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EMU and Long Interest Rates in Germany

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Abstract

The presence of an "EMU premium" in German long rates is tested by examining the co-movement of German and other European yields, as well as the exchange rate of the private ECU, *in reaction to EMU-related events*. If German yields incorporate an "EMU premium" while other European currencies expect lower interest rates from EMU, then German and other European long yields should react in opposite directions to events affecting the probability of EMU. In fact, they typically react in the *same* direction. Similarly, events which lead to an appreciation of the private ECU are associated with a *decline* in German yields.

JEL Classification Numbers:
E43, F33, E65

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Summary

This paper tests the hypothesis that German long yields incorporate an "EMU premium" by examining the co-movement of German and other European yields, as well as the exchange rate of the private ECU, in reaction to events affecting the probability that EMU will be realized. If other European countries can expect lower interest rates from EMU, their bond yields should fall in response to events making EMU more likely. German yields should rise under the hypothesis; thus, their co-movement should be negative. Similarly, events that make the private ECU appreciate (its exchange rate fall), should lead to a rise in German yields.

Forty-four political events not endogenous to same-day economic information and having no significant effects on bond markets except through their implications for EMU are selected. Changes in German bond yields on the days of these events are regressed on changes in French, Belgian, Italian, Spanish, and ECU bond yields and on the exchange rate of the private ECU on these days. To disentangle the effects of EMU related events and other shocks to bond markets, an instrumental variables technique is employed, in which the ex-ante classification of the EMU-related event in terms of its effect on the probability of EMU is used as an instrument.

The estimated coefficients are positive in all cases, and significant at the 5 percent level for most regressions. Thus, on average, events making EMU more likely have driven German yields down, not up. Alternative interpretations are consistent with this finding: (i) German bond markets do not expect higher inflation or real interest rates from EMU than would prevail under the Bundesbank; (ii) though skeptical about EMU, German markets prefer the successful completion of EMU process to the risks associated with its disruption.

I. Introduction

Has the expectation that monetary policy might in the foreseeable future be in the hands of a European monetary institutions maintained long interest rates in Germany at higher levels then they would otherwise be? Since the future European Central Bank (ECB) might be expected to adopt some weighted average of the traditional monetary policy stances of its members--tougher than most, perhaps, but not as tough as the Bundesbank, implying higher expected inflation and perhaps credibility premia--this idea has a fair amount of intuitive appeal. Moreover, it is consistent with three sets of facts, which have each received considerable attention in recent months:

First, opinion polls indicate that a large majority of Germans (almost two-thirds, according to a September 1995 report in The Economist) oppose a common currency, presumably because the D-Mark has a track record of stability while the future European currency does not.[2] If this view is shared by financial markets, it could contribute to relatively high long yields.

Second, there is anecdotal evidence of a German "capital flight" particularly among small investors and savers into Swiss Franc denominated assets. [3]

Third, the shape of the German yield curve relative to the U.S. yield curve has been somewhat puzzling for most of 1995 and early 1996 (Chart 1). From May 1995 to March 1996, German long yields were higher than U.S. long yields even though at the short end German interest rates are below U.S. rates, with the intersection occuring at medium maturities (5-8 years). This pattern--i.e. a positive U.S.-German yield differential at the short end but a negative one at the long end--has not been observed since the mid-seventies (Chart 2). Since the positive differential at the short end can probably be accounted for by differences in the stances of monetary policy and/or business cycle positions, the question becomes what explains the relatively high German rates at the long end. A lack of faith in the anti-inflationary credentials of the future European Central Bank could certainly be among the candidates.

The objective of this paper is to examine whether this potential explanation is valid, i.e. whether skepticism about EMU has in fact exerted upward pressure on long yields in Germany,

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[2]The Economist, 9/16/95, pp. 58-59; The Economist, 11/11/95, p.47.

[3]In particular, The Economist, 9/16/95, pp. 58-59. The Swiss National Bank also hints at capital flows into Switzerland in response to fears about EMU, although it does not say where these capital flows come from. See Swiss National Bank Monthly Reports, October 1995, p. III and November 1995, p. III.

or at least prevented them from coming down as much as they could have.[4] More precisely, I define the "EMU hypothesis" as the following proposition: if financial markets believe that EMU will come about with positive probability within the next T years, then German bond yields for maturity T will be higher than if financial markets attach zero probability to the event. The objective is to test this hypothesis.

To develop an appropriate test, the paper exploits the following idea. If it is really true that expectations of EMU are keeping German bond yields at higher levels then they would otherwise be, then news which make EMU seem more likely in the foreseeable future should lead to a jump up in German long yields, and vice versa. This suggests that we should examine the reaction of German long yields to events affecting the probability that EMU will realize over the time horizon of the bond. However, we have a problem in that the magnitude and even the direction in which an event affects the expected timing of EMU are not directly observable. Thus, if German bond yields fail to jump up in response to an event which we classify as making EMU more likely, this might either indicate that the EMU hypothesis is untrue, or it might be due to a misclassification of the news content of the event. Consider, however, bond yields in some other European country i for which the EMU process constitutes a commitment to a tougher anti-inflationary stance than has traditionally been associated with that country. For this country, yields should jump down in response to unanticipated events making EMU more likely, and up in response to bad news about EMU. Thus, if the EMU hypothesis is right we should see a reaction of bond yields in Germany and country i in *opposite* directions in response to an EMU-related event. Under the EMU hypothesis, this prediction will hold irrespective of whether the event had the effect of making EMU more or less likely and whether or not the event was anticipated.

Forty-four political events were selected--beginning with the Maastricht agreement itself, and ending with the recent debate about the EMU timetable in view of large deficits in several European countries--which should have had some effect on the perceived probabibility of EMU realizing (unless they were entirely anticipated), were not endogenous to same-day economic information, and would not have had significant effects on bond markets except through their implications for EMU. Using an instrumental variables procedure to address the possible simultaneous presence of other economic information to which bond markets might also have reacted, changes in German bond yields *on the days of these events* were then regressed on changes in (i) French, (ii) Belgian, (iii) Italian, (iv) Spanish bond yields on the same days. In addition, changes in German bonds on the same event-days were regressed on changes in ECU bonds and the exchange rate of the private ECU relative to the ECU basket; the latter was used as an alternative measure of the news content of the event. The EMU hypothesis predicts negative coefficients in each of these regressions.

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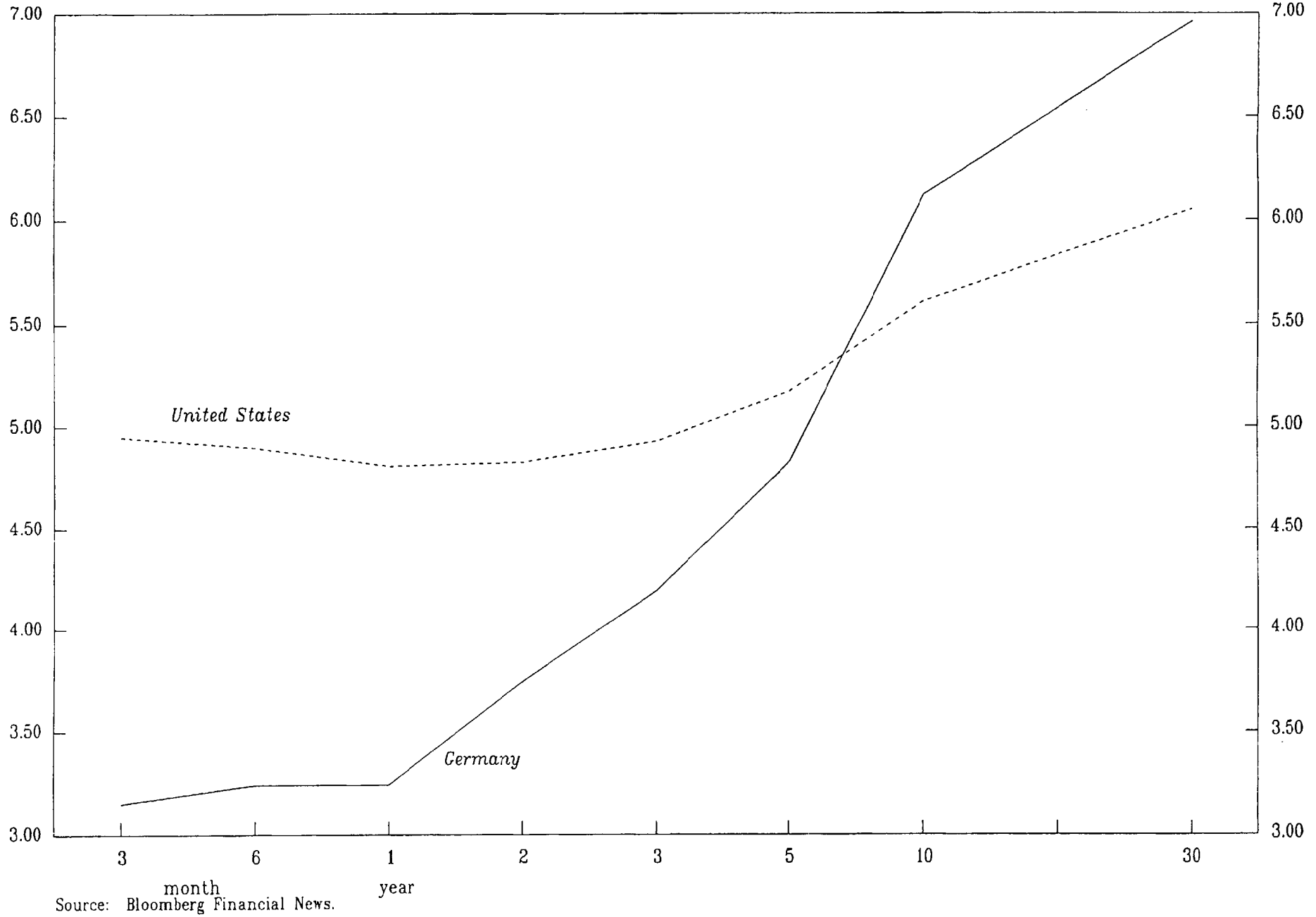
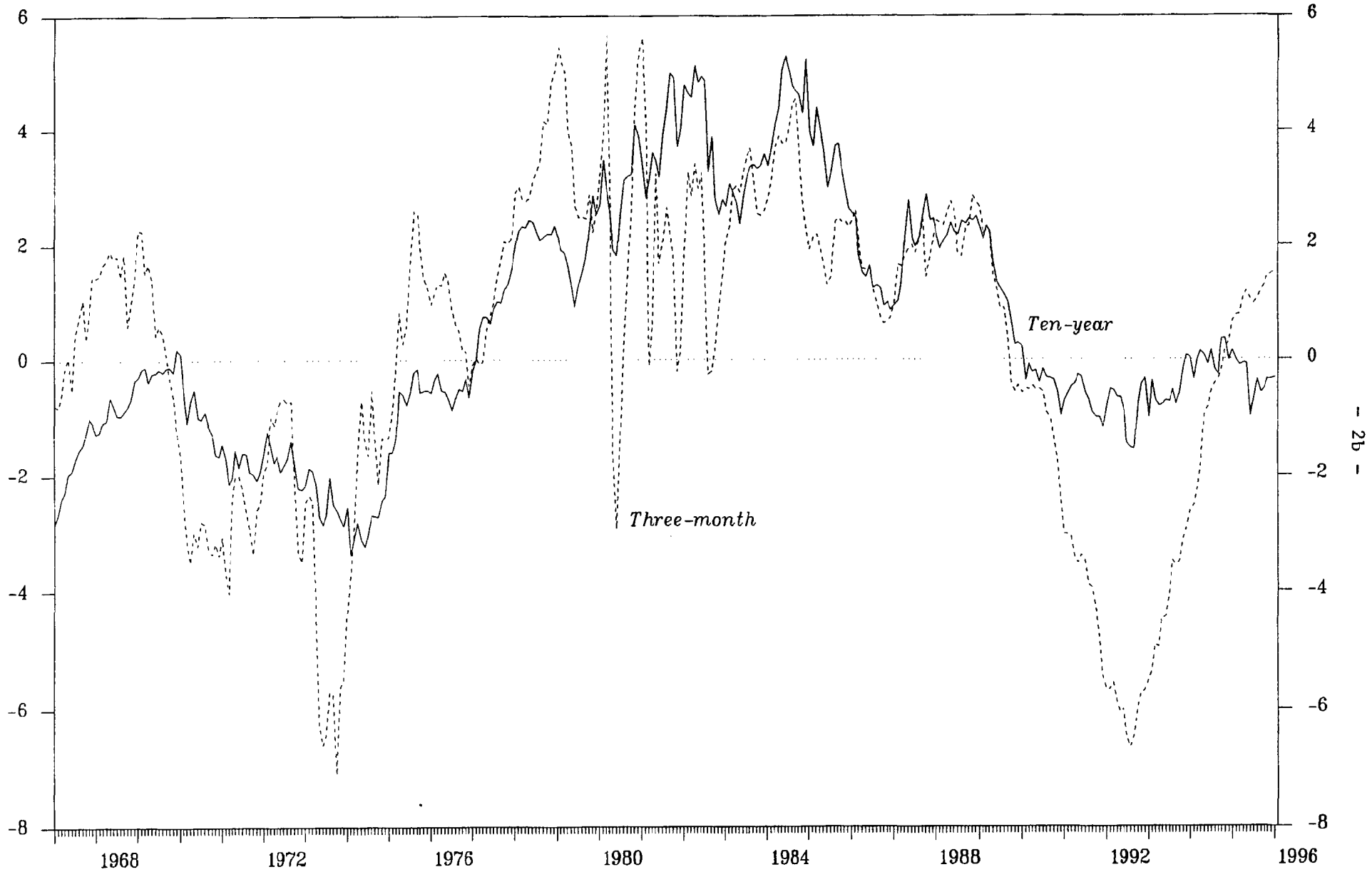
[4]Whenever "EMU" is referred to in this paper, I mean in particular the third stage of EMU with the irrevocable fixing of exchange rates and the move to a common European Central Bank.

Chart 1. U.S. and German Yield Curves, 2/12/96



Source: Bloomberg Financial News.

Chart 2. U.S. - German Interest Rate Differentials
at the Three-month and Ten-year Maturities, January 1967 - January 1996



Source: IMF

The main finding is that, contrary to this prediction, the estimated coefficient is *positive* in all cases, and significant at the five percent level for all regressions except that on changes in the ECU exchange rate (p=0.11 in this case). In other words: events that--based on the response of French, Belgian, Italian, Spanish and ECU yields and to a lesser extent the ECU exchange rate--seem to *increase* the chances of EMU coming about, tend to move German yields *down*, not up. On the basis of this result, the EMU hypothesis is rejected.[5]

In the following, the testing methodology summarized above is developed and justified in more detail and in a more formal setup. Next, the criteria for selecting events and the final selection are discussed. We then present the test results, discuss potential sources of bias, and conduct some tests for structural breaks. A final section interprets the results, and concludes.

II. Methodology

For the purposes of developing testable implications, it is useful to state the EMU hypothesis formally. Let $i_g(0,T)$ denote the (annualized) German T-year long interest rate in year zero (i.e. today). For example, $i_g(0,10)$ is today's German ten year rate. Next, let $i_{gD}(t,T)$ denote the annualized German T-year long rate expected today for time t (t being an integer greater zero) assuming that domestic monetary institutions are in place between dates t and $t+T$. Similarly, let $i_{gE}(t,T)$ denote the annualized German T-year long rate expected today for time t assuming that European monetary institutions will be in place between dates t and $t+T$. Thus, both $i_{gD}(t,T)$ and $i_{gE}(t,T)$ are todays's conditional expectations about long rates of maturity T at time t, conditioning on different institutional settings in each case.

Suppose initially that financial markets are certain that the third stage of EMU will begin at time t, $0 \le t < T$. From the expectations theory of the term structure, we can then write (to a first approximation):

$$i_g(0,T) = \frac{t}{T} i_{gD}(0,t) + \frac{T-t}{T} i_{gE}(t,T-t) \qquad (1)$$

Now let us introduce uncertainty about the timing of EMU. Define $p_g(T)$ as the probability (from the perspective of financial markets) that Germany will enter EMU before time T. Next, let $\phi_g(t)$ denote the probability that, conditional on Germany entering EMU some time between 0 and $T-1$, it will enter EMU in year t. (thus, $\Sigma\phi_g(t)$ from t=0 to $T-1$ equals 1). Then,

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[5] While to my knowledge there is no other paper directly testing for the presence of an EMU premium in German interest rates, this result is consistent with a recent IMF time series study of German long interest rates which also fails to detect an EMU premium. See Drees, Lee, Lund, and Symansky, 1996, Appendix III, entitled, "Monetary Policy Rules, Intermediate Targets, and their Effects on the Yield Curve and Monetary Transmission."

$$i_g(0,T) = p_g(T)\sum_{t=0}^{T-1}[\frac{t}{T}i_{gD}(0,t)+\frac{T-t}{T}i_{gE}(t,T-t)]\phi_g(t) + [1-p_g(T)]i_{gD}(0,T) \quad (2)$$

where $i_{gD}(0,T)$ is the German T-year long rate that would prevail today if it was certain that German institutions would continue in place over the entire maturity period of the bond, i.e. EMU does not realize before T.

The "EMU hypothesis" is then defined as the following proposition:

$$H_{EMU}: \quad i_g(0,T) > i_{gD}(0,T) \quad (3)$$

or, using (2)

$$H_{EMU}: \quad \sum_{t=0}^{T-1}[\frac{t}{T}i_{gD}(0,t)+\frac{T-t}{T}i_{gE}(t,T-t)]\phi_g(t) > i_{gD}(0,T) \quad (4)$$

which (to a first approximation) is equivalent to

$$\sum_{t=0}^{T-1}[\frac{T-t}{T}i_{gE}(t,T-t)]\phi_g(t) > \sum_{t=0}^{T-1}[\frac{T-t}{T}i_{gD}(t,T-t)]\phi_g(t) \quad (5)$$

In other words, $i_g(0,T) > i_{gD}(0,T)$ will be the case if and only if future interest rates under the European monetary regime are on average expected to be higher than under the Bundesbank, where the precise meaning of "on average" is given by equation (5).

Consider now the reaction of $i_g(0,T)$ to a change in the probability that EMU will realize within the maturity period of the bond. Bearing in mind that the distribution of the conditional probabilities $\phi_g(t)$ may be affected by this change, and assuming that interest rates conditional on continuing domestic monetary institutions in Germany (i.e. $i_{gD}(0,t)$), are unaffected by changes in $p_g(T)$, [6] we have:

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[6]This is justified if we assume that the Bundesbank mostly pays attention to domestic economic conditions in setting interest rates. For example, the Bundesbank's interest rate policy for the next two years is unlikely to be affected by events affecting the probability that EMU will materialize three years from now.

$$\frac{di_g(0,T)}{dp_g(T)} = \sum_{t=0}^{T-1}[\frac{t}{T}i_{gD}(0,t) + \frac{T-t}{T}i_{gE}(t,T-t)]\phi_g(t) + p_g(T)\sum_{t=0}^{T-1}[\frac{t}{T}i_{gD}(0,t) + \frac{T-t}{T}i_{gE}(t,T-t)]\frac{\delta\phi_g(t)}{\delta p_g(T)} - i_{gD}(0,T) \quad (6)$$

Comparing equations (4) and (6), it is clear that the EMU hypothesis will imply $di_g(0,T)/dp_g(T) > 0$ unless the second term on the right hand side of (6) is sufficiently negative, i.e. unless financial markets weigh the drop in the conditional probability of EMU realizing in some periods so strongly that this overcompensates both the increases in ϕ_g in other periods *and* the effect of the increase in the overall probability $p_g(T)$ of EMU realizing. In view of the fact that the changes $\delta\phi_g(t)$ must sum to zero, this seems very unlikely. In the following, we thus assume that the second term on the right hand side of (6) is sufficiently close to zero be ignored, which is the same as assuming that the weights on the positive and negative components of the sum are approximately the same.[7] Thus, we assume:

$$\frac{di_g(0,T)}{dp_g(T)} \approx \sum_{t=0}^{T-1}[\frac{t}{T}i_{gD}(0,t) + \frac{T-t}{T}i_{gE}(t,T-t)]\phi_g(t) - i_{gD}(0,T) \quad (7)$$

Then, condition (4) implies that $di_g(0,T)/dp_g(T)$ is greater than zero, and consequently a test of H_0: $di_g(0,T)/dp_g(T) > 0$ constitutes a test of the EMU hypothesis, since a rejection of the former implies a rejection of the latter.

As mentioned in the introduction, the complication in putting this approach to practical use is that $dp_g(T)$ is not directly observable. Suppose we simply check the reaction of German bond yields to major events influencing the timing and likelihood of EMU--for example, a referendum outcome during the Maastricht ratification process. We could then be vulnerable to two problems. First, a change in p_g and thus a reaction of bond yields will only occur to the extent that the outcome is unanticipated. Thus, for a perfectly anticipated outcome we would not observe any change in yields, even if the EMU hypothesis were true, which could lead us to falsely reject (or at least underestimate the evidence in favor of the hypothesis). Second, and perhaps more importantly, the interpretation of certain events in their effect on EMU may be ambiguous. Consider, for instance, the French referendum, which was won by the pro-Maastricht groups by an extremely narrow margin. What was more newsworthy about this event: the fact of victory for Maastricht, or its narrowness, indicating further resistance to EMU in the future?

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[7]In Section IV.2., we return to the issue of whether or not this assumption is plausible for the types of events we select.

The approach suggested here in attempting to resolve these problems is to examine the consequences of EMU related events for the *co-movement* of German bond yields and other forward-looking market variables, rather than for the movement of German bond yields directly. In a sense, the change in these other market variables is used as a measure of the change in p_g resulting from a given event. I make use of two families of variables, which are discussed in turn.

1. Tests Based on Domestic Bond Yield Co-movements

Consider an EMU candidate other than Germany ("country *i*"). In general, the desire to maintain its exchange rate close to a certain parity to the D-Mark will play a role in the way this country conducts its monetary policy. Consequently, interest rates in this country will be affected by conditions in foreign exchange markets, which in turn may depend on the perceived probability that EMU realizes within a given time period. This leads to the following more general version of equation (7) (based on (2), and again neglecting the term involving changes in conditional probabilities):

$$\frac{di_i(0,T)}{dp_i(T)} \approx \sum_{t=0}^{T-1} [\frac{t}{T} i_{iD}(0,t) + \frac{T-t}{T} i_{iE}(t,T-t)]\phi_i(t) + p_i(T)\sum_{t=0}^{T-1} \frac{t}{T}\frac{\delta i_{iD}(0,t)}{\delta p_i(T)}\phi_i(t) - i_{iD}(0,T) \quad (8)$$

The difference between this and (7) is the second to last term, in which we allow for an effect of changes in p_i on interest rates conditional on continuing domestic monetary institutions (i.e. *pre*-EMU interest rates).

Equation (8) implies that $i_i(0,T)$ will *fall* in response to an increase in p_i if the following conditions are satisfied:

(i) future interest rates in country *i* are on average expected to be *lower* under EMU than under continuing domestic institutions (i.e. the reverse of what the EMU hypothesis states for Germany):

$$\sum_{t=0}^{T-1} [\frac{t}{T} i_{iD}(0,t) + \frac{T-t}{T} i_{iE}(t,T-t)]\phi_i(t) < i_{iD}(0,T) \quad (9)$$

(ii) an increase in the probability of joining EMU within a given period will lower pre-EMU interest rates--for example, because it tends to strengthen the currency against the D-Mark, allowing domestic authorities to relax interest rates: [8]

$$\frac{\delta i_{iD}(0,t)}{\delta p_i(T)} < 0, \quad 0 \le t < T \tag{10}$$

Suppose, then, we have a country i for which (i) and (ii) are both satisfied. If the EMU hypothesis is true, equations (7) and (8) imply that long bond yields in country i and Germany should move in the *opposite* direction in reaction to an event which affects both Germany's and country i's chances of entry into EMU in the same direction (i.e. for which p_i and p_g move together in response to the event). This implies that the we could test the EMU hypothesis by collecting a set of events which affected the EMU timetable in both countries in the same direction--but had negligible effects on long yields through other channels--and regressing the change in German bond yields on the change in the bond yields of country *i on these event days*. The EMU hypothesis would predict a negative coefficient in this regression. This prediction is independent of the magnitude and direction of the jumps dp_g and dp_i (as long as they have the same sign). As a result, the suggested procedure is valid irrespective of the direction in which a

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[8]To clarify this mechanism, consider the following two period example. In period zero, domestic monetary authorities in country i set interest rates $i_i(0,1)$ in order to maintain their currency at a given parity to the DM. In period one, EMU succeeds with probability p_i and permanently fails with probability $1-p_i$. A third possibility--that EMU is postponed--can be introduced if we extend the model to more than two periods; it would not affect the economic mechanism illustrated in the two-period example.

If EMU succeeds at the beginning of period one, then the period zero exchange rate to the DM is frozen irrevocably and interest rate $i_E(1,1)$ will apply in country i. If EMU fails, then the exchange rate to the DM depreciates by k relative to period zero, the currency returns to floating vis a vis the DM and a given interest rate $i_i(1,1) > i_E(1,1)$ applies. Thus, country i's term structure at time 0--today's long and short rates--is determined as follows:

$$i_i(0,2) = \tfrac{1}{2} i_i(0,1) + \tfrac{1}{2}[p_i i_E(1,1) + (1-p_i) i_i(1,1)]$$
$$i_i(0,1) = i_g(0,1) + E[\Delta e(0)] = i_g(0,1) + (1-p_i)k$$

Consequently, an increase in p_i will lead to a decline in country i's long rate through two effects: (a) expected future interest rates decline because the probability of having low "European" rates in period two is higher; (b) pre-EMU short rates decline because the chance that country i's currency will depreciate at the end of period 1 is lower:

$$di_i(0,2) = \tfrac{1}{2}\{[i_i(1,1) - i_E(1,1)] - k\} dp$$

certain event might have affected the probability of EMU, or the extent to which the outcome of the event was anticipated.

We would argue that most signatories of the Maastricht agreement that are either members of the ERM or are shadowing the Bundesbank in order to re-enter into the ERM (such as Italy) are likely to satisfy conditions (i) and (ii)--the possible exceptions being Austria, the Netherlands and, of course, Germany itself. In all other cases, there appears to be a concensus that the EMU process enhances the credibility of tight monetary policy in the country, in the sense that it constitutes a commitment to a more consistently anti-inflationary policy stance than was traditionally associated with the country in the past. Indeed, there is plenty of anecdotal evidence, which we will attempt to confirm more systematically below before conducting our test, that countries in this group have witnessed upward jumps in long yields in response to events that made their EMU participation less likely, and vice versa. This is obvious for high yield countries such as Spain and Italy, but it is also the case for countries such as France or Belgium, which have had, and continue to have, positive interest differentials with Germany at the long end, in spite of the fact that their inflation rates have been somewhat lower than the German inflation rate in recent years.

Moreover, using the reactions of French or Belgian bond yields to EMU-related events as right hand side variables in the regressions proposed has one major advantage over using Spanish or Italian yield reactions, which is that the implication of the events for the German EMU timetable is likely to resemble the implications for France or Belgium much more closely than those for Italy or Spain. In this sense, jumps in French or Belgian yields in response to EMU-related events are likely to be a better proxy for changes in p_g than jumps in Italian or Spanish yields in response to the same events.[9] We thus consider bond yield reactions in all four countries as a potential right hand side variable in the regressions proposed.

2. Tests Based on ECU-denominated Variables

The above discussion suggests another candidate for use as a right hand side variable in the proposed test: ECU denominated bonds. Since converting the D-Mark to a European currency would almost certainly coincide with the conversion of the ECU to this currency, $dp_{ecu}=dp_g=dp$ is automatically satisfied for events affecting the likelihood of EMU. In addition, we would expect the average yield of a basket of bonds in the underlying ECU currencies (the so-called "theoretical yield" of ECU bonds) to react to EMU related events in the same direction as French, Belgian, Italian or Spanish yields: in view of the institutional design of the

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[9]This is most obvious in the case of France, for which $dp_g=dp_i$ was probably literally satisfied given a general view--emphasized on many occasions by German policy-makers--that a common European currency would be "unimaginable" without the participation of France. See, for example, remarks by German Finance Minister Theo Waigel on September 20, 1995 (FT 9/21/95, p.2).

ECB, inflation and nominal interest rates associated with the future European currency can on average be expected to be lower than the weighted average of inflation and nominal interest rates of the basket currencies (the low interest rate currencies D-mark and Guilder combined have a weight of about 40 percent in the basket). Indeed, this effect--that the ECB would be more credible than the sum of its parts--is one of the principal arguments in favor of EMU relative to the EMS of the 1980s.

However, the relationship between the yield of the ECU bond and its "theoretical" yield is not entirely straightforward. Since November 1988, when ECU clearing banks stopped exchanging ECUs into currency baskets at par, "no active official or private market mechanism guarantees a one-to-one exchange of private ECUs into units of the ECU basket."[10] As a result, the (private) ECU--the unit of denomination of ECU bonds--fluctuates in value against the currency basket. Consequently, the relationship between the yield on ECU bonds and the yield of the underlying basket is governed by an uncovered interest parity condition. Following Folkerts-Landau and Garber (1995), this condition can be written as

$$1 = p(T)\sum_{t=1}^{T} \frac{1+i_{ecu}(0,t)}{1+i_b(0,t)} \frac{E\epsilon(t)}{\epsilon(0)} \phi(t) \qquad (11)$$

where $\epsilon(0)$ and $E\epsilon(t)$ denote the exchange rate of today's ECU basket to the ECU at time 0 and the exchange rate expected for time t, respectively. Thus, an increase in ϵ indicates an appreciation of the ECU. The remainder of the notation is unchanged. [11]

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[10]Folkerts-Landau and Garber (1995), p. 135. For a detailed description on the institutions and practices governing the use of the private ECU and the ECU bond market, see Mehnert-Meland (1994).

[11]The condition is easily derived at follows. Suppose we knew with certainty that EMU would realize at time t. At this time, the ECU will be exchanged into an ECU basket with fixed weights which is subsequently converted into the European currency. The weights in that basket are uncertain at time zero, in particular, they might differ from the current weights in the basket. As a result, even though we know with certainty that at time t the ECU will be exchanged into the new basket at par, its exchange rate at t vis a vis the old basket might differ from par, and is uncertain at time zero. Consequently, the following standard UIP condition applies:

$$\epsilon(0)=\frac{1+i_{ecu}(0,t)}{1+i_b(0,t)} E\epsilon(t)$$

Equation (11) follows after taking expectations on both sides and using the definition of conditional probabilities.

Consider now, as before, the effects of an increase in $p(T)$ on the various terms in equation (11). While we lack an equilibrium model which would tell exactly us how the terms adjust in response to such a change, the discussion presented in Folkerts-Landau and Garber (1995) suggests the following. In general, one would expect an increase in $p(T)$ to prompt *both* a change in yield spreads in favor of the ECU (first term under sum declines) *and* a decline in the expected appreciation of the ECU vis a vis the basket (second term under sum delines), with the latter taking the form of a jump in the spot rate $\epsilon(0)$. This is because an increase in the probability that the ECU will be converted at par into a European currency which is expected to be more stable than the current basket makes the ECU more attractive relative to the basket. Thus, demand for ECU denominated assets will rise relative to basket assets both on bond and foreign exchange markets, resulting both in a drop in ECU yields relative to basket yields and in an appreciation of the private ECU in terms of the basket.

On the basis of this argument, we include two additional variables among the right hand side variables which we use to test the EMU hypothesis, namely ECU denominated long bonds and the spot value of the private ECU. As before, the test is whether or not these variables move in the opposite direction as German bond yields in reaction to events affecting the probability that EMU will come about within the maturity period of the bond.

Before moving on, it is worth noting that the two families of variables discussed above seem to exhaust the set of market variables for which events affecting the EMU timetable, on an *ex ante* basis, would seem to have unambiguous implications. In particular, and contrary to this author's initial intuition, the response of "safe haven" bond yields--say, Swiss long bond yields--to events affecting the probability of EMU is ambiguous. True, the EMU hypothesis suggests that as EMU becomes more likely, German long bond holders will substitute away from German paper, whose "fundamentals" are affected adversely by EMU, and into "safe haven" paper such as Swiss bonds. However, the same events will make bonds denominated in traditionally less stable European currencies *more* attractive, leading investors to substitute out of "safe haven" paper and into these bonds. The net effect of such an event on the yields of "safe haven" paper is thus ambiguous, as would be the effect of an event that lowers the chances of EMU. Consequently, the EMU hypothesis implies nothing about the co-movement between German yields and "safe haven" yields in response to EMU-related events that could be exploited in order to test the hypothesis.

3. Econometric Issues

Before the test suggested in the previous sections can be implemented--regressing the change in German yields on the change of appropriate market variables on the day at which EMU-related events were announced--we need to adress the possibility that other shocks affecting bond markets on the same day might confound the underlying structural relationship we are trying to uncover. Some of these shocks might be measurable, and can be controlled for. In particular, as in Skinner and Zettelmeyer (1995), one can control for shocks related to

German monetary policy announcements by including the jump in the German three month rate on days of such announcements as a measure of the unanticipated content of the announcement.[12] In other cases, however, shocks might not be easily measured or altogether unobservable. The presence of these shocks will then constitute a measurement error problem which could seriously bias the OLS coefficient in the suggested regression to test the EMU hypothesis. In particular, the estimated coefficient in a regression of German yield changes on French yield changes on the day of EMU related events might be positive even if the true structural relationship is negative, leading us to falsely reject the EMU hypothesis, und undermining the validity of our test.

This can easily be seen as follows. Assume we select events such that the EMU-shock embodied in the event is unrelated to other economic information on the same day. Then--abstracting from German monetary policy news or other news for which we can control--the true model can be written as

$$\begin{aligned} \Delta i_{gt} &= \alpha \Delta p_t + \epsilon_{gt}\ ; \qquad E[\epsilon_{gt}|\Delta p_t] = 0 \\ \Delta x_t &= \Delta p_t + \epsilon_{xt}\ ; \qquad E[\epsilon_{xt}|\Delta p_t] = 0 \end{aligned} \tag{12}$$

where x stands the market variable which we want to use as a measure of the news content of an EMU-related event (i.e. French, Belgian, Italian Spanish or ECU yields or the ECU exchange rate), and the EMU-shock Δp is measured in the units of the reaction of x.

The EMU hypothesis implies that $\alpha < 0$. In order to test this implication, and in view of the fact that the change in the probability p of EMU realizing is not directly observable, the suggestion is to run:

$$\Delta i_{gt} = \beta \Delta x_t + u_t \tag{13}$$

Substituting (12) into (13), it is clear that $\beta = \alpha$; thus, a consistent estimate of β is a consistent estimate of the parameter we are interested in. The problem is that running OLS on (13) will *not* consistently estimate β, since

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[12]The idea is that the three-month interest rate is (1) sufficiently short to react to unexpected monetary policy actions (or news which lead to the expectation of such an action in the future) and (2) sufficiently long such that it will only react to monetary policy actions (or news relevant to policy) to the extent that these were *unanticipated.* Thus, changes in the three month rate following monetary policy actions or policy-relevant news can be used as a proxy for the unexpected monetary policy content of such news (see Skinner and Zettelmeyer (1995)). Alternatively, one can drop the observations which coincided with German monetary policy news from the OLS regression sample; see Section IV.1.

$$u_t = \epsilon_{gt} - \beta\epsilon_{xt} \tag{14}$$

Thus, x_t and u_t in equation (13) will be correlated, which implies that the OLS estimator of β is inconsistent. Substituting (12) into the definition of the OLS estimator and taking probability limits, it is easy to show that (under standard assumptions about the existence of probability limits):

$$plim\ \hat{\beta}_{ols} = \frac{1}{1+(\sigma^2_{\epsilon_{xt}}/\sigma^2_{\Delta p})}\ \alpha + \frac{E[\epsilon_{gt}\epsilon_{xt}]}{\sigma^2_{\epsilon_{xt}}+\sigma^2_{\Delta p}} \tag{15}$$

The first term on the right hand side of (15) is well known from the textbook measurement error problem. It will be smaller than α in absolute value whenever the noise-to-signal ratio in the numerator is greater than one, biasing the OLS estimator towards zero. This type of bias would of course not produce a change in the *sign* of the coefficient (i.e. the OLS estimator of β being of different sign than α), however, this could well result from the second term on the right hand side of (15). In particular, suppose the EMU hypothesis holds, i.e. $\alpha<0$. If the noise terms in (12) are positively correlated--as would seem likely with integrated capital markets--and this correlation is large enough, then this could still lead to a positive estimate of β.

There are two ways in which one might address this problem. The standard approach is to estimate (13) using an instrumental variables procedure, which will give a consistent estimate of β even if the noise terms in (12) are highly correlated. This raises the question of what would be valid instruments in this context. One obvious choice is to use the *ex ante* categorization of the EMU shocks we are considering--in other words, a classification of each shock as "good news for EMU" ($\Delta p > 0$), "bad news for EMU" ($\Delta p < 0$), or "ambiguous". If we pick a valid market measure x (i.e. a measure which satisfies assumptions (i) and (ii) of section II.1) then our ex ante categorization of EMU related events should be negatively correlated with x. Moreover, if the categorization used is truly ex ante in the sense that we classify a particular event as "good for EMU", "bad for EMU" or "ambiguous" purely on the basis of political and economic background information about the event we are considering, i.e. *without* knowledge of the market reaction on the same day, then the instrument will by construction be uncorrelated with the noise terms in (12). Thus, a dummy variable which, for example, assigns a value of 1 to events which are "good for EMU", -1 to events which are "bad for EMU" and 0 to "ambiguous" events would constitute a valid instrument, and (13) can be estimated consistently using two-stage least squares in the usual fashion. The instrument can also be used to perform a Hausman (1978) specification test which compares the IV and the OLS estimates of (13). If the

null of no misspecification is not rejected, so that OLS be assumed consistent, then OLS can be used as the more efficient of the two estimators.

An alternative would be to pick a subset of events in a way that (a) excludes events which coincided with other published news that might have influenced bond markets and (b) restricts the sample to instances in which the EMU-related event was actually mentioned in bond market reports. One might then hope that this set only includes events with high signal to noise ratios, so that the remaining measurement error problem is negligible and OLS can be assumed to be consistent. This approach was explored in an earlier version of this paper, and led to qualitatively similar results as those presented in Section IV.[13] However, it suffers from a series of disadvantages relative to the IV approach. First, it misses unobservable shocks which might still have affected bond prices on the days selected. Second, it is vulnerable to reporting inaccuracies or omissions in bond market reports. For both reasons, it might not be successful in reducing the measurement error problem to an extent at which it can be ignored. Finally, it excludes events which, although they happened to coincide with other major news, contain valuable information about the reaction of bond markets to EMU related shocks. In that sense, it uses information inefficiently. This approach is thus not pursued in what follows, even though it would not have changed the conclusions of the paper.

III. Events

In practice, the events on which our dataset is based were selected according to the following procedure. With the help of past issues of *The Economist* and the *Financial Times* (FT), we compiled an initial set of about 50 candidate events with implications for the likelihood and timing of EMU. In order to generate an event-set that would satisfy the assumptions embodied in system (12) and thus give us a chance at estimating α consistently, we subsequently eliminated events which

i. were endogenous in the sense that they constituted within-day reactions to economic news, and

ii. had direct implications for bond yields in addition to their implications for yields via their effects on the probability of EMU.

An example for ii. is a government defeat over EMU ratification that increases the chances of early elections (as was the case during Britain's EMU ratification process). In addition to hurting the prospects for EMU, an event of this kind affects the chance of a change

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[13] "EMU and Long Interest Rates in Germany", presented at the Conference "European Monetary Union: Transition, International Impacts, and Policy Options", at the European Institute for International Economic Relations, Potsdam, April 1996.

in government policy in general, which might have consequences for bond yields unrelated to EMU. An example for both i. and ii. is a class of "events" which may have had the largest effect of all on perceptions about EMU, namely ERM currency crises. It is clear that the movement of long bond yields during these crises might be driven as much by perceptions of what these crises implied about the conduct of monetary policies and interest rates in the *pre*-EMU future, as by their implications for EMU itself. In addition, there is no reason to believe that the exchange rate movements defining the EMU crises were exogenous to economic information on the days on which we would be studying jumps in bond yields.

The application of these criteria left us with a set of 44 events for use as the basic sample on which to conduct IV regressions as described in the previous section. For all events included in this set, we used the FT to collect the yields of ten year benchmark government bonds before and after the event from the same FT issues which we used to check the event. The ten year maturity was chosen because it constituted the longest maturity for which yield data was readily available for all countries.

To report on how criteria i. and ii. were applied--and, in particular, why certain events were *not* excluded although they might have been candidates for exclusion under criterion ii.--we now briefly review both the initial set of candidate events and the final event set, which is summarized in Table 1. They can divided into two groups: early events, mostly during 1992 and 1993 and related to the Maastricht ratification process; and more recent events, mostly during 1995 and related to the EMU timetable and to whether or not certain countries--in particular France--would be able to meet the Maastricht convergence criteria in accordance with this timetable.

1. Events Related to the Maastricht Ratification Process

Depending on the stipulations of each national constitution, the Maastricht agreement needed to be ratified either by parliament or through a referendum in each country. Most of the referenda involved substantial ex ante nervousness about the outcome, in particular after the unexpected defeat of Maastricht in the first Danish referendum. Their outcomes typically constituted major news both in the political sections of the FT and in the bond market reports, were not influenced by any within-day economic news, and had no implications on bond markets except through their implications for EMU. They thus constitute ideal "events" for our purposes. Parliamentary ratification, on the other hand, was never in doubt in view of ruling party majorities in parliaments, except for the U.K., where there was cross-party opposition to the ratification process. U.K. parliamentary votes on Maastricht were thus included in the event set with the exception of the final U.K. Maastricht votes on July 22 and 23, 1993, which constituted news primarily because they almost led to a collapse of the Conservative government. Since the implications of these votes for the Maastricht timetable was clearly secondary to their general political implications, these events were excluded under criterion ii.

Table 1. Broad Event Set

Date	Event	Classi-fication	Changes in ten-year bond yields and the ECU spot rate							
			GER10y	FRA10y	BEL10y	ITA10y	SPA10y	ECU10y	ECUEX	USA10y
12/10/91	Maastricht agreement	G	0.01	-0.11	-0.01	-0.07	-0.14	-0.11	0.00	0.00
06/02/92	First Danish Referendum rejects agreement	B	0.00	0.13	0.08	0.22	0.32	0.23	0.13	0.02
06/18/92	Irish Referendum: M passes by wide margin	G	0.01	0.06	-0.02	-0.08	-0.11	0.01	-0.09	0.04
09/20/92	French Referendum: M accepted very narrowly	A	0.07	0.05	0.01	0.02	0.11	-0.04	-1.66	0.01
11/04/92	First Commons vote won	G	0.02	-0.06	-0.09	-0.01	-0.23	-0.08	0.03	-0.02
12/12/92	EC Edinburgh Summit: success for EMU	G	0.02	0.03	0.02	-0.02	-0.07	-0.02	-0.06	0.05
03/08/93	Commons vote lost after Tory right wing revolt	B	0.02	0.10	0.03	0.09	0.08	0.07	0.02	0.06
05/05/93	UK gov. forced to accept amendment to M bill	B	0.07	0.08	0.05	0.02	0.05	0.08	0.00	-0.01
05/18/93	Second Danish Referendum won	G	0.04	0.04	-0.01	-0.06	-0.13	0.02	-0.01	0.00
07/30/93	UK High Court rejects challenge to M	G	0.02	-0.03	0.06	-0.13	-0.24	0.01	1.60	0.01
10/12/93	German constit. court rejects challenge to M	G	-0.03	-0.02	0.00	-0.05	0.01	-0.06	-0.17	0.01
10/29/93	EU Brussels summit confirms M. timetable	G	0.02	0.06	0.00	0.17	0.09	0.04	0.00	0.12
06/12/94	European Elections: victory for anti-M forces	B	0.10	0.29	0.19	0.37	0.20	0.20	-0.04	0.04
04/09/95	EU CB governors' and Finance Ministers' meet	A	0.01	0.03	0.04	0.01	-0.01	0.08	-0.19	0.01
05/31/95	Eur. Comm. releases "Green Paper" on EMU	G	0.02	-0.01	-0.02	0.02	0.10	-0.01	-0.02	0.00
06/19/95	EU finance ministers write off 1997, affirm 1999	A	-0.02	-0.01	-0.01	-0.19	0.01	-0.01	-0.01	0.03
06/22/95	First Juppé mini-budget	G	-0.06	-0.12	-0.05	-0.08	-0.11	-0.05	-0.01	-0.09
06/26/95	EU Cannes summit reiterates 1999 deadline	G	-0.03	0.00	0.01	0.01	-0.01	0.03	0.10	0.03
08/25/95	Madelin resigns over proposed spending cuts	B	-0.02	0.04	0.01	0.16	0.07	0.02	0.03	0.00
09/20/95	Juppé presents 96 budget; Waigel on ITA ,BEL	A	-0.06	0.04	-0.03	0.10	0.01	0.00	0.02	-0.02
09/21/95	Gaddum: EMU criteria must be strictly satisfied	B	0.03	0.00	0.03	0.10	0.11	0.00	0.05	0.09
09/25/95	OECD report: France unlikely to meet criteria	B	0.01	-0.02	0.02	0.04	0.01	0.08	0.39	0.00
09/28/95	Juppé announces French revenue shortfall	B	-0.05	-0.22	-0.04	0.02	-0.07	-0.03	0.12	-0.08
10/01/95	EU Valencia summit seals 1999 as EU target date	G	-0.04	-0.03	-0.05	0.11	-0.04	-0.07	-0.05	-0.05
10/10/95	First French public sector strike (24 hours)	A	0.00	-0.03	0.00	-0.05	0.00	-0.06	-0.20	0.00
10/26/95	Chirac committs to deficit-cutting as no. 1 priority	G	0.01	-0.10	0.01	-0.07	0.01	-0.04	-0.35	-0.02
11/07/95	French cabinet resigns	G	0.01	-0.08	-0.02	-0.07	-0.04	-0.09	-0.06	0.03
11/07/95	Composition of new cabinet announced: fiscally conserv.	G	-0.04	-0.11	-0.05	-0.10	-0.10	-0.10	-0.07	-0.06
11/14/95	EMI presents EMU blueprint	G	-0.01	0.00	-0.02	-0.07	-0.04	-0.02	-0.10	-0.01
11/15/95	Juppé unveils welfare reform package	G	-0.02	-0.10	-0.04	-0.03	-0.09	-0.03	-0.15	0.04
11/23/95	French railway strike begins	B	-0.02	-0.05	-0.03	-0.02	-0.08	-0.08	-0.31	-0.03
11/27/95	EU fin. min. favorable on Waigels "stability pact"	G	0.03	0.05	0.02	0.04	0.00	0.02	-0.27	0.00
11/29/95	Bundestag hearing on EMU: Germans tough on criteria	B	0.00	0.07	0.03	0.04	0.10	0.08	0.22	-0.05
12/03/95	French Unions vow to intensify strike	B	-0.02	0.06	0.02	0.04	0.04	0.05	0.10	-0.07
12/05/95	Juppé: will not back down on welfare reform	G	-0.04	-0.12	0.04	0.06	-0.02	-0.11	0.14	0.03
12/07/95	Kohl: confidence in early French EMU membership	G	-0.04	-0.05	-0.02	0.02	-0.08	-0.03	-0.05	0.00
12/10/95	Juppé compromises on parts of package	A	0.03	0.03	0.03	-0.04	-0.02	0.02	0.23	0.03
12/13/95	French govt. abandons public pension reform	A	-0.02	0.03	0.02	0.01	-0.05	0.04	0.21	0.02
12/15/95	EMU Madrid summit, end of strike	G	-0.02	-0.08	-0.02	-0.12	-0.09	-0.06	-0.22	-0.02
01/09/96	Waigel: Germany missed M deficit target in 95	B	-0.01	-0.02	-0.03	0.02	0.02	-0.03	-0.11	0.12
01/15/96	Lamfalussy: EMU remains attainable by 1999	G	-0.03	-0.03	-0.05	-0.03	-0.08	-0.03	0.19	-0.09
01/24/96	Giscard: criteria should be relaxed	A	-0.04	-0.02	-0.05	-0.09	-0.05	-0.04	0.10	-0.06
01/25/96	Giscard views sharply ciriticized by FRA, GER	B	0.06	0.06	0.03	0.06	0.11	0.04	0.32	0.11
01/29/96	GER unlikely to meet M criteria in 97; Kohl reassures	A	0.05	0.04	0.04	0.01	0.09	0.06	0.09	0.02

Sources: Financial Times, Kredietbank N.V. "G" stands for "Good News for EMU"; "A stands for "Ambiguous News", "B" for "Bad News for EMU".

In addition, we included the EC's Edinburgh summit in December 1992, which was crucial for EMU in that it put the Maastricht process back on track by reaching a compromise with Denmark, and two major court decisions--in Germany and the U.K.--which could have derailed the treaty.

2. EMU Related Events Following Maastricht Ratification

Following the EU Brussels summit at the end of October 1993, which confirmed the beginning of the second stage of EMU with the creation of EMI in January 1994, Maastricht was largely out of the headlines until the European election of June 1994, which in most countries consituted the first opportunity for the general public to cast a vote on Maastricht. In the event, anti-Maastricht groups made substantial gains, and the election was primarily interpreted as a setback for EMU. However, in some countries--notably Spain, where the Socialists' poor showing prompted fears of political instabilty and early elections--the domestic implications of the election may have outweighed its implications for EMU. We thus ran our regressions both including and excluding this datapoint (see Section IV).

After the election until early 1996, there was a large number of political events with implications for EMU, which can be roughly divided as follows: (1) various EU summits, declarations and blueprints designed to salvage the 1999 deadline for the beginning of the third stage and put some flesh on the EMU process both until 1999 and thereafter; (2) French efforts to reduce the budget deficit in order to meet the Maastricht convergence criteria, including a wave of strikes triggered by the government's fiscal reform plans; (3) German officials' remarks emphasizing the need to adhere strictly to the Maastricht convergence criteria and suggesting that certain countries might not make it into the first group of EMU members.

While events in the first category rarely constituted large surprises and were often ignored in bond market reports, they are unproblematic in terms of criteria i.and ii. above, and were thus generally included in our event set. Interpreting the remaining events primarily in terms of their implications for the likelihood that EMU will be achieved within a certain time--changes in p, in the notation of the previous sections--is more problematic, and needs to be justified.

In the case of the French consolidation and welfare reform efforts and the public protests which they gave rise to, the problem is that these events carry obvious direct implications for the French economy in addition to the prospects for joining EMU, and that these in themselves can be expected to affect long rates (for example, through the effect of fiscal consolidation on real interest rates). We would argue, however, that both the urgency of the government in pushing these reforms and the reaction of bond markets to the proposals were primarily driven by the implications of the proposed reforms for France's chances to join EMU in 1999. Both general press reports on the events in France and bond market reports support

this view.[14] Thus, bond market reactions would primarily reflect the effect of the events on the probability of joining EMU. Moreover, to the extent that there was a direct effect on long real rates, it would tend to push French bond yields in the same direction (i.e. down for events increasing the chances of a lower deficit in the future). Thus, the basic prediction regarding the expected co-movement between French and German yields is unaffected, unless the French fiscal reform also implies lower long real rates in *Germany* through integrated capital markets. In view of the magnitude of adjustment involved (reducing the French deficit from about 5.5 to about 3 percent) and the size of French public borrowing relative to the integrated capital market among industrial nations, this effect would seem sufficiently small to be neglected, in the sense that it would not generate a correlation between Δp and the error terms in system (12).[15] The dataset underlying the initial set of results presented in the next section thus includes events based on French fiscal reform efforts; however, in Section IV.2 we return to this issue and test whether our conclusions would be affected if we had excluded this class of events.

In the case of German officials remarks about the need to scrupulously observe the Maastricht criteria, the issue is that these remarks can be somewhat ambiguous in their implications for EMU itself. While they were interpreted by the press and--according to the FT--by bondmarkets as making EMU more difficult for the majority of European countries, including France, and thus the 1999 deadline less realistic, their main intention was presumably to reassure the German public on the prospects for low inflation under the third stage of EMU. In general, we would thus expect these remarks to have two effects: first, to reduce the probability that EMU will come about within a given time period ($p_i(T)$ falls); second, to lower inflationary expectations and thus nominal interest rates conditional on European monetary institutions ($i_{iE}(t,T)$ falls). Under the EMU hypothesis, these would work in the same direction for Germany (namely, pushing yields down) but in opposite directions for the other countries, i.e. France, Belgium, Spain and Italy. In these cases, the effect of the remarks on the EMU timetable would tend to push yields up, while their effect through inflationary expectations conditional on EMU materializing would push them down. On the other hand, in the cases of Belgium, Italy and Spain we would also expect the effects of these remarks on the respective

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[14]See, for example, reports on President Chirac's October 26, 1995 commitment to reduce the deficit (FT, 10/27/95, p. 2; *The Economist*, 11/04/95, p.55), on market's reaction to that announcement (FT, 10/28/95, pp. 2 and 13), on the Nov. 7 cabinet reshuffle (FT 11/08/95, p.3, *The Economist*, 11/11/95, p.47), and on the Nov. 15 welfare reform package (FT 11/16/95, p. 26, *The Economist*, 11/18/95, p.57). The most drastic reference to the connection between the French fiscal reform struggle and EMU is made in *The Economist*, 12/09/95, where the cover shows log-burning demonstrators on the Champs Elysées along with the headline "France prepares for EMU".

[15] As long as this is not the case, the presence of an independent fiscal shock as part of the error terms of (12) is not problematic, since the IV procedure suggested in Section II.3 is designed to deal with this.

EMU timetables to be more severe than for Germany, since the remarks specifically adress criteria that might be harder for these countries to satisfy than for France and Germany. This would tend to offset the potential decline in yields through $i_{IE}(t,T)$. On the whole, thus, our priors are that a country such as Belgium, Spain or Italy and probably also France would evaluate remarks of this kind primarily in terms of its chances to participating in EMU. Indeed, in only one case out of twelve (Belgium, 9/20/95--see Table 1) do we observe a fall of French, Belgian, Italian or Spanish yields on the day of on which one of the German statements became public, and in only in one instance do we register no reaction at all (France, 9/21/95). Our approach was thus to retain the statements of German officials and to run our regressions both with and without the corresponding datapoints to ensure that our results are not sensitive to their inclusion.

In principle, the same ambiguity applies for ECU bond yields and the value of the private ECU. Statements emphasizing the need to apply tough convergence criteria can affect the value of the ECU and ECU yield differentials vis a vis the basket in at least two ways: first, through expectations that the beginning of the third stage will be delayed--the effect we want to capture; second, through expectations that the ECU might be converted into a smaller basket which only includes traditionally stable European currencies. Since these currencies would, in general, tend to be strong within their ERM bands, this expectation could, by itself, strengthen the private ECU and lower ECU bond yields. Again, we have two potentially offsetting effects, and again the observed reaction suggests that the former is stronger at least in its effect on the private ECU, which depreciates (jumps up) in all cases. The ECU yield, on the other hand, jumps up in one case but shows no reaction in the two others. As in the case of regressions involving yield changes on the right hand side, we thus decided to run the regressions based on changes in the value of the ECU and ECU yields both including and excluding the datapoints in question.

Table 1 presents all events included in the final event set with their classification in terms of their presumed unanticipated effects on EMU which is to be used as an instrument as described in Section II.3 ("good news", "bad news" and "ambiguous"). Note that in one case two EMU-related events coincided, so that bond yields are interpreted to reflect their net implications for EMU (09/20/95), whereas in another case--the November French cabinet reshuffle--news of the reshuffle were spread over two days, because bond markets learned about the resignation of the old cabinet during the trading session, while the composition of the new cabinet became known after markets had closed (11/07/95).

IV. Results

1. Basic Regressions

Table 2 presents the results from the regression-based tests proposed in in Section II.3. The upper panel presents the coefficient and standard errors from first stage of the IV

Table 2. Results from IV and OLS regressions

	Right-Hand Side Measure of EMU Shock																	
	FRA 10y			BEL10y			ITA10y			SPA10y			ECU10y			ECUEX		
	IV	OLS(1)	OLS(2)	IV	OLS(1)	OLS(2)	IV	OLS(1)	OLS(2)	IV	OLS(1)	OLS(2)	IV	OLS(1)	OLS(2)	IV	OLS(1)	OLS(2)
First Stage Regression:																		
INTERP	-0.04	...	...	-0.03	...	...	-0.06	...	...	-0.07	...	...	-0.05	...	...	-0.07	...	...
S.E.	0.014	...	...	0.007	...	...	0.015	...	...	0.015	...	...	0.010	...	...	0.027	...	...
CONST	0.01	...	...	0.01	...	...	0.03	...	...	0.01	...	...	0.02	...	...	0.02	...	...
S.E.	0.013	...	...	0.006	...	...	0.014	...	...	0.014	...	...	0.009	...	...	0.025	...	...
Second Stage Regression:																		
Measure	0.29	0.26	0.21	0.50	0.47	0.36	0.22	0.11	0.06	0.16	0.12	0.07	0.26	0.22	0.16	0.18	0.00	0.00
S.E.	0.118	0.051	0.051	0.191	0.098	0.100	0.106	0.052	0.048	0.081	0.048	0.046	0.114	0.069	0.064	0.109	0.034	0.029
GER3m	0.63	0.65	0.75	0.34	0.36	0.53	0.65	0.70	0.85	0.69	0.70	0.84	0.49	0.53	0.70	0.50	0.75	0.88
S.E.	0.358	0.354	0.331	0.397	0.372	0.354	0.456	0.431	0.387	0.426	0.421	0.382	0.423	0.411	0.371	0.585	0.442	0.380
USA10y	...	...	0.23	...	...	0.23	...	...	0.33	...	...	0.31	...	...	0.30	...	...	0.35
S.E.	...	...	0.085	...	...	0.089	...	...	0.096	...	...	0.097	...	...	0.090	...	...	0.090
R^2	...	0.42	0.51	...	0.39	0.48	...	0.15	0.34	...	0.19	0.42	...	0.25	0.41	...	0.07	0.33
N	44	44	44	44	44	44	44	44	44	44	44	44	44	44	44	42	42	42
Hausm. p		0.76			0.84			0.19			0.52			0.67			0.03	

Notes: Hausman p denotes the significance level at which the Hausman test would reject the Null of no misspecification of the OLS(1) model.

regression; the dependent variables are the six market variables listed in the heading of each group of columns. In the main panel ("Second Stage Regression"), the dependent variable is the change of the German ten year government bond yield on the days selected, and the six market variables listed in the headings of the columns are now the main right hand side variables of interest; their coefficients are reported in the line "Measure". For each of these six right hand side variables, we run three regressions: an IV regression using the ex-ante interpretation of the events as an instrument, denoted "INTERPR" (see Table 1 and Section II.3); an OLS regression on the same right hand side variables as the IV regression, and a second OLS regression which in addition includes the change in the US ten year bond yield--as a proxy for changes in the world interest rate--on the right hand side. This second OLS regression model must be interpreted with care. If the Hausman test based on the comparison of the first two regressions has rejected the null of no misspecification then one cannot, in general, expect this regression to be correctly specified. Even if the Hausman test has not indicated misspecification of OLS(1), the presence of the US ten year bond yield in OLS(2) may introduce an endogeneity problem of its own through reverse causality. If, however, reverse causality is not deemed to be a problem (for example, it might be argued that the German bond market is small relative to the U.S. bond market) and the Hausman test can*not* reject no misspecification of the OLS(1) regression model, then the OLS(2) model offers the opportunity of a more efficient use of information, since a proxy for changes in the world interest rate is directly included as a regressor whereas in IV and OLS(1) it is not.[16]

In all regressions, we control for influences of German monetary policy on the German ten year bond yield by including the change in the German three month interbank rate in our regression whenever German monetary policy actions or related news (e.g. about German monetary aggregates) were mentioned in bond market reports; this occured on sixteen occasions. In other words, the variable "GER3m" contains a zero entry except for these sixteen occasions, when it contains the change of the German three month rate on that day. To satisfy ourselves that the inclusion of events which coincided with German monetary policy announcements did not bias the results in spite of our attempt to control for the announcements, we also ran the OLS regressions without GER3m after dropping the events in question. Not surprisingly, we obtained somewhat larger standard errors, but the regression coefficients on the market variables of interest were very close to those reported in the OLS columns of Table 2.[17]

Finally, note that the sample for the regressions using ECUEX, the spot exchange rate of the private ECU relative to the ECU basket, is slightly smaller than that for the remaining regressions. According to Folkerts-Landau and Garber (1995, p. 135), the market for private

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[16] Ideally, one would want to test the specification of OLS(2) directly. Unfortunately, this was not possible since we could not come up with a good instrument for the change in the US ten year bond yield.

[17] Available from the author on request.

ECUs "did not operate for a week after September 16, 1992" (the date of the first ERM crisis). While exchange rates are still quoted for this week, typical day-to-day changes are about ten times larger than usual, indicating that the market was very thin and not functioning normally. September 20, 1994 was thus excluded from the regressions involving ECUEX, and July 30, 1995, which coincided with the second ERM crisis, was excluded on similar grounds.

Consider first the upper panel in Table 2, which reports the results from the regression of the market variables listed in the column group headings on the instrument "INTERPR". As can be seen, the coefficient on "INTERPR" is highly significant in all cases. This is interesting not only because it suggests that "INTERPR" is a reasonable instrument (well correlated with the variable we are instrumenting for), but as a way of confirming the basic property assumed in Section II for the right hand market variables used as a measure for EMU shocks, namely that "good news for EMU" reduces the yields of these variables (leads to an appreciation), and conversely for "bad news". The significant negative coefficients on INTERPR imply that, assuming that the classification embodied in INTERPR tends to correctly capture the direction of the true underlying EMU-related shocks, the market variables we picked for our test really react to these shocks in the direction in which they were assumed to react.

A further point to note from the upper planel of Table 2 are the relatively large standard errors of INTERPR in the ECUEX regressions, suggesting that ECUEX, the daily change of the spot rate of the private ECU relative to the ECU basket, may be a noisier measure of EMU-releated shocks than changes in the long yields of the bonds chosen. Finally, note that the constant in the first stage regression is positive throughout, although typically not significant. This implies that events whose news content was classified as "ambiguous" on average lead to slight increases in yields, or depreciations--thus, the "bad" news content of these ambiguous cases seems to have dominated slightly.

Now turn to the lower panel of the table. To begin with, note that the Hausman test rejects the null of no misspecification strongly in only one case (p=0.025), namely in the model with ECUEX as right hand side market measure. This is not surprising given the "noisiness" of ECUEX as apparent from Table 1, the large standard errors in the first stage regression, and the catastrophic R^2 of the OLS (1) specification; all these suggest that the ϵ_{xt} noise term in system (12), which drives misspecification, has high variance for this particular variable. In addition to ECUEX, in the case of ITA10y the p-value of the Hausman statistic is much lower than for the other yield variables. If we are worried about misspecification--as we should, given the priors established in Sections II.3 and III--this, too should be interpreted as a rejection; in other words, we should work with an alpha level of at least 0.2.

It follows that for ITA10y and ECUEX, we should trust only the results from the IV regressions. In all other cases, the use of the OLS(1) regression would seem safe. What about OLS(2)? Comparing the standard errors of OLS(1) and OLS(2), it is clear that OLS(2) does not buy us much in terms of estimating "measure", our main variable of interest, more precisely. On

the other hand, OLS(2) has not been subjected to a specification test. Thus, this author prefers to stick to OLS(1). On the other hand, it is true that OLS(2) gives a better fit and that USA10y is significant in the OLS(2) regressions. If the reader feels comfortable with the idea of treating USA10y as exogenous, he or she can work with OLS(2) instead. Either way, the qualitative implications are largely the same.

This leads to the main result of Table 2: in all IV regressions, and in all OLS(1) regressions which were not rejected as misspecified, the coefficient on the right hand side yield variables is *positive* rather than negative, as implied by the EMU hypothesis, and significant at the five percent level for all specifications except ECUEX (in which case p=0.11). This implies that the null hypothesis of a true negative coefficient on "measure" should be rejected at the 2.5 percent significance level on the basis of all regressions except for ECUEX, where the likelihood that the regression result is consistent with a true negative coefficient on ECUEX is about 6.5 percent.[18]

Less importantly for our purposes, note that the coefficient on GER3m, the proxy variable for German monetary policy or expectations of German monetary policy, comes out positive, as expected, although it is fairly imprecise. Finally, the presence of USA10y in the OLS(2) regressions leads to slightly lower estimates for the "measure" variables relative to the OLS(1) specification, but that with one exception (SPA10y) the OLS(2) estimates for "measure" are still highly significant whenever the OLS(1) specification was not found to be misspecified.

2. Discussion and Testing

The results presented above constitute strong evidence against the null that German bond yields and the remaining market variables studied respond to EMU related events in opposite direction. Before we conclude that the EMU hypothesis should be rejected, however, we should examine what possibilities remain that this conclusion might be mistaken, in spite of the relatively straightforward idea underlying the test and the criteria used to selecting events.

First, in developing our test in Section II, we made the auxiliary assumption that changes in conditional probabilities that EMU will realize in any given year in response to changes in the overall probability that EMU will realize in the maturity period of the bond (the conditioning event) approximately cancel out in their effect on long yields. In other words, we ruled out the following situation: the EMU hypothesis is right, in the sense that calling off European monetary union altogether would lead to a drop in German yields. However, in response to certain events making EMU less likely over the maturity period of the bond, German yields might still rise (i.e. react "perversely") if the reduction in the overall probability goes along with

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[18]Since we are testing a one-sided hypothesis, the p-values associated with the usual significance test must be divided in half.

a change in the probability distribution across years such that the probability of EMU realizing increases for years of particularly high expected interest rates conditional on EMU happening (see equation (6)). In this case, one could falsely reject the EMU hypothesis on the basis of the observed response of German yields to EMU related events.

In view of the nature of the events studied in the previous two sections, this possibility seems very unlikely. Any redistribution of probabilities that EMU will come about following an event affecting the overall probability of EMU is likely to happen in the neighbourhood of the year "earmarked" for the beginning of EMU. In this neighbourhood, however, expected interest rates conditional on EMU occuring will not vary much across years. For example, consider events during 1995 which made EMU less likely over the maturity period of the ten year bond. These events generally take the form of making EMU less likely in 1999, which might perhaps be consistent with the perceived probability of EMU rising for the years immediately following 1999. However, since the interest rate expected for 1999 in 1995 conditional on EMU realizing will not be very different from that expected for 2000 or 2001, the yield on the ten year bond should still jump down if the *overall* effect of the event was to make EMU less likely over the maturity period.

Second, we need to address the possibility of bias resulting from the inappropriate inclusion of certain events. Section III reported on three types of events--the European election, German officials' statements about the need to apply the Maastricht criteria "strictly", and events related to French fiscal consolidation efforts-- whose inclusion was debatable on the grounds of criterion ii., i.e. because they may have contained information which could have exercised a major effect on bond yields in other ways than through changes in the perceived probability of EMU. In terms of system (12), the risk of inappropriately including these events is to generate a correlation between Δp and the errors ϵ_{gt} and ϵ_{xt}. In this event, (12) cannot be estimated consistently through any of our methods, including IV, since IV will only protect us from the measurement error problem (i.e. the presence of ϵ_{xt} and its likely correlation with ϵ_{gt}) *assuming* that the assumption of system (12) are satisfied, i.e. that ϵ_{gt} and ϵ_{xt} are orthogonal to the EMU shock.

The most straightforward way of checking whether the inclusion of these event-groups is driving our result is to re-estimate Table 2 excluding each of the questionable event groups. However, this is a bit cumbersome since we would have to go through various combinations of excluded groups, and provides no information beyond making the basic point. An easier and more informative alternative is to use the graphic structural stability analysis capabilities of PCGIVE 8.0, the econometric package used for the earlier regressions, to check how the inclusion of any of these events groups modifies the regression results and at the same time take the opportunity to check parameter stability in general.

In order to apply the graphical analysis functions of PCGIVE to our problem, we take advantage of the fact that our sample has no dynamic structure and re-order the sample such

that the event-goups whose properties we want to test are ordered last, as follows: the first 27 observations of the sample are all "unproblematic" events, in chronological order, i.e. all events related to the Maastricht ratification process and all EMU related summits and statements excepting the three statements by German officials discussed in Section III. These three are next (observations 28, 29 and 30), followed by twelve events related to the French fiscal consolidation efforts of 1995 (observations 31 to 43). The European election of June 1994, which stands out because of the exceptionally large reactions in European bond markets, comes last (observation 44).

We then estimate the coefficient on each of the six measures of EMU-related shocks by applying OLS (for FRA10y, BEL10y, SPA10y and ECU10y) or two-stage least squares (for ITA10y and ECUEX) recursively, i.e. beginning with the first few observations and extending the regression over the whole sample observation by observation, and plot (a) the resulting coefficients with standard errors, (b) the t-statistics and (c) the Chow breakpoint $N\downarrow$ and $N\uparrow$ statistics. These constitute two variants of the Chow test for predictive stability. The former tests for a structural break between the first t observations in our sample and the last $N\equiv 44-t$ observations (the "forecast period"). For each t between a fixed observation M, which is defined initially, and 44, PCGIVE plots the value of the Chow statistic which tests whether t is a breakpoint; the test is referred to as $N\downarrow$ because the "forecast period" gets smaller as t approaches 44. The $N\uparrow$ test, on the other hand compares a fixed "estimation period" comprising observations 0 to M-1 with a "forecast period" comprising observations M to $t\geq M$. It is called $N\uparrow$ because the forecast period increases as t approaches 44.[19] In our case, we first set M-1 equal to 11, which is the number of events from the initial Maastricht ratification process in our sample. We subsequently repeated the Chow tests after setting M-1 equal to 27 so that the null of the N↑ test referred to the structural equality of a growing forecast period which included increasing numbers of events belonging to the three "problematic" groups, and the set of "unproblematic" events.

Figures 1 to 4 show these plots for the variables for which we can use OLS. In each figure, the upper two plots show the recursive regression coefficients with standard errors and the t-statistics as t approaches 44, the next two the $N\downarrow$ and $N\uparrow$ Chow tests setting M-1=11, and the bottom two the two Chow tests with M=27. Figure 5 contains only the first two plots for the right hand side variables ITA10y and ECUEX, which required IV and for which Chow tests could not be performed. The main results are as follows.

1. The last observation in our reordered sample, i.e. the reactions to the European election, has a disproportionate affect on our t-values--witness the sharp surge at the end of all t-value graphs--and generates a structural break (at the ten percent level) in two cases (see N↓ graph for SPA10y and ECU10y). It seems to be a clear outlier and should probably be excluded on those grounds. Note, however, that its exclusion will not affect

[19] See Doornik and Hendry (1995), p. 328-329 for a definition of the test statistics and details.

Figure 1. Tests for FRA10Y

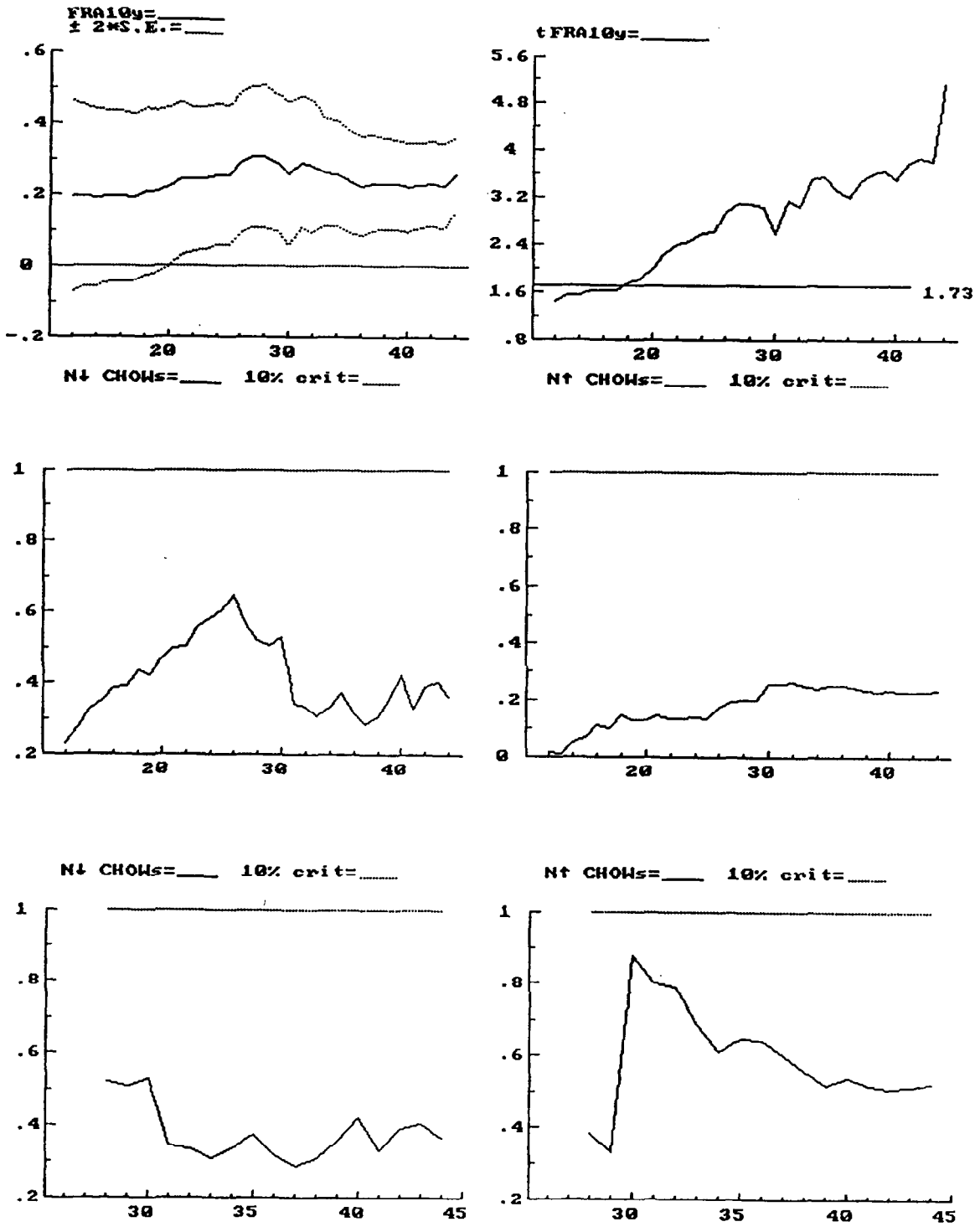


Figure 2. Tests for BEL10Y

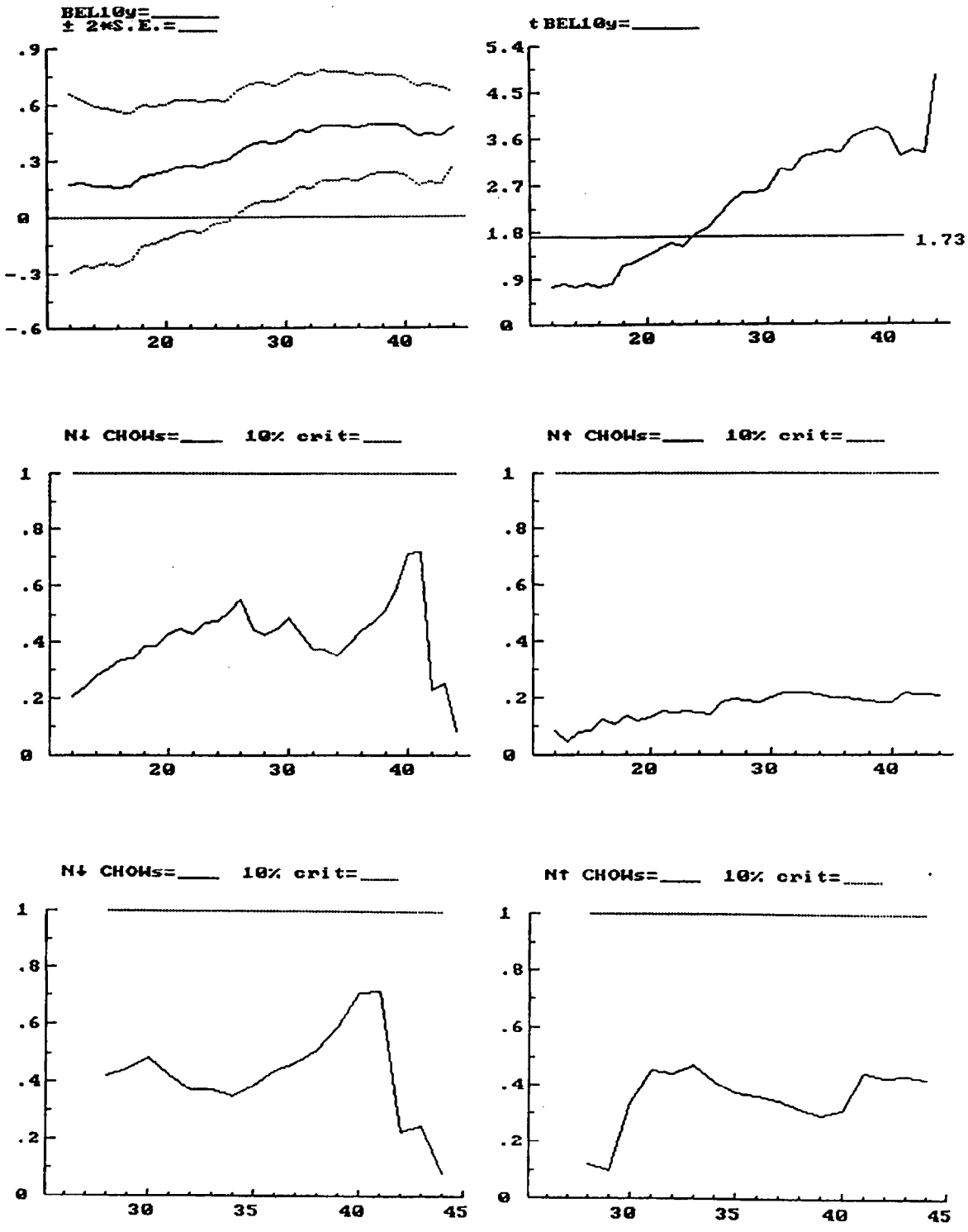


Figure 3. Tests for SPA10Y

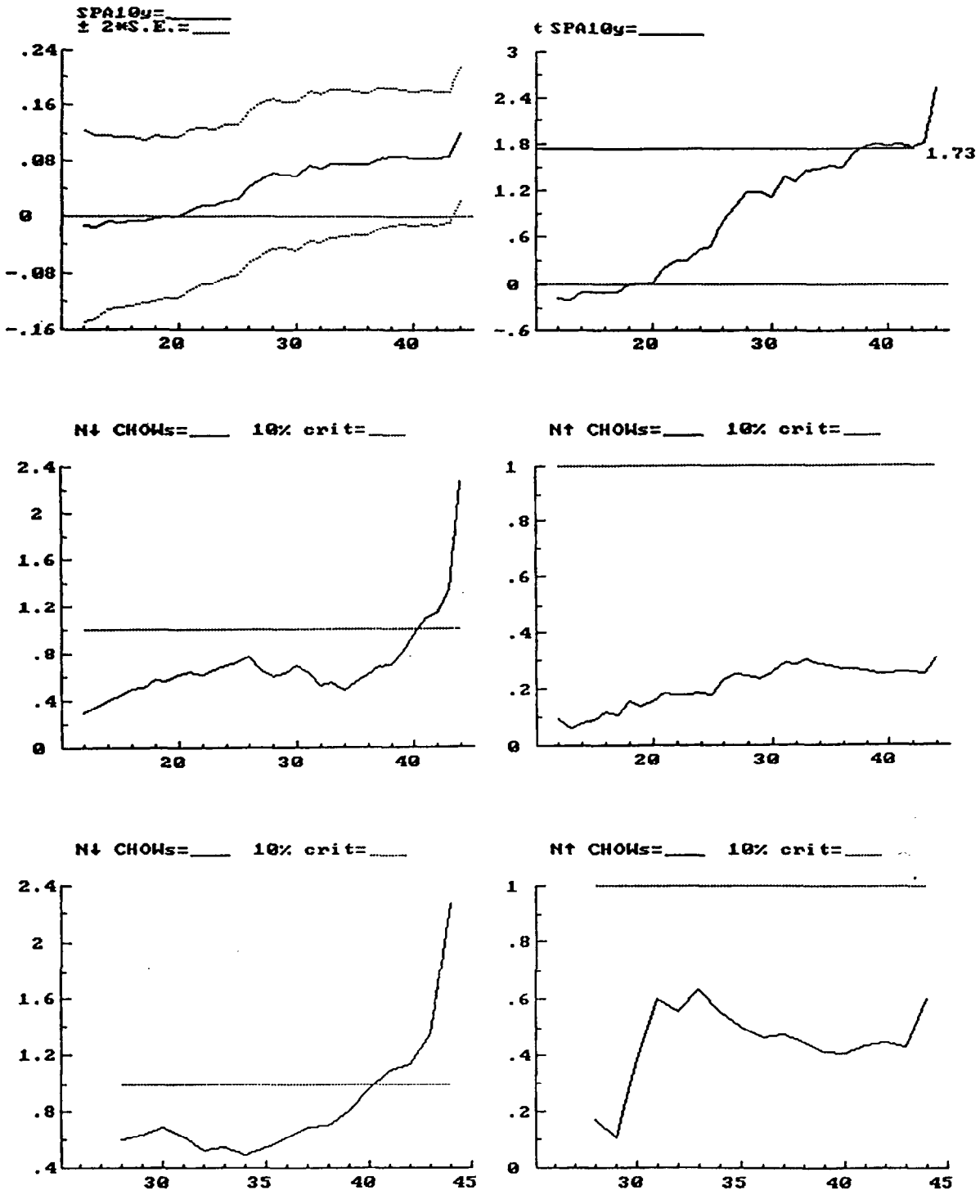


Figure 4. Tests for ECU10Y

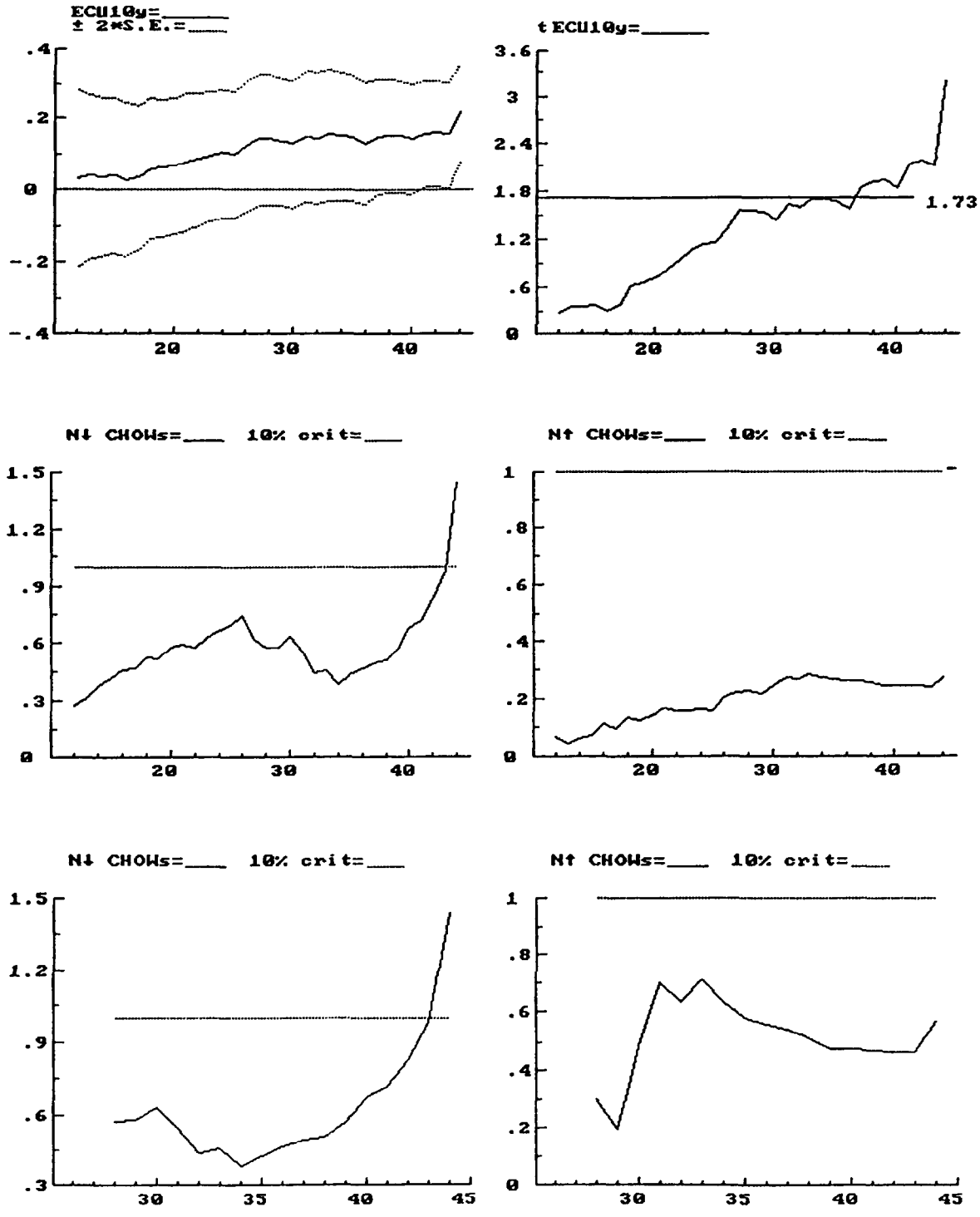
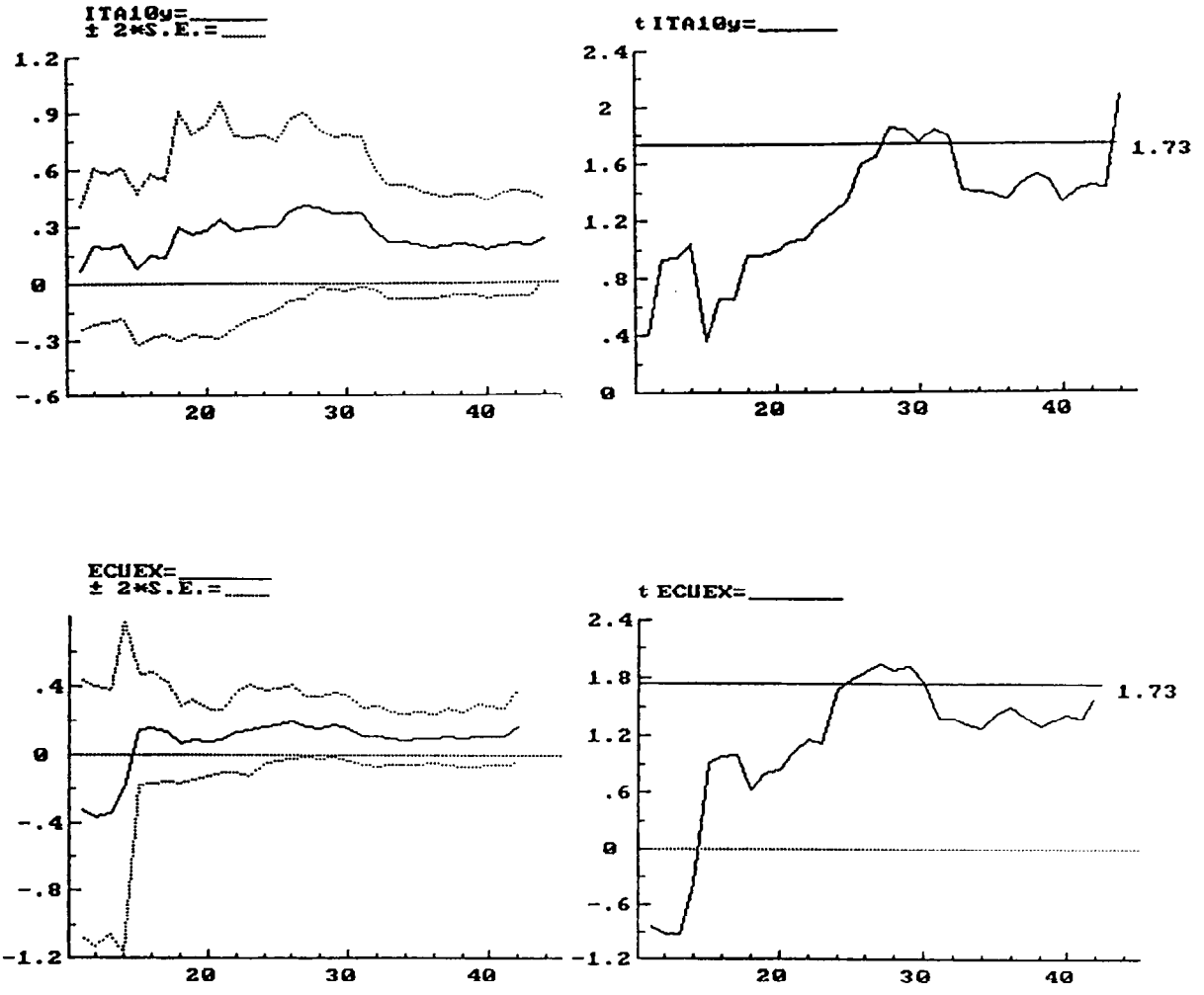


Figure 5. Coefficients on ITA10Y and ECUEX



the rejection of the EMU hypothesis, whose critical value at the 5 percent alpha level (t = 1.73) is shown in the graphs, except for the case of ITA10y. In all other cases, the test still rejects whenever it rejected over the whole sample. Even in the case of ITA10y, we are not far off. In that sense, the conclusions of the previous section are robust to the exclusion of this datapoint.

2. No other structural break is detected at the ten percent level. However, in some instances the Chow statistics gets close to its critical values; in particular, the $N\downarrow$ test does reject at t=26 at the 20 and 25 percent levels, respectively, for SPA10y and ECU10y and at t=40 at the 15 percent level for BEL10y (all for M-1=11). After setting M-1=27, the $N\uparrow$ tests rejects at t=30 at the 15 percent level for FRA10y and at the 25 percent level for ECU10y. Whether or not this is enough to conclude that the event groups related to German official's remarks and French fiscal reform should be excluded is debatable. However, note that even if they are entirely excluded (along with the European elections datapoint), so that the sample is reduced to observations 1 to 27, the EMU hypothesis would still be rejected at the five percent level by the tests involving FRA10y, BEL10y, ITA10y and ECUEX (see the t-value plots in all these cases), and at the 10 percent level for ECU10y. Thus, the basic result is robust to the exclusion of *all* "problematic" events from the sample.

3. In no case could the EMU hypothesis have been rejected on the basis of the events associated with the Maastricht ratification process alone. This may not just be a small sample problem, since the estimated coefficients actually appear lower for the first dozen or so observations in the sample (see top right charts showing coefficients and standard errors). This is particularly striking for SPA10y, ECU10y and ECUEX, which have coefficients close to zero in the first part of the sample, but is also suggested by the graphs of BEL10y and ITA10y. Only in the case of FRA10y does the graph suggest reasonable parameter constancy across the event groups according to which the samples were ordered. While imprecise estimations preclude the detection of a structural break which would distinguish the 1992-93 events from later events, the evidence in favor of a true positive relationship between GER10y and the other market variables for the early part of the sample is much weaker than over the whole sample.

V. Conclusion

The main result in this paper is that German bond yields appear to react to events affecting the probability that EMU will in fact happen over the medium term in the *same*, rather than the opposite direction as French, Belgian, Spanish, Italian and ECU bond yields. In most cases, the hypothesis of a true negative relationship can be rejected at the five percent level. In addition, EMU related events that lead to an appreciation of the private ECU relative to the ECU basket tend to be associated with declines in German bond yields, and vice versa. On this basis, we conclude that the "EMU hypothesis" as defined in the introduction should be rejected:

events making EMU more likely have, on average, led to lower, not higher long interest rates in Germany.

We also find that the apparent positive association between German and other European bond yields in response to events affecting the probability of EMU is mainly driven by the way German bonds react to EMU related events *after* 1993--i.e. after the Maastricht process was ratified--in the sense that the hypothesis could not have been rejected based on German yield reactions to Maastricht ratification events alone. For this early event subset, the reactions of German yields are essentially uncorrelated with the reactions of other European yields. This suggests a change in the way German yields reacted to EMU related events. Initially, German bond markets seem fairly indifferent to events with large implications for EMU, showing very little reaction to events such as the Maastricht agreement itself, the first Danish referendum or the Irish referendum--in sharp contrast to the behavior of bond yields elsewhere in Europe. Eventually, however, German bond markets begin reacting to EMU related events in line with the reaction of other European bond markets. For example, German and French bond reactions to news about EMU are correlated from about September 1992 onwards (the French referendum, see Table 1), while German and ECU bond reactions to EMU news appear correlated from about the summer of 1993 onwards.

Two alternative interpretations are consistent with these findings. One is simply that the EMU process has put no pressure on German yields, and that German bond markets, if anything --perhaps after a short period of indifference following the Maastricht agreement--are happy with the idea of European monetary union. Maybe German markets expect the European Central Bank to be as tough on inflation as the Bundesbank, or perhaps they expect lower real interests under EMU (for example, as a result of the application of the Maastricht criteria) which would offset slightly higher inflation rates under the ECB. Under this interpretation, one would need to look elsewhere for explanations why German yields were higher than U.S. yields at the long end during most of 1995 and early 1996--for instance, at expectations regarding U.S. fiscal consolidation.

On the other hand, the results presented still allow for one interpretation in which the EMU process as a whole might have raised the level of German yields, even if the EMU hypothesis as defined in the introduction and Section II is rejected. Markets may not like the idea of EMU *per se*, but *conditional on the EMU process having been initiated*, prefer the successful completion of this process to the disruptions which would ensue if the process were called off. In this interpretation, German yields might well be lower now if the Maastricht agrement had never been signed, or had not included a commitment to a single currency. Yet, after this fact--or at least after German markets became aware of the disruptive implications of a failure of the EMU process--one would observe German yields rising in reaction to events which threaten the process, and falling at events that enhance it.

This idea has some appeal not only as a logical possibility but also in view of the indifference of German yields to EMU related events which we found early on in the sample. As described above, the behavior of German bond markets in reaction to EMU related shocks seems to undergo a change either in the late 1992 or mid 1993, depending on the right hand side variable we use to measure these shocks. This happens to coincide with the timing of the two ERM crises. There is thus some support for the idea that German bond markets, after an initial period of indifference or even skepticism, became supporters of the EMU process only after they realized that it could no longer be called off without major disruptions in Europe's monetary system. Specifically, these crises may have led to the perception that a plain and simple return to the old EMS was no longer feasible.

While one cannot tell which of these two interpretations is right, distinguishing between the two may be interesting primarily from the perspective of economic history. As to the present, the results of this paper are unambiguous: German bond markets seem to prefer the successful completion of the EMU process as envisaged by Maastricht and subsequent EU summits to the perceived alternatives if the third stage is not attained.

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