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THE IDENTIFICATION OF DESTABILIZING FOREIGN EXCHANGE SPECULATION

by

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Ever since Nurkse's (1944) claim that speculation was destabilizing in the 1920s French franc market, theorists and empiricists have endeavored to explain what was meant by such a claim, show how one could identify the phenomenon, and present evidence that proved or disproved its existence in a variety of markets over various sample periods. With the advent of generally floating exchange rates in the 1970s, there has been renewed interest in the subject in both the academic and popular literature.

In this paper, a technique for directly identifying the concept of destabilizing foreign exchange speculation is developed and then it is shown that previous empirical techniques used in the foreign exchange market literature have not provided correct criteria for identifying its existence. In addition, an example of this technique is presented in the form of tests for the existence of destabilizing speculation in the 1973-1975 exchange markets.

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The existing literature on destabilizing foreign exchange speculation has in general been concerned with three problems: 1) definition and identification, 2) policy implications, and 3) (belatedly) welfare implications. There are a number of unresolved and important issues that are central to the identification of destabilizing speculation and to the conclusions that should be drawn once it has been identified. Some of these issues are discussed briefly below, but a full treatment is beyond the scope of the present paper.

The foremost of these issues is the question of whether "speculation" can be identified at all as a distinct empirical phenomenon. Whereas economists do not hestitate to distinquish conceptually between speculative and nonspeculative motives of demand and supply, the ultimate power of any empirical work on speculation depends on the ability of the test to accurately separate the impact of speculation from the impact of nonspeculative market forces. Any work that claims to identify the existence of destabilizing speculation must first of all have successfully identified the full impact of speculation itself. In the empirical work presented in section 4 below, the weight of the presented evidence depends upon the validity of the interpretation of relative interest rates within a monetarist model as being a correct proxy for speculative influences on the exchange rate.

At present, the welfare aspects of this issue remain essentially unresolved: Johnson (1976) showed "that destabilizing speculation involves a social loss," while Salant (1976) has demonstrated that profitable speculation necessarily improves welfare even if it is destabilizing. If destabilizing speculation cannot be shown to be necessarily welfare reducing, then the policy implications of destabilizing speculation are by no means clear.

Merely showing that destabilizing speculation has existed does not imply that the benefits of eliminating it are outweighed by the costs of doing so (including the use of foreign exchange reserves and manpower, and the resource costs of possible capital and trade controls). In order to prove that the existence of destabilizing speculation under a floating regime implies that less flexibility is desirable, it must be shown that not only is it accompanied by a welfare loss, but also that there would be no (or at least less) destabilizing speculation under alternative systems (Johnson (1976)). Put another way, just because central banks recognize the existence of destabilizing speculation, does not necessarily mean that they are able to eliminate it (or that they should eliminate it) by intervening in the foreign exchange markets.

Setting aside these unresolved issues, this paper addresses the question of how to correctly identify the phenomenon of

destabilizing foreign exchange speculation. Section 2 develops this technique, section 3 shows that previous techniques used in the literature have been neither necessary nor sufficient conditions for identifying destabilizing speculation, and section 4 presents results of an empirical application of this technique to the French franc-Deutschemark-dollar markets of the 1970s.

I. Definitions

"Speculation" is defined to be purchases or sales of foreign exchange based on expectations on future prices. This is consistent with the generally accepted concept of speculation presented in Johnson(1976) ("purchase now for sale later, or vice versa"), Kemp (1963)("buying (or refraining from selling) in the expectation of later selling (or refraining from buying) at a higher price"), and Salant (1976)("inter-temporal carry-overs").

"Destabilizing speculation" is defined to be speculation that causes the observed time series of the price to be more volatile than it would have been in the absence of such an activity. This definition is a standard definition and is consistent with that used in almost all of the empirical work on destabilizing foreign exchange speculation.[1] As will be shown, this definition is quite distinct from looking at volatility per se as a technique for identifying destabilizing speculation, since it accounts for the variance of the

exchange rate that is explained by fundamental economic determinants before determining the characteristics of speculation. It is, however, only a special case of the much broader concept that is often used (and so far not yet subjected to empirical testing) that destabilizing speculation is speculation that causes a price to move away from some medium-term "equilibrium" level.

The mean-squared deviations of the price series around its mean is used as our measure of stability or volatility as suggested by Farrell, Kemp, Salant, Schimmler, and Telser (for convenience, this measure will be called the variance of the price series, but no probability statements are implied by the use of the term). This measure has a potential defect which turns out to be not relevant to our empirical work: for a price series that is a function of time or otherwise nonstationary, the variance is an inappropriate measure of stability or volatility.[2]

For our purposes, a careful destinction is made between what destabilizing speculation is and what different techniques exist that can be used to identify it once it is defined. Examples of techniques that have often been used to identify destabilizing speculation, but that cannot in and of themselves be considered definitions of destabilizing speculation, include: 1) prices that are volatile, 2) evidence that market participants buy after the price starts rising and sell after it starts falling

(i.e., "bandwagons" or "self-justified" speculation), and 3) net profits or losses made by speculators as a whole. Such criteria will be analyzed in detail in section 3.

II. Directly Identifying Destabilizing Foreign Exchange Speculation

The hypothesis to be tested then is that the observed exchange rate time series is more volatile than the exchange rate time series that would have occured in the absence of a supply and demand generated purely on the basis of expectations on future exchange rates.[3] Assume that the process that generates the exchange rate can be represented by the simple (linear) expression:[4]

$$X_t = \beta W_t + \alpha \Delta X_t^e + u_t \qquad (1)$$

where X is the price of foreign exchange in terms of domestic currency, β is a vector of coefficients, W includes all "non-speculative" variables that determine the current exchange rate, α is a positive scalar coefficient, ΔX^e is the variable representing speculative expectations and is equal to the difference between the expected future exchange rate and the current rate ($\Delta X^e = X^e - X$), and u is a normally distributed disturbance term with zero mean. The exchange rate that would exist in the absence of the influence of expectations on the future exchange rate can be represented to be (dropping the t subscripts for simplicity):

$$\tilde{X} = X - \alpha \Delta X^e = \beta W + u \qquad (2)$$

Speculation will than be destabilizing when:

$$\sigma_X^2 > \sigma_{\tilde{X}}^2 \qquad (3)$$

where σ^2 is the variance of the time series around its mean, and stabilizing when

$$\sigma_x^2 < \sigma_{\underset{\sim}{x}}^2 \qquad (4)$$

Since

$$\sigma_x^2 = E\{\beta(W-\bar{W})(W-\bar{W})'\beta'\} + \alpha^2\sigma_{\Delta x^e}^2 + 2\alpha\beta\,\mathrm{cov}(\Delta x^e, W) + \sigma_u^2 \qquad (5)$$

and $$\sigma_{\underset{\sim}{x}}^2 = E\{\beta(W-\bar{W})(W-\bar{W})'\beta'\} + \sigma_u^2 \qquad (6)$$

(where $\bar{W}$ is the mean of W, and $(W-\bar{W})'$ and β' are the transpose of $(W-\bar{W})$ and β respectively), the condition for the existence of destabilizing speculation is:

$$\sigma_x^2 - \sigma_{\underset{\sim}{x}}^2 = \alpha^2\sigma_{\Delta x^e}^2 + 2\alpha\beta\,\mathrm{cov}(\Delta x^e, W) > 0 \qquad (7)$$

Intuitively, this relationship indicates that if a change in the variables that are fundamental determinants of the exchange rate is associated with a change in the exchange rate and a change in the expected change in the exchange rate in the same direction, then the impact of expectations is to increase the variance of the exchange rate from what it would have been if expectations were not present in the market. That is, expectations would be destabilizing. Alternatively, if, say, an increase in the interest rate caused an increase in the exchange rate and a reduction in the expected increase (or an increase in the expected decrease) of the exchange rate, then the impact of these expectations would be to reduce the fluctuations in the exchange rate (as long as this effect was large enough to

offset $\alpha^2\sigma^2_{\Delta\chi^e}$). A sufficient condition for the existence of destabilizing speculation is that expected changes in the future exchange rate be orthogonal to the other explanatory variables of the model.

III. Past Attempts at Identifying Destabilizing Foreign Exchange Speculation

There have been many attempts since Nurkse (1944) to identify the existence of destabilizing foreign exchange speculation, especially in the 1920s French franc market and the 1950s and 1960s Canadian dollar market.[5] These techniques can be broken down into roughly two major categories, neither of which contains any criteria that have been shown to be either a necessary or a sufficient condition for identifying destabilizing speculation. In this section, the usefulness of these criteria as conditions for identifying destabilizing speculation are analyzed in light of conditions (3) and (7) above.

The first category includes those techniques that merely analyze the behavior and time path of the exchange rate without utilizing some notion of the underlying determinants of the rate. Within this category are included those arguments that claim that: 1) a high amplitude of exchange rate fluctuations *per se* is evidence of destabilizing speculation, and 2) there is destabilizing speculation when the spot rate and the forward premium move in the same direction.[6]

The issue of increased exchange rate volatility usually has been presented in the following manner: if the exchange rate is more volatile in period 2 than in period 1 (i.e. $\sigma^2_{x_2} > \sigma^2_{x_1}$), then speculation is said to be destabilizing in period 2. That is, from (3):

$$\sigma^2_{x_2} - \sigma^2_{x_1} > 0 \Rightarrow \sigma^2_{x_2} - \sigma^2_{\tilde{x}_2} > 0.$$

This of course is not true. In fact, all that can be said, given the information that $\sigma^2_{x_2} > \sigma^2_{x_1}$, is that $\sigma^2_{x_2} - \sigma^2_{\tilde{x}_2} > \sigma^2_{x_1} - \sigma^2_{\tilde{x}_2}$, which implies nothing about whether $\sigma^2_{x_2} - \sigma^2_{\tilde{x}_2}$ is greater than, less than, or equal to zero. Increased variability in the exchange rate can be evidence of stabilizing speculation, destabilizing speculation, or no speculation at all.

The statement that there is destabilizing speculation when spot rates and forward premia move in the same direction (Aliber (1970, 1973) and Hodgson (1972)) is equivalent to claiming that there is destabilizing speculation if the $\text{cov}(X' - X, X) > 0$ (where X' is the forward exchange rate). Assuming that the forward rate accurately reflects exchange rate expectations, it can be shown from (1) above that the

$$\text{cov}(X' - X, X) > 0 \Rightarrow \frac{\partial X}{\partial (\tilde{x}^e - X)} \ (=\alpha) > 0.$$

From (7) it can be seen that $\alpha > 0$ does not imply destabilizing speculation since it does not ensure that $\alpha^2 \sigma^2_{\Delta x^e} + 2\alpha\beta \ \text{cov}(\Delta X^e, W) > 0$. The mere observation that the forward premium (or the expected change in the exchange rate) moves in the same direction as the

exchange rate cannot identify the existence of destabilizing speculation, since this analysis includes no information about the net effect of the endogenous components of expectations on the variability of the exchange rate ($2\alpha\beta$ cov $(\Delta X^e, W)$).

The second major category includes those techniques that utilize some knowledge of the relationship between the exchange rate and some set of fundamental economic variables (e.g., the components of W).

The first technique of this sort claims that exchange rate "bandwagons" are evidence of destabilizing speculation. This argument is usually made in one of two ways. The first is a special case of the excessive variability argument discussed above,and claims simply that exchange rates that move in excessively large swings or "bandwagons" are evidence of destabilizing speculation. As was shown above, excessive movements of the exchange rate per se imply nothing at all about the net effect of the endogenous components of expectations on the variability of the exchange rate, and thus nothing at all about the nature of speculation.[7]

A second type of "bandwagon" argument is often represented by expressing the expected future exchange rate as an increasing function of the current rate[8]:

$$X^e = \delta_1 Z + \delta_2 X \qquad (8)$$

where Z is a matrix of other variables that are used to form expectations (perhaps even coincident with W), δ_2 and

δ_1 are a scalar and a vector of coefficients repectively, and bandwagons are implied by $\delta_2 > 0$.

Substituting from (8) into (1) and solving for X yields:

$$X = \frac{\beta}{1-\alpha(1-\delta_2)} W + \frac{\alpha\delta_1}{1-\alpha(1-\delta_2)} Z + \frac{1}{1-\alpha(1-\delta_2)} u \qquad (9)$$

Assuming for simplicity that W and Z are each composed of only one variable, we find that[9]:

$$\sigma_x^2 - \sigma_{\underset{\sim}{x}}^2 = \frac{1}{1-\alpha(1-\delta_2)}^2 [(\alpha\delta_1)^2 \sigma_z^2 + 2\beta\alpha\delta_1 \text{ cov } (W,Z)$$

$$+(\alpha(\delta_2(\alpha(2-\delta_2)+2)-(2+\alpha)))(\beta^2\sigma_w^2 + \sigma_u^2)] \qquad (10)$$

If there are no bandwagons (δ_2 is negative) the behavior of $\sigma_x^2 - \sigma_{\underset{\sim}{x}}^2$ will be less volatile then if there are, and as $\alpha\delta_2$ approaches unity, $\sigma_x^2 - \sigma_{\underset{\sim}{x}}^2$ approaches positive or negative infinite. If δ_2 is positive and thus there are bandwagons, speculation is more likely to be destabilizing, but the sign of δ_2 implies nothing in general about whether speculation is stabilizing or destabilizing.[10] The reason it does not is that the sign of δ_2 gives no information on the net effect of the relationships among the other fundamental variables ($2\beta\alpha\delta$, cov (W,Z) on the variability of the exchange rate.

A second technique within this category has been to identify as periods of destabilizing speculation those periods where the exchange rate "overreacts" to changes in certain fundamental variables such as prices or interest rates (Aliber (1970), Artus (1976), Kohlhagen (1975a, 1975b), Price and Wood (1974), Thomas (1973a, 1973b), and Williamson (1973)). There have been two approaches

to identifying this phenomenon empirically. The first has been to show that the regression coefficient of the exchange rate as a function of the fundamental variable is greater than unity. That is, separating out some fundamental variable, say p, our true model of the foreign exchange market can be represented by $X=\beta^{*}W^{*} + \gamma p + \alpha\Delta x^{e} + u$, (11) where β^{*} and W^{*} are the remaining coefficients and variables after removing γ and p. The hypothesis is that $|\gamma| > 1$ implies destabilizing speculation. Using (11) to solve for $\sigma^2_{\underset{\sim}{x}}=\sigma^2_{x-\alpha\Delta x^{e}}$ and substituting for σ^2_x from (5), yields

$$\sigma^2_x-\sigma^2_{\underset{\sim}{x}}=\alpha^2\ \sigma^2_{\Delta x^{e}}+2\beta^{*}\alpha\ \mathrm{cov}\ (X^{e}, W^{*}) + 2\gamma\alpha\ \mathrm{cov}\ (p,\Delta x^{e}), \quad (12)$$

which is by no means necessarily positive when $|\gamma|>1$.

Alternatively, it has often been claimed that an exchange rate with a higher volatility (σ^2_x) than the fundamental variable (σ^2_p) implies destabilizing speculation.[11] That is, $\sigma^2_x - \sigma^2_p > 0 \Rightarrow \sigma^2_x - \sigma^2_{\underset{\sim}{x}} > 0$. Using (11) to solve for σ^2_x (and thus $\sigma^2_x - \sigma^2_p$), subtracting (12), and rearranging yields:

$$(\sigma^2_x-\sigma^2_{\underset{\sim}{x}}) = (\sigma^2_x-\sigma^2_p) - \beta^{*2}\sigma^2_{w^{*}} - (\gamma^2-1)\sigma^2_p - 2\beta^{*}\gamma\ \mathrm{cov}\ (W^{*},p) \quad (13)$$

It is clear, that whereas $\sigma^2_x > \sigma^2_p$ is more likely to occur during periods of destabilizing speculation, it by no means guarantees that the period is necessarily characterized by destabilizing speculation.

The third criterion in this category has been implicit in much of the literature and explicit in Aliber (1975, p.375). It is claimed that destabilizing speculation exists when the expected exchange rate itself is affected by the fundamental variable in such a way as to reinforce capital flows. That is, if the expected future exchange rate is: $X^e = X^{e*} + \Psi p$, (14) where X^{e*} is the portion of the expected exchange rate that is independent of the fundamental variable p, speculation is destabilizing if γ (from (11)) and Ψ have the same sign (i.e., $\gamma\Psi>0$).

Substituting into (11) for X^e from (14), and then solving for σ_x^2 and $\sigma_{\underset{\sim}{x}}^2$ $(=\sigma^2_{x-\alpha\Delta x^e})$ yields

$$\sigma_x^2 - \sigma_{\underset{\sim}{x}}^2 = \frac{\alpha}{(1+\alpha)^2}\left[\gamma(2\Psi - \gamma(2+\alpha) + \alpha\Psi^2)\,\sigma_\rho^2 - (2+\alpha)(\beta^2\sigma^2_{w^*} + \sigma_u^2) + \right.$$

$$\alpha\sigma^2_{x^{e*}} + 2\beta^*(\Psi - \gamma(2+\alpha))\,\mathrm{cov}(w^*,p) + 2\beta^*\mathrm{cov}(w^*,x^{e*})$$

$$\left. + 2(\gamma + \alpha\Psi)\,\mathrm{cov}(p,x^{e*})\right] \qquad (15)$$

This expression is not necessarily positive if $\gamma\Psi>0$, since this condition provides no information about the relationships among the variables other than p.

In summary, analyses of exchange rate behavior that are partial equilibrium in nature in that they examine the relationship between expectations and the exchange rate through only a subset (or none) of their fundamental economic determinants, cannot identify the nature of speculation. Studies that show that the exchange rate is volatile or is more volatile than should be justified by some incomplete set of independent variables have not shown that the net effect of all speculative forces is destabilizing. To correctly characterize

speculation as stabilizing or destabilizing, empirical work must identify the "true" model determining the dependent price variable and then show that the net effect of all speculative forces has been to increase the volatility of the price from what it would have been in the absence of speculation.

IV. A Direct Empirical Test For Destabilizing Speculation

In this section, a test is presented for the presence of destabilizing speculation in three foreign exchange markets during the 1973-1975 float. This test is meant to be illustrative of the technique presented in section 2 and is subject to all of the qualifications outlined in the introduction to this paper. Essentially, in order to accept this test as actually identifying destabilizing speculation, the reader must accept the following assumptions: a) speculative demands and supplies can be empirically distinguished from other sources of demand and supply, b) the model of exchange rate determination presented in this section is the "true" model, and c) the variable representing exchange rate expectations in this model fully measures the impact of speculation in the market.[12]

Our "true" model of the foreign exchange market is the empirical monetary model of the foreign exchange rate developed and tested by Bilson (1976) and Frenkel (1976). Basically, this model advances the notion that the exchange rate is the relative price of two currencies. Demand and supply equilibrium in two money markets is specified and both Purchasing Power Parity and Interest Rate Parity conditions are invoked

to specify a monetarist model of the determination of the foreign exchange rate. Reproducing this model, it is assumed that the demand for real money balances can be represented in the familiar form:

$$\frac{M^d}{P} = \alpha_0 \left(\frac{Y}{P}\right)^{\alpha_1} e^{\alpha_2 i} \qquad (16)$$

where M^d is the nominal demand for money, P is the price level, Y is nominal income, i is the interest rate, α_0 and α_1 (the income elasticity of the demand for money) are expected to be positive, and α_2 negative (where the interest elasticity of the demand for money equals $\alpha_2 i$).

Taking logs of (16) yields:

$$\ln M^d = \alpha_0 + \alpha_1 \ln (Y/P) + \alpha_2 i + \ln P \qquad (17)$$

and similarly for the "foreign" country:

$$\ln M^{d*} = \alpha_0^* + \alpha_1 \ln \left(Y^*/P^*\right) + \alpha_2 i^* + \ln P^* \qquad (18)$$

where (*) denotes foreign, and α_1 and α_2 are assumed the same for both countries.

If Purchasing Power Parity and Interest Rate Parity hold then:

$$\ln X = \ln P - \ln P^*, \text{ and} \qquad (19)$$

$$i^* - i = \frac{X - X'}{X} \quad . \qquad (20)$$

Subtracting (18) from (17) and substituting from (19) and (20) then yields:

$$\ln X = \alpha_0' + \alpha_1 \ln \frac{Y^*/P^*}{Y/P} + \alpha_2 \left(\frac{X - X'}{X}\right) + \alpha_3 \ln \left(\frac{M^d}{M^{d*}}\right), \qquad (21)$$

where $\alpha_0' = \alpha_0^* - \alpha_0 \gtrless 0$, and $\alpha_3 = 1$.

This final form then states that the exchange rate is a function of relative money supplies and demands, where relative demand factors are represented by relative real income (transactions demand) and relative nominal interest rates or, equivalently, expected changes in the exchange rate as represented by the forward premium or discount (demand based purely on expectations of future values of currencies, i.e., speculation). This interpretation of the model depends upon a particular point of view about the role of interest rates. In this model the interest rate is viewed as a price of "futures" money, so that relative interest rates (and thus forward premia) represent the relative price of two future monies. A relatively high interest rate is then indicative of an expected depreciation in the value of that currency. The full impact of expectations in the market for currencies is then reflected in relative interest rates and the interest elasticity (i.e. elasticity of expectations) for the demand for money.[13] Equation (21) is a specific form of (1), where the elements of W are the constant, relative nominal money supplies, and relative real incomes, and where speculative expectations are represented by the forward premium or discount. The exchange rate that would have existed in the absence of speculation is

$$\text{then: } \tilde{X} = Xe^{-\alpha_2 \frac{(X-X')}{X}} = \alpha_0' \left(\frac{Y^*/P^*}{Y/P}\right)^{\alpha_1} \left(\frac{M^d}{M^{d*}}\right)^{\alpha_3} \qquad (22)$$

Table 1 presents the 2SLS estimates of (21) for three currency markets for March 1973 - December 1975, where the forward premium is treated as an endogenous explanatory variable with levels and changes of the exogenous variables used as instruments in the first stage of the estimation, and, since exchange rates were floating over the sample period, the relative money supply variable is treated as exogenous.

For each of the markets [14] the important coefficients had the correct sign and were significant while the standard error of the estimate was from 3 to 5%. The only truly perverse coefficient was the relative money supply coefficient in the French franc - U.S. dollar market, which is significantly different from unity. It is not clear whether or not this provides an explanation for the relatively smaller coefficient on the expectations variable in this case. The income elasticity of the demand for money (α_1) is surprisingly volatile, ranging from 0.261 in the Deutschemark-French franc case to 1.367 (but not significantly greater than unity) in the Deutschemark-U.S. dollar case. The interest elasticity of the demand for money (α_2) is only about 0.4 for the French-franc-U.S. dollar case, but about 0.75 for the two German cases.

Figures 1-3 present graphs of the observed exchange rate series (X), and the exchange rate time series that would have occurred in the absence of speculation ($\tilde{X}$ from (22)) as estimated from the regression results presented in Table 1.

Table 2 presents the variance of each observed exchange rate and each derived exchange rate that would have occured in the absence of speculation and indicates that speculation has been destabilizing in each French franc market and stabilizing in the Deutschemark-U.S. dollar market. That is, as a result of foreign exchange speculation during the 1973-1975 floating exchange rate regime, the variance of the French franc has been 23% higher against the Deutschemark and 46% higher against the U.S. dollar than it would have been had there been no speculation. In contrast, the variance of the Deutschemark against the U.S. dollar has been 19% less than if there had been no speculation, implying that speculation has been stabilizing in this case.[15]

If the three assumptions at the beginning of this section are accepted, evidence has been found that there was destabilizing speculation in the first three years of the 1970s floating exchange rate regime. During this period there were many instabilities and large exogenous shocks, and one might be cautious about projecting from the experience of these early years of the float. In addition, during this period economic agents were only just beginning to learn to live with the float, so that, allowing for some "learning by doing", future speculation might well be structurally different from that in this period.

V. Summary and Conclusions

In this paper, it has been shown that the criteria that have been developed in the foreign exchange market literature are neither necessary nor sufficient conditions for identifying destabilizing speculation. A technique was then presented for directly testing for the presence of destabilizing speculation. Using a monetary model of the foreign exchange rate, evidence was presented that is consistent with the presence of destabilizing speculation in the 1973-1975 French franc-Deutschemark and French franc-U.S. dollar markets, and stabilizing speculation in the Deutschemark-U.S. dollar markets.

Acceptance of the conclusions of this illustrative test is contingent upon acceptance of the fact that speculation is an empirically identifiable phenomenon, that the monetary model of the exchange rate is the "true" model, and that the forward premium fully reflects the impact of speculation in the market. Alternative models and empirical specifications are potentially fruitful areas for future research on this subject.

The presence of destabilizing speculation however does not imply that either more central bank exchange market intervention or fixed exchange rates are necessarily desirable. As discussed earlier, the welfare theory of the economic costs of higher exchange rate volatility induced by destabilizing speculation are simply not very well developed. It is by no means clear that the benefits of Central Bank action to

reduce or limit fluctuations outweigh the costs associated with doing so. Similarly, it is not clear that during periods of volatile financial markets, any other exchange rate system other than floating is possible without overly restrictive capital and trade controls. In addition, since there was significant Central Bank intervention during the period analyzed, a complete interpretation of these results cannot exclude the possibility that the observed presence of destabilizing speculation was because of Central Bank intervention rather than despite it.

Table 1

Monetary Model of Exchange Rate Determination: 1973 - 1975

Market \ Variable	Constant	$\ln\left(\frac{Y^*/P^*}{Y/P}\right)$	$\ln\left(Md/Md^*\right)$	$\frac{X-X'}{X} = X^e$	$\bar{R}^2$	DW	SE
Deutschemarks / French franc	0.264 (1.39)	0.261 (1.93)	0.872 (3.68)	-0.720 (-2.73)	.641	1.49	.030
French francs / U.S. dollar	3.477 (3.97)	0.669 (6.02)	0.318 (2.40)	-.398 (2.80)	.711	1.46	.033
Deutschemarks / U.S. dollar	6.856 (4.06)	1.367 (4.92)	0.785 (3.51)	-.771 (2.77)	.384	1.40	.046

Data: All data for March 1973 - December 1975. X: end of month spot exchange rate (Harris Bank); X': end of month forward exchange rate (Harris Bank); Y: industrial production index (FRB macrodata library); P: wholesale price index (FRP macrodata library); M^d: M1 (FRB macrodata library). Numbers in parantheses are t-statistics.

Table 2

Variance of Observed Spot Rate and Calculated Spot Rate in the Absence of Speculation

Case	σ_x^2	$\sigma^2_{\tilde{x}}=\sigma^2_{xe^{-\alpha_2 x}}$	$\sigma_x^2-\sigma^2_{\tilde{x}}$
Deutschemarks / French francs	.02686	.02187	.00499
French francs / U.S, dollar	2.52767	1.73141	.79626
Deutschemarks / U.S. dollar	.73351	.90193	-.16842

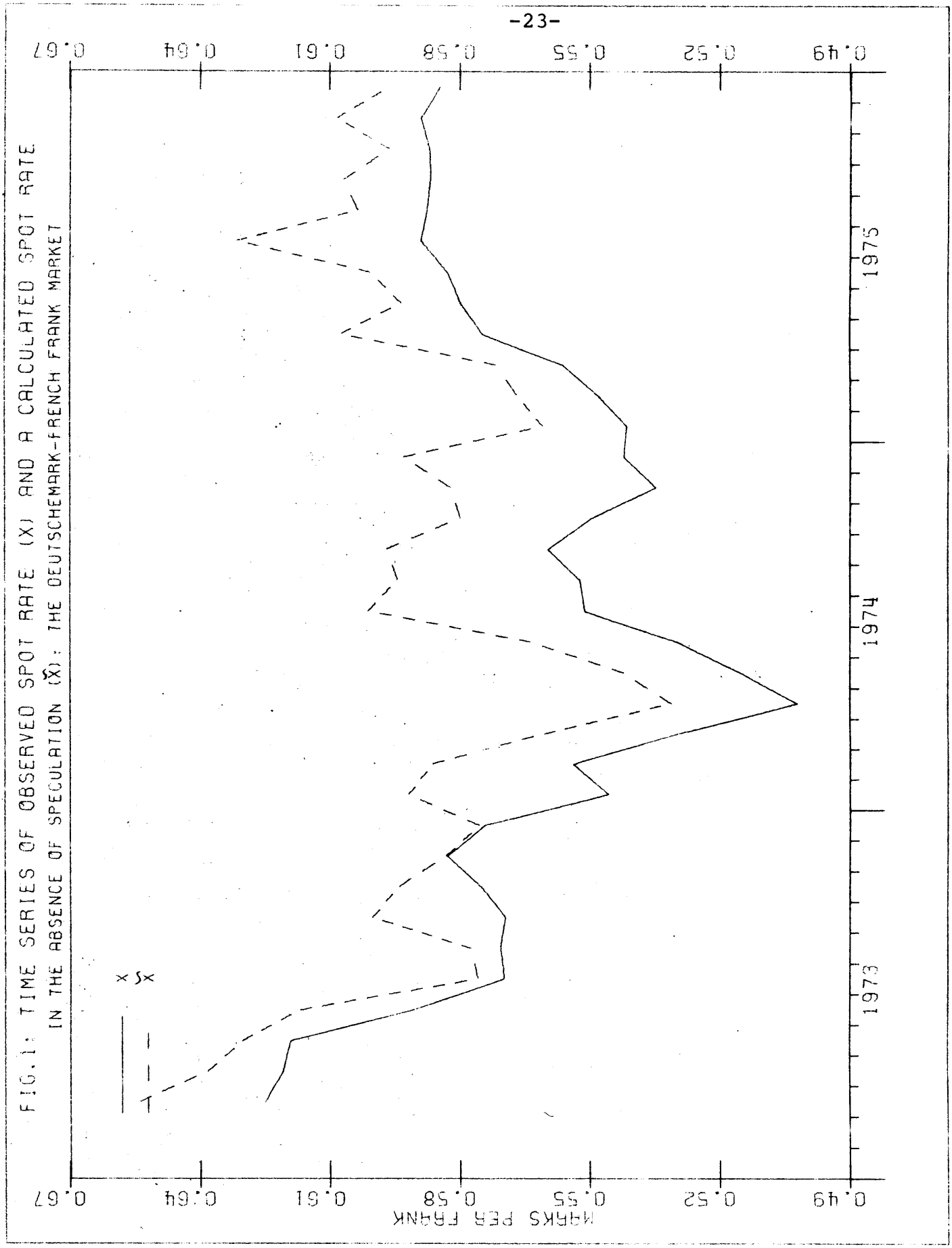

FIG.1: TIME SERIES OF OBSERVED SPOT RATE (X) AND A CALCULATED SPOT RATE ($\hat{X}$): THE DEUTSCHEMARK-FRENCH FRANK MARKET IN THE ABSENCE OF SPECULATION

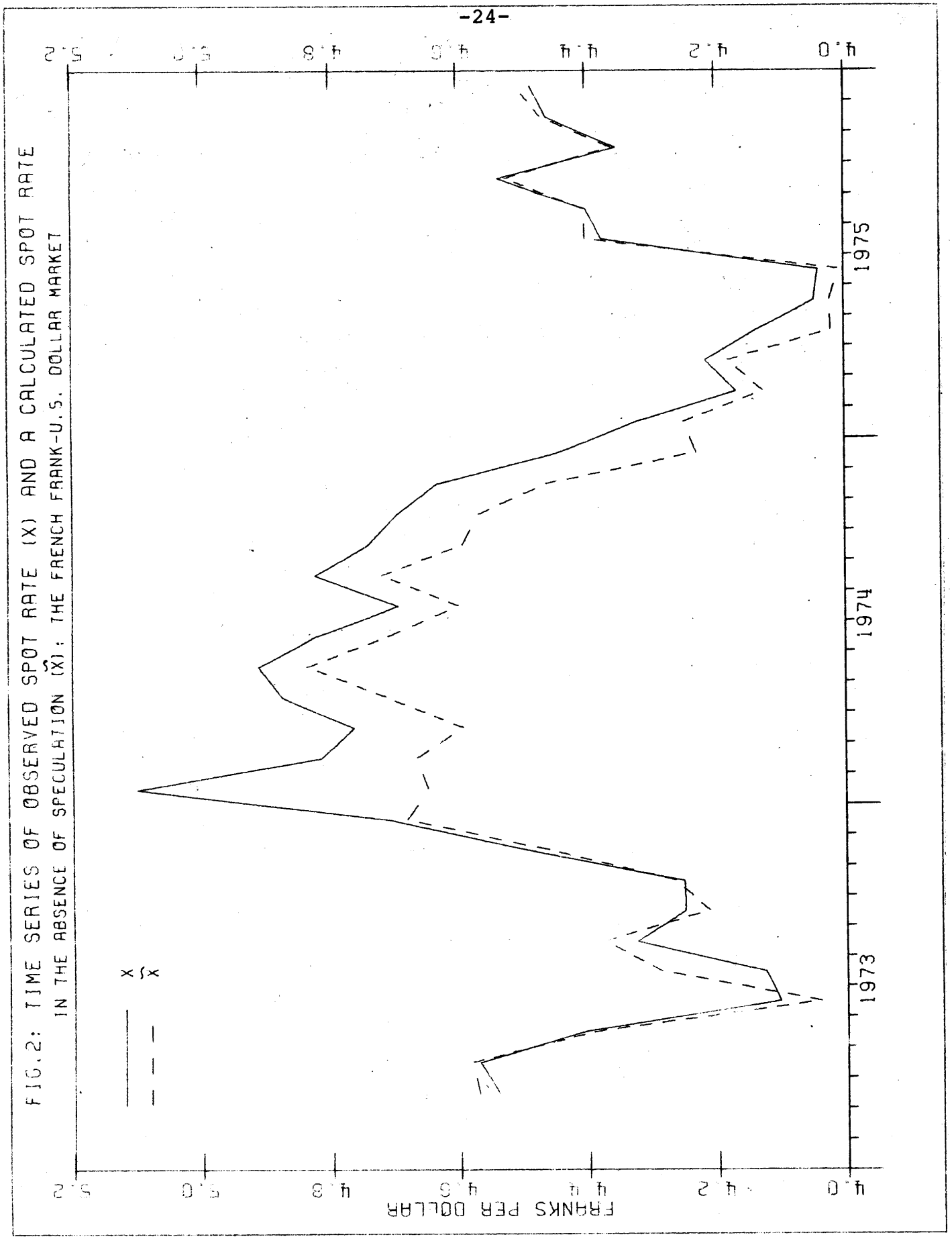

FIG.2: TIME SERIES OF OBSERVED SPOT RATE (X) AND A CALCULATED SPOT RATE $\tilde{(X)}$: THE FRENCH FRANK-U.S. DOLLAR MARKET IN THE ABSENCE OF SPECULATION

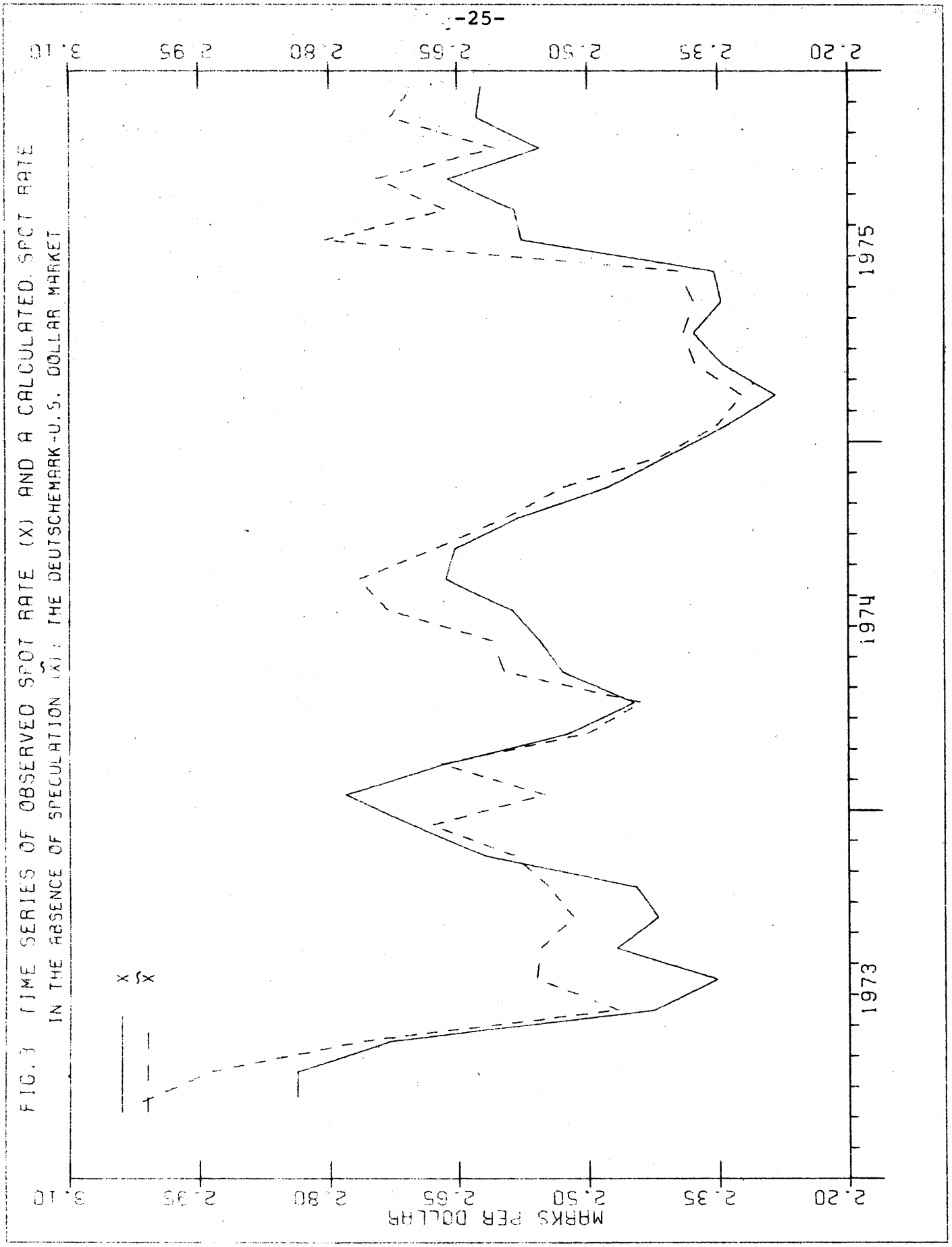

FIG. 1 TIME SERIES OF OBSERVED SPOT RATE (X) AND A CALCULATED SPOT RATE IN THE ABSENCE OF SPECULATION (X̃) IN THE DEUTSCHEMARK-U.S. DOLLAR MARKET

Footnotes

1. It is explicitly used in Farrell (1966), Friedman (1953), Johnson (1976), Kemp (1963), Salant (1976), Schimmler (1973), Stern (1973), Telser (1959), and Yeager (1976), and implicit in Nurkse (1944). The other definition that has been used in this literature, but that is not used in this paper, is speculation within the context of a simultaneous equations model that causes the system to be mathematically unstable (e.g., Stein and Tower (1967)).

2. The general problems of a non-finite variance arising from non-stationarity do not arise in our empirical work, since the sample period is short (less than three years of monthly data) and, as a result of the unique set of events that occurred, is treated as though it were the whole population (e.g., the oil crisis, unusually high and widely dispersed inflation rates, and the unfamiliarity of many economic agents with floating exchange rates). In addition, no exchange rate time series that is a function of time has been used as the dependent variable in our empirical work (i.e., all exchange rates were estimated as linear functions of the constant and time, and all exchange rates that had a significant coefficient on the time variable at at least the .9 level were eliminated from consideration in our empirical work).

3. This test is based on implicit suggestions made in a somewhat different context by both Kemp (1963, p. 189) and Salant (1976, p.3).

4. As is shown in section 4, the functional form of (1) may also be non-linear.

5. See Kohlhagen (1976) for a survey of the literature on foreign exchange speculation.

6. This has been referred to as a "speculative period" in the sense of Stein, from his characterization of "speculative" and "normal" periods (Stein(1962)).

7. Our analysis implies nothing about the efficient markets literature in which the presence of significant bandwagons is used as evidence of market inefficiencies. Bandwagons have been used in the literature variously as evidence of destabilizing speculation, too little stabilizing speculation, poorly behaved speculation, and inefficient markets. For a discussion of this literature and a list of references see Chapter 2 of Willett (1977). Only the fact that bandwagons are not evidence of destabilizing speculation is shown in the present paper.

8. For the use of this type of evidence, see Arndt (1968), Artus (1976), Black (1972), Eastman (1958), Kohlhagen (1975a,b), Myhrmann (1976), Nurkse (1944), Poole (1967).

9. If W and Z are composed of more than one explanatory variable, the results are more complex due to the multiple variance terms and the covariance terms within Z, but they are not substantively different:

$$\sigma^2_x - \sigma^2_{\hat{x}} = E\left\{\left(\frac{\alpha\delta_1}{1+\alpha(1-\delta_2)}\right)(Z-\bar{Z})\ (Z-\bar{Z})'\left(\frac{\alpha\delta_1}{1+\alpha(1-\delta_2)}\right)'\right\} + \frac{2\beta\alpha\delta_1}{1+\alpha(1-\delta_2)^2}\ \text{cov}\ (W,Z)$$

$$+ \frac{(\alpha(\delta_2(\alpha(2-\delta_2)+2) - (2+\alpha)))}{1+\alpha(1-\delta_2)}\ (\beta^2\sigma^2_w + \sigma^2_u)$$

where $\bar{Z}$ is the mean of Z, and $(Z-\bar{Z})'$ and $\left(\frac{\alpha\delta_1}{1+\alpha(1-\delta_2)}\right)'$ are the transpose of $(Z-\bar{Z})$ and $\left(\frac{\alpha\delta_1}{1+\alpha(1-\delta_2)}\right)$ respectively.

10. In the special and somewhat unrealistic case where Z is coincident with W and W is composed of only one fundamental explanatory variable, the existence of bandwagons does imply that destabilizing speculation exists.

11. In both the economic and popular literature, it is often asserted that a major problem with floating exchange rate regimes (as evidenced by the experience in the 1920s and 1970s) is that they are characterized by periods of destabilizing speculation as reflected in the high volatility of exchange rates relative to prices and interest rates.

12. If the first assumption cannot be accepted, destabilizing speculation can never be identified. If one or both of the latter assumptions is unacceptable then the test suggested in section 2 could more profitably be applied to a different model than the one used here.

13. The interest rate therefore will not adjust to choke off an excess demand or supply of money in this interpretation. Full adjustment must come from price and possibly income changes.

14. These three markets were chosen because consistent data were available and the exchange rate time series during the sample period were not functions of time.

15. Since X and $\tilde{X}$ are not independent time series we cannot use a simple F-test to see if their variances are <u>significantly</u> different. In addition (for the reasons given in footnote 2), since our sample variance is unlikely to be an unbiased sample of a larger population, even more sophisticated tests (e.g. using the Wishart distribution presented in Anderson (1962)) will not necessarily yield meaningful tests of significance in this case.

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