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EMS INTEREST RATE DIFFERENTIALS AND FISCAL POLICY: A MODEL WITH AN EMPIRICAL APPLICATION TO ITALY

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ABSTRACT

This paper develops a model showing how EMS interest rate differentials are influenced by fiscal policy. For countries like Italy, with large budget deficits, the commitment to a stable EMS exchange rate can entail costly fiscal adjustment. If the government believes these costs to be excessive, it may choose to adopt a more inflationary monetary policy and realign periodically. It is this possibility that the policy of targeting the stable exchange rate will be abandoned in favor of one with periodic EMS realignments that contributes to the interest differential.

Estimation of the model indicates that fiscal variables explain part of the Italian-German interest differential, and co-integration tests reveal that this relationship holds over the long-run. These results imply that the Italian-German interest differential is likely to persist in the second stage of European Monetary Union (EMU) if Italy fails to reduce its budget deficit, providing support for the view that fiscal convergence is a necessary element of EMU.

EMS Interest Rate Differentials and Fiscal Policy: A Model with an Empirical Application to Italy

R. Sean Craig[1]

I. Introduction

The European Monetary System (EMS) is widely credited with facilitating a convergence of interest and inflation rates. Participation in the EMS led countries to adopt restrictive monetary policies in order to reduce pressures to realign. Over time, as realignments have become less frequent, this monetary stance acquired greater credibility and interest rate differentials with Germany, the low inflation country, became small for many EMS countries.

Italy is an exception to this model of EMS convergence. Its interest rate differential with Germany has remained substantial until recently, despite a large reduction in the inflation differential, and the absence of significant lira realignments since early 1987. The Italian experience suggests that a restrictive monetary policy is not sufficient for convergence, and that fiscal restraint may also be necessary. The interest differential may result from Italy's large budget deficit and debt/GDP ratio, which provides an incentive for it to abandon its restrictive monetary stance and realign periodically.

This paper develops a model in which EMS interest differentials reflect the influence of fiscal variables. Estimation of the model indicates that Italian fiscal policy can explain part of the Italian-German interest rate differential. This result implies that this interest differential may persist in the second phase of European Monetary Union (EMU) if Italy fails to reduce its budget deficit,

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1. The author is a staff economist in the Division of International Finance. This paper represents the views of the author and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff. I would like to thank Richard Freeman, Dale Henderson, Karen Johnson, Joe Joyce and Andrew Rose for comments.

providing support for the view that fiscal convergence is a necessary element of EMU.

II. EMS Interest Rate Differentials

A model of EMS interest rate differentials is provided by open interest rate parity, shown in equation 1. Open interest parity attributes the differential between yields on two securities denominated in different currencies to expected exchange rate movements over the period to maturity. This specification is most appropriate for euromarket interest rates that are not influenced by capital controls, and differences in tax systems and national financial markets.

The expected depreciation of a currency within the EMS exchange rate band can be decomposed into two components; the expected depreciation within the EMS band, and the realignment of the central rate, as shown in equation 2. This decomposition makes it possible to rewrite the open interest parity condition as equation 3, so that the expected realignment appears as the right hand side variable.

1) $$i_t - i_t^f = E_t \tilde{e}_{t+1}, \qquad \text{(open interest parity)}$$

2) $$E_t \tilde{e}_{t+1} = E_t \tilde{s}_{t+1} + E_t \tilde{c}_{t+1}$$

3) $$i_t - i_t^f - E_t \tilde{s}_{t+1} = E_t \tilde{c}_{t+1}$$

$\tilde{e}$ - exchange rate, percent depreciation, foreign currency units
i - euromarket interest rate (home country)
i^f - euromarket interest rate (foreign country)
$\tilde{s}$ - percent deviation of the exchange rate from central rate
$\tilde{c}$ - EMS central rate, percent depreciation

This paper uses equation 3 to develop and estimate a model of EMS interest rate differentials. The next section develops a model of EMS realignments to describe the right hand side of equation 3. Section IV reviews the Italian experience in the EMS. Section V uses the method of Rose and Svensson (1991) to estimate the expected depreciation within the EMS band so that the left hand side of equation 3 can be constructed. This permits, in Section VI, estimation of equation 3, to test whether fiscal variables influence the Italian-German interest differential.

III. EMS Realignments and Fiscal Policy

The influence of fiscal policy on EMS interest differentials results from the interdependence of fiscal and monetary policy. Convergence of interest and inflation rates in the EMS is generally attributed to the use of monetary policy to maintain a stable EMS exchange rate. However, if fiscal policy is too expansionary, contributing to unsustainable growth of the debt/GDP ratio, this restrictive monetary stance cannot be maintained indefinitely[2]. When the debt burden become excessive the country will seek to reduce the real value of this debt through surprise inflation and devaluation[3].

Investors are uncertain whether the necessary fiscal adjustment will be undertaken, due to the possibility that an increase in the budget deficit could cause the political and economic costs associated with this fiscal adjustment to exceed the benefits of convergence. In the event,

2. Buiter (1987) and Van Wijnbergen (1988), study models where if fiscal policy is not consistent with a finite debt stock, a speculative attack on a fixed parity occurs, forcing a realignment.

3. The alternative to a surprise inflation is default. Default would make continued participation in the EMS difficult, as no one would hold domestic assets and foreign exchange markets would have to close.

government has an incentive to abandon its restrictive monetary stance and run a more inflationary monetary policy, reducing the need for fiscal adjustment by generating inflation tax revenues. Inflation will be higher than in other EMS countries, making periodic realignments necessary to maintain competitiveness. This shift in exchange rate policy is equivalent to moving from a fixed to a crawling peg exchange rate regime.

The expected realignment can be expressed as the probability that the central rate will be devalued "p_t", multiplied by the average size of the realignment "k_t", expected over a specific period of time, as shown in equation 4.

$$4) \qquad E_t\tilde{c}_{t+1} = p_t k_t$$

1) The Probability of a Realignment

The probability of a realignment "p_t", is an increasing function of size of the fiscal adjustment necessary to stabilize the debt/GDP ratio, for reasons mentioned above. Consequently, it can be expressed as the probability that the budget deficit/GDP ratio "f_t" exceeds some threshold level "f^T", due to an exogenous shock[4] to this ratio, as shown in equation 5. If these shocks are normally distributed, with variance "σ", equation 6 results. This threshold, which is unobservable, defines the level above which the costs of fiscal adjustment exceed the benefits, inducing the government to abandon its restrictive policy stance. It can be interpreted as an index of the credibility of the governments

4. An important assumption is that the budget deficit "f_t", follows an autoregressive process. If the budget deficit did not show persistence, then a positive shock would not increase the necessary fiscal adjustment.

commitment to a stable EMS exchange rate. The probability of a realignment will be low if the difference between the deficit and its threshold level is large, either because the threshold level is high (reflecting high credibility), or the actual deficit is low. Note that realignments could occur even if fiscal policy has been consistent with a stable EMS exchange rate, due to a large exogenous deficit shock.

5) $$p_t = \text{prob}[f_t \geq f^T]$$

6) $$p_t = \Psi \exp\{-\frac{1}{2\sigma}(f^T - E_t f_t)^2\}, \qquad \Psi = (\sqrt{\sigma 2\Pi})$$

2) Inflation and EMS Realignments in the Event of a Policy Shift

In the event that a government chooses to abandon the stable EMS exchange rate, monetary policy becomes more expansionary in order to generate inflation tax revenues. The exchange rate is devalued periodically, as in a crawling peg exchange rate regime, offsetting the differential between home and foreign inflation. As long as the country remains in the EMS it will face a policy dilemma resulting from the fact that it has one instrument, monetary policy, and two targets, the exchange rate and inflation tax revenues. In the short run the country is likely to have some flexibility to manage the exchange rate. However, over the longer run, the commitment to an inflation tax target means that it will have to accept a decline in its exchange rate consistent with this monetary policy[5]. The choice of the inflation tax is assumed to be

5. A special case would be to allow the currency to float and withdraw from the EMS.

the outcome of a government's optimization problem that minimizes the welfare cost of taxation.

The government welfare function, equation 7, is a model of optimal taxation determining the extent to which the governments relies on inflation or conventional taxes[6]. Welfare is reduced by the distortionary impact of the tax rate "τ", and inflation "π". The government minimizes the welfare loss subject to three constraints: the government budget constraint, equation 8; the quantity equation, equation 9; and, open interest parity, equation 10.

7) $$W(\tau,\pi) = E_t \sum_{j=0}^{\infty} \beta^j (\omega_1 \tau_{t+j}^{\gamma+1} + \omega_2 \pi_{t+j}^{\theta+1})^{\frac{1}{\gamma+1}}$$

8) $$db_t = (i_t - \pi_t - n)b_t + g_t - \tau_t - \frac{dM_t}{Y_t},$$

9) $$\frac{dM_t}{Y_t} = (\pi_t + \psi i_t + n)m_t$$

10) $$i_t - i_t^f = E_t \tilde{s}_{t+1} + k_t$$

π - domestic inflation rate
d - debt/GDP ratio
M - nominal money supply
Y - nominal GDP
m - money/GDP ratio
n - growth of real income (assumed to be constant)
β - discount rate
g - expenditures (exclusive of interest payments)/GDP ratio
τ - tax revenue/GDP ratio, (tax rate)

6. This specification is a generalized CES welfare function similar to one used in a recent paper by Poterba and Rotemberg (1990).

In the government budget constraint, the debt/GDP ratio increases if the real interest rate "$i_t - \pi_t$", exceeds the real GDP growth rate "n", and if there is a primary deficit "$g_t - \tau_t > 0$", but is reduced by seignorage revenues "dM_t/Y_t". The quantity equation (in rate-of-change form) gives the relationship between seignorage, monetary policy, and inflation. The nominal interest rate term "ψi_t", is introduced through the assumption that the rate of change of velocity is a function of the interest rate[7]. The open interest parity condition, differs from the more general specification (given by equations 1, 2 and 4), in that the probability of a realignment has been set equal to one "$p_t = 1$", as the realignment has occurred.

3) Implications of the Model Solution

The solution to the government welfare maximization problem, equation 11, equates the marginal welfare cost of additional revenue raised through an increase in the tax rate to the marginal cost of raising this revenue with the inflation tax. It shows that the inflation rate associated with the optimal inflation tax depends upon the tax rate "τ_t", and the money stock "m_t", which is the inflation tax base.

Equation 11 gives a characterization of exchange rate behavior consistent with monetary policy generating optimal inflation tax revenues. In it the average devaluation of the EMS central rate over a specific period of time equals to the differential between the optimal inflation rate and foreign inflation, thereby offsetting the effect of

7. Money demand is likely to be relatively interest-inelastic, given the narrow definition of money appropriate to a model of seignorage. Velocity could be assumed to be constant, as the interest-elasticity of money demand does not appear in the solution to the model.

this differential on competitiveness and external balance[8]. Note that this implies that the interest differential will equal the inflation differential, plus the term representing the within band depreciation.

11) $\pi_t^* = \tau_t^{\frac{\gamma}{\theta}} m_t^{\frac{1}{\theta}} \Theta, \qquad \Theta = \left(\frac{(\theta+1)^{\omega_1}}{(\gamma+1)\omega_2}\right)^{\frac{1}{\theta}}$

12) $k_t = \pi_t^* - \pi_t^f$

π^f - foreign inflation rate
π^* - inflation rate consistent with the optimal inflation tax

The solution to the model, obtained by substituting equations 6, 11 and 12 into equation 4, is presented in equation 13, and its properties summarized in Table 1. The probability of a realignment and the EMS interest rate differential are increased by a rise in primary deficit/GDP ratio, but reduced by an increase in the threshold level (which represents greater credibility). An increase in the variance of the budget deficit raises the probability that the primary deficit will exceed its threshold level. A higher tax rate has a positive effect, because it encourages greater reliance on the inflation tax. A higher money/GDP ratio has a positive effect by increasing the inflation tax

8. This specification, imposing a constant real exchange rate, is the most reasonable characterization of exchange rate behavior in the event that the stable exchange rate is abandoned. In reality, there are likely to be fluctuations in the real exchange rate, if only because realignments are discrete events. Allowing long run changes in the real exchange rate requires a model that explains why a government would accept the costs of a real exchange rate misalignment. Once the stable EMS exchange rate is abandoned, countries no longer have an incentive to allow the real exchange rate to appreciate to build credibility.

base. Finally, a rise in foreign inflation narrows the differential, by reducing the expected realignment size.

13) $$E_t\tilde{c}_{t+1} = p_t k_t = \Psi\exp\{-\frac{1}{2\sigma}(f^T - E_t f_t)^2\}(\tau_t^{\frac{\gamma}{\theta}} m_t^{\frac{1}{\theta}} \Theta - \pi_t^f)$$

TABLE 1

Response of the Interest Differential to Shifts in Exogenous Variables

Exogenous Variable	Sign of the Response	Derivative
primary deficit/GDP ratio	+	$\frac{\partial(i-i^f)}{\partial f_t} = \frac{p_t k_t}{\sigma}(f^T - E_t f_t)$
threshold primary deficit/GDP ratio	-	$\frac{\partial(i-i^f)}{\partial f^T} = -\frac{p_t k_t}{\sigma}(f^T - E_t f_t)$
variance of primary deficit	+	$\frac{\partial(i-i^f)}{\partial \sigma} = \frac{p_t k_t}{2\sigma}(1 + \frac{1}{\sigma}(f^T - E_t f_t)^2)$
tax rate	+	$\frac{\partial(i-i^f)}{\partial \tau_t} = \frac{p_t k_t}{\tau_t}$
money stock	+	$\frac{\partial(i-i^f)}{\partial m_t} = \frac{p_t k_t}{m_t}$
foreign inflation	-	$\frac{\partial(i-i^f)}{\partial \pi_t^f} = -p_t$

IV. The Italian Experience in the EMS

Italy's participation in the EMS contributed to a convergence of its inflation rate to a level close to the average in other EMS countries, as shown in Chart 1. The cost, in terms of slower growth, appears to have been relatively small, as real GDP growth exceeded average growth in the EMS countries until 1989, as shown in Chart 2. It also resulted in exchange rate stability, as shown in Chart 3, which plots the lira in its EMS band. The last significant realignment of the lira was in January 1987. In January 1990, the lira's 12 percent EMS band was replaced by the narrower 4-1/2 percent band targeted by most other EMS members. Despite these achievements, convergence of nominal interest rates was more limited until recently[9], as shown in Chart 1, contributing to the high level of real interest rates shown in Chart 4.

These developments may reflect the fact that the consensus that developed among Italian policy makers following entry into the EMS was limited to monetary policy, and is reflected in the 1981 agreement, between the Bank of Italy and the Treasury, curtailing the monetization of the budget deficit. Fiscal policy remained expansionary. Italy's deficit/GDP ratio has consistently exceeded 10 percent, despite strong revenue growth, contributing to a rapid rise in the debt/GDP ratio to above one hundred percent of GDP, as Chart 5 shows.

Another important factor contributing to the rise in the debt/GDP ratio was the high level of real interest rates. This can be illustrated by decomposing the increase in this ratio into the primary deficit/GDP ratio, the positive effect of real interest payments, and the negative effect of real GDP growth, as shown in Chart 6. (This decomposition is given in equation 8). The Chart shows that during the first half of the 1980s large primary deficits were the most important factor contributing to the debt/GDP ratio. However, since 1985, the real interest burden has been the most important contributing factor, as the primary deficit has declined from an average of roughly 6 percent between 1980 and 1985, to 0.6 percent in 1990. The contribution of strong real GDP growth has been large enough, since 1985, to roughly offset the impact of the primary deficit, implying that the increase in the debt/GDP ratio since 1985 is largely due to high real interest rates.

9. The recent narrowing may largely be due to German unification.

Monetary tightening is a plausible explanation for these high nominal, and real, interest rates only prior to 1987, because monetary policy became less restrictive in 1987. Chart 4 shows that the growth rate of the targeted monetary aggregate, M2, slowed until the end of 1987, but then began to rise, and has been consistently above its target range since 1987. The failure to coordinate monetary and fiscal policy following entry into the EMS contributed to a risk of realignment, and consequently, to high interest rates. These high interest rates contributed to the debt/GDP ratio and increased the size of the necessary fiscal adjustment by raising interest payments on the debt.

V. Estimation of Expected Exchange rate Depreciation Within the EMS Band

To test whether fiscal variables influence EMS interest rate differentials it is necessary to estimate the expected exchange rate depreciation within the EMS band (equal to the difference between the exchange rate and the EMS central rate, as shown in equation 2). A method of estimating this variable is developed by Rose and Svensson (1991), drawing on results from a paper by Svensson and Bertola (1991). They show that the expected change in the exchange rate within the EMS band is a nonlinear function of the current exchange rate, as in equation 14. This specification relies on the basic insight, due to Krugman (1990), that as an EMS currency approaches the edge its band exchange market intervention forces it back towards the center. Clearly, this intervention decision, and consequent change in the exchange rate, depends on the current position of the exchange rate within the band. The relationship is nonlinear because the exchange rate display's strong mean reversion near the edges of the band, but not near the center.

$$14)\qquad E_t\Delta \log s_{t+1} = \psi_1 \log s_t + \psi_2 \log s_t^2 + \psi_3 \log s_t^3 + \sum_{i=1}^{r} D_i \psi_{0i}$$

Equation 14 is estimated using the lira/DM exchange rate. It is essentially the same equation as that estimated by Rose and Svensson using the FF/DM exchange rate. The percentage change in the exchange rate has been approximated by the change in its log. The constant is combined with dummy variables allowing it to change with realignments[10].

Equation 14 is estimated in level, as this improved its statistical properties. An OLS estimator is used on monthly data for the period from the founding of the EMS in 1979 through 1990. Hetroscedasticity-corrected standard errors are reported with the estimation results in Table 2 due to evidence of hetroscedasticity. There is no evidence of parameter non-constancy over different sample periods, as can be seen from the plot of the Recursive Least Squares parameter estimate and Chow-test results shown in Chart 7. The fact that the parameter estimates remained stable when Italy adopted the narrower 4-1/2 percent band, may be due to the fact that the Bank of Italy had begun targeting a narrower band by intervening infra-marginally before it was officially adopted. Tests also rejected autocorrelation at 1 through 12 lags, and non-normality of the residuals. Also, an F-test rejected the hypothesis of linearity. Chart 8 plots the fitted value of the dependent variable in equation 14, which is the estimate of the expected change of the exchange rate within the EMS band.

10. Dummies were also used when the central rate changed because of the entry of a new currency into the EMS which alters the ECU's weights.

VI. Evidence of the Impact of Fiscal Policy on Interest Differentials

The effect, implied by the theoretical model, of fiscal variables, the money stock, and foreign inflation, on the Italian-German interest differential, can be tested by estimating equation 15. This specification was developed from equation 3 in two steps: first, the right hand side, representing the risk of an EMS realignment, was obtained by substituting a log-linear approximation of the right hand side of equation 13 into equation 3. Second, the dependent variable in equation 3 was constructed using the estimate (or fitted value), denoted using a hat "^", of the expected depreciation within the EMS band from equation 14. This estimate differs from the expected depreciation by an error term "ϵ_{t+1}", as shown in equation 16. This error term appear with the conventional error term "v_t", in equation 15. The fact that it is dated "t+1" means that it could be correlated with right hand side variables, resulting in an errors-in-variables bias. This suggests that an instrumental variables (IV) estimator might be appropriate.

$$15)\quad y_t = \alpha_1 f_t + \alpha_2 f_t^2 + \alpha_3 \log\tau_t + \alpha_4 \log m_t + \alpha_4 \log\pi_t^f + \sum_{i=1}^{\tau} D_i\alpha_{0i} + v_t + \epsilon_{t+1}$$

$$y_t = i_t - i_t^f - \Delta\log\hat{s}_{t+1}$$

$$16)\quad \Delta\log\hat{s}_{t+1} = E_t\Delta\log s_{t+1} - \epsilon_{t+1}$$

Equation 15 is estimated using one-month Eurolira and EuroDM interest rates, the M1 monetary aggregate, and central government fiscal variables[11]. Estimation results are significantly improved by allowing a one-period lag on the right hand side variables, probably due to the fact that these variables are released with a one month lag. OLS and IV estimation results are reported in Table 3 for the case of a constant intercept term; and, for the case where the intercept term is combined with realignment dummies, allowing it to vary with each realignment. An F-test supports including these dummies. Monthly seasonal dummies are used to correct for seasonal effects[12]. The equation residuals are tested for non-normality, hetroscedasticity and ARCH processes, and show no signs of autocorrelation at one through 12 lags. The Durbin-Watson (DW) co-integration test indicate that each variable, except M1 (which was not significant), is I(1).

Dickey-Fuller (DF), and Augmented DF co-integration tests, reported in Table 4, indicate that the dependent variable is co-integrated with the right hand side variables. This implies the existence of a long run relationship between the adjusted interest differential and fiscal variables. It also suggests that estimation of the error correction representation (ECR) of equation 15 should yield more precise estimates, as it captures the short run as well as the long run relationship. Table 5 reports estimates for four version of the ECR (OLS and IV estimators, with and without realignment dummies). The equation residuals passed all the statistical tests mentioned above.

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11. In the model variables appear as ratios to GDP. Fortunately, it is possible to normalize GDP to unity, allowing the use of monthly data. The variance of the budget deficit "σ", and the threshold deficit, are unobservable, and will be reflected in the constant and error term.
12. The Table does not include the estimates of the twelve constant dummies and eleven seasonal dummies. These variables were generally not statistically significant.

The estimation results show that the budget deficit and the tax rate are statistically significant, with the right sign, in all eight reported regressions. (The negative sign on the budget deficit implies that as it becomes more negative the interest differential increases). The IV estimation results are quite similar to the OLS results, except that the significance levels are a bit lower, and sensitive to the choice of instruments. In the ECR, foreign inflation is significant when OLS is used, while the money supply variable is significant when IV is used, both with the right sign, providing additional support for the model. The relatively low R^2 and partial-r^2 (giving the correlation of each regressor with the dependent variable), suggests that the variables in the model are able to explain only a portion of the movements in the dependent variable. The instruments used were lagged model variables, Italian industrial production and exports, and German M1 and imports.

VII. Conclusion

This paper develops a model showing how EMS interest differentials are influenced by fiscal policy. For countries like Italy, with large budget deficits, the commitment to a stable EMS exchange rate can entail costly fiscal adjustment. As a result, there is a risk that an increase in the budget deficit will cause a government to adopt a more inflationary monetary policy with periodic realignments to generate inflation tax revenues, as an alternative to fiscal adjustment. It is the possibility of these periodic realignments that contribute to the EMS interest differential.

Empirical tests support the model, as both the deficit and the tax rate are statistically significant with the correct sign. In addition, co-integration tests reveal a long-run relationship between the budget deficit and the interest differential. However, the low R^2 statistics suggest that fiscal variables only explain part of the interest differential. The model and empirical results imply that the Italian-German interest differential is likely to persist in the second phase of EMU, if Italy fails to reduce its budget deficit, providing support for the view that fiscal convergence is a necessary element of EMU.

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TABLE 2

Estimation of the Expected the Exchange Rate Change Within the EMS Band

$$E_t \log s_{t+1} = (1+\psi_1)\log s_t + \psi_2 \log s_t^2 + \psi_3 \log s_t^3 + \sum_{i=1}^{r} D_i \psi_{0i}$$

Coefficent	Estimate	Heteroscedasticty Corrected Standard Error
$(1+\psi_1)$	0.93	0.24
ψ_2	1.15	1.87
ψ_3	-143.4	157.7
ψ_{01}	0.0037	0.0034
ψ_{02}	0.0076	0.0018
ψ_{03}	0.0009	0.0026
ψ_{04}	0.0019	0.0027
ψ_{05}	-0.0042	0.0081
ψ_{06}	-0.0043	0.0041
ψ_{07}	-0.0043	0.0051
ψ_{08}	-0.0025	0.0048
ψ_{09}	-0.003	0.0041
ψ_{010}	0.0038	0.0025
ψ_{011}	0.0002	0.0027
ψ_{012}	-0.0009	0.0034

$R^2 = 0.83$, DW = 2.033, RSS = 0.0126, no. observations = 145

TABLE 3
Estimation of Adjusted EMS Interest Differential Equation

$$y_t = \alpha_1 f_t + \alpha_2 f_{t-1} + \alpha_3 f_t^2 + \alpha_4 f_{t-1}^2 + \alpha_5 \log r_t + \alpha_6 \log r_{t-1}$$
$$+ \alpha_7 \log m_t + \alpha_8 \log m_{t-1} + \alpha_8 \log \pi_t^f + \alpha_{10} \log \pi_{t-1}^f$$

OLS Estimation

	VERSION 1 (with realignment dummys)			VERSION 2	
Coefficent	Estimate	t-statistic	partial-r^2	estimate	t-statistic
α_1	0.0001	0.61	0.004	0.00014	0.86
α_2	-0.0003	-1.73	0.027	-0.00025	-1.90
α_3	0.000003	0.43	0.002	0.000004	0.69
α_4	-0.00001	-1.89	0.032	-0.00001	-2.10
α_5	0.012	2.50	0.054	0.015	3.61
α_6	0.002	0.42	0.002	0.004	0.91
α_7	-0.011	-0.17	0.0003	-0.003	-0.46
α_8	-0.014	-0.21	0.0004	-0.002	-0.03
α_9	0.42	1.14	0.012	0.46	1.35
α_{10}	-0.41	-1.08	0.01	-0.40	-1.17
Constant				0.11	3.59

Version 1: R^2 = 0.58, DW = 2.09, RSS = 0.0065,   Version 2: R^2 = 0.26, DW = 2.02, RSS = 0.007

Instrumental Variables Estimation

	VERSION 1 (with realignment dummys)		VERSION 2	
Coefficent	Estimate	t-statistic	estimate	t-statistic
α_1	-0.001	-0.97	-0.00004	-0.10
α_2	-0.0004	-1.79	-0.0003	-1.69
α_3	-0.00005	-1.05	-0.000006	-0.37
α_4	0.000001	0.06	-0.000008	-0.88
α_5	0.025	1.89	0.016	3.35
α_6	0.007	0.89	0.004	0.84
α_7	0.007	0.08	-0.028	-0.44
α_8	-0.057	-0.62	-0.003	-0.05
α_9	0.25	0.51	0.50	1.42
α_{10}	-0.62	-1.21	-0.40	-1.20
Constant			0.11	3.44

Version 1: DW = 1.99, RSS = 0.01,   Version 2: DW = 1.98, RSS = 0.007

TABLE 4

Co-Integration Test Results

$$\Delta ECT_t = \phi_1 ECT_{t-1} + \sum_{i=2}^{13} \phi_i \Delta ECT_{t+1-i}$$

	Dickey-Fuller Test		Augmented Dickey-Fuller Test	
Coefficent	Estimate	t-statistic	estimate	t-statistic
ϕ_1	-1.05	-12.4	-1.56	-3.51
$\sum_{i=2}^{13} \phi_i$			Estimates not significantly different from zero for all 12 lags	

TABLE 5

Error Correction Representation of the Interest Differential Equation

$$y_t = \alpha_1 \Delta f_t + \alpha_2 \Delta f_{t-1} + \alpha_3 \Delta f_t^2 + \alpha_4 \Delta f_{t-1}^2 + \alpha_5 \Delta \log \tau_t + \alpha_6 \Delta \log \tau_{t-1}$$

$$+ \alpha_7 \Delta \log m_t + \alpha_8 \Delta \log m_{t-1} + \alpha_8 \Delta \log \pi_t^f + \alpha_{10} \Delta \log \pi_{t-1}^f + \alpha_{11} ECT_{t-1}$$

OLS Estimation

	VERSION 1 (with realignment dummys)			VERSION 2	
Coefficent	Estimate	t-statistic	partial-r^2	estimate	t-statistic
α_1	0.0002	1.31	0.016	0.00012	1.38
α_2	-0.0002	-1.59	0.023	-0.0002	-1.60
α_3	0.000005	0.93	0.008	0.000005	0.98
α_4	-0.000009	-1.85	0.031	-0.000009	-1.92
α_5	0.013	3.08	0.081	0.013	3.33
α_6	0.002	0.54	0.003	0.002	0.64
α_7	0.036	0.50	0.002	0.014	0.23
α_8	0.133	1.81	0.029	0.11	1.67
α_9	0.48	1.44	0.019	0.52	1.66
α_{10}	-0.48	-1.42	0.018	-0.47	-1.47
α_{11}	-1.04	-9.94	0.478	-1.04	-10.35
Constant				-0.01	-1.09

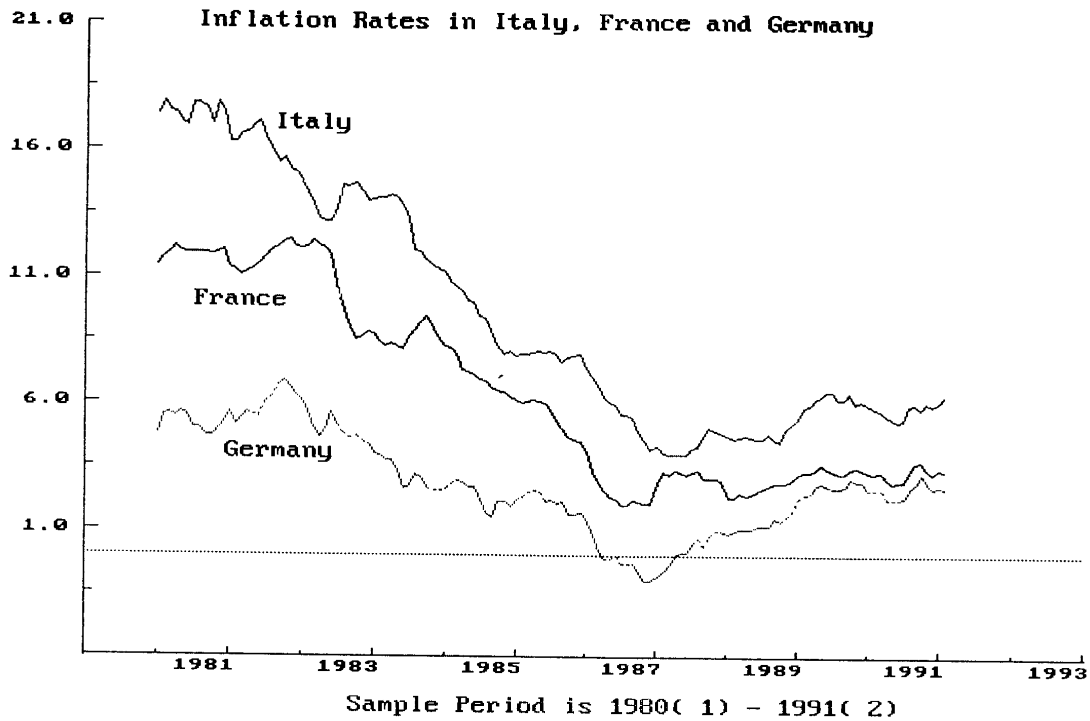
R^2= 0.60, DW = 2.00, RSS = 0.0074, R^2= 0.26, DW = 2.02, RSS = 0.007

TABLE 5 (continued)

Instrumental Variables Estimation

	VERSION 1 (with realignment dummys)		VERSION 2	
Coefficent	Estimate	t-statistic	estimate	t-statistic
α_1	-0.0004	-1.91	-0.00025	-2.02
α_2	0.00002	0.11	0.00004	0.32
α_3	-0.00002	-2.33	-0.00001	-2.44
α_4	0.000001	1.61	-0.000009	1.59
α_5	0.02	4.32	0.019	4.55
α_6	0.002	0.45	0.002	0.47
α_7	0.023	0.30	0.01	0.15
α_8	0.094	1.19	0.08	1.14
α_9	0.36	0.99	0.43	1.29
α_{10}	-0.71	-1.94	-0.65	-1.89
α_{11}	-0.88	-8.61	-0.86	-8.99
Constant			-0.13	-1.54
	DW = 2.21, RSS = 0.008,		DW = 2.24, RSS = 0.009	

CHART 1


Inflation Rates in Italy, France and Germany
21.0
16.0
11.0
6.0
1.0
Italy
France
Germany
1981
1983
1985
1987
1989
1991
1993
Sample Period is 1980(1) - 1991(2)

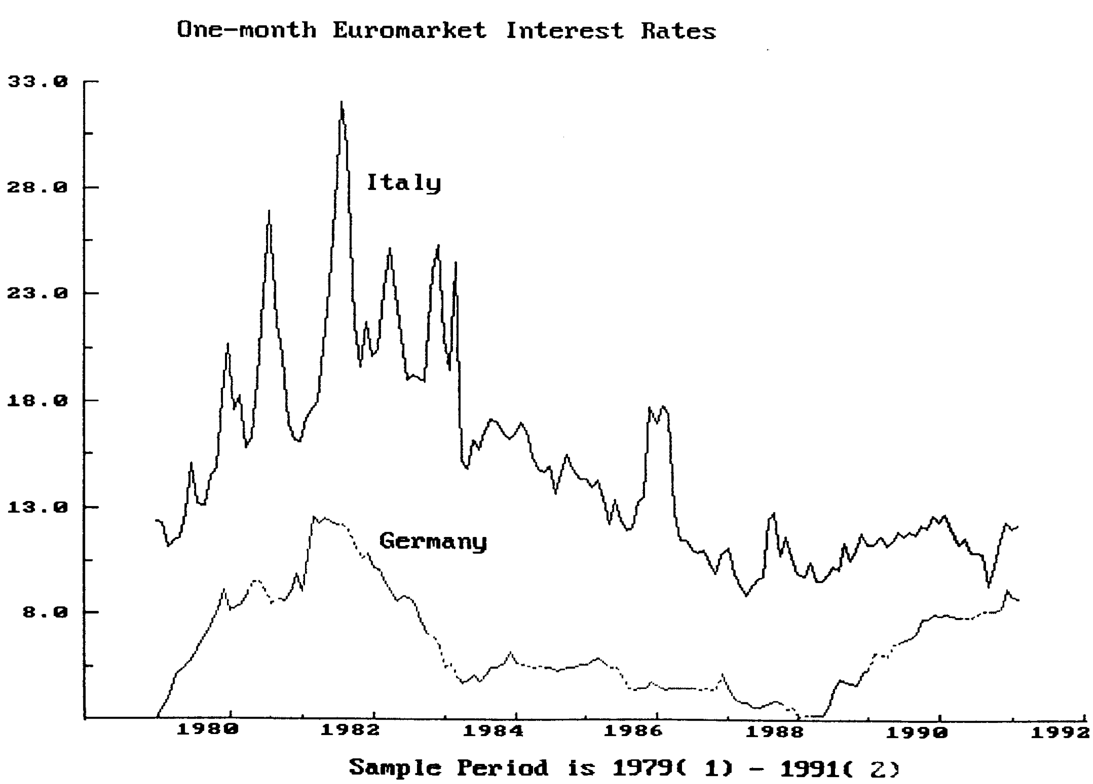
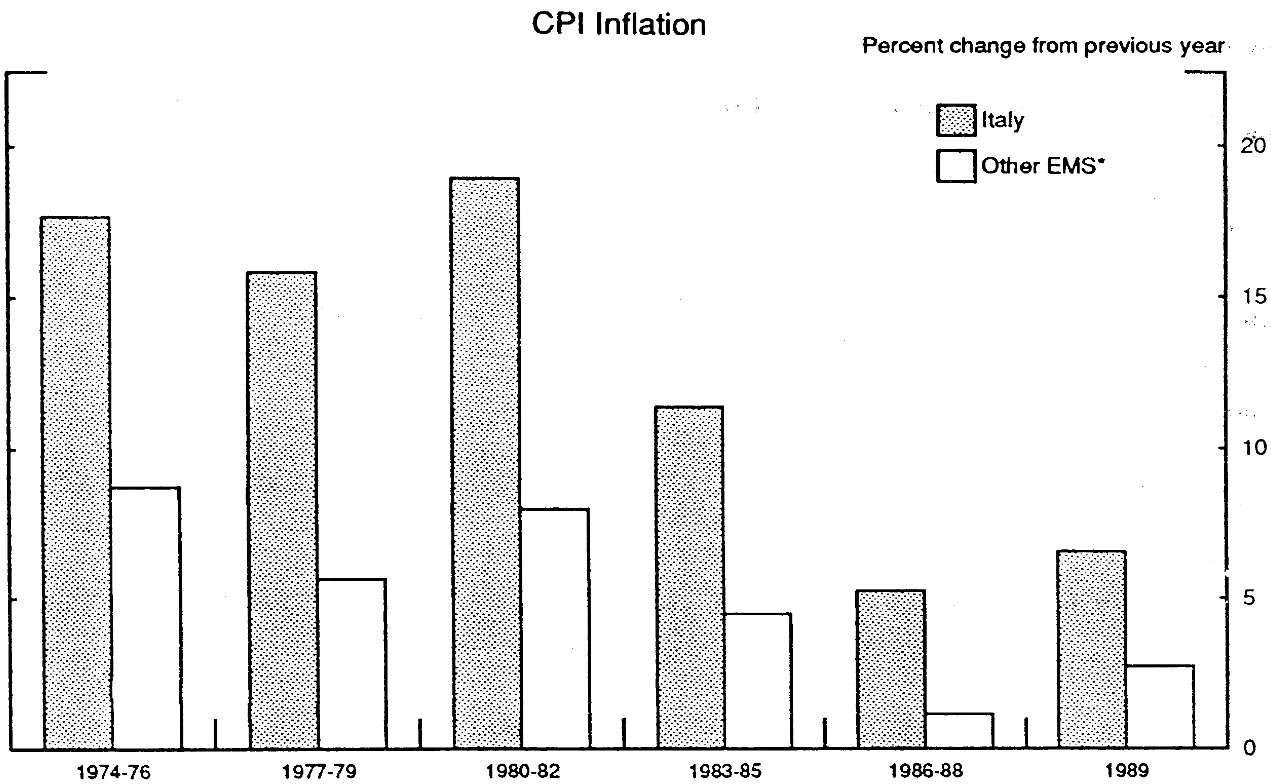
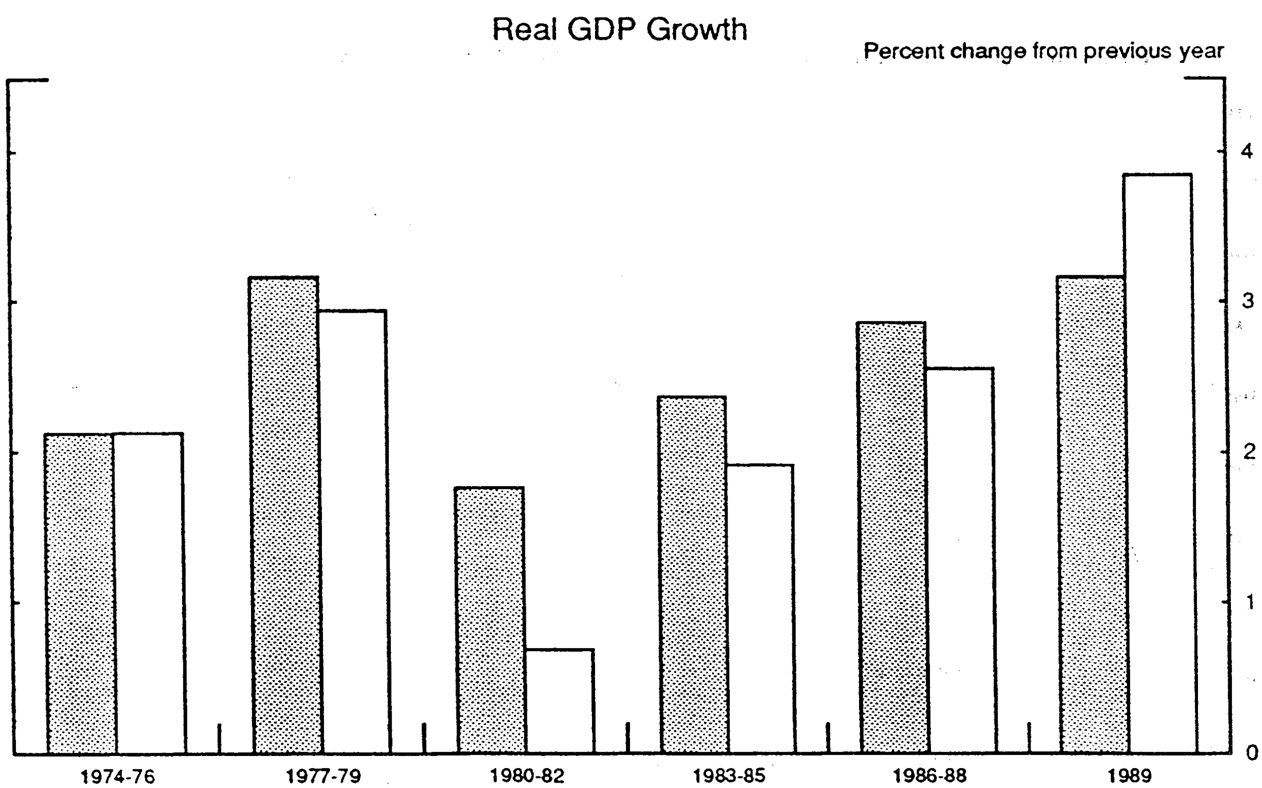

One-month Euromarket Interest Rates
33.0
28.0
23.0
18.0
13.0
8.0
Italy
Germany
1980
1982
1984
1986
1988
1990
1992
Sample Period is 1979(1) - 1991(2)

CHART 2

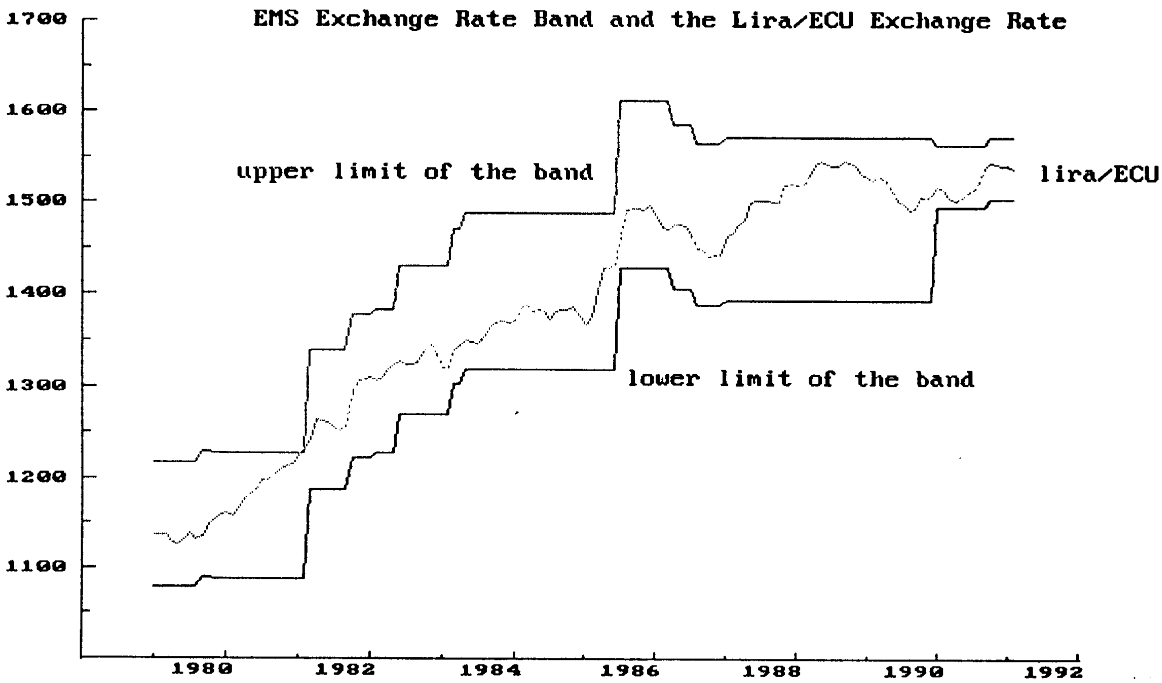




*Germany, France, Netherlands, Belgium

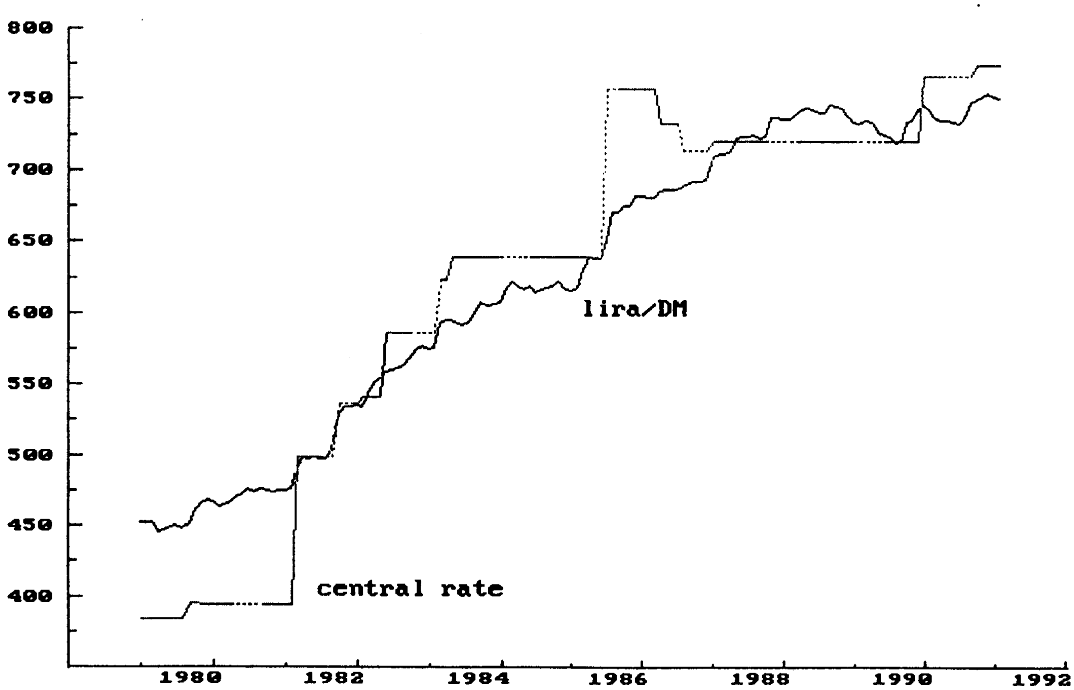
CHART 3

EMS Exchange Rate Band and the Lira/ECU Exchange Rate



Sample Period is 1979(1) - 1991(2)

Plot of The Lira/DM Exchange Rate and EMS Central Rate

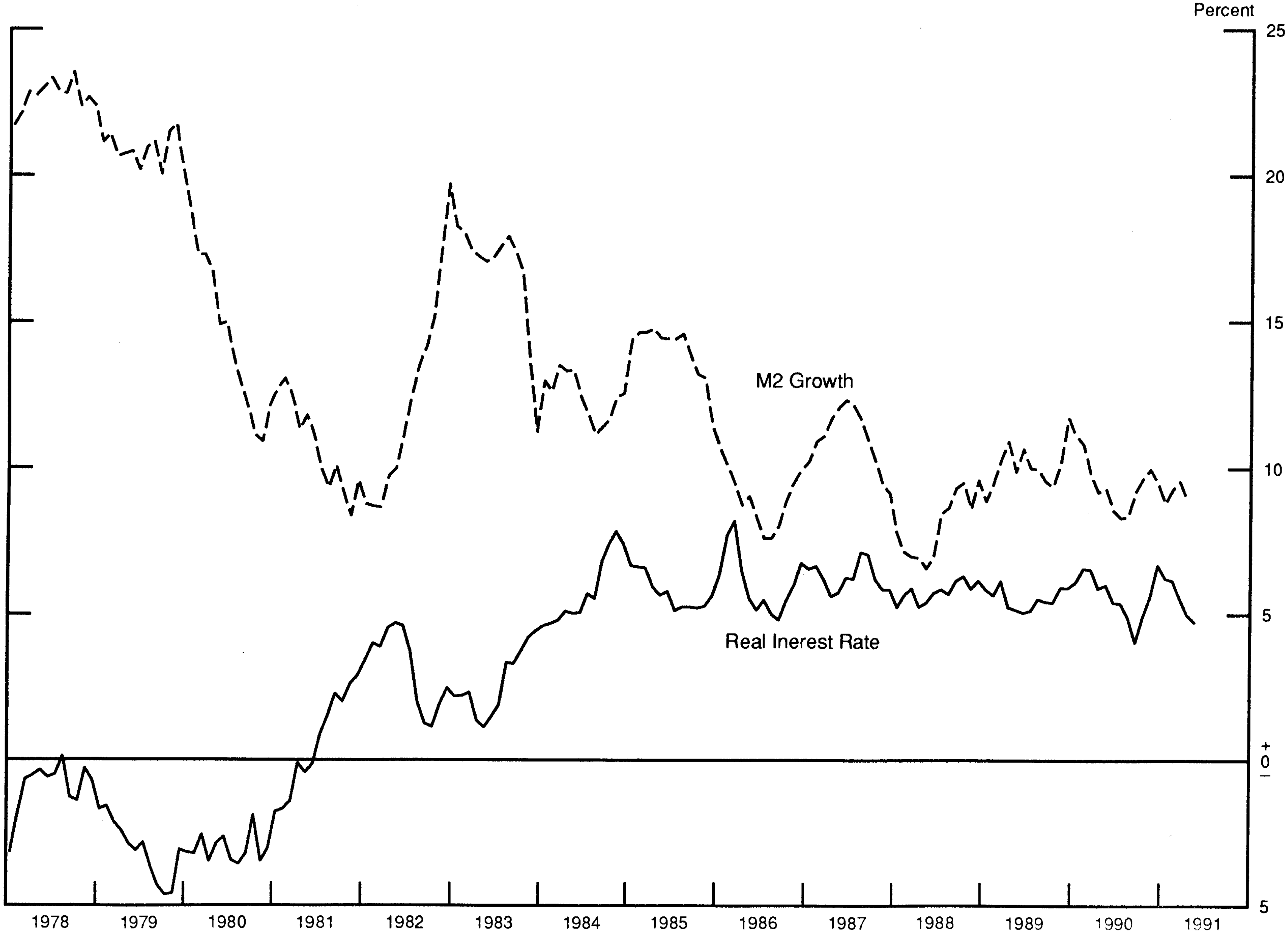


Note: mean of the central rate adjusted to match that of the DM

Chart 4

6/17/91

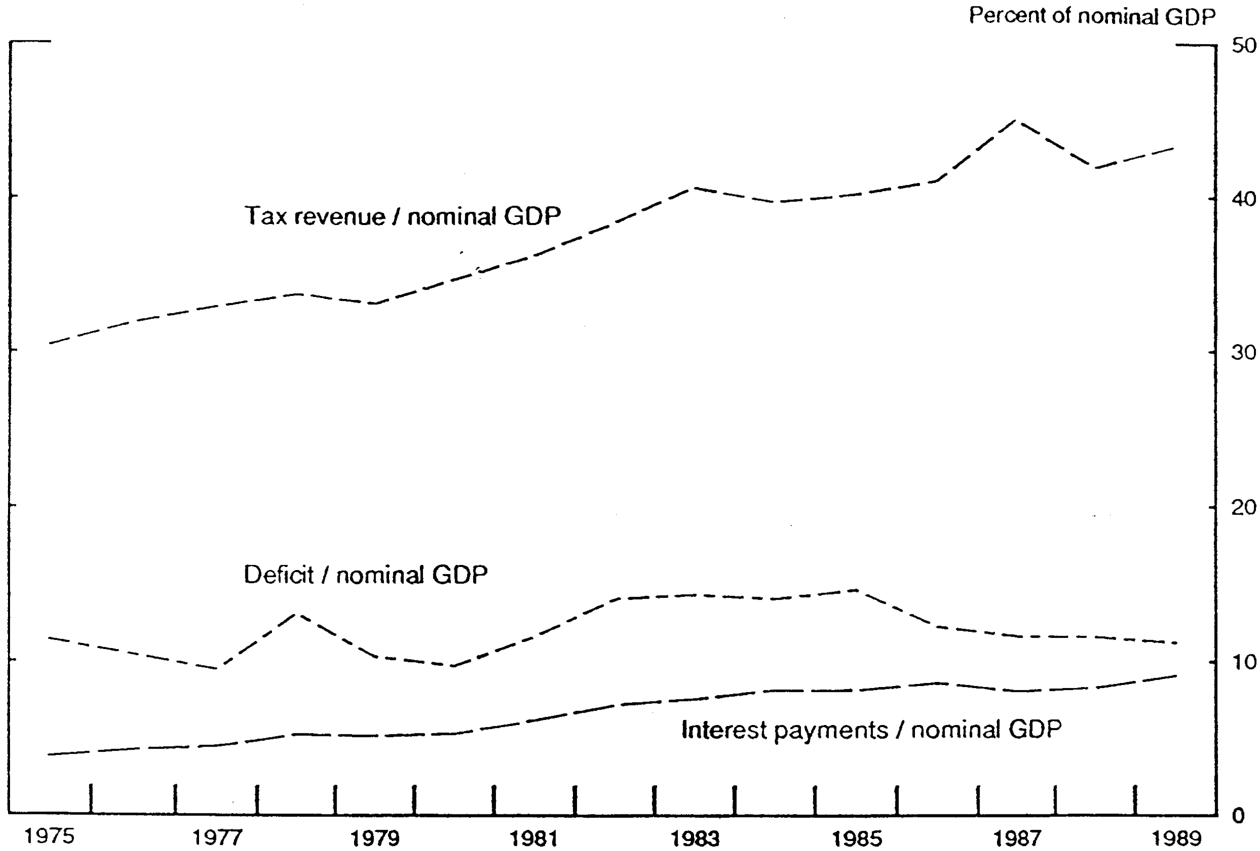
Italian Real Interest Rate and M2 Growth



Real Interest Rate is computed using the 3-month interbank rate and the consumer price index.
M2 Monetary Aggregate is seasonally adjusted.

CHART 5

Italian Government Revenues and Interest Payments



Italian Public Sector Debt

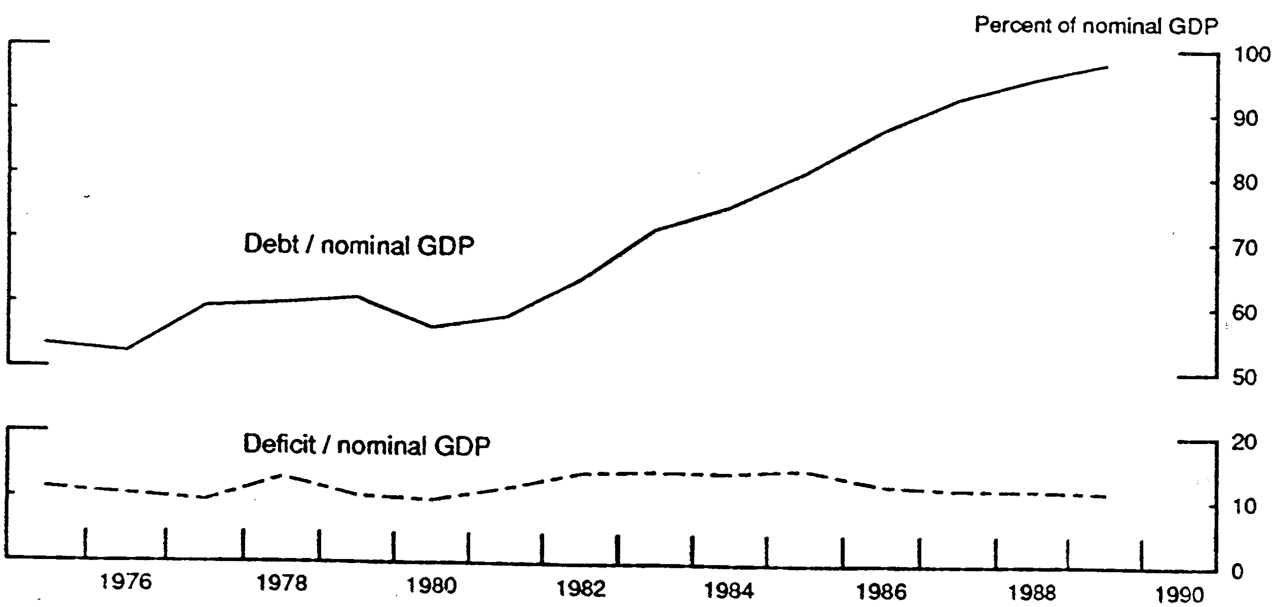


CHART 6

Decomposition of Increase in Italian Debt / GDP Ratio

Increase in debt / GDP ratio

equals primary deficit / GDP ratio

plus effect of real interest burden on debt / GDP ratio

less effect of real GDP growth on debt / GDP ratio

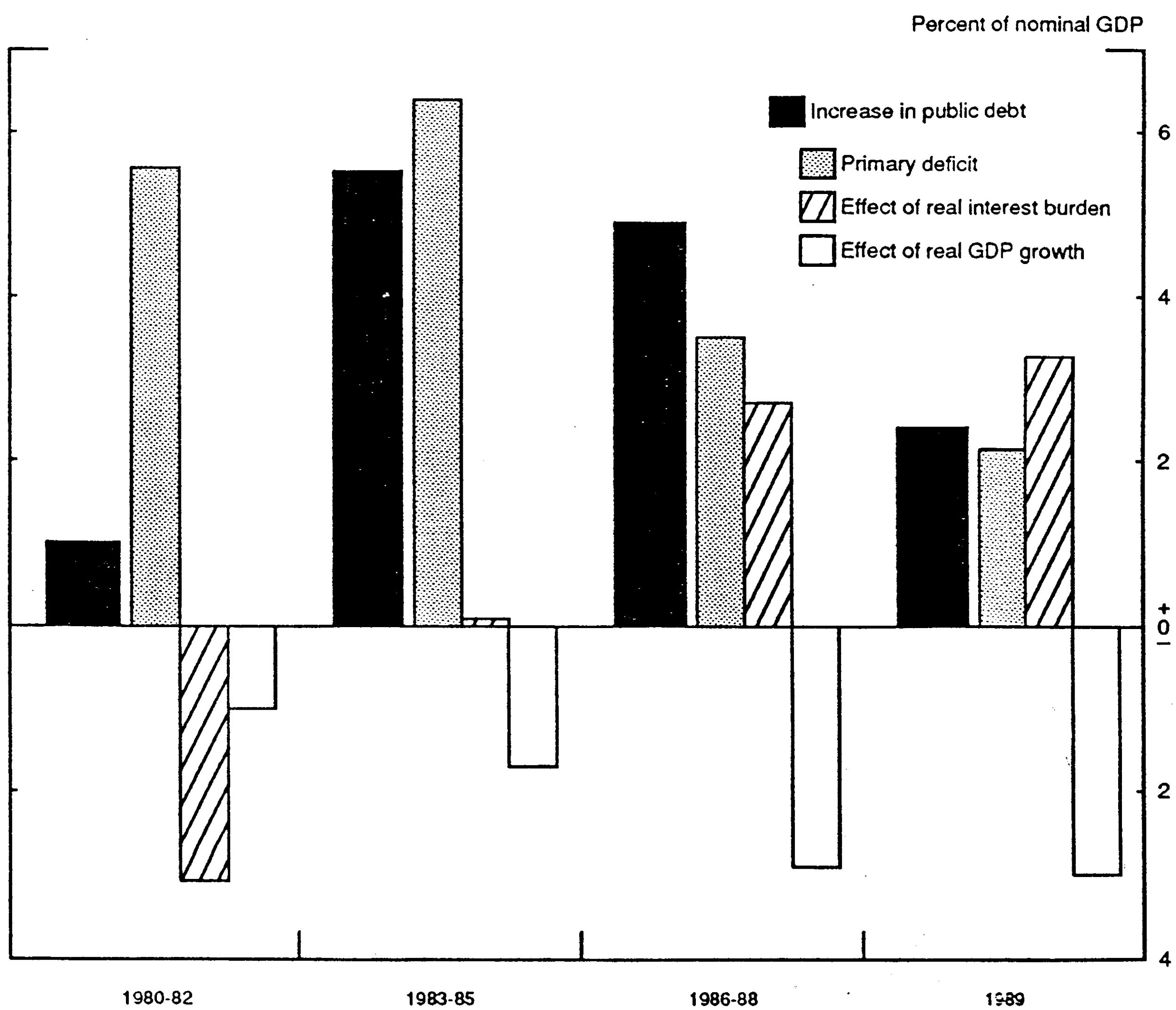
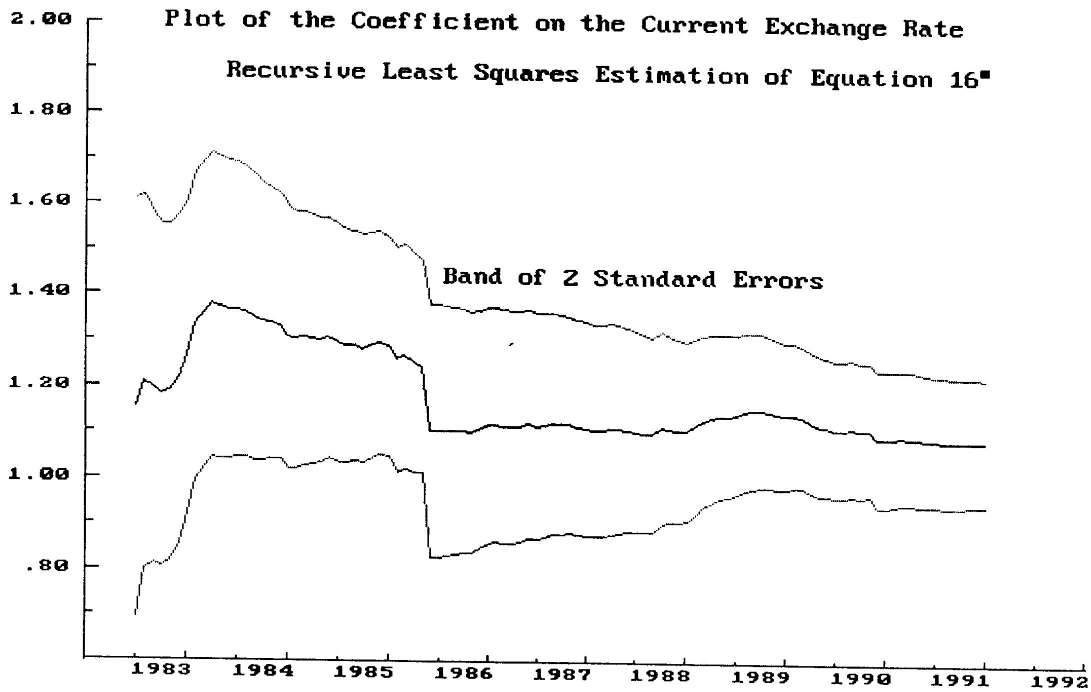
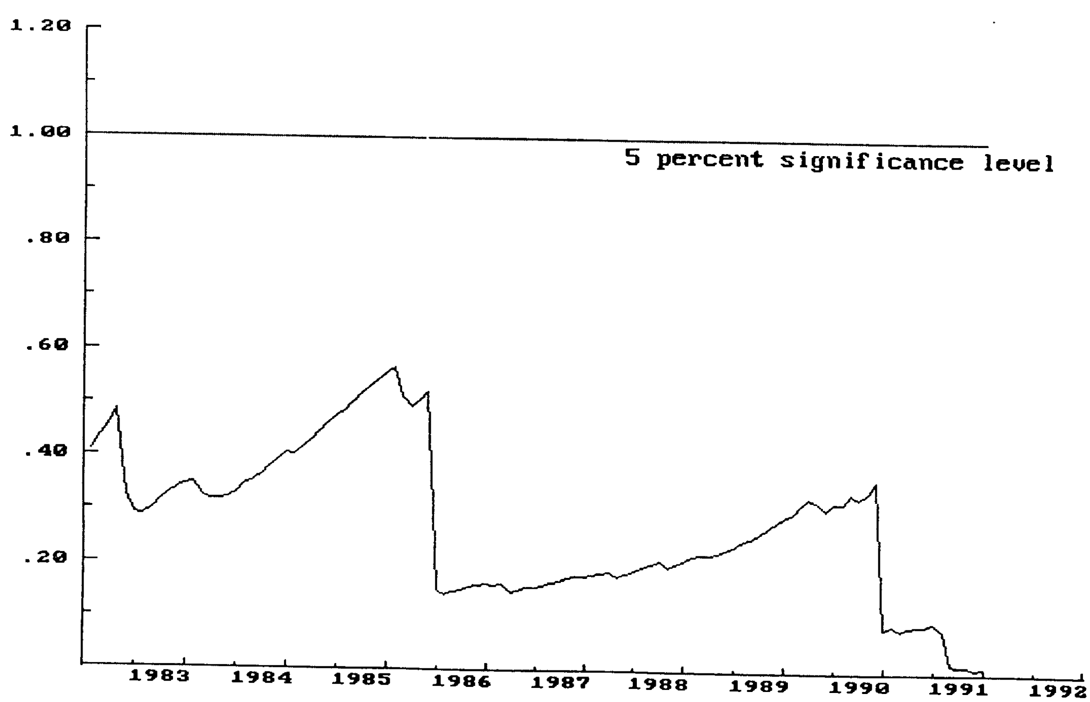


CHART 7

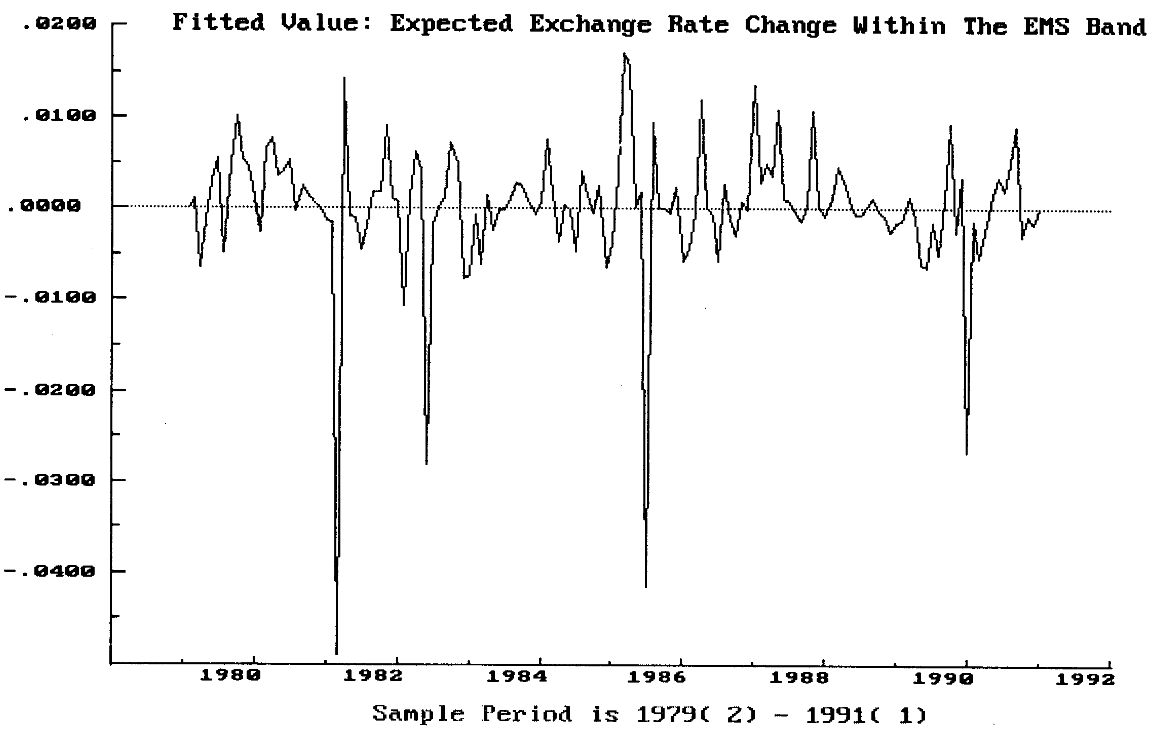


CHOW-test of Constancy of Coefficient on the Current Exchange Rate



CHOW-test of full sample estimate against each sub-period estimate

CHART 8


Fitted Value: Expected Exchange Rate Change Within The EMS Band
.0200
.0100
.0000
-.0100
-.0200
-.0300
-.0400
1980
1982
1984
1986
1988
1990
1992
Sample Period is 1979(2) - 1991(1)

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