

The European Monetary System and Real Interest Parity: Is there any Connection?

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I. INTRODUCTION

The motivation for testing real interest parity (RIP) within the European Monetary System (EMS) emanates from the proposition that testing RIP amounts to testing if EMS countries meet the necessary conditions to move to the third stage of the European Monetary Union (EMU). Although RIP is not stated explicitly as one of the five convergence criteria for moving to the third stage of the EMU, the first and second criteria boil down to something that resembles RIP.¹ Moreover, the EMS is conceived (or hoped) to be one of the factors conducive to a greater degree of market integration in Europe.² Indeed, UNGERNER et al. (1983, p. 11) assert that a substantial part of the convergence of interest rates within the EMS can be attributed to monetary measures following the establishment of the EMS.

Several economists have tested RIP in Europe invariably by taking Germany to be the reference country including, *inter alia*, CUMBY and MISHKIN (1986), BLUNDELL-WIGNALL and BROWNE (1991) and TAYLOR (1991). The objective of these studies was to test the hypothesis that the existence of the EMS and the resulting closer monetary co-operation may lead to closer linkages between European interest rates than those between the U.S. and Europe. The results of these studies are not generally supportive of this hypothesis.

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We would like to thank an anonymous referee for his perceptive comments on an earlier version of this paper. We are also grateful to RAID FAHMI and ANDREW TYLECOTE for their help at the final stages of writing this paper.

1. The first criterion is that inflation in a particular country may not exceed the average of the three lowest inflation rates by more than 1.5%, while the second is that (nominal) interest rates may not exceed the average in the three countries with the lowest inflation rates. If these two criteria are combined, the single criterion that emerges is that the real interest rate in a particular country may not exceed the average real interest rate by more than 1.5%. Convergence of real interest rates is assigned special importance due to its implications for achieving stability of exchange rates.
2. The other factors are lower transportation costs, the gradual abolition of trade barriers and the removal of capital controls. The second and third factors may or may not be due to the creation of the EMS since some non-EMS countries have also indulged in these practices.

The objective of this paper is broadly similar to that of earlier studies. More specifically, the objective is to show whether EMS membership makes any difference to the performance of RIP, using the example of Switzerland as a non-EMS country. The EMS countries considered in this study are Belgium, Italy, and the Netherlands in addition to the reference country, Germany.³ Moreover, the U.K. is considered as a country that was a member of the EMS for a short time only.

II. THE HYPOTHESIS OF REAL INTEREST PARITY

The RIP condition has been used as a measure of capital mobility, market integration and macroeconomic convergence, such that deviations from the condition imply a lower degree of capital mobility, integration and convergence.⁴ The RIP hypothesis can be derived by assuming (1) covered interest parity (efficiency of domestic and foreign capital markets), (2) ex ante purchasing power parity (efficiency of commodity and financial markets) and the unbiasedness of the forward rate as a forecaster of the market's expectations of the future spot rate (ROLL, 1979, pp. 356-57). These conditions are given by

$$f_t - s_t = i_t - i_t^* \quad (1)$$

$$E_t s_{t+1} - s_t = E_t \pi_{t+1} - E_t \pi_{t+1}^* \quad (2)$$

$$E_t s_{t+1} = f_t, \quad (3)$$

respectively, where f is the one-period forward exchange rate, s is the spot exchange rate, i is the nominal interest rate, π is the inflation rate, an asterisk denotes the reference country's variables, and E is the expected value operator such that $E_t x_{t+1} = E(x_{t+1} | \Omega_t)$ is the value of the variable expected to prevail in period $t + 1$ conditional on the information set Ω which is available in period t . The exchange rates s and f are measured in natural logarithms and expressed as the domestic currency price of a

3. Taking Germany to be the reference country should not be interpreted to imply asymmetry in the system and acceptance of the hypothesis that the EMS operates like a DM zone. This is a controversial issue which is not our concern here. For details see, *inter alia*, GIAVAZZI and GIOVANNINI (1989), PORTES (1990), DE GRAUWE (1990), and FRATIANNI and VON HAGEN (1990). Apart from the tradition of using Germany as a reference country in similar studies, Germany is a low inflation country which may be used as a proxy to satisfy the first and second EMU convergence criteria.
4. Convergence is generally defined as «the narrowing of international differences in the development of economic variables», which in the case of RIP are inflation and nominal interest rates. Market integration is implied by RIP because this condition encapsulates both covered interest parity and ex ante purchasing power parity. It also implies capital mobility because perfect capital mobility equalises real rates of return on identical assets denominated in different currencies.

unit of the foreign currency. The inflation rate is measured as the first difference of the logarithm of the consumer price index. Combining equations (1) and (3), we obtain uncovered interest parity, which is given by

$$E_t s_{t+1} - s_t = i_t - i_t^* \quad (4)$$

Substituting equation (2) into equation (4), we obtain

$$i_t - E_t \pi_{t+1} = i_t^* - E_t \pi_{t+1}^* \quad (5)$$

Equation (5) implies that if the FISHER closed condition is valid in both countries then the nominal interest rate differential fully adjusts to the expected inflation differential, maintaining the constancy and equality of ex ante real interest rates, r and r^* . Therefore

$$E_t r_{t+1} = E_t r_{t+1}^* \quad (6)$$

Under the assumption that expectations are formed rationally across countries, the actual (ex post) real interest rate realised at time $t + 1$ will differ from the ex ante real interest rate by a random term orthogonal to past information. This is given by

$$r_{t+1} = E_t r_{t+1} + \varepsilon_{t+1} \quad (7)$$

$$r_{t+1}^* = E_t r_{t+1}^* + \varepsilon_{t+1}^* \quad (8)$$

Substituting equations (7) and (8) into equation (6), we obtain

$$r_{t+1} = r_{t+1}^* + \zeta_{t+1} \quad (9)$$

where $\zeta_{t+1} = \varepsilon_{t+1} - \varepsilon_{t+1}^*$ is the inflation differential expectation error which is serially uncorrelated with a zero mean. By applying the backward shift operator to equation (9) and writing it in a testable form we get

$$r_t = \beta_0 + \beta_1 r_t^* + \xi_t \quad (10)$$

where ξ is a stochastic term reflecting inflationary expectation errors and other disturbances. For RIP to hold (with all its implications), equation (10) should produce a good statistical fit such that β_0 and β_1 are not statistically different from 0 and 1, respectively.

III. ECONOMETRIC ANALYSIS AND EMPIRICAL RESULTS

The empirical results are based on a sample of quarterly data covering the period 1979:1-1993:2, with some variations for some countries. Data series were obtained from Datastream.

Table 1: Real Interest Rates: Basic Statistics

	Mean	Coefficient of Variation	Skewness	Correlation with Germany
Germany	0.0052	0.95	-0.21	1.00
Belgium	0.0149	0.39	0.75	0.18
Italy	0.0057	1.52	-0.57	0.23
Netherlands	0.0060	0.50	1.33	0.16
Switzerland	0.0034	1.56	-0.23	0.64
U.K.	0.0110	1.07	-1.41	0.44

Table 2: Real Interest Rate Differentials: Basic Statistics

	Mean	Coefficient of Variation	Skewness
Belgium	0.0097	0.72	1.14
Italy	0.0010	8.64	-0.42
Netherlands	0.0061	1.08	1.35
Switzerland	-0.0020	2.94	-0.40
U.K.	0.0058	1.82	-1.04

Table 1 and Table 2 report the basic statistics of the levels and differentials (vis-à-vis Germany) of ex ante real interest rates. These results show the hazards of relying on the mean values of the real interest rates to jump to conclusions about real interest parity, since they imply that the best relationship exists in the case of Germany and Italy. However, it is obvious from the high value of the coefficient of variation of the interest differential between Italy and Germany that there are significant deviations from equality. A better measure of the closeness of the real rates is the correlation coefficient which is highest in the case of Switzerland followed by the U.K. These results constitute some (rather casual) evidence against the hypothesis that EMS membership is conducive to RIP. Rigorous evidence will now be presented.

In order to test RIP by estimating equation (10) we must first determine the degree of integration of the real interest rates. This is a necessary step because if the real interest rates turn out to be nonstationary then the OLS estimates of equation (10) will not be fully efficient even if the real rates are cointegrated. Moreover, the estimated standard

errors would not have a limiting normal distribution, which means that they cannot be used to test the hypotheses $\beta_0 = 0$ and $\beta_1 = 1$. We, therefore, test the real interest rates using the DICKEY-FULLER (1979) τ_μ statistic and the more robust $\hat{Z}_\alpha$ and $\hat{Z}_t$ statistics proposed by PHILLIPS (1987) and PHILLIPS and OULIARIS (1990). The τ_μ statistic is the t ratio of the coefficient on r_{t-1} in the regression equation

$$\Delta r_t = \alpha_0 + \alpha_1 r_{t-1} + \sum_{i=1}^k \gamma_i \Delta r_{t-i} + \varepsilon_t \quad (11)$$

where the value of k is fixed as the smallest number necessary to achieve residual whiteness in the equation.

The PHILLIPS-OULIARIS test is based on the $\hat{Z}_\alpha$ and $\hat{Z}_t$ statistics which were originally proposed by PHILLIPS (1987). The calculation of these statistics is based on the regression

$$r_t = \alpha r_{t-1} + v_t \quad (12)$$

If $\hat{\alpha}$ is the estimated value of the parameter α in equation (12), then the $\hat{Z}_\alpha$ statistic is given by

$$\hat{Z}_\alpha = N(\hat{\alpha} - 1) - (1/2)(s_T^2 - s_V^2)(N^{-2} \sum_{t=2}^N v_{t-1}^2)^{-1} \quad (13)$$

where N is the sample size. S_T^2 and S_V^2 are given by

$$S_V^2 = N^{-1} \sum_{t=1}^N v_t^2 \quad (14)$$

and

$$S_T^2 = N^{-1} \sum_{t=1}^N v_t^2 + 2N^{-1} \sum_{s=1}^k w_{sk} \sum_{t=s+1}^N v_t v_{t-s} \quad (15)$$

for some window such as $w_{sk} = 1 - s / (k + 1)$. The $\hat{Z}_t$ statistic is given by

$$\hat{Z}_t = \left(\sum_2^N u_{t-1}^2 \right)^{1/2} (\hat{\alpha} - 1) S_T - (1/2)(S_T^2 - S_T^2) \left[S_T \left(N^{-2} \sum_2^N v_{t-1}^2 \right)^{1/2} \right]^{-1} \quad (16)$$

In all cases the null hypothesis of unit root (nonstationarity) is rejected if the calculated value of the test statistic is greater than the critical value. The results of these tests, which are reported in Table 4, indicate that real interest rates are stationary. The null hypothesis of unit root is rejected by the $\hat{Z}_\alpha$ and $\hat{Z}_t$ in all cases, while the τ_μ statistic rejects the null in three out of six cases.⁵

Table 3: Unit Root Test for Real Interest Rates

	τ_μ	$\hat{Z}_\alpha$	$\hat{Z}_t$
Germany	-3.35*	-37.98*	-5.27*
Belgium	-7.19*	-57.28*	-7.30*
Italy	-2.16	-25.80*	-3.97*
Netherlands	-1.65	-67.38*	-7.72*
Switzerland	-5.46*	-37.64*	-5.50*
U.K.	-2.61	-53.84*	-7.91*

* significant at the 5% level.

5. More weight is given to the $\hat{Z}_\alpha$ and $\hat{Z}_t$ tests than to the τ_μ test because they are more robust with respect to serial correlation and time varying heteroscedasticity.

Table 4: Testing Real Interest Parity ($r_t = \beta_0 + \beta_1 r_t^*$)

	Belgium	Italy	Netherlands	Switzerland	U.K.
β_0	0.014 (0.001)	0.004 (0.002)	0.010 (0.001)	-0.001 (0.001)	0.006 (0.002)
β_1	0.214 (0.155)	0.436 (0.253)	0.172 (0.164)	0.829 (0.139)	1.041 (0.285)
R^2	0.034	0.057	0.024	0.404	0.195
DW	1.94	0.94	2.38	1.61	2.06
SC(4)	4.18	21.52*	13.78*	6.65	12.22*
FF(1)	1.87	0.04	3.02	0.50	0.40
HS(1)	2.80	0.17	0.50	0.35	4.15*
$t(\beta_0 = 0)$	12.37*	2.18*	9.14*	-0.67	2.70*
$t(\beta_1 = 1)$	-5.07*	2.23*	-6.18*	-1.23	0.14
$\chi^2(\beta_0 = 0)$	153.02*	4.75*	83.62*	0.44	7.31*
$\chi^2(\beta_1 = 1)$	25.72*	4.95*	25.43*	1.50	0.02

* significant at the 5% level.

The results of testing equation (10) are reported in Table 3. In all cases r^* is the German real interest rate.⁶ The Table reports the regression coefficients, β_0 and β_1 , their standard errors (in parentheses), the coefficient of determination, and the *DW* statistic. Moreover, three diagnostic test statistics are reported: the LM test of serial correlation, *SC*, which is distributed as $\chi^2(4)$; the RESET functional form test, *FF*, which is distributed as $\chi^2(1)$; and a heteroscedasticity test, *HS*, which is distributed as $\chi^2(1)$. The coefficient restrictions are tested using the conventional *t* statistics as well as the Wald test, the latter being distributed as $\chi^2(1)$. It is obvious that the best results are obtained in the case of Switzerland as the equation has the highest R^2 , passes all diagnostic tests and it is the only case in which the coefficient restrictions cannot be rejected. The second best set of results is obtained for the U.K. but in this case the equation does not pass the diagnostics for serial correlation and heteroscedasticity. When the estimates for the U.K. are based on WHITE'S (1980) heteroscedasticity-consistent covariance matrix, the results are not qualitatively different. In order to account for the possible cross equation restrictions in the results, the equations were also estimated using Seemingly Unrelated Regressions

6. Again, the direction of normalisation should not be interpreted to imply German dominance. It is important to note that equation (10) is a static model that does not suggest any direction of causality. Our objective here is to test the coefficient restrictions in a static model because we are only concerned with whether or not there is convergence of real interest rates, and not about the direction of causality between the rates. For studies dealing with the direction of causality among EMS (nominal) interest rates, see KARFAKIS and MOSCHOS (1990) and KATSIMBRIS and MILLER (1993).

(SUR). But the results did not turn out to be significantly different from those obtained by applying OLS.⁷

In order to take the matter further, equation (10) was estimated for Switzerland using the Time Varying Parameters (TVP) technique. In this case the coefficients β_0 and β_1 are not assumed to be fixed as in OLS but to change over time according to a particular generating process which may be a random walk. In order to illustrate the technique we may write equation (10) in a general form as

$$R(t) = R^*(t)B(t) + u(t) \quad (17)$$

where $B(t)$ is a vector of time-varying parameters and $u(t)$ is normally distributed with $E[u(t)] = 0$ and $\sigma^2[u(t)] = V$. A common specification of the parameter variation is

$$B(t) = AB(t-1) + w(t) \quad (18)$$

where $w(t)$ is a vector random variable with $E[w(t)] = 0$ and $\sigma^2[w(t)] = W$. A is a diagonal matrix given by

$$A = \begin{bmatrix} a_{11} & 0 & \dots & 0 \\ 0 & a_{22} & \dots & 0 \\ \vdots & \dots & a_{n-1,n-1} & 0 \\ 0 & \dots & 0 & a_m \end{bmatrix} \quad (19)$$

such that $0 < a_{ii} < 1$, $i = 1, 2, \dots, n$.⁸ The random walk model can be obtained by setting $A = I$, i.e. $a_{ii} = 1 \forall i$. The estimation of the vector $B(t)$ can be carried out recursively using the KALMAN filter technique.⁹ This is because equations (17) and (18) form the state space representation of the system, in which equation (17) is the measurement equation and equation (18) is the transition equation which allows for systematically varying parameters. The state of the system $B(t)$ is not directly observable but can be observed through $R(t)$. Let

$$E[B(t) | R(t-1)] = B(t | t-1) \quad (20)$$

7. Equation (10) was also estimated using Switzerland as a reference country. As expected, the results did not support RIP between Switzerland and any of the other countries except Germany.
8. This restriction on the values of the elements of A is necessary to guarantee the stability of the generating process.
9. See, for example, CUTHBERTSON et al. (1992), Chapter 7.

and

$$E[B(t) - B(t | t-1)][B(t) - B(t | t-1)]' = \sigma^2(t | t-1) \quad (21)$$

The KALMAN filter equations are given by

$$B(t | t-1) = AB(t-1 | t-1) \quad (22)$$

$$\sigma^2(t | t-1) = A \sigma^2(t-1 | t-1) A' + W \quad (23)$$

$$G(t) = \sigma^2(t | t-1) R^{*'}(t) [R^*(t) \sigma^2(t | t-1) R^*(t) + V]^{-1} \quad (24)$$

$$B(t | t) = B(t | t-1) + G(t) [R(t) - R^*(t) B(t | t-1)] \quad (25)$$

$$\sigma^2(t | t) = G(t) R^*(t) R^*(t) \sigma^2(t | t-1) \quad (26)$$

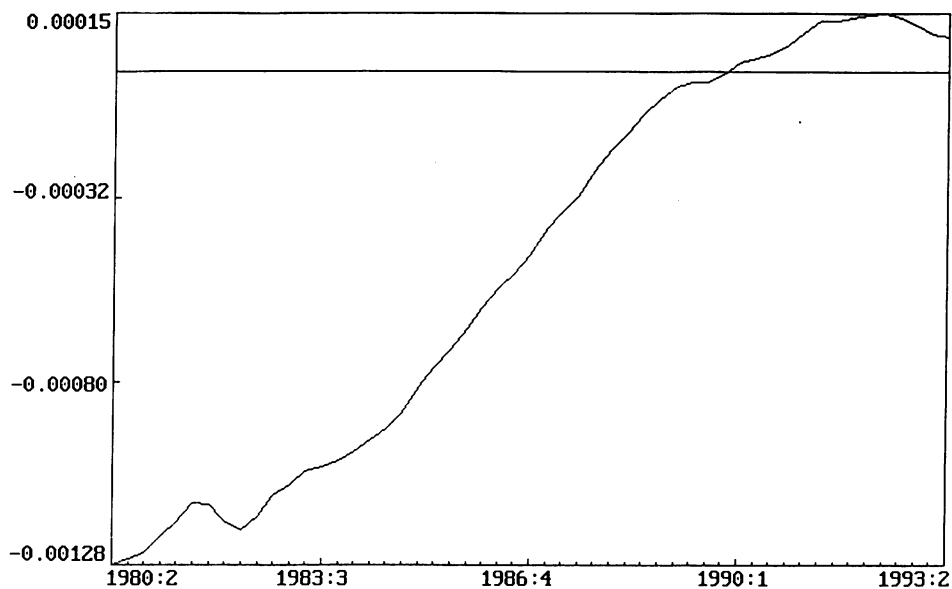
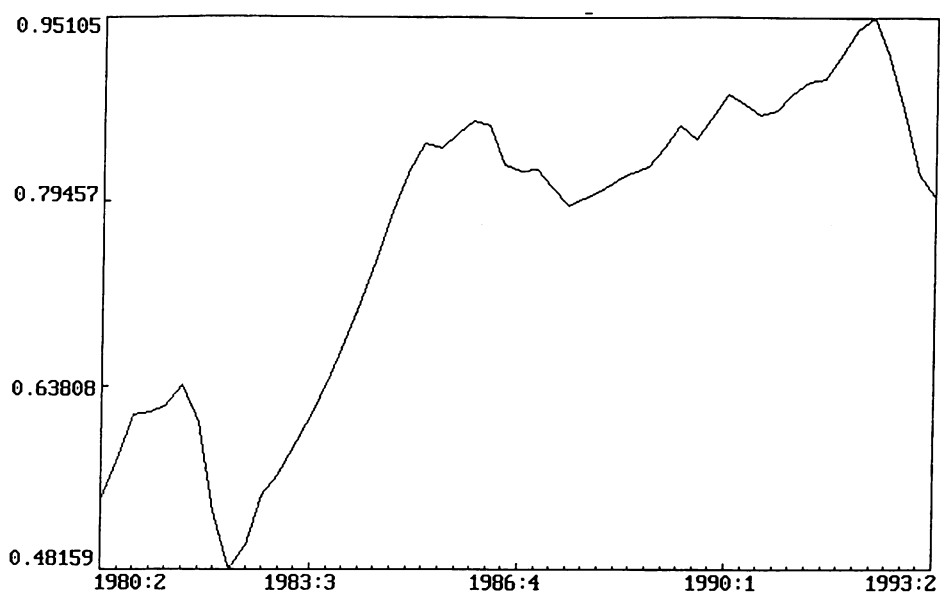
while the initial conditions are given by

$$B(0|0) = B(0) \quad (27)$$

$$\sigma^2(0|0) = \sigma^2(0) \quad (28)$$

This system of equations tells us that the optimal estimator of $B(t)$ at time t , $B(t|t)$ is represented by a linear combination of the previous estimator, $B(t | t-1)$ and the current observation, $R(t)$. Equation (25) shows the recursive nature of the computation.

The objective of this exercise is to observe the evolution of the values of the coefficients β_0 and β_1 in the case of Switzerland. The smoothed values of β_0 and β_1 are plotted against time in Figures 1 and 2, respectively, and clearly show gradual convergence of Swiss and German real interest rates. It can be seen that the intercept term β_0 moved towards the value 0 throughout the 1980s, while the slope term β_1 has a secular trend towards the value of 1.

Figure 1: Smoothed Time-Varying Intercept Term (Switzerland – Germany)**Figure 2: Smoothed Time-Varying Slope Term (Switzerland – Germany)**

IV. CONCLUDING REMARKS

If RIP is a measure of integration and convergence, then it is obvious that there is more integration and convergence between Germany and Switzerland than between Germany and other members of the EMS. It is not difficult to explain why this is the case. While the Bundesbank and the Swiss National Bank share the characteristics of independence and a distaste for inflation (and thus pursue similar policies), the EMS sets out some institutional arrangements which were expected to achieve convergence among heterogeneous economies run by diverse political ideologies and completely different central banks.

Such a conclusion may not do the EMS full justice, however. As far back as the early eighties, it was realised that the hopes that had been placed in the EMS were not fulfilled, but optimists have repeatedly argued that the existence of and the constraints implied by the EMS have helped to avoid an even greater divergence. After all, achievements must not be evaluated without reference to the difficulty of the task to be achieved. Moreover, using the German-Swiss case as a standard against which the performance of the EMS (using RIP as a criterion) is measured is, perhaps, far-fetched. One must remember, however, that out of the remaining countries the closest convergence is found in the case of the U.K. over a period during which the U.K. was mostly out of the System.

The convergence of the German and Swiss interest rates can be attributed to the similarity of monetary policies pursued by the respective central banks. The Bundesbank has been striving to preserve the purchasing power of the German currency by limiting the monetary expansion to rates consistent with non-inflationary growth. Its ability to do so has been enhanced by its legal status, including an obligation to maintain price stability and independence from the government. Likewise, the Swiss National Bank has been largely free of political influence in conducting a monetary policy which is based on targeting the monetary base. While the similarity in policies is conspicuous, this should not be taken to imply that the Swiss National Bank mirrors the policies of the Bundesbank.

It seems that the findings of this study lend support to the view put forward by some observers that it makes more sense to talk about a monetary union between Germany and Switzerland (and other countries of the DM bloc) than between Germany and some EMS countries. After all, the EMS is a set of arrangements which cannot (and should not) be expected to perform miracles.

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ZUSAMMENFASSUNG

Dieser Artikel untersucht die Frage, ob die Mitgliedschaft im Europäischen Währungssystem EWS eine notwendige Bedingung für die Gültigkeit der realen Zinsparität bildet.

Dabei wird Deutschland als Referenzland genommen. Die empirischen Resultate deuten an, dass die EWS-Mitgliedschaft keine notwendige Bedingung für die Annäherung an die deutschen Realzinsen ist, denn diese Annäherung ist im Falle der Schweiz am stärksten. Die aus der Regression von zeitvariablen Parametern gewonnenen Resultate zeigen, dass sich die schweizerischen Realzinsen den deutschen seit Anfang der 80er Jahre zunehmend angeglichen haben. Daraus lässt sich folgern, dass der entscheidende Faktor für die Konvergenz in der Ähnlichkeit der deutschen und der schweizerischen Zentralbank und nicht in einem institutionellen Arrangement wie dem EWS liegt.

SUMMARY

This paper examines the proposition whether or not EMS membership is a necessary condition for real interest parity to hold, taking Germany as a reference country. Empirical results indicate that EMS membership is not a necessary condition for convergence on German real interest rates, since the relationship seems to hold best for Switzerland followed by the U.K. Moreover, results obtained from time-varying parameter regressions reveal that Swiss real interest rates have progressively converged on those of Germany since the early 1980s. It is concluded that the important underlying factor is a similarity between the German and Swiss central banks, rather than institutional arrangements like the EMS.

RESUME

Prenant l'Allemagne comme référence, cet article examine si l'appartenance au SME est une condition nécessaire au maintien de la parité des taux d'intérêt réels. Les résultats empiriques indiquent que l'appartenance au SME n'est pas une condition nécessaire pour que les taux d'intérêt convergent avec les taux d'intérêt réels allemands, puisque la relation semble le mieux établie pour la Suisse, puis pour le Royaume-Uni. Les résultats obtenus par regressions aux paramètres chronologiquement variables montrent en outre que les taux d'intérêt réels suisses convergent progressivement avec ceux de l'Allemagne depuis le début des années 1980. On en conclut que le facteur sous-jacent important est plutôt la similarité des banques centrales allemande et suisse que des dispositions institutionnelles telles que le SME.