Who is ruling Europe? Empirical Evidence on the German Dominance Hypothesis[¤]

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Abstract

The aim of this paper is to analyze the hypotheses of German dominance and asymmetry in the European Monetary System (EMS). We use monthly data for British, Dutch, French, German, Italian, Spanish and US interest rates from January 1979 to the second half of 1997. In particular, we test the stability of the implied long-run relationships to assess whether there has been a signi…cant change in the EMS performance. The econometric methodology is based on Johansen's maximum likelihood procedure and several tests for parameter instability. The most important …nding is that despite it is not possible to accept both dominance and asymmetry in an strict sense, there is enough evidence to support the existence of German leadership.

Key words: asymmetry, cointegration, structural change, German dominance, interest rate, weak exogeneity.

Classi…cation J.E.L.: C32, F36.

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1 Introduction

At the start of the third stage in the process of monetary integration, it is time to examine the evolution and performance of the EMS in order to draw some lessons for the future of the European Monetary Union. This paper tries to …nd some empirical evidence on the possible change of regime that occurred in the EMS at the beginning of the nineties and to determine whether its functioning has been in‡uenced by the convergence process and the German reuni…cation. Consequently, we would expect to …nd a more symmetric and coordinated EMS during the nineties, in contrast to the eighties, when the system worked in a quite asymmetric fashion. This theory is known in the literature as the German Dominance Hypothesis (GDH).

In an incomplete monetary union, as the EMS, may arise the problem known as n-1 exchange rate paradigm: if n countries join a monetary union, there are n-1 central parities and just one degree of freedom in order to set the monetary policy in the system. Thus, only one common authority or country can set its monetary policy independently, and this policy, through the …xed exchange rates commitment, will be one for the whole system. The problem is to decide who is going to use this degree of freedom. The GDH assumes that Germany is the EMS leader and sets its monetary policy quite independently, using therefore the degree of freedom, while the rest of the member countries follow that policy.

Several authors as Gardner and Perraudin (1993), Henry and Weidman (1995) and Kirchgässner and Wolters (1995) have found evidence that supports the existence of GDH by applying a VAR framework using interest rates. These authors also found evidence of a structural change in the dates of German reuni…cation by analyzing the EMS performance before and after this event. However, Thom (1997) found the opposite result using the same technique, and rejected the existence of GDH. Other authors, based on different econometric methods, conclude that there may be some independence in setting the monetary policy in the EMS. This is the case of Fratianni and von Hagen (1990), von Hagen and Fratianni (1990) and Koedijk and Kool (1992). Consequently, the empirical literature is not conclusive: the data and techniques employed are di¤erent and, most important, the authors have decided to work with di¤erent and relatively small samples on the grounds of the stages and shocks which the EMS has gone through. In all these contributions, the samples have been split exogenously, that is, depending on the a priori author's criteria and not on the long-run relationship properties. Thus, the chosen breaking point may not match the actual structural change (if there is any) of the chosen long-run relationship and, therefore, the results obtained depend on the accuracy of the choice of both the sample and the

breaking points.

Unlike the previous studies, the present paper attempts to apply a stronger test of the GDH hypothesis by using cointegration tests that allow for structural changes, and examines the performance of the EMS since 1979, when it was created. Thus, we endogenously determine possible structural changes occurring in the long–run relationships that link the Exchange Rates Mechanism (ERM) interest rates. Consequently, the possible regime shifts in the EMS functioning are located without making any a priori assumption. An interesting issue would be to compare EMS performance before and after the beginning of the process of convergence towards the EMU.

Although the ERM of the EMS has already been replaced by stronger commitments in the context of a Monetary Union, the GDH is still important from the point of view of the future design of the monetary policy in the Union: the presence of causality from the German interest rates to the rest of the European countries may re‡ect the linkages existing between the national transmission mechanisms of monetary policy.

Finally, the use of a variety of European countries allows us to compare not only the existence of asymmetry between every country and Germany but also the di¤erences between the so-called "core" and "peripheral" countries.

The paper is organized as follows: the second section summarizes the various hypotheses related to the GDH and the way they can be tested using cointegration and causality tests; the third section presents the main empirical results and the fourth section contains the conclusions.

2 Formulating the German Dominance Hypothesis in terms of Granger Causality and Cointegration.

2.1 Tests based on Granger causality.

Traditionally, in the empirical literature, the GDH has been tested by analyzing the existence or absence of Granger causality from German to other countries' monetary policy. Two are the variables have commonly been used in order to study the reaction of monetary authorities to monetary innovations coming from other countries: a monetary aggregate and short-run interest rates. According to Sims (1992), if the monetary authorities accommodate changes in money demand, the monetary aggregates cannot correctly re‡ect shifts in monetary policies. Moreover, Bernanke and Blinder (1992) have shown that the "true" indicator of monetary policy in the short-run is

the (call-money) interest rate, that is, the rate that central banks can control very closely. Following these considerations, we use one-month interest rates as indicators of monetary policy.

On the other hand, monetary innovations do not necessarily have their origin in an ERM member country. The distinction is important in the sense that it permits us to measure the ability of the EMS to isolate the system from external shocks. Thus, if German monetary policy is invariant with respect to monetary innovations elsewhere in the ERM but the other member countries' are not, we could say that the EMS performance is asymmetric. Moreover, if the ERM member countries' monetary policy, excluding Germany, are invariant with respect to shocks from countries outside the EMS, we could accept that Germany is able to isolate the System from external shocks. This would mean that there exists German domination.

Thus the GDH can be characterized in terms of Granger causality using the following hypotheses:

- Asymmetry, that implies:
  1. There is Granger causality from the German interest rates to the interest rates of the other member countries and/or instantaneous causal relations between Germany and the other countries, that is called Dependence on German Policy[1].
  2. There is no Granger causality from the interest rates of the other member countries to German interest rates (German Policy Independence).
- Domination: If German interest rates are included in the information set and there are no Granger causal or instantaneous causal relations from countries outside the EMS to the interest rates of the other member countries, this can be called World Insularity. As in von Hagen and Fratianni (1990), the United States are taken to represent the most important world influence on European monetary policies.

2.2 Causality tests based on the cointegration relationships.

As Kirchgässner and Wolters (1995) pointed out, testing for the GDH needs explicitly to formulate the distinction between the long and the short-run.

[1] The definitions of dependence on German Policy, German policy Independence and World Insularity that we adopt have been formulated by Kirchgässner and Wolters (1995).

This can be done in the framework of a cointegrated VAR, as proposed by Johansen (1988, 1991), which can be represented as follows:

$$\Delta x_t = \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-1} + \varepsilon_t$$

where x_t is a vector of n different interest rates corresponding to the set of countries analyzed. According to Thom (1997) x_{jt} Granger-causes x_{it} unless the latter is weakly exogenous relative to the former and the lagged differences of x_{jt} do not enter the equation for Δx_{it}. Thus, testing for asymmetry in the long-run consists of testing for the weak exogeneity of x_{it}. This hypothesis is called H_{LR} by Thom, while the hypothesis of short-run non-causality, H_{SR}, states that Δx_{jt-i} does not enter the equation of Δx_{it}:

1. $H_{LR} : \Pi = A\alpha$, where A is an $n \times n$ diagonal matrix with zeros in the ith row, $i = 1, \ldots, n$.
2. $H_{SR} : \prod_k = B_{ik}$; where B is an $n \times n$ matrix with zeros in the jth row, $i, j = 1, \ldots, n$; $k = 1, \ldots, p-1$; $j \neq i$.

In this paper we test for the GDH using a trivariate cointegrated VAR where Germany and the United States are always present as well as a third European country. Let x_{1t} to x_{3t} denote, respectively, the German, French and American interest rates. Thus, starting with the asymmetry hypothesis, it is possible to express the above conditions or definitions as follows:

1. Dependence on German Policy:
   (a) H_{LR} is rejected for $i = 2$.
   (b) H_{SR} is rejected for $i = 2$; $j = 1$; $k = 1, \ldots, p-1$.
2. German Policy Independence:
   (a) H_{LR} is accepted for $i = 1$.
   (b) H_{SR} is accepted for $i = 1$; $j = 2$; $k = 1, \ldots, p-1$

If we assume that the setting of monetary policy in Europe is a non-cooperative game, there is not any reason to exclude that, in the short-run, Germany would be able to take into account the other players' actions. Thus, in the short-run, it wouldn't be necessary to fulfil German Policy Independence in order to accept the GDH.

The hypothesis of domination or German dominance requires to introduce the American interest rates in the above conditions. Thom (1997) states that if the American interest rates are denoted as x_{nt} and the r cointegration relations as:

$$Z_{jt} = \sum_{i=1} \beta_{ij} x_{it} \quad j = 1, \ldots, r$$

then, the dominance hypothesis can be tested as the absence of causality from the American interest rates to any of the estimated relationships:

1. $H_{GD} : \beta_{jn} = 0; \quad \forall j = 1, \ldots, r$
2. $H_{SR} : \prod_k = B_{ik}$; where B is an $n \times n$ matrix with zeros in the nth row, $i = 1, \ldots, n-1$; $k = 1, \ldots, p-1$:

In this paper we partially modify the H_{GD} condition to allow German interest rates to be Granger-caused by the American rates. Although this change can make the conditions seem less restrictive, they are, in fact, more realistic. Germany would still isolate the System from the United States (and then full...l the hypothesis of dominance) even if it is in‡uenced itself by the American rates. Assuming that j is the r^0th cointegration relation that causes the ith country and β^i_{jn} the American interest rates coe¢cient in these relations, it is possible to rewrite these conditions as follows:

1. $H^0_{GD} : \beta^i_{jn} = 0; \quad \forall j = 1, \ldots, r^0; \; i = 2, \ldots, n-1$:
2. $H^0_{SR} : \prod_k = B_{ik}$; where B is an $n \times n$ matrix with zeros in the nth row, $i = 2, \ldots, n-1$; $k = 1, \ldots, p-1$:

We then apply Johansen's maximum likelihood procedure to determine the rank of the cointegration space, as well as the existence of long-run causality. However, when we ...nd more than one cointegration vector, a behavioural interpretation of weak exogeneity requires the identi...cation of the cointegration vector based on an economic hypothesis. In this case, the most likely interpretation of such relations would be the uncovered interest rate parity condition.

Next, the existence of short-run causality is determined using the two-stage procedure developed by Chow (1993). This test is performed retrieving the residuals of the cointegration relationships from Johansen's procedure and testing the null hypothesis that Δx_{jt} does not Granger-cause Δx_{it} in the ECM-VAR representation:

$$\Delta x_t = \alpha z_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta x_{t-i} + \varepsilon_t$$

where z_t is an $n \times n$ matrix of residuals from the r cointegration relationships estimated by Johansen's maximum likelihood procedure. Consequently, Δx_{jt} does not cause Δx_{it} if the lags corresponding to the former are not significant in the equation of the latter. It should be emphasized that the residuals of the cointegration relationships will only appear in the ECM equations corresponding to the interest rates for which such relations are significant. The ECM-VAR would then be estimated by the method of Seemingly Unrelated Regressions (SUR).

2.3 Hansen (1992) and Hansen and Johansen (1993) tests for parameter instability.

Although the EMS has been working for almost twenty years, the arrangements that determine the performance of the System have changed and adapted to the different economic and even political circumstances that occurred in the last two decades. Consequently, the relations among the countries, i.e. the existence of dominance or symmetry, may have also changed. These changes can give rise to identification problems or to false rejections of the existence of cointegration among the variables considered. Thus, in order to avoid such problems, it would be of interest to use tests for cointegration that allow for the presence of structural changes.

In this paper we focus on two different approaches to test for the stability of the cointegration relationships. First, in the context of the fully modified estimation of the static cointegration relations by Phillips and Hansen (1990), Hansen (1992) proposes several tests for parameter instability, called L_c, Mean F and Sup F[2] tests. According to Hansen (1992), a test statistic with a probability value under 20% would imply that the parameters are not stable. The tests are accompanied by an analysis based on their graphic representation.

The second approach is a multivariate recursive estimation developed by Hansen and Johansen (1993). These authors propose a procedure to evaluate the constancy of the estimated cointegration rank as well as a test of the constancy of the cointegration space for a given cointegration rank. The output of the first test consist of a graph of the recursive estimation of the Trace test against the time which is scaled so that the cointegration rank is determined by the number of values over unity. In the second test, the output consists of a graph where values over unity imply that there is a change in the cointegration space.

[2] See footnote to Table 6 for a discussion of these tests statistics.

3 Empirical Results

The data used in this work are monthly interest rates for the period January 1979 to the second half of 1997 and have been taken from the International Financial Statistics (IFS) data tape of the International Monetary Fund as well as the OECD Main Economic Indicators. In particular, the series are call money rates for France (frr_t), Germany (ger_t), Spain (spr_t) and Netherlands (ner_t) and Treasury bill rates in the case of Italy (itr_t), the United Kingdom (ukr_t) and the United States (usr_t).

We have chosen a variety of EMS countries that may reflect the performance of the EMS during its twenty years of functioning. We are interested in comparing "core" countries, such as the Netherlands with "peripheral" countries, like Italy and Spain; and, on the other hand, comparing countries that left the EMS after many years of remaining inside its discipline (this is the case of Italy), with others that only remained in the System for some months, like the UK and others that never left, like France.

The empirical analysis of this paper is based on the cointegration methodology which is applied in several steps. First, we test for the stationarity of the country-specific interest rates. Then, we analyze the existence of cointegration for the sample period available for each country as well as the stability of the cointegration relationships in a trivariate VAR. Thus, these relations involve three countries: Germany, as the leader of the System, the US, as the main external influence on the European monetary policies, and finally, the country analyzed in each case. These results appear in table 3 and 6 respectively and are complemented by graphs 1 to 4. This evidence will allow us to determine the existence of a structural change and then the possibility of splitting the sample at the endogenously determined breaking-point. Third, we test for long-run causality in the full sample or in the two subsamples, depending on the existence of a change. The results, that also include the different specifications of the cointegration relationships, are shown in table 4. Finally, in table 5, we present the tests for short-run causality.

3.1 Unit root tests

The first step in the analysis will be to determine whether the individual country-specific interest rates are non-stationary, due to the fact that the applied methodology has been formulated for this type of variables. We have combined a stationarity test, in this case the Kwiatkowski, Phillips, Schmidt and Shin (1992), KPSS hereafter, with a unit root test, the one developed in the context of the Johansen procedure, which is a generalized ADF (see Tables 1 and 2 respectively). According to the KPSS test, the null

of stationarity in differences is not rejected for all the interest rates considered and for both the model with and without trend, while the opposite happens for the levels of the variables. Johansen's maximum likelihood method also allows us to test for stationarity in the context of a VAR system. The results of this test are presented in table 2 for a cointegration space of rank one and two. Taking into account that the number of cointegration relationships for the whole sample is one for every country, stationarity of all the interest rates can be rejected except for the United Kingdom. Consequently, from this analysis, it follows that all the interest rates are I(1), although in the case of the United Kingdom the results of the two tests are contradictory[3].

3.2 Cointegration relationships and structural changes

The results of the cointegration test for the whole sample are summarized in table 3 under the headline "whole sample". As we will see in this section, it is not possible to accept the existence of cointegration in the cases of France[4], Spain and the United Kingdom. However, in the models of the Netherlands and Italy there is evidence of cointegration. Thus, we present next the results for the five countries analyzed: France, Spain, the United Kingdom, Italy and the Netherlands.

In the case of France the rejection of cointegration could be due to the large number of realignments experienced at the beginning of the eighties and the disturbances introduced by the "Mitterand experiment". In order to avoid this problem, it is possible to estimate the cointegration space for the period starting in March 1983, after the French authorities adopted a more coordinated approach to their macroeconomic policies. The Johansen tests for the determination of the cointegration rank for this new sample are shown in table 3 under the headline "reduced samples". The results allow us to accept the existence of one cointegration vector. However, the difficulties found in its identification together with the analysis of the companion matrix, where three roots are close to unity, raises the question of whether the relation is not stable or a structural change is present.

The previous analysis is confirmed using the Hansen and Johansen (1993) tests. First, we test for the constancy of the estimated cointegration rank for the whole sample (graph 1), that allows us to reject the existence of cointegration. Moreover, the test for the constancy of the cointegration space for a given cointegration rank, depicted in graph 2, places a possible breaking-

[3] It is not unusual that some interest rates series are borderline cases between an I(1) and an I(0) process. Campbell and Perron (1991) recommend to treat them as I(1) processes.

[4] That is, absence of cointegration for the VAR system formed by France, Germany and the United States. The same notation is used for the other countries.

point at the end of 1990, the date of German reuni…cation but also the time of capital ‡ow liberalization in the majority of European Countries[5]. These …ndings are supported by the Hansen (1992) tests (see table 6), since they also are supportive of the absence of cointegration. Therefore, the rejection of cointegration for the whole period may be due to the presence of a structural change rather than the disturbances experienced at the beginning of the eighties.

The Johansen's cointegration results for both the pre and post-liberalization subsamples are presented in table 3 under the headline "subsamples". They clearly show that it is possible to accept the existence of one cointegration vector in the two cases. In the identi…cation process, the estimated relationship for the …rst sub-sample may re‡ect the ful…llment of the uncovered interest rate parity (UIP) between France and the United States. In contrast, for the second subsample, the cointegration vector contains a relationship including American, French and German interest rates. This fact con…rms, once again, the existence of a structural change[6].

The second country studied is Spain. When testing for the cointegration rank, only the $¸_{max}$ statistic allows us to accept the existence of one cointegration vector for the whole sample. Thus, it may be convenient to apply the tests for parameter instability of the cointegration space. According to Hansen (1992), in table 6, it is possible to reject the stability during the whole period. The Hansen and Johansen tests (1993) provide information about where the breaking-point may be placed. According to Graph 3, we can consider two possible breaking-points: the …rst at the dates when Spain joined the European Economic Community in 1986, and the second around 1989, at the time of the Spanish entry in the EMS. Due to the fact that our interest is on the EMS performance, we will reduce the sample and analyze the period starting in June 1989.

For this "reduced sample", it is possible to accept the existence of one cointegration vector that includes signi…cantly the American, German and Spanish interest rates, as it is shown in table 3 and vector number 7 in table 4.

In the case of the United Kingdom, the sample is split again at the begin-

[5] As it has been kindly noted by G. Tullio, the capital liberalization e¤ects may dominate the fall of the Berlin wall. In fact, German reuni…cation increased the risk premium and the variability of German interest rates. This fact probably reduced …nancial market integration between Germany and the other partners. The opposite e¤ect has been caused by the abolishment of capital controls.

[6] See table 4 for the actual parameters of the cointegration vectors. The cointegration relationships for France are numbered 1 and 2 for the pre and post capital liberalization period respectively.

ning of the nineties. This will permit us to compare the relative performance of France during the second subsample (which was a founder of the EMS and never left it) with the United Kingdom, a country that remained outside it except for a short two-years interval.

According to Johansen's cointegration results, it is possible to accept one cointegration vector for the pre-liberalization period and two for the second period, results presented in table 3. In the identi…cation process, the likelihood ratio test allows us to accept the existence of a stable long-run relation among the British, the German and the American interest rates for the …rst sub-sample. For the rest of the sample we may identify the …rst vector as the UIP between United States and United Kingdom, while the second is identi…ed as the UIP between the former and Germany[7].

As we pointed out, the Netherlands and Italy exhibit cointegration for the whole sample, accepting the existence of one vector for each country. However, in contrast to the case of the Netherlands, the recursive time path of the Trace test for Italy (see graph 4) shows signi…cant disturbances in 1992 and 1993. Furthermore, the Hansen and Johansen (1993) test for parameter instability for a given cointegrated rank allows us to place the breaking-point between the end of 1992 and the beginning of 1993, that is, when, after a devaluation of 7%, the lira left the EMS discipline. Despite the structural change, it will be still possible to identify the estimated cointegration vector due to the fact that the breaking-point is found at the end of the sample.

In the case of the Netherlands, the cointegration vector is identi…ed as the uncovered interest rate parity between this country and Germany. For Italy, the cointegration vector includes signi…cantly the American, German and Italian interest rates.

3.3 Long-run causality

Once it has been possible to identify the cointegration vectors for the di¤erent countries and samples, the third step in our analysis consists of examining, for each of the above trivariate VAR, the possible weak exogeneity of the interest rates with regards to the cointegration relationships. Following the methodology presented in section 2.2, this will allow us to test for the hypotheses of symmetry and domination in terms of the Johansen technique. Then, a country will be caused in the long-run by those countries that enter its equation through the error correction. The results are presented in table 4, where the …rst column presents the identi…ed vectors relating the interest

[7] See table 4 for the actual parameters of the cointegration vectors. The cointegration relationships for the United Kingdom are numbered 4 for the pre-liberalization period and 5 and 6 for the second period.

rates for each of the countries analyzed and columns 2 to 4 show the weak exogeneity tests.

Before studying each country separately, it should be pointed out that the American interest rates are weakly exogenous in all cases, that is, they are determined independently from the European countries and are not caused by them. On the other hand, interest rates in France, the Netherlands, the United Kingdom, Spain and Italy are not exogenous, so that they are causing and being caused in some cases. This result allows us to normalize the equations for each country using its interest rates. Finally, the German interest rates are, in general, causing the interest rates of the other European countries and, in a majority of the cases, being caused. The only clear exception is the Netherlands, that has followed very closely German monetary policy, as well as the United Kingdom in the equation identi…ed as the UIP between the US and Germany.

Starting with the case of France, from the estimated vectors it can be observed that the results are strikingly di¤erent in the pre and post capital liberalization period. During the …rst period, the German interest rates are excluded from the identi…ed long-run relationship with the French ones, that is, does not enter its equation. For the second period, however, France and Germany cause each other.

This result can be due to a regime shift that implies a higher degree of …nancial integration between both countries. Thus, for the …rst period, the UIP between United States and France drives the long-run equilibrium for the French interest rates, whereas for the second period Germany also enters this relation and, consequently, the French and German interest rates cause each other in the long-run. Therefore, the process towards EMU would have implied an increase of dependence between the French and German monetary policy, but of a bi-directional nature. In terms of the de…nitions that we are using, this means that there is no asymmetry between these two countries. By contrast, American interest rates enter the cointegration relationship for both subsamples, allowing us to reject the existence of domination.

The case of the United Kingdom is interesting not only by itself but also because of the possibility of comparison with the French case, since the sample has been split for both countries in 1990. Also in this case, the results are di¤erent in the pre and post-liberalization period. The …rst one is characterized by the existence of a stable long-run relationship among the American, British and German interest rates. This implies a bidirectional long-run causality between Germany and the United Kingdom as well as the absence of domination. On the other hand, two cointegration relationship have been found for the second period: the UIP between the United Kingdom and the United States and the UIP between the United Kingdom and

Germany.

Taken the latter two relations together, it may seem that there is bi-directional causality between Germany and the United Kingdom, due to the rejection of weak exogeneity in both cases. However, the signi…cance of each cointegration vector can be assessed separately using the t-values of the parameters of ®; the weighting matrix from the Johansen's procedure. These results are presented also in columns 2 to 4 of table 4 and show that the British interest rates are weakly exogenous relative to the UIP between the United States and Germany but not with regards to the UIP between Britain and the United States. Thus, the British monetary policy no longer depends on the German one during the second period analyzed, once the convergence process has started. Again, the domination hypothesis is rejected by the British data.

Due to the fact that France has always been part of the EMS whereas the United Kingdom remained outside the System[8], the results allow us to impute, at least partially, the higher degree of …nancial integration between France and Germany to the convergence process resulting from the creation of a monetary union in Europe. Moreover, the results show that a country that left the EMS discipline has been able to gain more independence with respect to Germany in the setting of the monetary policy.

As has already been pointed out, we found a stable relationship between the American, German and Spanish interest rates for the period starting when the peseta joined the EMS. According to the long-run causality test, only the American variable is weakly exogenous with respect to this relation, and, therefore, it can be accepted long-run bi-directional causality between the Germany and Spain. However, this result is quite surprising and it should be taken into account that the Spanish interest rates enter the cointegration vector with a relatively low weight if compared to the American one, so that it may not be very signi…cant. In order to shed some more light to this point we proceed to study the system formed by Spain and Germany. The Johansen's cointegration test, presented in table 3 under the headline "bivariate system", permits us to accept one cointegration vector, which is identi…ed as the UIP between Germany and Spain. The long-run causality test (table 4) shows that the German interest rates are weakly exogenous with respect this relation, and, therefore, there is only causality form Germany to Spain. The rejection of the hypothesis of bi-directional causality implies the existence of asymmetry between these countries. However, this does not mean that Spain is isolated from external shocks, since the American interest rates also cause the Spanish ones.

[8]Except for a short two-years interval

Comparing the French to the Spanish case, it should be noticed that for the former, the German in‡uence starts working after capital ‡ows liberalization, whereas in the Spanish case it seems to happen sooner. This means that the French monetary authorities have been able to maintain a stronger independence with the German monetary policy, that only decreased after the abolishment of the capital controls and the beginning of the process of convergence. In contrast, the German in‡uence in Spain started when the peseta joined the EMS, and therefore, no structural change is present in 1990, due to the fact that Spain only liberalized capital controls in 1992..

In the case of Netherlands we found that the cointegration relationship is identi…ed as the UIP linking the Dutch and German interest rates. Thus, according to the de…nitions in section 2, this allows us to accept the existence of domination, since the American interest rates are excluded from this relation and, therefore, they do not cause the Dutch interest rates in the long-run. Moreover, the causality test for this term shows that German interest rates are weakly exogenous with respect to the cointegration vector, that is, there is unidirectional causality from Germany to the Netherlands. Therefore, both asymmetry and domination can be accepted.

Taking into account the results for the Netherlands and Spain, it seems that Germany has a large in‡uence in the monetary policy of the EMS countries independently on their "core" or "peripheral" nature. However, the degree of in‡uence of Germany over these countries is di¤erent: according to our results, whereas the "core" countries are isolated from external shocks, the "peripheral" countries are not.

Finally, the long-run causality test for Italy shows bi-directional causality between Germany and Italy for the whole period. However, some doubts arise concerning the causality from Italy to Germany, that may only have been in‡uential under exceptional circumstances, such as the 92/93 crises. At the same time, the Italian rates cause the American interest rates as well. Thus, in this case both the hypotheses of domination and asymmetry are rejected. These results should, however, be treated with caution due to the presence of a structural break.

3.4 Short-run causality

The last step in our analysis consist of analyzing the existence of short-run causality between the interest rates variables, that are presented in table 5.

In the case of France, there is stronger evidence of monetary policy dependence relative to Germany than it appeared in the long-run. The results also di¤er before and after capital liberalization: whereas there is no long-run causality from Germany to France before 1990, it exists in the short-run.

During the second sub-sample, in contrast, there is bi-directional causality between France and Germany and only from Germany to France in the short-run. Therefore, in contrast to the long-run results, asymmetry and even domination can be accepted for the second period in the short-run. These strikingly di¤erent results do not imply that they are inconclusive: they point out to the fact that France has enough room to conduct its monetary policy independently in the long-run despite the strong in‡uence coming from Germany in the short-run.

The results for the United Kingdom and Spain show a similar pattern, in the sense that these countries also exhibit a higher degree of dependence on German monetary policy in the short-run than in the long-run. However, there are important di¤erences between these two countries.

For the United Kingdom, the degree of dependence is noticeably lower than in France, since the hypothesis of domination is rejected for both periods. Moreover, short-run dependence is larger, particularly in the post-liberalization period. In the Spanish case, the existence of short-run dependence arises when the peseta joins the EMS, being able to accept not only asymmetry but also domination. Thus, the domination hypothesis is accepted in the short-run, but rejected in the long. These results point out to the fact that the Spanish monetary authority has been able to set its long-run policy quite independently from the German one.

In the case of the Netherlands the short-run analysis just con…rms the long-run results. Thus, both asymmetry and domination might be accepted. Obviously, in this case we cannot distinguish a di¤erent degree of dependence between the long and the short-run, since the larger degree of dependence on the German monetary policy is exhibited in the long-run.

Finally, it is not possible to …nd any di¤erence between the short and the long-run results in the Italian case. This country enjoys larger degree of independence from the German monetary policy than the rest of the countries, both in the short and in the long-run, i.e., absence of asymmetry and domination. These results may re‡ect a relative asynchrony of the Italian economic cycles with respect to its European partners, as Amisano and Giannini (1997) point out. Other factors explaining the rejection of asymmetry and domination in the Italian case are the existence of variable risk premia in Italy and Germany (due to their di¤erent …scal developments) or the presence of very extreme episodes of Italian crises, the may have in‡uenced the average results of the period.

4 Concluding remarks

The purpose of this paper is to apply a more ‡exible de…nition of the German Dominance Hypothesis to a variety of member-countries of the EMS. The recent developments concerning the process of monetary integration in Europe suggest that the nature of the existing relationships among the European interest rates may have changed. Consequently, the main contributions of this paper are, …rst, to present a wide de…nition of the GDH based on a set of hypothesis formulated in terms of robust causality, cointegration and exogeneity tests and, second, to allow for the presence of structural changes occurring at unknown dates that can be used to distinguish di¤erent periods in the functioning of the EMS. Moreover, there are not a priori assumptions about the concrete relations linking the European and even the US interest rates, so that the testing strategy will determine the signi…cant variables entering each equation.

Except for the cases of the Netherlands, a country traditionally related to Germany, and Italy, where the convergence process seems to have been less consistent than in the rest of the countries, there is evidence of some instability in the long-run relations for the full sample period. In the two cases where the break appears to be more signi…cant, France and the United Kingdom, it can be placed at the date of capital ‡ows liberalization as well as German reuni…cation. However, this is not the only factor responsible for a change of regime at the beginning of the nineties: the start of the second stage of the process towards EMU and the abolishment of capital controls may also have been responsible for the changes that led to the monetary storm occurred in September 1992.

Moreover, the structural changes that have been detected using the Hansen (1992) and Hansen and Johansen (1993) tests have also an economic interpretation in terms of di¤erent direction of causality in the pre and post liberalization subsamples, as well as in the long-run cointegration relationships that can be identi…ed.

One of the most interesting cases is the French one: after the abolishment of capital controls, it is possible to …nd bi-directional causality between the interest rates of Germany and France. Moreover, whereas for the …rst period the cointegration vector that can be identi…ed is the UIP between the US and the French interest rates, in the second subsample the German interest rate also enters the equation. Consequently, the change that has been detected implies that, during the nineties, there has been an increase in the degree of …nancial integration between France and Germany that can be attributed to the process of convergence towards EMU.

The case of the United Kingdom has been completely di¤erent. This

country has not taken part in the convergence strategy due to its decision to leave the EMS in 1992. This fact is also re‡ected in the causal relationships linking its interest rate to the German one: before capital movements liberalization, there was long-run causality between the two rates, whereas this causality does not exist in the post-liberalization period. Thus, one country that left the EMS discipline has been able to gain independence from Germany in the setting of its monetary policy.

There is not only a sharp contrast between the countries that remained in the EMS and those that decided to abandon its discipline, but also between the EMS countries themselves. For example, if one takes a "core" country like the Netherlands and a "peripheral" one like Spain, although both of them show evidence of asymmetry with Germany, the Netherlands are, however, able to isolate from external shocks. Consequently, the relations that links the European interest rates with the German ones permit us to accept the existence of German leadership, that is, the ability of the European countries to isolate from the shocks having their origin in the dollar is di¤erent depending on the core or peripheral nature of the country. This outcome is specially relevant for the future of the EMU and the role of the Euro in the international …nancial markets in order to isolate Europe from the shocks occurring outside its borders.

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Table 1 KPSS unit root tests							
Series in di¤erences	¢der$_t$	¢frr$_t$	¢itr$_t$	¢ner$_t$	¢spr$_t$	¢ukr$_t$	¢usr$_t$
´$_1$	0.27	0.25	0.21	0.06	0.08	0.06	0.04
´$_¿$	0.13	0.08	0.09	0.05	0.02	0.05	0.05
Series in levels	der$_t$	frr$_t$	itr$_t$	ner$_t$	spr$_t$	ukr$_t$	usr$_t$
´$_1$	0.53*	1.74*	1.51*	0.83*	1.47*	1.48*	2.06*
´$_¿$	0.22*	0.15*	0.15*	0.24*	0.17*	0.21*	0.18*

Note: The critical values at 5% signi…cance level for ´$_1$ and ´$_¿$ are 0.463 and 0.146 respectively. An asterisk denotes rejection of the null hypothesis of stationarity, either in levels or in di¤erences.

Table 2 Johansen's procedure for stationarity					
France					
coint. relations	degrees of freedom	Chisq	der$_t$	usr$_t$	frr$_t$
1	2	5.99	15.23*	13.77*	13.13*
2	1	3.84	5.25*	3.74	3.52
Italy					
coint. relations	degrees of fredom	Chisq	der$_t$	usr$_t$	itr$_t$
1	2	5.99	16.79*	15.34*	19.25*
2	1	3.84	0.02	3.14	2.28
Netherlands					
coint. relations	degrees of fredom	Chisq	der$_t$	usr$_t$	ner$_t$
1	2	5.99	17.68*	14.70*	14.52*
2	1	3.84	2.00	0.24	2.00
Spain					
coint. relations	degrees of fredom	Chisq	der$_t$	usr$_t$	spr$_t$
1	2	5.99	12.16*	8.59*	10.54*
2	1	3.84	3.71	1.05	2.62
United Kingdom					
coint. relations	degrees of fredom	Chisq	der$_t$	usr$_t$	ukr$_t$
1	2	5.99	5.48	5.86	2.00
2	1	3.84	2.38	3.18	1.99

NOTE: The null hypothesis is stationarity. An asterisk denotes rejection of the null. "France" denotes the trivariate VAR formed by France, Germany and the United States. The same is valid for the rest of the countries.

Table 3. Johansen tests for the cointegration rank							
Whole sample				**Subsamples**			
France (79:1 to 97:11)				**France**			
Test statistics and H_0	p=0	p=1	p=2	Pre-liberalization period (79:1 to 90:12)			
$\lambda_{max}(r = p)$	18.38*	4.75	2.75*	Test statistics and H_0	p=0	p=1	p=2
Trace (r **6** p)	25.88	7.50	2.75*	$\lambda_{max}(r = p)$	35.60**	5.15	3.61*
The Netherlands (79:1 to 97:11)				Trace (r **6** p)	44.37**	8.76	3.61*
Test statistics and H_0	p=0	p=1	p=2	Post-liberalization period (91:1 to 97:11)			
$\lambda_{max}(r = p)$	21.45*	5.68	3.66*	Test statistics and H_0	p=0	p=1	p=2
Trace (r **6** p)	30.79**	9.34	3.66*	$\lambda_{max}(r = p)$	28.66**	8.70	3.73*
United Kingdom (79:1 to 97:11)				Trace (r **6** p)	41.09**	12.43	3.73*
Test statistics and H_0	p=0	p=1	p=2				
$\lambda_{max}(r = p)$	11.05	7.87	3.99*	**United Kingdom**			
Trace (r **6** p)	22.91	11.86	3.99*	Pre-liberalization period (79:1 to 90:12)			
Spain (79:1 to 97:7)				Test statistics and H_0	p=0	p=1	p=2
Test statistics and H_0	p=0	p=1	p=2	$\lambda_{max}(r = p)$	23.65**	4.88	2.94*
$\lambda_{max}(r = p)$	16.18*	6.15	2.26	Trace (r **6** p)	31.01**	7.37	2.94*
Trace (r **6** p)	24.95	8.41	2.26	Post-liberalization period (91:1 to 97:11)			
Italy (79:1 to 97:9)				Test statistics and H_0	p=0	p=1	p=2
Test statistics and H_0	p=0	p=1	p=2	$\lambda_{max}(r = p)$	35.67**	10.81*	4.01*
$\lambda_{max}(r = p)$	22.61**	5.45	1.92	Trace (r **6** p)	50.49**	14.82**	4.01*
Trace (r **6** p)	30.06**	7.45	1.92				
Reduced samples				**Bivariate system**			
France (83:4 to 97:11)				**Spain and Germany**			
Test statistics and H_0	p=0	p=1	p=2	Period 89:6 to 97:7			
$\lambda_{max}(r = p)$	25.10**	6.44	3.12*	Test statistics and H_0	p=0	p=1	
Trace (r **6** p)	34.66**	9.56	3.12*	$\lambda_{max}(r = p)$	17.49**	1.79	
Spain (89:6 to 97:7)				Trace (r **6** p)	19.73**	1.79	
Test statistics and H_0	p=0	p=1	p=2				
$\lambda_{max}(r = p)$	29.34**	7.01	2.60				
Trace (r **6** p)	38.95**	9.61	2.60				

Note: An asterisk denotes rejection of the null hypothesis at 10%, double asterisk at 5%. The critical values for L-max test are 20.97 (p=0); 14.07 (p=1) and 3.76 (p=2) at 5% signi…cance level and 13.39 (p=0); 10.60 (p=1) and 2.71 (p=2) at 10% signi…cance level. The critical values for Trace test are 29.68 (p=0); 15.41 (p=1) and 3.76 (p=2) at 5% signi…cance level and 26.70 (p=0); 13.31 (p=1) and 2.71 (p=2) at 10% signi…cance level. The critical values are from Hansen and Johansen (1993).

Table 4. Long-run causality Trivariate system			
France			
Vector n°1. Pre-liberalization period (79:1 to 90:12)	Δder_t	Δfrr_t	Δusr_t
$frr_t - usr_t$	23.50 [0.00]	17.99 [0.00]	1.43* [0.07]
Vector n°2. Post-liberalization period (91:1 to 97:11)	Δder_t	Δfrr_t	Δusr_t
$frr_t - usr_t + 1{:}24der_t$	12.89 [0.00]	14.59 [0.00]	1.45* [0.84]
The Netherlands			
Vector n°3. Whole sample (79:1 to 97:7)	Δder_t	Δner_t	Δusr_t
$ner_t - der_t$	4.28* [0.23]	10.67 [0.01]	2.26* [0.52]
United Kingdom			
Vector n°4. Pre-liberalization period (79:1 to 90:12)	Δder_t	Δukr_t	Δusr_t
$ukr_t - 1{:}59der_t + 1{:}01usr_t$	13.63 [0.00]	5.50 [0.02]	1.55* [0.21]
Vector n°5 and 6. Post-liberalization period (91:1 to 97:11)	Δder_t	Δukr_t	Δusr_t
$ukr_t - usr_t$ and $usr_t - der_t$	21.92 [0.00]	18.31 [0.00]	8.51* [0.07]
t-values (1)	Δder_t	Δukr_t	Δusr_t
$ukr_t - usr_t$	-4.089	2.849	2.147*
$usr_t - der_t$	4.504	-0.950*	-1.573*
Spain			
Vector n°7. Reduced sample (89:6 to 97:7)	Δder_t	Δspr_t	Δusr_t
$spr_t - 1{:}83der_t - 5{:}44usr_t$	14.12 [0.00]	5.13 [0.02]	3.64* [0.06]
Italy			
Vector n°8. Whole period (79:1 to 97:7)	Δder_t	Δitr_t	Δusr_t
$itr_t - usr_t - 0{:}543der_t$	10.12 [0.01]	10.39 [0.01]	1.55* [0.46]
Bivariate system **German and Spain**			
Vector n°9. Period 79:1 to 97:7	Δder_t	Δspr_t	-
$spr_t - der_t$	2.94* [0.23]	17.85 [0.00]	- -

Note: The null hypothesis is weak exogeneity, probabilities are in parentheses, and asterisk denotes acceptance of the null. (1) t-values of the parameters of ®, the weighting matrix. An asterisk denotes non-signi…cance of the parity in the corresponding equation.

Table 5. Short-run causality					
France					
Pre-liberalization period (79:1 to 90:12)					
der_t 9 frr_t	der_t 9 usr_t	frr_t 9 der_t	frr_t 9 usr_t	usr_t 9 der_t	usr_t 9 frr_t
5.47	-2.42	0.710*	1.22*	2.90	2.78
[0.000]	[0.015]	[0.477]	[0.219]	[0.003]	[0.005]
Post-liberalization (91:1 to 97:11)					
der_t 9 frr_t	der_t 9 usr_t	frr_t 9 der_t	frr_t 9 usr_t	usr_t 9 der_t	usr_t 9 frr_t
2.81	-0.57*	-0.044*	0.21*	-0.98*	-0.29*
[0.004]	[0.566]	[0.964]	[0.833]	[0.322]	[0.769]
The Netherlands					
Whole sample (79:1 to 97:7)					
der_t 9 ner_t	der_t 9 usr_t	ner_t 9 der_t	ner_t 9 usr_t	usr_t 9 der	usr_t 9 ner_t
4.94	-1.97	-2.72	3.53	1.85*	1.51*
[0.000]	[0.048]	[0.006]	[0.000]	[0.063]	[0.130]
United Kingdom					
Pre-liberalization period (79:1 to 90:12)					
der_t 9 ukr_t	der_t 9 usr_t	ukr_t 9 der_t	ukr_t 9 usr_t	usr_t 9 der	usr_t 9 ukr_t
1.60*	-2.12	1.93	0.66*	2.85	2.66*
[0.109]	[0.033]	[0.032]	[0.503]	[0.004]	[0.007]
Post-liberalization (91:1 to 97:11)					
der_t 9 ukr_t	der_t 9 usr_t	ukr_t 9 der_t	ukr_t 9 usr_t	usr_t 9 der	usr_t 9 ukr_t
3.41	0.40*	1.90*	-0.17*	0.70*	-2.19
[0.000]	[0.686]	[0.056]	[0.859]	[0.478]	[0.027]
Spain					
Reduced sample (89:6 to 97:7)					
der_t 9 spr_t	der_t 9 usr_t	spr_t 9 der_t	spr_t 9 usr_t	usr_t 9 der	usr_t 9 spr_t
-1.97	0.20*	-0.90*	0.52*	1.22*	0.32*
[0.048]	[0.835]	[0.365]	[0.596]	[0.222]	[0.743]
Italy					
Whole sample (79:1 to 97:7)					
der_t 9 itr_t	der_t 9 usr_t	itr_t 9 der_t	itr_t 9 usr_t	usr_t 9 der_t	usr_t 9 itr_t
2.24	2.14	-2.61	0.40*	2.84	2.32
[0.024]	[0.031]	[0.008]	[0.688]	[0.004]	[0.020]

Note: The null hypothesis is non-causality. The probabilities are in parenthesis, and an asterisk denotes acceptance of the null. The expression der_t 9 frr_t means non-causality from Germany to France. "France" denotes the trivariate VAR formed by France, Germany and the United States. The same is valid for the rest of the countries.

Table 6 Hansen's instability tests	
France	
L_c	0.467 [0.053]
Mean F	11.726 [0.010]
Sup F	77.223 [0.010]
Spain	
L_c	1.054 [0.010]
Mean F	6.920 [0.033]
Sup F	17.46 [0.027]

Note: The probabilities are in parenthesis. A value smaller than 20% means that the relationship is not stable. The critical values have been taken from Hansen (1992), tables 1, 2 and 3. "France" denotes the trivariate VAR formed by France, Germany and the United States. The same is valid for the rest of the countries.

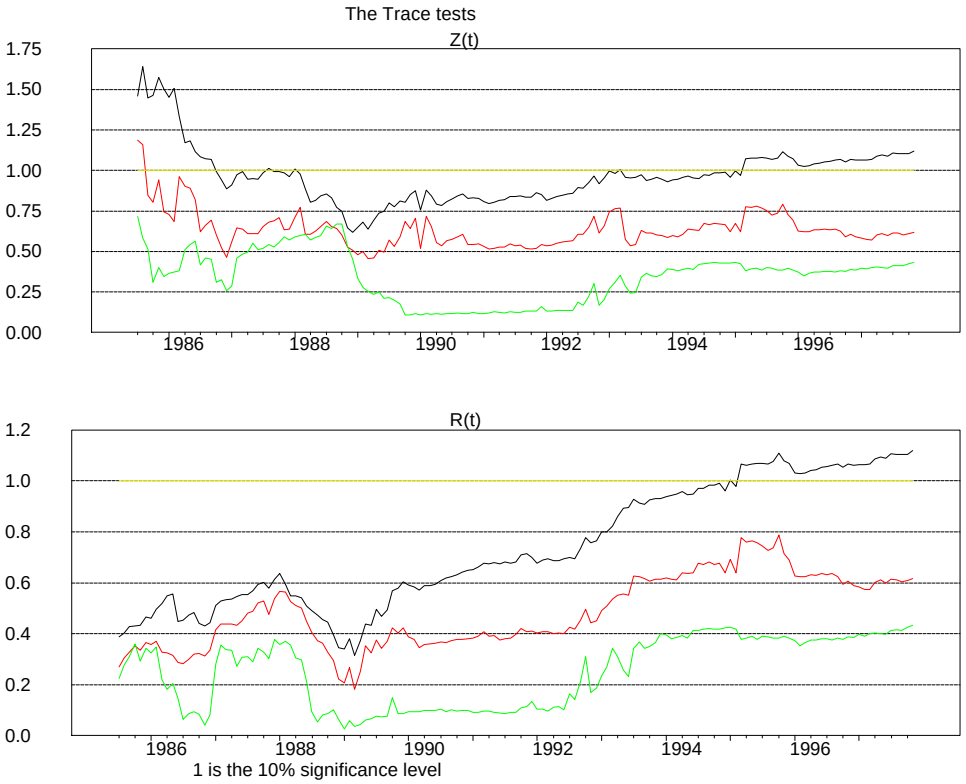
For all the test, the null hypothesis is that the coe…cient A is constant in the multiple regression model under cointegration :

$$y_t = A_t x_t + u_{1t} \qquad t = 1; :::; n$$

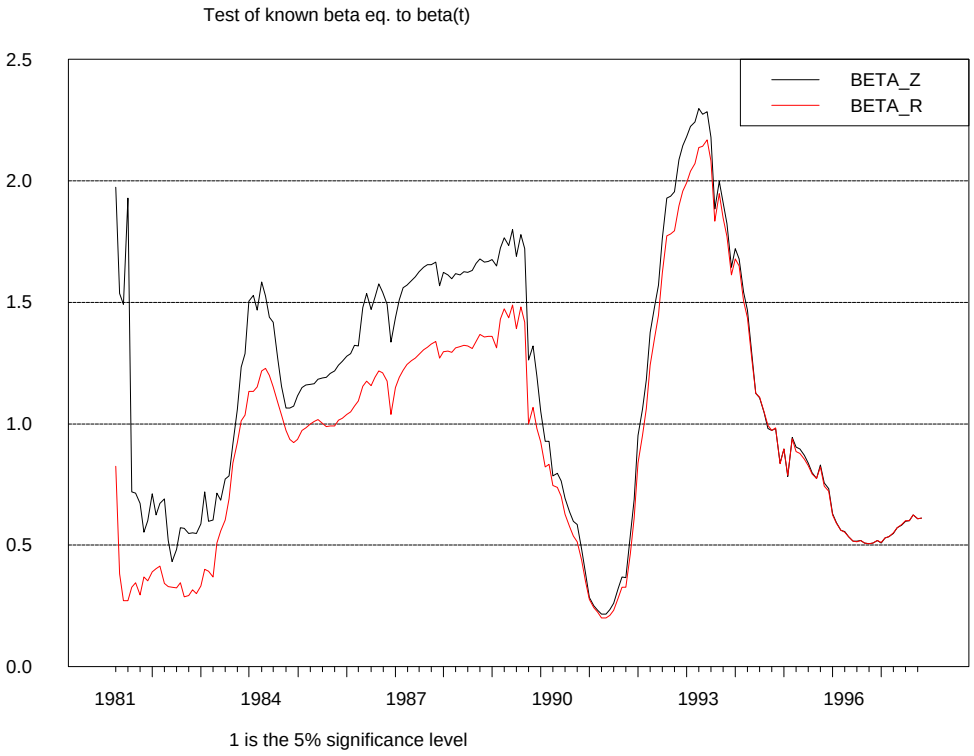
where the process $x_t = (x_{1t}^0; x_{2t}^0)$ is determined by the equations:

$$\begin{aligned} x_{1t} &= 1 \\ x_{2t} &= x_{2t\,i\,1} + u_{2t} \\ t &= 1; :::; T \end{aligned}$$

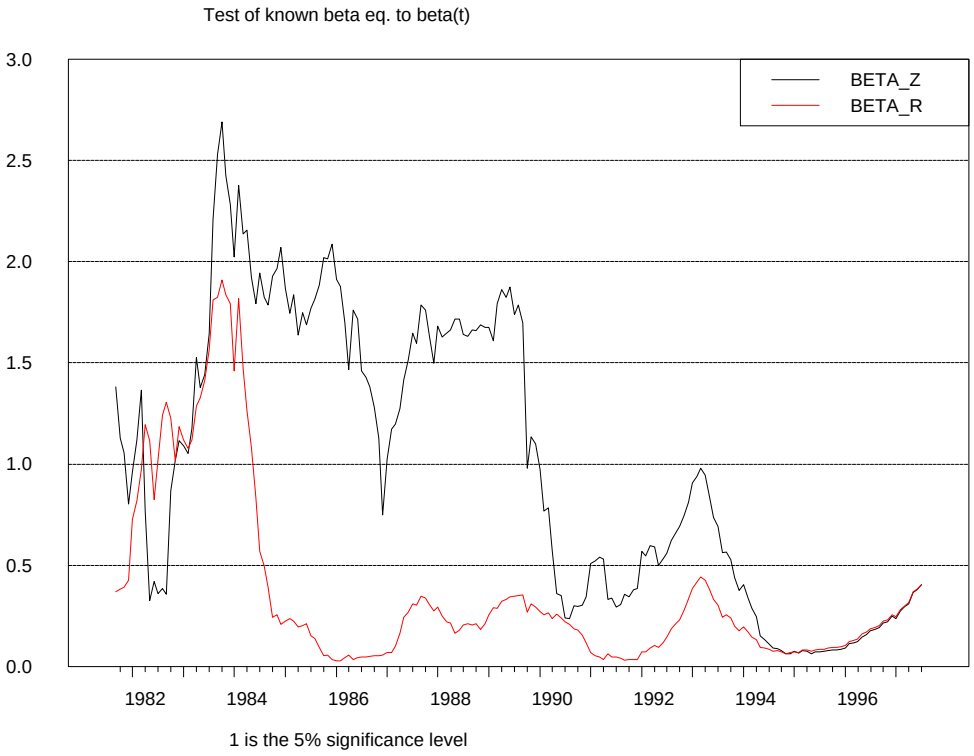
The di¤erent tests di¤er in the treatment of alternative hypotheses. In Sup F, A_t obey a single structure break treated as known at time t, where $1 < t < n$. The Mean F and L_c tests model the parameter A_t as a martingale process. In this case, the null hypothesis can be written as the constraint that the variance of the martingale di¤erences is null. One alternative hypothesis is that variance is not null. The Lc statistics can also be interpreted as a test for the null of cointegration.



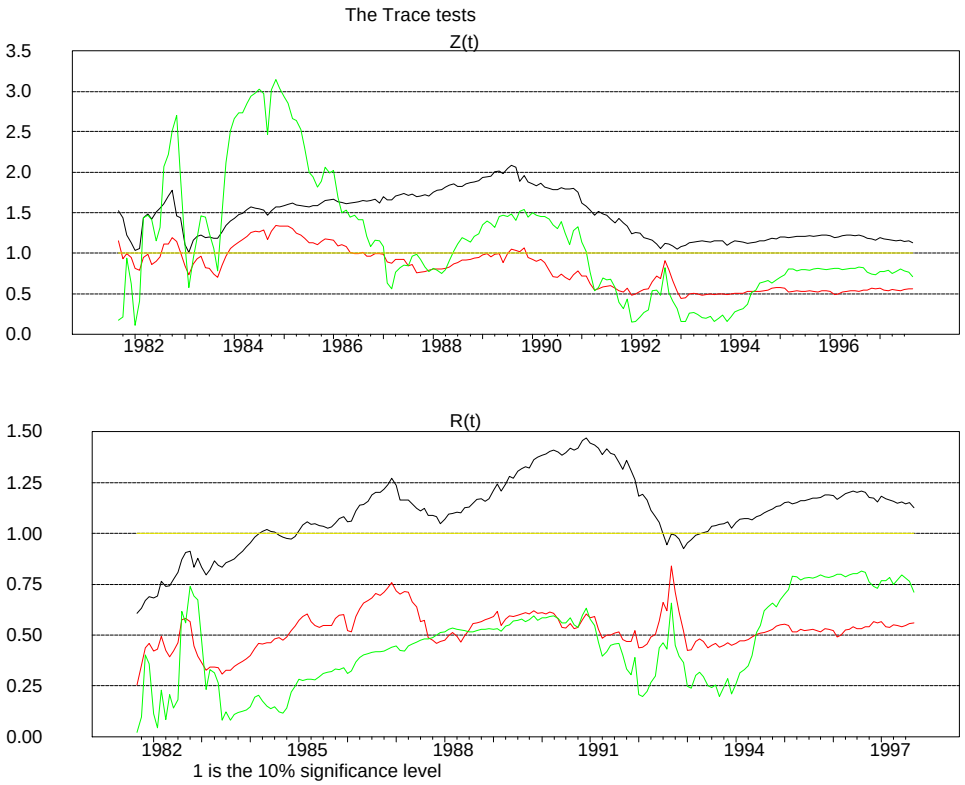
Graph 1: Test for the constancy of the estimated cointegration rank. France, Germany and the United States (83:4 - 97:11)



Graph 2: Test for the constancy of the cointegration space for a given cointegration rank. France, Germany and the United States (83:4 to 97:11)



Graph 3: Test for the constancy of the cointegration space for a given cointegration rank. Germany, Spain and the United States (79:1 - 97:7)



Graph 4: Test for the constancy for the estimated cointegration rank. Germany, Italy and the United States (79:1 - 97:9)