025 | .202 | .025 | .202 |
| FF | .19 | 1.31 | .167 | 1.14 | .168 | 1.15 | .225 | 1.54 | .235 | 1.62 |
| DM | .32 | .719 | .294 | .66 | .257 | .57 | .281 | .63 | .287 | .64 |
| GD | .013 | 1.15 | .008 | .70 | .016 | 1.40 | .015 | 1.31 | .014 | 1.22 |
| IL | .102 | 140 | .126 | 174. | .142 | 196. | .16 | 291 | .137 | 189 |
| IP | .012 | .008 | .017 | .012 | .016 | .011 | .008 | .005 | .007 | .005 |
| LF | .003 | .14 | -- | -- | -- | -- | .001 | .045 | .002 | .009 |
| NG | .101 | .251 | .112 | .283 | .104 | .263 | .057 | .144 | .058 | .146 |
| EP | .15 | .0878 | .161 | .094 | .176 | .103 | .194 | .114 | .194 | .114 |

Note to Table:
Formula use to derive $s_i$'s is:

$$s_i = w_i(0) * ECU(0) * FX_i(0).$$

Table 4: Correlogram of Exchange Rates
September 17, 1984 to December 12, 1985

| | BF | DK | FF | DM | GD | IL | IP | LF | NG | EP |
|---|---|---|---|---|---|---|---|---|---|---|
| BF | 1 | | | | | | | | | |
| DK | .982 | 1 | | | | | | | | |
| FF | .995 | .98 | 1 | | | | | | | |
| DM | .996 | .979 | .997 | 1 | | | | | | |
| GD | .557 | .535 | .507 | .562 | 1 | | | | | |
| IL | .898 | .857 | .848 | .879 | .859 | 1 | | | | |
| IP | .992 | .977 | .997 | .992 | .477 | .883 | 1 | | | |
| LF | 1 | .982 | .995 | .996 | .553 | .878 | .992 | 1 | | |
| NG | .995 | .979 | .996 | .999 | .561 | .878 | .991 | .995 | 1 | |
| EP | .884 | .875 | .917 | .895 | .207 | .607 | .926 | .884 | .899 | 1 |

**CHART 1: DOLLAR/ECU EXCHANGE RATE**

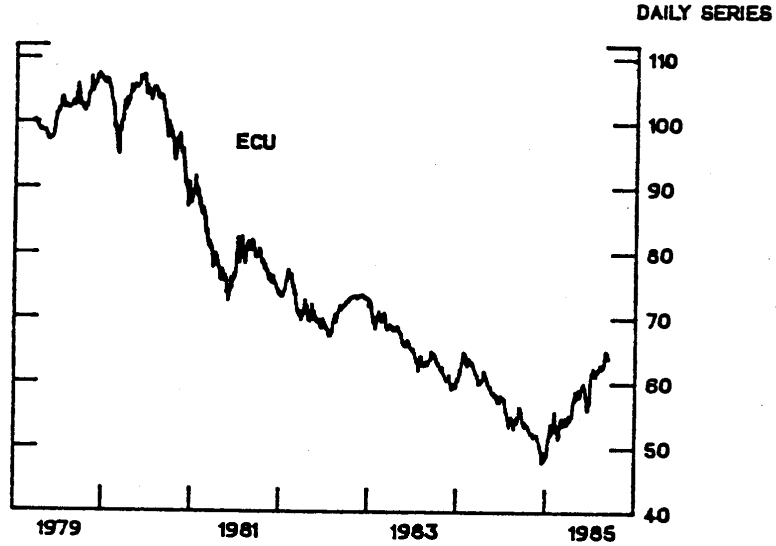



**CHART 2: SELECTED DOLLAR EXCHANGE RATE**

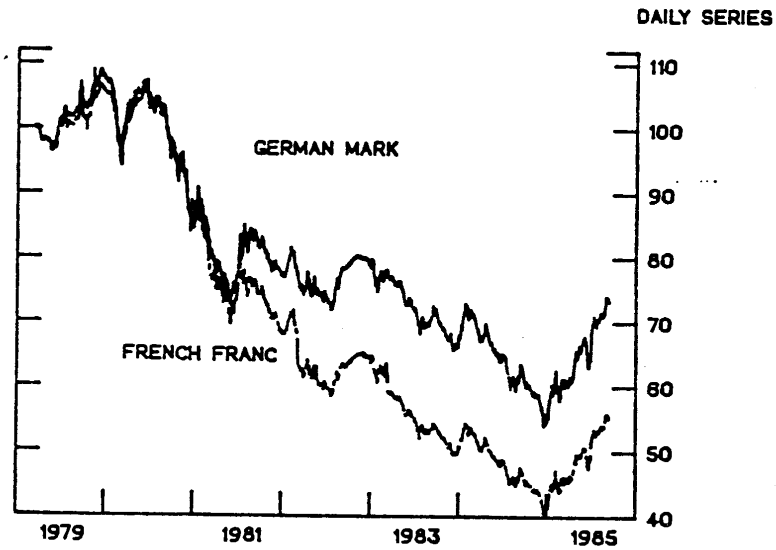
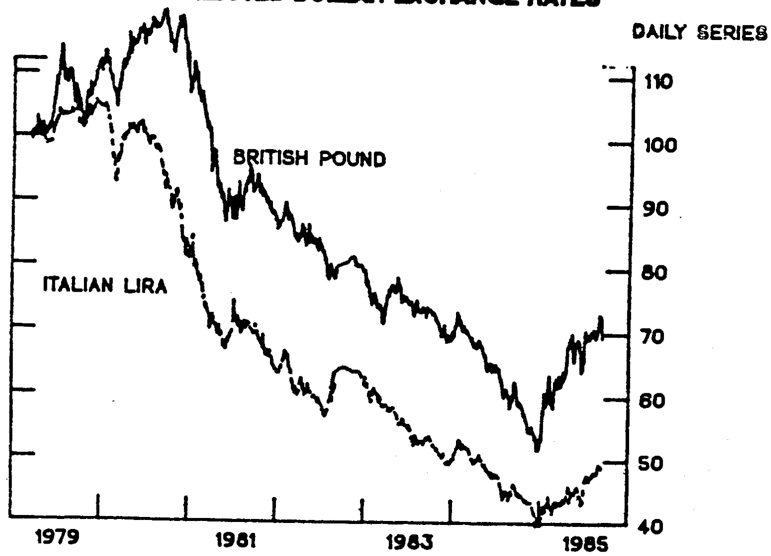
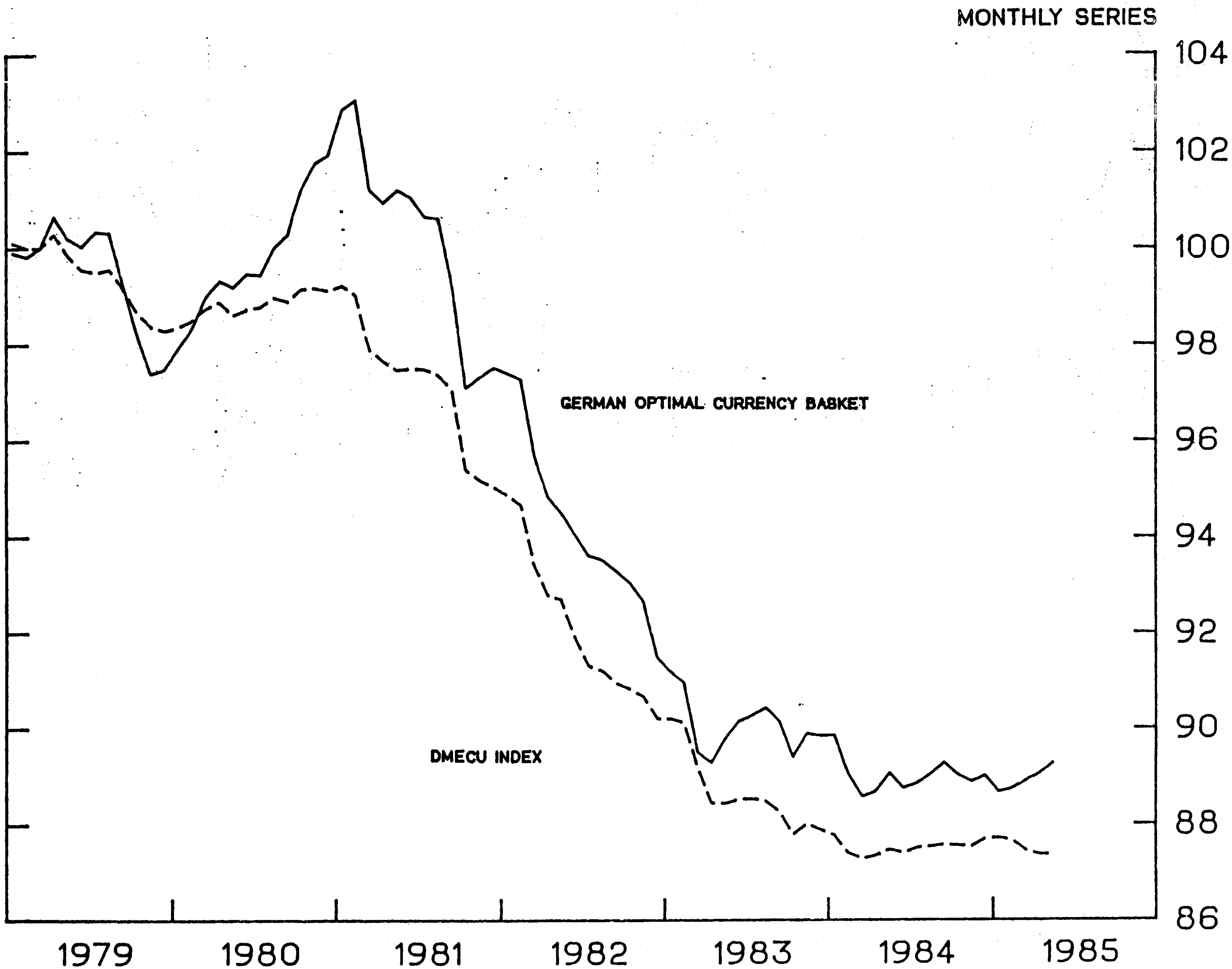



**CHART 3: SELECTED DOLLAR EXCHANGE RATES**



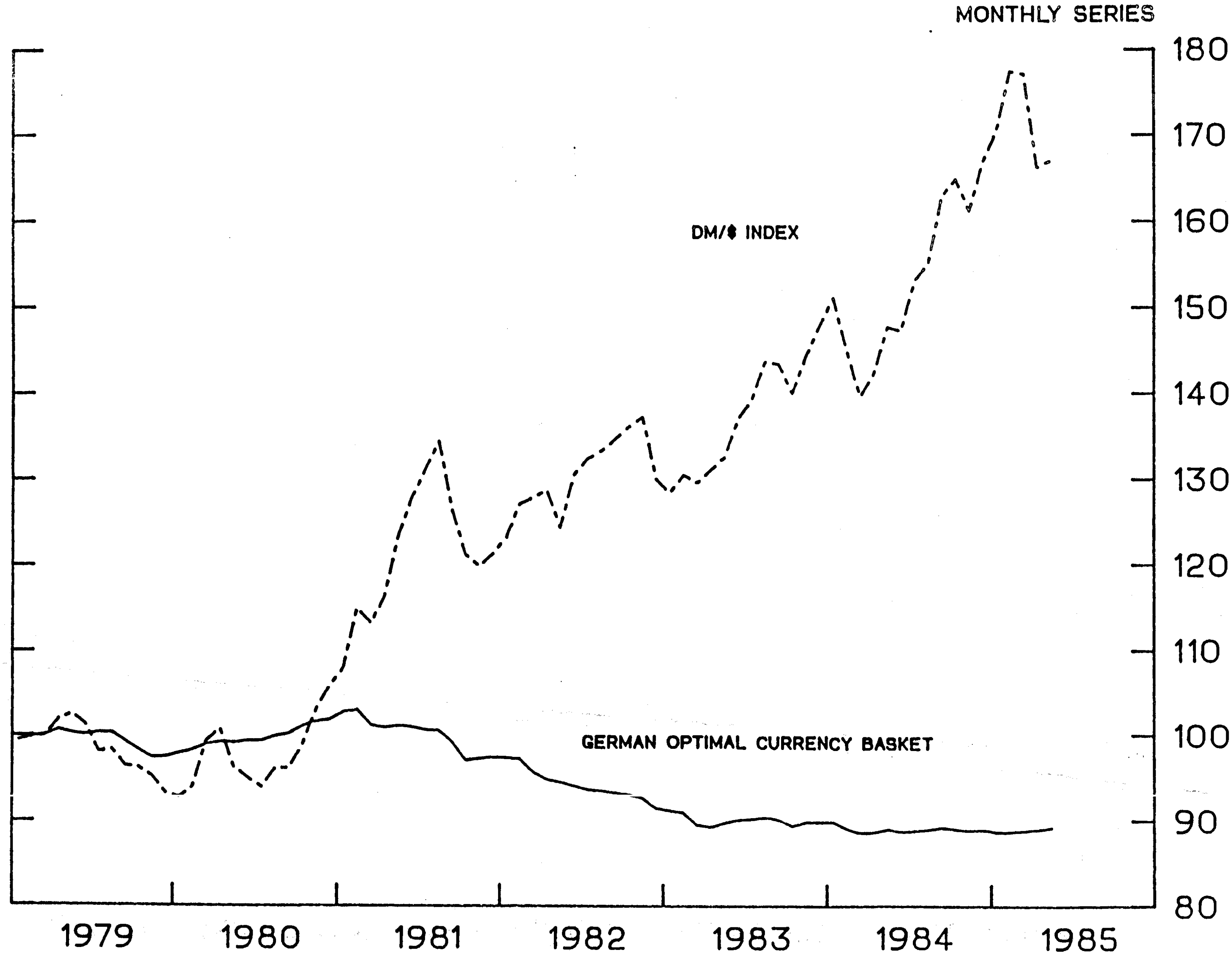

MARCH 13,1979 = 100

CHART 4: COMPARISON OF OPTIMAL AND ECU BASKETS FOR GERMANY




MARCH 1979 = 100

## CHART 5: COMPARISON OF OPTIMAL BASKET TO MARK/DOLLAR RATE




MARCH 1979 = 100

Footnotes:

* The author is a staff economist in the International Finance Division, Board of Governors of the Federal Reserve System. This paper was originally presented at the ECU conference at New York University on January 31, 1986. The author has benefited from discussions with many of her colleagues, in particular James Berry, Owen Evans, Catherine Mann, and John Morton. The usual caveat that the remaining errors are my own responsibility applies. The views expressed herein are solely those of the author and do not necessarily represent the views of the Federal Reserve System or any members of its staff.

1 As explained in an official EEC publication on the ECU.

2 Most of this section draws on the paper "The European Monetary System" published in European Economy (1979).

3 The exchange rates used for calculating the ECU are well defined. The central bank in each member state communicates a representative market exchange rate for its currency against the U.S. dollar. The dollar has been chosen as giving the most representative rate in all financial centers. The rates are taken from the exchange market at 2:30 p.m. They are communicated by the National Bank of Belgium to the EC Commission which uses them to calculate the ECU equivalent first in dollars and then in the currencies of the member state. If an exchange rate market is closed, the central bank agrees on a representative exchange rate for the currency against the dollar which is communicated to the EC Commission.

4 The ECU rate is assumed to be known at the calculation. In 1979 it was equivalent to the old value of the European Unit of Account (EUA). The EUA was constructed in such a way that on June 28, 1974 one EUA = 1 SDR = one ounce of fine gold.

5 The market reacted very calmly to this change. The timing was as expected. It occurred approximately five years after the previous revision.

6 See "The European Monetary System."

7 ibid.

8 Another crucial characteristic which should be examined is the volatility of each basket.

9 The interpretation of the test statisitics we use assumes normality. It is possible that with the EMS tendency to have large jumps in parity that this assumption is violated (that is, we have the Peso problem as described in Krasker (1980)). This problem needs to be addressed; however, it is beyond the scope of the paper.

10 A computer program was used which calculated the position of each day's bilateral exchange rate against the bilateral grid. The central rates were updated whenever there was a realignment.

11. The analysis in this section is based on my joint work with Erling Vardal.

12 Edison and Vardal (1985) explain these conditions in complete detail.

13 For details see Lipschitz and Sundararajan (1982).

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