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THE DETERMINANTS OF REALIGNMENT EXPECTATIONS UNDER THE EMS: SOME EMPIRICAL REGULARITIES

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ABSTRACT

The stability of the EMS depends crucially on realignment expectations of the market participants. In this paper we discuss how to measure such expectations and how to relate them to economic fundamentals, central bank reputation, and institutional arrangements of the EMS. We find the following empirical regularities for FF/DM and IL/DM exchange rates : (1) expected devaluations are positively related to the current exchange rate deviation from the central parity; (2) expected devaluations are negatively related to the length of time since last realignment in the short and medium run; (3) the Basle-Nyborg agreements seem to have a stabilizing effect for both currencies examined, albeit through different channels; (4) large revaluation expectations occur immediately after devaluations. (1) and (4) are not inconsistent with the hypothesis of over-speculation or market inefficiency.

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1 Introduction

One of the central questions in the theory of international monetary regimes is whether fixed but adjustable exchange rates are a contradiction in terms. In other words, can a system of adjustable parities survive? Is it, in some sense, stable? This question has dominated the policy debate on the European Monetary Systyem (EMS), especially since the liberalization of international capital movements in the second half of the 1980's. It also characterized the debate on exchange-rate based stabilizations, started by Diaz Alejandro (1981), Dornbusch (1982) and Calvo (1983).

Recent research in international finance, in particular the work of Flood and Garber (1984) and the empirical research in the vein of Lizondo (1983), has clearly and convincingly established the linkage between the collapse of a fixed exchange rate and expectations held by actors in financial markets. In addition, the analysis of the stabilizing properties of monetary policy rules—Simons (1936), Friedman (1968) and Barro and Gordon (1983)—has shown that the crucial channel through which such rules can stabilize inflation and economic activity is the behaviour of the private sector's expectations. Hence the "strength" or "weakness" of an adjustable rate system is directly related to the behaviour of expectations under such a regime.

This paper is an exploration of the determinants of expectations of the French franc/Deutsche mark and Lira/Deustche mark parity changes during the EMS period. Such an exploration should be, in our view, the first step of a broader analysis of the stability properties of a fixed-but-adjustable rate system. More precisely, the question that we ask in this paper is: What determines the expectations of parity changes? Are the institutional arrangements of the EMS—designed to stabilize the foreign exchange market, such as the target zone and intergovernmental coordinations—effective at all? In order to answer these questions we need to obtain reliable estimates of such expectations, and then attempt to relate them to economic and institutional variables.

The next section deals with the empirical measurement of realignment expectations, section 3 discusses how to select the fundamental and institution variables, section 4 discusses the estimation methodology, section 5 reports the results, section 6 contains some concluding remarks.

2 Measuring Expected Parity Changes

The first step in studying the empirical behaviour of market expectations is to find an empirical measurement of such unobservable expectations. The measurement of expected parity changes has to take into account two problems. The first is the measurement of expected changes in exchange-rates. In this study, we assume interest-rate parity. That is, interest-rate differentials reflect expectations of exchange rate changes and that risk premia, or other sources of differences between ex-ante returns in different currencies, are insignificant. Svensson (1990) argues that in a managed exchange rate regime with target zones, given realistic distributional assumptions about fundamentals, the exchange-rate risk premium should be insignificant.

The second problem in measuring parity changes is the presence of exchange-rate bands, or target zones. Since exchange rates are flexible within these target zones, in order to estimate the expected change in a central parity it is necessary to separate the expected changes within the band and the expected shift of the central parity. In this, we extend the work of Collins (1984, 1986), who first studied realignment expectations in the EMS using interest-rate differentials.

To fix ideas, decompose the log exchange rate S into the log central parity c and the log percentage deviation from the central parity x:

$$s_t = c_t + x_t \tag{1}$$

It follows that the one-period expected change (devaluation) of the exchange rate can be decomposed into the expected central parity shift and the expected change in the percentage deviation from the central parity:

$$E[\Delta s_t | I_t] = E[\Delta c_t | I_t] + E[\Delta x_t | I_t]. \tag{2}$$

All expectations are conditional upon information available at time t, denoted by I_t. Under interest rate parity, the left hand side can be replaced by the interest rate differential between the home country and the foreign country. Denote the differential of interest of deposits of maturity j by δ^j, the expected devaluation can be written as:

$$E[C_{t+j} - C_t | I_t] = \delta_t^j - E[(x_{t+j} - x_t) | I_t]. \tag{3}$$

With δ_t^j observed in the interest rate data, the task of measuring expected devaluation is reduced to measuring expected changes in x. Notice that the expectation is a *full information* expectation in the sense that the information set I_t should contain information concerning the possibility of both a realignment and no realignment in the next j periods, in other words, the observations on x should reflect the markets assessment of future realignment possibilities.[1] It is thus essential to make sure that the sample on x contain enough realignment observations. When the data are available, we can obtain the *ex post* measure of expected realignment devaluation as

$$C_{t+j} - C_t = \delta_t^j - (x_{t+j} - x_t). \tag{4}$$

We can obtain an *ex ante* measure of realignment expectations by projecting the above on the current information set, as will be defined below.

3 Choosing the Variables in the Information Set

To determine what information variables to be included in the projection equation, it would be ideal to have a theoretical model that links the fundamental variables to expected realignment in equilibrium. It is well known, however, that the available theoretical models do not tell us what constitute the "fundamentals," so they are suggestive at best. A familiar brand of models, based on the Barro-Gordon (1983) framework of monetary policy games, describe the central bank's main objective as price stability, which can be achieved through exchange rate targeting as in the EMS. However, the central bank also has other objectives, and when those objectives are in crises, the central bank may deviate from the exchange rate targeting policy. This notion of "crises mentality" is consistent with evidence found in the Bernanke-Mishkin (1992) case study of central bank behaviour in major industrialized countries. Giovannini (1990) contains a model of this kind, known as an "escape-clause model."

[1] Svensson (1991) develops an alternative measure of expected devaluation associated with realignment expectations: $\delta_t^j - E[(x_{t+j} - x_t)|\text{no realignment}]$. The key feature of this measure is that the second term is a *conditional* expectation, conditional on an information set that is generally smaller than the full set I_t, with the realignment events excluded from the latter. While desirable in the case of few realignment observations, the conditional expectation of x can not, in general, be correctly estimated from the data even with realignment observations excluded from the sample, since the possibility of a future realignment should be "priced" by the market under rational expectations, and the sample x is conditional on both realignment and no-realignment possibilities.

Instead of resorting to a particular model, we rely on the projection-equation approach. The following observations serve as background to our choice of variables in the information set.

Assume that q is the probability of a large adverse shock to the economy occurring in the next period, and that the shock is so big that it warrants a realignment attempt (the escape clause). The government may choose to devalue, or to defend the parity. Suppose the public assigns a subjective probability p to the event that the government will devalue in face of the shock, then the expected devaluation $E\Delta \mathrm{c}$ is a probability weighted average defined as follows:

$$E\Delta \mathrm{c} = (1-p) \times 0 + p[q\hat{\mathrm{c}}^{e,d} + (1-q) \times 0], \tag{5}$$

where $\hat{\mathrm{c}}^{e,d}$ is the expected size of devaluation if the central bank is pursuing a discretionary (devaluation) policy. Its value can be determined in the equilibrium. In general, it is positively related to the adverse shock and the weakness of the economy and the exchange rate mechanism — the stronger the economy and the better the intergovernmental coordination in defending the parity, the easier it is for the government to weather the negative shocks, and therefore the smaller the expected size of realignment. Simplifying, the above definition can be written as

$$E\Delta \mathrm{c} = pq\hat{\mathrm{c}}^{e,d}. \tag{6}$$

It can been clearly seen that expected realignment depends on p, q and $\hat{c}^{e,d}$. The empirical task now is to find proxies that capture the essence of these three variables.

To measure p, the public's subjective probability that the central bank will devalue the currency under crises, we need to specify a rule on how this probability is formed. One hypothesis, as suggested by the experience of many EMS countries, is that the longer the central bank manages to keep the exchange rate parity free of realignment, the smaller is p, since the public may gain more confidence on the central bank based on its past record of success. A simple way to capture this idea is to use the length of time since last realignment (we actually use $ln(1+t)$) as a proxy for this behaviour of p. The hypothesis suggests that we should expect to find a negative correlation between p and this measure of time. An alternative hypothesis is the so called "honeymoon" effect commonly seen in the post-election popularity of a winning political party:

the popularity surges after the election, and gradually dies out, exhibiting a hump-shaped pattern.[2] In the case of the public's perception of the central bank after a realignment, one can imagine a similar scenario: p may first decline as the public begins to be convinced that the new parity is properly in line with fundamentals so it may last into the future. But as time gets longer, uncertainty about the central bank's resolve may increase for various reasons. This hypothesis implies that p can be viewed as a U-shaped function of time. A third hypothesis, as suggested by Ghisellini (1992), assumes that there is a fixed cost of realignment, so realignment is infrequent, but the longer the time since last realignment, the more likely a new realignment will occur. This implies a positive relationship between p and time. Combining the above discussions, we use two separate formation rules for p, one is a direct measure of time since last realignment ($t^* \equiv ln(1+t)$), the other is a quadratic measure ($at^* + bt^{*2}$) aimed at capturing the U-curve effect (negative a and positive b).

The probability of a large adverse shock to the domestic economy relative to the foreign counterpart, q, can be measured in terms of various fundamental variables, such as trade balance, industrial production, etc. While the expected size of devaluation, $\hat{c}^{e,d}$, can also be linked to the above variables, as well as to such fundamental positions as foreign exchange reserve, budget deficit, wages and inflation, and nominal variables such as liquidity. It should be noted that p may also depend on the government's financial positions such as deficit and foreign exchange reserves. Put together, we can actually isolate the independent effect of time since last realignment after controlling for these fundamentals.

We also incorporate some important institutional features of the EMS and evaluate their effectiveness in reducing realignment expectations. One such institutional arrangement is the fluctuation band, or the target zone. The target zone literature has shown on both theoretical and empirical grounds that the band has a stabilizing, or mean reverting effect on expected exchange-rate deviation from the central parity. In other words, the expected change in exchange rate deviation from the central parity is *negatively* correlated with the current deviation from the central parity. Although the models deal specifically with the *deviations from central parity*, the mean

[2] We thank Charles Goodhart for suggesting this idea.

reverting result has been commonly interpreted in a naive way, which leads to the conclusion that the band has a stabilizing effect on *realignment* expectations. Changes in deviation from central parity and changes in central parity itself are equivalent only in the case of no realignment. So in general, when realignment is allowed, the stabilization property, at least in the form of negative correlation, may not apply. We include a variable representing the deviation from the central parity in our empirical estimation and examine whether the negative correlation holds for expected parity changes. This is crucial in evaluating the stability of the EMS.

Another feature of the EMS is the institutionalized coordination among member countries. The coordination efforts are aimed at strengthening member countries' position in preventing and counteracting crises and speculations. We focus on the effectiveness of one such coordination—the introduction of the Basle-Nyborg agreements. Finally, the credibility and stability of the EMS can also be explored by studying the reaction of the foreign exchange market to the event of a realignment. This is done employing a "realignment dummy."

The following is a complete list and definitions of the information variables.

- **C1, C2, ...**: Constant dummies corresponding to each central parity regime. 10 regimes for IL and 7 for FF.

- **X1**: Log relative foreign exchange reserve position measured in terms of the DM.

- **X2**: The percent change in budget surplus on a cash basis (Italy or France minus Germany).

- **X3** The difference of the trade balance surpluses (Italy or France minus Germany).

- **X4** Relative industrial production indices. Denote foreign (German) variable with a star, the definition can be written as

$$\ln\left(\frac{IP}{IP^*}\right) \tag{7}$$

- **X5** The position of the exchange rate within the band (x).

- **X6** Form 1: The log of one plus the number of months since last realignment, denoted as t^*; Form 2: $at^* + bt^{*2}$.

- **X7** An index of relative CPI's. Denote S the exchange rate measured in terms of domestic currency value of one unit of DM, the index is written as

$$\ln\left(\frac{CPI}{CPI^* \times S}\right). \tag{8}$$

- **X8** An index of relative wages, i.e.:

$$\ln\left(\frac{W}{W^* \times S}\right). \tag{9}$$

- **X9**: Relative liquidity, i.e.:

$$\ln\left(\frac{L}{L^* \times S}\right) \tag{10}$$

- **X10**: DM/US$ exchange rate.

- **X11**: Jump dummy that takes the value 1 at the first month of realignment and zero otherwise.

- **X12**: X1 multiplied by the slope dummy that equals 0 before the Basle-Nyborg agreements and 1 afterward.

- **X13**: X5 multiplied by the same slope dummy as in X12.

The sources for the data used are listed at the end of the paper. The frequency of our data is monthly, and the horizons we study are 1 month and 3 months. We look at the lira/DM and French franc/DM exchange rates since the beginning of the EMS.

4 Estimation

In the previous sections we have argued that the estimation of the expected change in the central parity requires an estimation of the expected change in the exchange rate within the band. Our task is to explore the determinants of expectations of parity changes. To do this, we estimate the following equation:

$$\delta_t^j - (x_{t+j} - x_t) = Z_t'\beta + u_{t+j}, \tag{11}$$

where Z_t' is a vector of variables in agents' information set at time t. Here we assume Z_t consists of all the information variables listed in the previous subsection. The disturbance term u_{t+j} has two components. One is the expectations error $(x_{t+j} - Ex_{t+j})$, the other is an error due to the imprecise measurement of expectations, or the existence of variables affecting expectations that are left out from the vector Z. The former is, under the assumption of rational expectations, orthogonal to any variable included in Z, depending on the severity of specification errors. In general, the expectation error always swamps the error due to mismeasurement, because, as it is well known, the variance of the unpredictable component of exchange rates is very high. When $j > 1$ the expectation error follows a moving average process of order $j-1$.

Equation (11) allows us to estimate, simultaneously, the expected change in the exchange rate within the band and the determinants of expected parity changes. Consider the linear projection:

$$\delta_t^j - E[(x_{t+j} - x_t)] = Z_t'\hat{\beta}, \tag{12}$$

where $\hat{\beta}$ is a consistent estimate of β. Equation (12) shows that the projection of the interest-rate differential net of the realized exchange-rate changes within the band on information provides an estimate of the expected change in the central parity. The coefficient vector β will indicate the relation of the expected change in the central parity to fundamentals.

The basic strategy of this regression is inspired by the following observation. Under the assumption of linear rational expectations, the best estimate of the expectations of any economic variable is its projection on variables in agents' information set at the time such expectation is formed. the property of this estimate is that the estimated residuals, which represent the "surprises," are orthogonal to the variables used to form expectations. In that sense, information cannot be used more efficiently to form expectations, and therefore expectations are rational.

A problem with unrestricted projection using target zone data is that it fails to explicitly specify the restrictions implied by the presence of the target zone band, which is a part of the public's information set, and is nonlinearly related to, and correlated with many other information variables. This may result in incorrect estimates of expectations. This problem is discussed by Chen and Giovannini (1992b), who propose a type of Box-Cox transformation which recovers the good properties of projection equations. This transformation cannot be used in the equation we estimate in this paper, because it would not allow the easy joint estimation of expectations of realignments and exchange-rate movements within the band. However, we have verified that, in the case of the EMS, the errors that arise from not exploiting the information on exchange-rate bands are likely to be negligible (see also Svensson, 1991).

5 Results

Tables 1 (plus 1A and 1B) and 2 (plus 2A and 2B) report the estimates of the projection equation over the 1-month horizon, respectively for the lira and the French franc. Tables 1 and 2 contain the estimates over the full sample (March 1979 to January 1992), tables 1A and 2A contain the estimates over the period from March 1979 to August 1987, while tables 1B and 2B contain estimates over the period from September 1987 to January 1992. The breakpoint is the date of the Basle-Nyborg agreement (September 12, 1987), of the Committee of Central Bank Governors, which strengthened the Exchange Rate Mechanism of the EMS by adopting a number of measures, including in particular an extension of the use of the Very Short Run Financial Facility to finance intra-marginal interventions.

In the case of Italy, the variables whose coefficients tend to be consistently significant are $X5$ (the position of the exchange rate within the band), and $X6$ (time since last realignment—a variable meant to capture learning and reputation effects). The coefficient of $X5$ is always positive, indicating that a wider deviation from a central parity increases expectations of exchange-rate changes. Interestingly, it is not significant at the 5% level in the period since the Basle-Nyborg agreements (table 1B). The strong significance and the negative sign on the coefficient of $X6$ implies that a proven tough exchange-rate stance—represented by the lack of recourse to realignment for a long period—other things equal, seems to improve the credibility of the exchange rate regime. The jump dummy $X11$ has a large negative coefficient, and is some times significant. This suggests that the occurrence of a realignment induces sharp revisions of realignment expectations. The fact that $X11$ is not significant after Basle-Nyborg (table 1B) is not surprising: the realignment of the lira of January 1990 was only due to the narrowing of the fluctuation band of that currency vis-a-vis the ERM partners.

The results for the case of France are broadly similar to Italy's, with X5, X6 being the most significant variables, i.e., the position of exchange rate within the band and the time elapsed since last realignment are the most powerful source of revision of expectations. The jump dummy $X11$ also exhibits negative significance in table 2.

Tables 3 and 4 report regression results for 1-month projections over the whole sample for Italy and France, with slope dummies on X1 and X5 to capture the effects of Basle-Nyborg on the sensitivity of realignment expectations with respect to reserves and exchange rate position within the band. Tables 3A and 4A contain regression results for the 3-month horizon. The slope dummies X12 and X13 are obtained by multiplying X1 and X5, respectively, by a series that equals zero up to August 1987, and one thereafter.

For Italy, the slope dummy on the position of exchange rate within the band, $X13$, is negative and significant for both one month horizon (5.4% $p-$value) and three month horizon (2.8% $p-$value), while the slope dummy $X12$ is not significant. The opposite holds for France: the slope dummy on the foreign exchange reserve position, $X12$, is positive and significant for both one month horizon (5.6% $p-$value) and three month horizon (0.27% $p-$value), while the slope dummy $X13$ is not significant. Overall, this evidence suggests that Basle-Nyborg agreement may have indeed strengthened the central bank's ability to defend the announced parity. However, such gains in credibility appear to have been achieved through different channels in the two countries: for Italy, exchange rate deviation from the central parity less worrisome to the public (negative coefficient on $X13$) since the Basle-Nyborg, probably because of the perceived availability of the Very Short Run Facility that may strengthen the central bank's ability to intervene and regulate the exchange rate within the band; For France, the gains in credibility primarily come from the strengthened exchange reserve positions.

The 3-month projections (tables 3A and 4A) contain some more interesting results. For the case of Italy, X4 (the relative industrial production) becomes significant, with a negative sign indicating a decline in realignment probabilities when the Italian industrial production improves relative to that of Germany. For the case of France, $X1$ and $X9$ become significant at 5% level, with negative signs suggesting that stronger relative reserve positions and relative liquidity help reduce realignment expectations.

To visualize the projected devaluations arising from the equations we estimated, we plot the predicted values of the regressions, together with the dates of the actual EMS realignments (each indicated by the tip of a triangle). Figures 1 and 3 plot the predicted 1-month devaluation (expressed in percent per annum) for the Lira/DM and the FF/DM respectively (the predictions are based on equations whose estimates are in tables 3 and 4). Interpreting the figures in terms of the model in section 2, we observe that they imply unambiguously a positive p (perceived probability that the government follows an escape clause policy, and does not credibly peg the currency) throughout most of the sample. The figures also show that the market tends to anticipate a realignment in the 1-month horizon at all times, but such anticipation becomes more pronounced (indicated by large spikes in the figures) in the few months prior to actual realignments. The figures also highlight the importance of the information about the occurrence of the realignment: after the realignment the expected devaluation of the lira and of the franc turn sharply negative.

For comparison, figures 1A and 3A report the observed 1-month interest rate differentials. While there are visible spikes they do not appear to match the timing of realignments with good precision. Another noteworthy feature of figures 1A and 3A is the familiar evidence of interest rate convergence for both countries (relative to Germany) over time. We cannot, however, find corresponding drastic decline of realignment expectations in figures 1 and 3, although the variability of the expected devaluation has decreased over time. In other words, interest rate convergence is not necessarily a full reflection of a decline in expected devaluation.

In order to get a clearer indication of the accuracy of the estimated predictions about the timing of realignments, we plot in figures 2 and 4 the difference between the 1-month and the 3-month expected devaluations (the term premia). Simple intuition tells us that a positive term premium implies the estimated probability of a realignment is higher in the next month than in the two months at the long end of the horizon. Figures 2 and 4 show that the term premium tends to rise sharply one month prior to realignments, implying that the timing of realignments is correctly anticipated.

In contrast, figures 2A and 4A show the 1-month vs. 3-month term premia directly calculated from the term difference of the interest rate differentials. They do not appear to anticipate the timing of realignments with any good precision. This evidence further demonstrates that the interest rate differential is not a precise measure of realignment expectations.

Finally, our fitted data in figures 1, 2, 3 and 4 reveal large reverse of realignment expectations in the month immediately following realignments. Again, such negative expected realignments are absent in the figures constructed directly from interest rate differentials (figures 1A, 2A, 3A and 4A).

In the above report, $X6$ takes the form t^*. When it is replaced by the alternative form $at^* + bt^{*2}$, we find some evidence of the so called "honeymoon" effect, or the U-curve effect. As we can see from table 5, the estimated coefficient $\hat{a}$ is consistently negative for both the lira and the French franc in both the one-month and three-month projection horizons. This also holds for $\hat{b}$ with an opposite sign. The coefficients in the one-month regressions are all significant at the 5% level, but they become less significant in the three month regressions. The results indicate that lack of realignment initially helps dampen realignment expectations (negative slope of the U-curve when t^* is small), but as time goes on, this trend tends to be reversed (upward-sloping part of the U-curve). To assess which part of the effects matters more in practice, we calculate the number of months it takes to reverse the downward trend using the one-month regression results.[3] We find the turning point occurs roughly 22 months after a realignment for the case of the lira and about 42 months for the case of the franc. Time periods of such lengths are long enough for practical considerations. So we view the dampening effect of a clean realignment record on the market expectations as the dominating effect, which is consistent with the result obtained by using the proxy t^* alone.

[3]This is simply done by setting the derivatives of $at^* + bt^{*2}$ (with respect to t^*) to zero and solve for t^*.

6 Concluding Remarks

In this paper we have presented a methodology to explore the relationship between expectations of parity changes and economic variables. This methodology accounts for the expectation of exchange-rate changes within fluctuation bands, and therefore should in principle yield more precise estimates of expected parity changes.

Interest rate differentials are commonly used as a proxy for realignment expectations. As Svensson (1991) pointed out, the flexibility of exchange rates within the target zones, however, makes such a proxy imprecise. This is confirmed in our study with a more carefully constructed realignment expectation measurement. In addition, our estimated expectations reveal some facts about realignment expectations that are not apparent in the interest rate differential proxy, such as less than dramatic reduction in expected devaluation as implied by interest rate convergence, and more precision in expected timing of realignment than implied by interest rate differential and its term premium.

The most important finding is that expected parity changes vary over time, and appear to be significantly related to a number of variables. The variables that have consistently high explanatory power are the length of time since last realignment (measuring the reputation of the central bank) and the deviation of exchange rates from the central parity. The results indicate that in general the absence of realignments improves the central bank's reputation. Such an effect is strong in the short and medium run, but in the long run, the trend may be reversed. This is consistent with the "honeymoon" hypothesis and the presence of a fixed cost of realignments. We have also found that a change in regime is detectable after the Basle-Nyborg agreements.

In order to evaluate the performance of adjustable parity systems like the EMS it is tempting to assess whether the expectations of parity changes which we estimate in this paper appear, according to given criteria, to be rational. Some of our observations in the previous section were indeed motivated by that question. The two most important results of our regressions are the positive significance of the variable $X5$, representing the percent deviation of the exchange rate from the centre of the band, and the large turnaround of expected parity changes following realignments. The first finding is opposite to the naive generalization of the "stabilization effect" of the fluctuation band, a hallmark of recent target zone literature. Our evidence could be consistent with herd-like behaviour in the foreign exchange markets, which however is not necessarily inconsistent with rational expectations under imperfect information.

The second finding, that the estimates of expected parity changes after realignments are always negative—the DM is to be devalued relative to the lira and the franc—and large, together with the size and significance of the dummy variable representing the recent occurrence of a realignment in some cases, is difficult to interpret. There are two potential explanations for this puzzle. One is that market participants take larger-than-necessary short positions, and find the market is over-sold after realignment. This could happen when speculators trying to bring down the parity overestimate the government's ability to defend the system.

An alternative explanation is that speculators abandon the market after having profited from the change in parity. This would be the case, for example, of fund managers who are given performance targets and do not have much of an incentive to active trading after those targets are met. As a result, information may not be efficiently used in the marketplace, with the resulting puzzling discrepancies between actual observations and predictions of models that assume rational expectations, such as ours. In general, the data at our disposal do not seem to provide evidence in support of the theory that adjustable parity systems are "stable". Indeed, two of the most significant empirical facts we have uncovered—discussed heretofore—are not inconsistent with the hypothesis that the fluctuation band generate insufficient stabilization on private realignment expectations, and that over-speculation or market inefficiency are present.

These suggestions, however, should not be taken as conclusive evidence in favour of market inefficiency. Such test requires a structural model. While our evidence cannot be considered conclusive, it adds to other empirical regularities that characterize adjustable parity systems, the most prominent of which is perhaps the so-called "capital-inflow problem" (see, for a discussion on the EMS, Giovannini, 1992). Our results, together with the empirical regularities studied in the literature on the capital-inflow problem, point to potential inherent instabilities of adjustable parity systems.

Data Sources

Exchange Rates: *Financial Times.* End of month observations.

Interest Rates: *Financial Times.* Eurodeposit rates. End of month observations.

Interest Rates:

X1:

- Germany: *Bundesbank external position. Monthly Report*, Table 12. Measured in Millions of DM.

- France: *Banque de France Quarterly Bulletin,* Table 10, Counterparties de M3. Measured in billions of FF.

- Italy: Banca d'Italia net external position, *Economic Bulletin.* Measured in Billions of IL.

Budget Surplus/Deficit:

- Italy: Treasury borrowing requirement. Bank of Italy.

- Germany: Federal fiance on a cash basis. Data Resources, Inc.

- France: Public authority financial deficit (national accounts). *INSEE Comptes et Indicateurs Economiques.*

Trade Balances: OECD.

Industrial Production: OECD. Index 1985=100.

Consumer Prices: OECD. Index 1985=100.

Wages:

- Italy — Contract wages. *International Financial Statistics.*

- Germany — Monthly wage and salary rate in the overall economy. Datastream Internaltional, Inc.

- France: Labor costs. *International Financial Statistics.*

X9:

- Germany and Italy — Liquidity of deposit banks, line 20, IFS.

- France — M1, IFS.

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TABLE 1

One-Month IL/DM Expected Devaluation:

Full-Sample Regression

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	-478.1773	-0.7268	0.4686
C 2	-479.8048	-0.7349	0.4637
C 3	-472.0257	-0.7249	0.4698
C 4	-479.6472	-0.7355	0.4633
C 5	-460.6358	-0.7099	0.4790
C 6	-458.5521	-0.7096	0.4792
C 7	-471.8912	-0.7329	0.4649
C 8	-459.9705	-0.7188	0.4735
C 9	-467.0552	-0.7313	0.4659
C 10	-460.8237	-0.7251	0.4697
X 1	6.4620	0.6659	0.5066
X 2	-0.1873	-0.4917	0.6238
X 3	126.6341	0.2778	0.7816
X 4	-14.0219	-0.2477	0.8048
X 5	0.5303	6.0541	0.0000
X 6	-9.6477	-4.7456	0.0000
X 7	-59.6633	-0.3861	0.7001
X 8	8.5227	0.0721	0.9426
X 9	-23.5367	-1.4285	0.1555
X 10	19.6028	0.6498	0.5170
X 11	-17.8491	-2.5136	0.0131

Diagnostics

Number of observations	155
Standard Error	16.636
R-squared	0.457
$F(21,134)$	7.211
Durbin-Watson	2.320

TABLE 1A

One-Month IL/DM Expected Devaluation:

Sub-Sample Regression

(March 1979 — August 1987)

Variable	Coefficient	t-Value	p-Value
C 1	1.3754	0.0659	0.9476
C 2	-11.0142	-0.8400	0.4033
C 3	6.2068	0.3890	0.6982
C 4	-2.0331	-0.1243	0.9014
C 5	22.4409	1.1763	0.2428
C 6	33.2140	1.6584	0.1010
C 7	10.2432	0.6146	0.5405
C 8	12.8307	1.1084	0.2709
X 1	1.3248	0.0945	0.9249
X 2	-0.2116	-0.4676	0.6413
X 3	159.1566	0.2536	0.8004
X 4	38.9896	0.4786	0.6335
X 5	0.6434	4.9941	0.0000
X 6	-10.5628	-3.4840	0.0008
X 7	-37.4572	-0.2197	0.8266
X 8	67.4376	0.4187	0.6765
X 9	-39.3983	-1.6092	0.1114
X 10	-35.6960	-0.7698	0.4436
X 11	-15.7087	-1.6153	0.1100

Diagnostics

Number of observations	102
Standard Error	19.310
R-squared	0.509
$F(19, 83)$	6.067
Durbin-Watson	2.471

TABLE 1B

One-Month IL/DM Expected Devaluation:

Sub-Sample Regression

(September 1987 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	-2301.4348	-2.0236	0.0497
C 2	-2294.3506	-2.0177	0.0504
X 1	26.9352	2.0824	0.0437
X 2	0.4132	0.4327	0.6676
X 3	687.5019	1.2733	0.2103
X 4	-45.1056	-0.8098	0.4228
X 5	0.2382	1.8003	0.0794
X 6	-2.9499	-1.4582	0.1526
X 7	-417.4870	-1.6094	0.1154
X 8	67.4277	0.4962	0.6225
X 9	-5.5523	-0.4192	0.6773
X 10	32.8205	1.1532	0.2557
X 11	-1.9425	-0.1953	0.8462

Diagnostics

Number of observations	53
Standard Error	7.856
R-squared	0.385
$F(13, 40)$	3.236
Durbin-Watson	1.860

TABLE 2

One-Month FF/DM Expected Devaluation:

Full-Sample Regression

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	317.9150	3.2361	0.0015
C 2	322.2156	3.4408	0.0008
C 3	321.1153	3.4300	0.0008
C 4	333.0882	3.4148	0.0008
C 5	331.2239	3.3702	0.0010
C 6	323.2528	3.2734	0.0013
C 7	317.1123	3.2861	0.0013
X 1	-13.3100	-2.2929	0.0234
X 2	-0.2640	-1.2067	0.2296
X 3	-93.8045	-0.4467	0.6558
X 4	70.5748	0.9709	0.3333
X 5	0.8730	7.6783	0.0000
X 6	-9.1515	-4.2937	0.0000
X 7	276.7218	1.9938	0.0481
X 8	-22.4749	-0.2186	0.8273
X 9	-21.5987	-1.0839	0.2803
X 10	-8.4588	-0.4482	0.6547
X 11	-13.9427	-1.4449	0.1508

Diagnostics

Number of observations	155
Standard Error	15.916
R-squared	0.545
$F(18,137)$	9.912
Durbin-Watson	2.423

TABLE 2A

One-Month FF/DM Expected Devaluation:

Sub-Sample Regression

(March 1979 — August 1987)

Variable	Coefficient	t-Value	p-Value
C 1	414.2165	2.9950	0.0036
C 2	413.8643	3.1375	0.0023
C 3	410.6509	3.1160	0.0025
C 4	416.5870	3.0512	0.0030
C 5	414.2206	2.9974	0.0036
C 6	412.1694	2.9652	0.0039
C 7	405.4981	2.9893	0.0037
X 1	-20.2068	-2.4533	0.0162
X 2	-0.2537	-0.6182	0.5381
X 3	-110.4367	-0.3692	0.7129
X 4	89.1508	0.7758	0.4401
X 5	0.9472	5.8764	0.0000
X 6	-7.3715	-2.3743	0.0199
X 7	237.1713	0.9697	0.3350
X 8	79.2739	0.3859	0.7006
X 9	-32.3508	-1.0448	0.2991
X 10	-28.5935	-0.9969	0.3217
X 11	-11.2882	-0.8933	0.3742

Diagnostics

Number of observations	102
Standard Error	19.312
R-squared	0.575
$F(18, 84)$	6.943
Durbin-Watson	2.415

TABLE 2B

One-Month FF/DM Expected Devaluation:

Sub-Sample Regression

(September 1987 — January 1992)

Variable	Coefficient	t-Value	p-Value
X 1	-18.8457	-2.5994	0.0127
X 2	-0.3606	-3.4552	0.0012
X 3	-50.9597	-0.3756	0.7091
X 4	-31.7236	-0.7245	0.4727
X 5	0.2597	2.1636	0.0361
X 6	13.2109	2.4251	0.0196
X 7	21.6307	0.3970	0.6933
X 8	29.2768	0.5437	0.5894
X 9	-8.6638	-0.8264	0.4131
X 10	10.5750	0.7958	0.4305

Diagnostics

Number of observations	53
Standard Error	4.970
R-squared	0.414
$F(10, 43)$	3.691
Durbin-Watson	1.885

TABLE 3

Final Regression Results With Regime Dummies:

Expected One-Month IL/DM Devaluation

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	-688.0799	-0.9628	0.3374
C 2	-690.6784	-0.9710	0.3333
C 3	-676.1609	-0.9540	0.3418
C 4	-684.9434	-0.9650	0.3363
C 5	-662.2425	-0.9396	0.3492
C 6	-655.5832	-0.9334	0.3523
C 7	-671.8954	-0.9596	0.3390
C 8	-660.1667	-0.9479	0.3449
C 9	-669.7942	-0.9650	0.3363
C 10	-673.9213	-0.9738	0.3319
X 1	2.4665	0.1594	0.8736
X 2	-0.1933	-0.5125	0.6091
X 3	298.6601	0.6427	0.5215
X 4	-0.9510	-0.0169	0.9866
X 5	0.6774	5.8305	0.0000
X 6	-8.4593	-4.0102	0.0001
X 7	-124.9686	-0.7844	0.4342
X 8	43.1606	0.3646	0.7160
X 9	-26.0058	-1.5849	0.1154
X 10	7.6254	0.2416	0.8095
X 11	-11.1960	-1.4228	0.1572
X 12	9.2878	0.7399	0.4607
X 13	-0.4418	-1.9414	0.0543

Diagnostics

Number of observations	155
Standard Error	16.471
R-squared	0.476
$F(23, 132)$	6.922
Durbin-Watson	2.270

TABLE 3A

Final Regression Results With Regime Dummies:

Expected Three-Month IL/DM Devaluation

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	-205.5754	-0.7205	0.4725
C 2	-200.4904	-0.7039	0.4827
C 3	-184.0127	-0.6502	0.5167
C 4	-184.2734	-0.6480	0.5181
C 5	-174.2544	-0.6173	0.5381
C 6	-175.1046	-0.6229	0.5344
C 7	-183.7843	-0.6560	0.5129
C 8	-187.4939	-0.6720	0.5027
C 9	-197.9485	-0.7112	0.4782
C 10	-205.4887	-0.7417	0.4596
X 1	-0.2918	-0.0401	0.9681
X 2	-0.0223	-0.1992	0.8424
X 3	135.2704	0.7845	0.4341
X 4	-67.0406	-2.9483	0.0038
X 5	1.1806	7.3367	0.0000
X 6	-3.1201	-3.3994	0.0009
X 7	19.9725	0.2943	0.7690
X 8	-49.1452	-1.0143	0.3123
X 9	-4.6889	-0.8648	0.3887
X 10	-15.9043	-1.1238	0.2632
X 11	0.1448	0.0476	0.9621
X 12	7.3982	1.3353	0.1841
X 13	-0.5789	-2.2083	0.0289

Diagnostics	
Number of observations	155
Standard Error	6.898
R-squared	0.625
$F(23,132)$	19.330
autocorrelations order	2
Autocorrelation of errors:	
One period	0.193
Last period	0.037

TABLE 4

Final Regression Results With Regime Dummies:

Expected One-Month FF/DM Devaluation

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	368.5814	3.5424	0.0005
C 2	370.0584	3.7313	0.0003
C 3	369.2664	3.7354	0.0003
C 4	377.8181	3.6990	0.0003
C 5	376.2023	3.6429	0.0004
C 6	374.1967	3.5823	0.0005
C 7	370.5824	3.6129	0.0004
X 1	-18.2409	-2.9416	0.0038
X 2	-0.2471	-1.1117	0.2682
X 3	-84.2307	-0.4062	0.6852
X 4	46.1439	0.6252	0.5329
X 5	0.9458	7.6955	0.0000
X 6	-7.5872	-3.3990	0.0009
X 7	267.8869	1.9424	0.0542
X 8	26.3587	0.2533	0.8004
X 9	-19.6365	-0.9974	0.3204
X 10	-18.3181	-0.9569	0.3403
X 11	-12.1930	-1.2015	0.2317
X 12	14.5593	1.9234	0.0565
X 13	-0.2006	-0.6343	0.5269

Diagnostics

Number of observations	155
Standard Error	15.711
R-squared	0.563
$F(20, 135)$	9.436
Durbin-Watson	2.344

TABLE 4A

Final Regression Results With Regime Dummies:

Expected Three-Month FF/DM Devaluation

(March 1979 — January 1992)

Variable	Coefficient	t-Value	p-Value
C 1	195.8427	4.0488	0.0001
C 2	195.1067	4.2145	0.0000
C 3	195.7883	4.2517	0.0000
C 4	198.5340	4.2608	0.0000
C 5	191.7341	4.3632	0.0000
C 6	191.2826	4.1282	0.0001
C 7	187.3248	4.1287	0.0001
X 1	-9.2245	-3.0188	0.0030
X 2	0.0093	0.1770	0.8598
X 3	28.4486	0.3100	0.7570
X 4	1.7272	0.0795	0.9367
X 5	1.3195	11.4652	0.0000
X 6	-1.7053	-1.6346	0.1045
X 7	70.1270	1.6173	0.1081
X 8	75.3372	1.8853	0.0615
X 9	-15.9054	-2.2699	0.0248
X 10	-14.6836	-1.6717	0.0969
X 11	0.8762	0.3458	0.7300
X 12	6.4625	3.0575	0.0027
X 13	-0.2650	-1.1693	0.2443

Diagnostics	
Number of observations	155
Standard Error	6.303
R-squared	0.642
$F(23, 135)$	16.974
Number of autocorrelations	2
Autocorrelation of errors:	
One period	0.057
Last period	0.003

TABLE 5

The "Honeymoon" Effect:

Estimated coefficients $\hat{a}$ and $\hat{b}$ in the full projection equation with $X6 \equiv at^* + bt^{*2}$

Regression	a	b
One Month IL	-3.0357 (-3.8742)	0.0686 (2.5591)
One Month FF	-1.4222 (-3.4337)	0.0170 (2.1384)
Three Month IL	-0.8002 (-2.5606)	0.0144 (1.5264)
Three Month FF	-0.2090 (-1.8091)	0.0035 (1.3440)

Note: t-value in parentheses.

Figure 1

One-Month Expected Devaluation: IL/DM

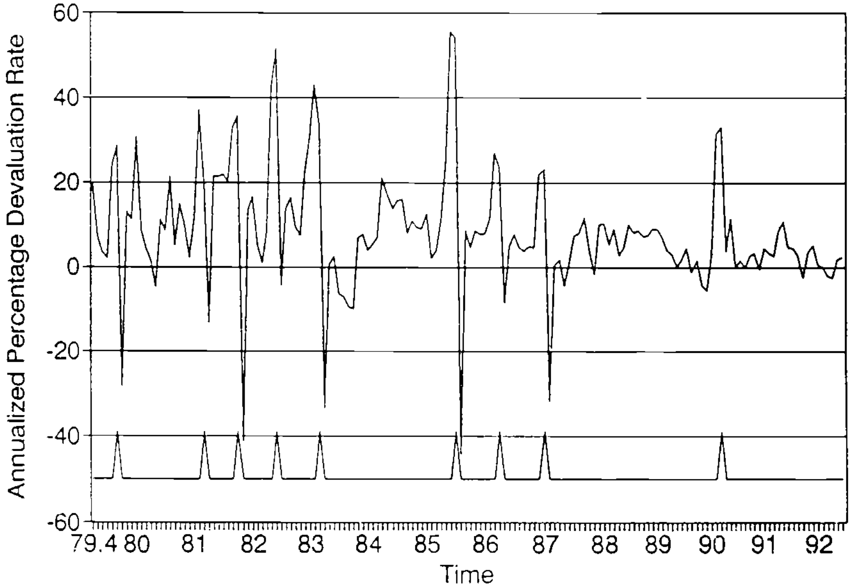

Figure 1a

IL-DM Interest Rate Differential (1 Mo)

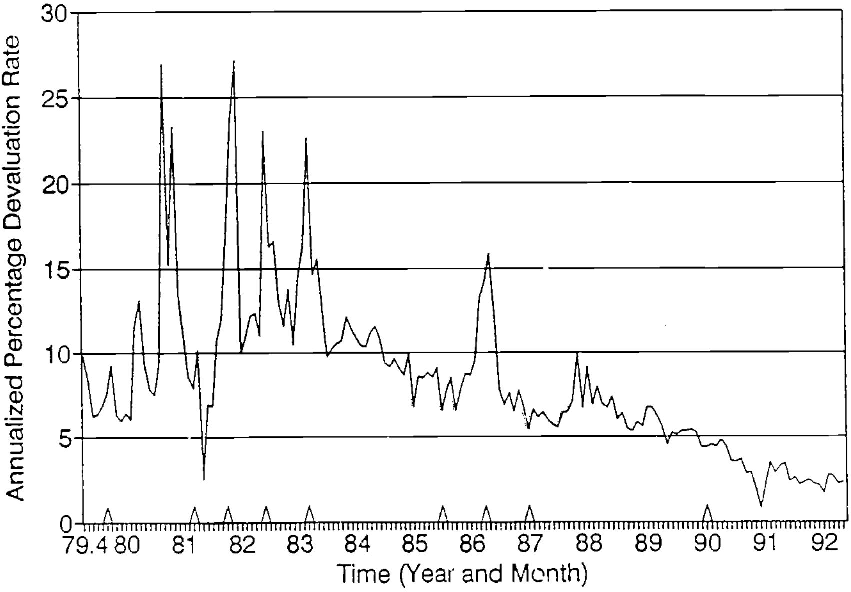

Figure 2

1 Month vs. 3 Month IL/DM Term Premium

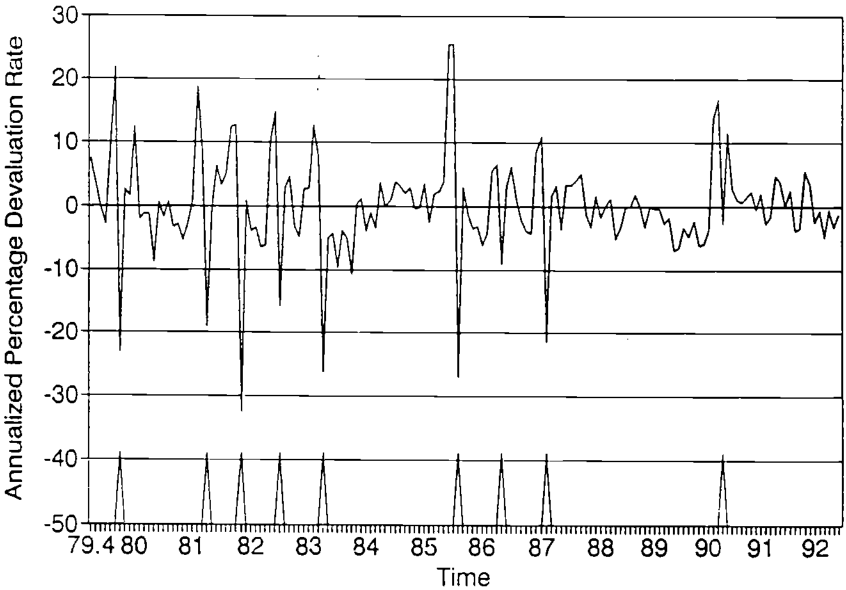

Figure 2a
IL-DM Term Premium of Interest Rates

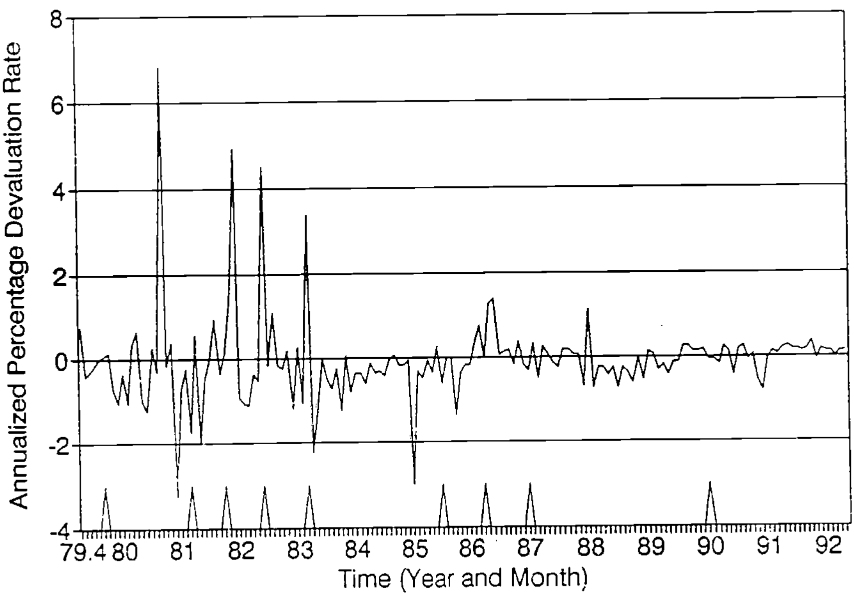

Figure 3

One-Month Expected Devaluation: FF/DM

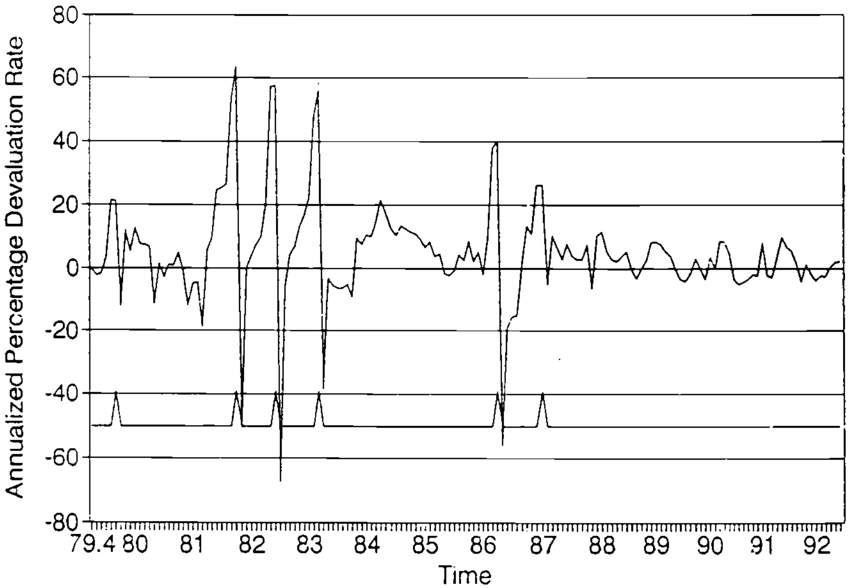

Figure 3A

FF-DM Interest Rate Differential (1 Mo)

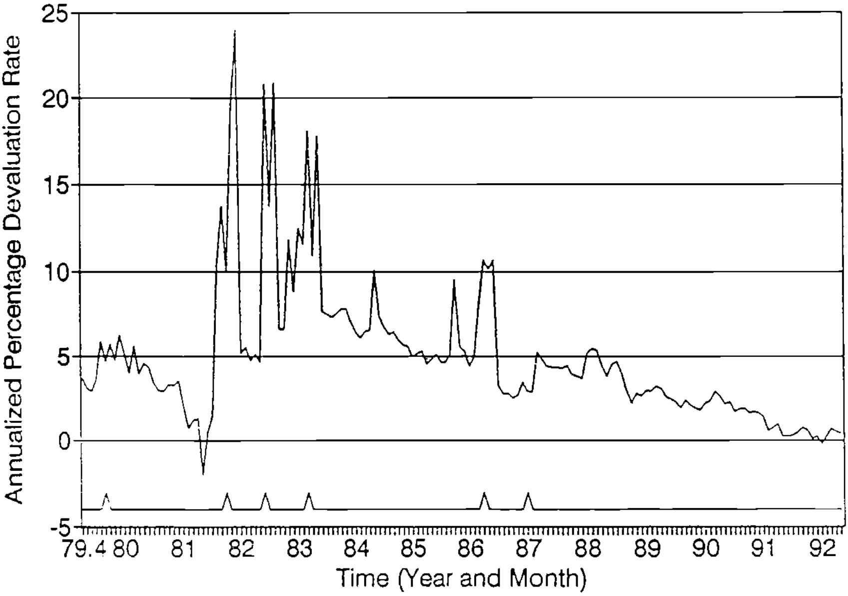

Figure 4
1 Month vs. 3 Month FF/DM Term Premium

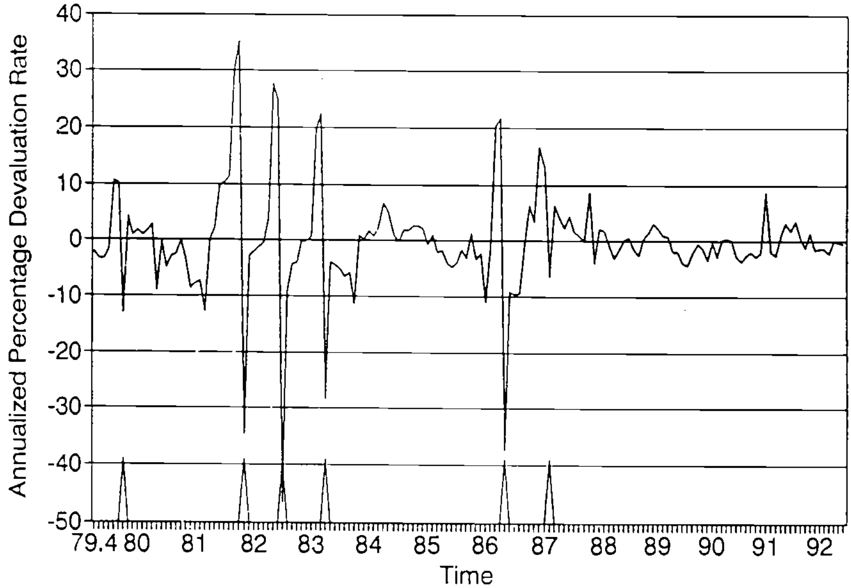

Figure 4a

FF-DM Term Premium of Interest Rates