Did the EMS Encourage Inflation Convergence?

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Abstract

This paper studies the convergence of inflation rates over the period of 1983-93 for some countries within the European Monetary System. Three different price indices are considered for consumer goods, services, and industrial products. This study focuses on the difference between core and peripheral countries for measuring convergence speed. By using β- and σ-convergence tools, as previously identified in studies on output growth convergence, it was found that the convergence process did not evolve equally whether considered through price indices, time, or countries. (JEL E31, C31, C32, O52)

Introduction

The purpose of this study is to analyze the convergence in inflation rates within some countries belonging to the European Monetary System (EMS) in the period prior to 1993. Even though the final criterion for nominal convergence were stipulated in the Maastricht Treaty (revised in October 1993) and the EMS was founded in 1979, it was not until 1983 that the countries realized that lower inflation rates were necessary [Lambertini et al., 1992, p. 334].

Instead of focusing on the achievement or non-acheivement of the Maastricht Criterion for inflation, this study centers on the underlying behavior of the inflation rates for the period 1983-93. Pegging each currency to the Deutsche mark (DM) was the main policy adopted by countries to reach convergence during this period [Giavazzi and Pagano, 1988; De Grauwe, 1992]. However, the final accession of many countries to the European Monetary Union (EMU) required the implementation of additional restrictive policies after 1993 [Alderton, 1997]. In this work, the 1983-93 period is studied to evaluate the deflationary policies put in place by several countries in the EMS before additional measures were introduced.

Not only is the evolution of the Consumer Price Index (CPI) investigated, but the analysis of inflation convergence is extended to other price indices such as the Industrial Price Index (IPI) and the Services Price Index (SPI).[1] This enables the study to look for possible dual behavior. Canzonery et al. [1996] pointed out the existence of dual inflation, since the prices of tradable goods are more likely to harmonize between countries than the prices of non-tradable goods. Therefore, CPI convergence could be delayed by the lack of competition in service goods.

This fact of dual inflation may be more relevant in countries with above average inflation. Giavazzi and Pagano [1988] were the first to note that some countries may converge at a

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faster rate than others. For example, Dutch inflation had converged to the German rate by 1979 [Berk and Winder, 1994], while inflation in Belgium, Denmark, and France appeared to have converged by the late 1980s. In contrast, the United Kingdom, Italy, and Spain needed more time (and additional policies) to achieve full convergence. In fact, Dornbusch [1990] suggested the possibility of a two-speed Europe, and Bini-Smaghi and Del Giovane [1996] advised the negative consequences of this possibility.

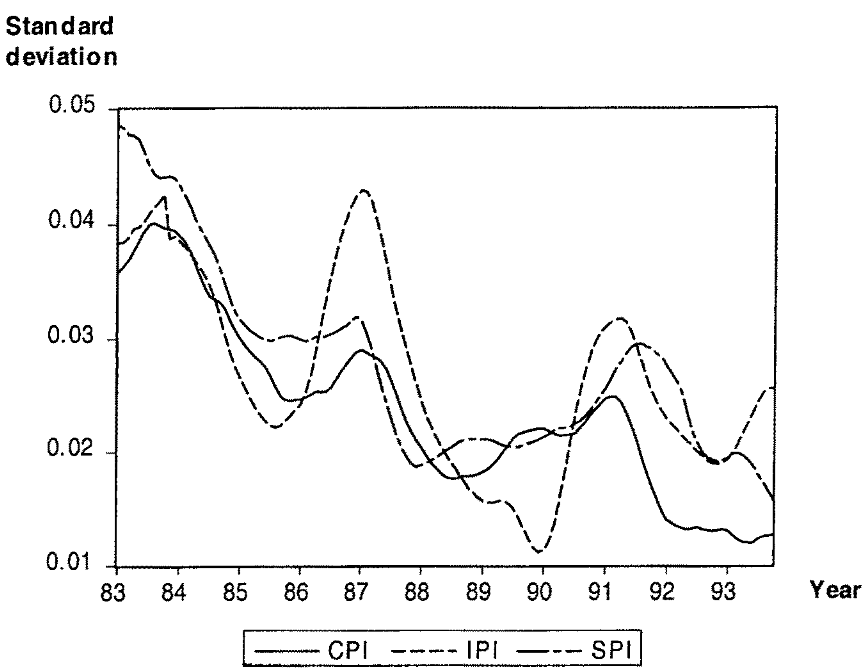
The notion of convergence that is considered throughout this study is in line with Bernard and Durlauff [1995]. Convergence takes place when differences between the inflation rates of two countries and the dispersion between the inflation rates for all countries die over time. Convergence is defined in terms of computing differences with respect to a leading country. In this work, two possibilities are taken as the benchmark. First is the average inflation of the three countries with the lowest inflation rates (the Maastricht Criterion), and the second is the non-weighted average inflation rates of all the countries involved.

From the ample set of techniques available for evaluating convergence [Hall et al., 1992], two that are widely utilized in the literature of output growth convergence were selected. These are dispersion measures, also known as σ-convergence, and mean reversion tests, or β-convergence [Barro and Sala-i-Martín, 1992]. As anticipated, both methodologies confirm a generalized convergence over the period, even though it evolved dissimilarly for the countries and the price indices.

The rest of the paper is organized as follows. The next section analyzes convergence through the use of the dispersion measures, which allows σ-convergence to be studied. The following section shows the mean reversion tests, which allows for an investigation using β-convergence. Thus, it is assessed whether an overall convergence for the countries analyzed was achieved or not. The study then finishes with some concluding remarks.

Sigma-Convergence

FIGURE 1
Dispersions of CPI, IPI, and SPI



The σ-convergence method consists of plotting the dispersion (standard error) for the series over time across countries. When the graph shows a decreasing dispersion trend, it indicates that inflation rates for different countries are converging. The graph for the three different inflation rates under consideration is shown in Figure 1.

It can be seen that dispersion declined over time; in 1993, it was clearly much smaller than in 1983. This indicates that inflation rates for different countries were getting closer, and hence, convergence was in process. However, this general behavior was at times interrupted by periods in which dispersion increased, causing some peaks in the graphs. These peaks are sharper in the IPI case, perhaps reflecting its greater sensitivity to external shocks. This is presumably due to the fact that industrial goods are subjected to international competition, and therefore, their prices are more dependent on the evolution of the international economy. In contrast, the CPI and the SPI are likely to move mainly according to internal forces and in turn, were not as affected by shocks coming from abroad.

Beta-Convergence

This method has been widely used in modern studies on convergence of the output growth rate. According to this idea, convergence means that countries with higher inflation rates should exhibit a growth rate which is slower than that of countries with lower rates. This can be tested on the basis of cross-sectional inflation values by regressing the change in inflation of a country at two points in time, one being its initial value. This technique became very popular after the work of Barro and Sala-i-Martin (BSM) [1992]. The convergence discussed here is, in the terminology of BSM, absolute β-convergence. Formally, one would say that a set of countries exhibits absolute β-convergence if for all i, j in the set of countries, and for all time:

$$E_t[\lim_{s \longrightarrow \infty} (\pi_{it+s} - \pi_{jt+s})] = 0 \quad ,$$

where π_{it} and π_{jt} are the inflation rates in countries i and j, respectively.

The aim pursued by such regressions is to estimate a parameter, for example, β, which measures how rapidly inflation convergence is taking place among countries. It gauges the change in the relative inflation rate, expressed as a fraction of its initial value, which is negative if convergence exists.[2] In the output growth convergence literature, the regression equation is derived from a log-linearization around the steady state of a single good neoclassical model. This is not the case in this study, where there is no theoretical or economic reason why inflation rates between countries should converge. However, if all the countries are considered as belonging to a DM standard, where pegging each currency to the DM acted as a deflationary pressure, then a process of convergence in inflation rates would, in fact, be expected. Therefore, the aim is to assess whether convergence took place or not, that is, to test $0 < \beta < 1$ and also compare estimates of β between the different price indices used.

The Model

A general model in which convergence is not explicitly posited is expressed as:

$$\pi_{jt} - \pi_{jt-1} \equiv \Delta\pi_{jt} = \mu - \beta\pi_{jt-1} + \delta_t + \alpha_j + \varepsilon_{jt} \quad . \tag{1}$$

In (1), the inflation rate in country j can be explained by the following components: μ, a constant component; π_{jt-1}, a component depending on the lagged value of the inflation rate in that country; δ_t, a component which is constant for each country, but varies across time; and α_j, a component which is constant over time, but is specific to each country. If all α_j

components are the same, then after some transitory dynamics, the inflation rates of each country will converge to the same level, dictated by δ_t (assuming that $\varepsilon_{jt} = 0$, for all j).

Constructing the average for all j results in:

$$\Delta\bar{\pi} = \mu - \beta\bar{\pi}_{t-1} + \delta_t + \bar{\alpha} + \bar{\varepsilon}_t \quad , \tag{2}$$

and subtracting (2) from (1) results in:

$$\Delta\pi_{jt} - \Delta\bar{\pi}_t = -\beta\left(\pi_t - \bar{\pi}_{t-1}\right) + \left(\alpha_j - \bar{\alpha}\right) + u_{jt} \quad . \tag{3}$$

This can be replaced by:

$$D\pi_{jt} - D\pi_{jt-1} = -\beta D\pi_{jt-1} + D\alpha_j + u_{jt} \quad , \tag{4}$$

where $D\pi_{js} = \pi_{js} - \bar{\pi}_s$ for all $s = 1,..,T$, and $D\alpha_j = \alpha_j - \bar{\alpha}$ for all j. At this point, one can proceed in two alternative ways, either by estimating non-linear squares (NLS) as used by BSM, or by estimating seemingly unrelated regressions (SUR) using maximum likelihood estimation, as proposed by Symons [1995]. Both are analyzed in turn.

The BSM regression is derived from iterated substitution in (4), where $D\alpha_j = 0$ for all j is assumed.[3] This results in:

$$D\pi_{jt} - D\pi_0 = -\left[1 - (1-\beta)^T\right] D\pi_0 + u_j \quad , \tag{5}$$

where $u_j = \sum_{h=0}^{T} (1-\beta)^h u_{jT-h}$. Thus, an estimate of β can be found by NLS.

SUR estimation is carried out by rewriting (4) as:

$$D\pi_{jt} = (1-\beta)\, D\pi_{jt-1} + D\alpha_j + u_{jt} \quad , \tag{6}$$

where it is clear that both $D\alpha_j = 0$ for all j and $|\beta| < 1$ are required for absolute β-convergence, as has been defined.[4] Furthermore, β should be different from zero for stationarity in inflation rates. If $D\alpha_j \neq 0$, then countries show different long-run inflation rates. This is known as the conditional β–convergence (as defined in BSM). Therefore, the use of a non-weighted inflation average (NWA) to compute the inflation rate differences is justified. In an analogous way, a country's inflation rate differences can be computed against some other leading country. The Maastricht Criterion (MC) is considered as well. Therefore, throughout this section, the hypothetical leading countries use both the NWA and the MC.

Which estimation yields more reliable values of the parameter is not discussed here (for a detailed comparison of both regression equations, see Symons, 1995). In principle, although BSM regression is more robust against the risk of misspecifications, the SUR estimation is more efficient. Additionally, (6) allows for u_{jt} to be contemporaneously correlated across countries. Lastly, the possibility of the parameter varying from hard- to soft-EMS[5] can be investigated by imposing a common slope for core countries on one side, a common slope for peripheral countries on the other side, then comparing them.

Estimation

BSM

Equation (5) is now estimated by NLS. The whole sample and three sub-periods, as defined in Lambertini et al. [1992], are studied.[6] It is investigated whether the adjustment speed was unchanged throughout the period, or whether there were some intervals in which the process accelerated or slowed down. The null of structural breaks in 1986 and 1990 is not rejected by the likelihood ratio test [as applied in BSM]. The results are shown in Table 1.

TABLE 1
NLS Estimates
Differences Computed Relative to NWA

Price Index	Year	β	t-ratio	R^2	White	LR
CPI	1983-86	0.055	(2.30)	0.60	0.23	
	1986-90	0.027	(2.72)	0.35	0.89	
	1990-93	0.097	(2.82)	0.73	4.47	
	1983-93	0.052	(1.98)	0.89	5.06	
	1983-93*	0.052	(3.77)			51.34
IPI	1983-86	0.068	(1.93)	0.45	1.26	
	1986-90	0.140	(1.63)	0.77	0.50	
	1990-93	0.024	(2.73)	0.23	1.94	
	1983-93	0.026	(4.58)	0.66	2.75	
	1983-93*	0.066	(3.07)			43.41
SPI	1983-86	0.043	(4.64)	0.72	2.54	
	1986-90	0.029	(2.21)	0.37	0.31	
	1990-93	0.075	(3.12)	0.72	1.61	
	1983-93	0.044	(2.38)	0.61	1.39	
	1983-93*	0.043	(4.42)			58.76
Differences Computed Relative to MC						
CPI	1983-86	0.045	(4.06)	0.71	0.68	
	1986-90	0.022	(2.06)	0.35	1.88	
	1990-93	0.051	(2.38)	0.59	3.87	
	1983-93	0.032	(6.77)	0.91	1.51	
	1983-93*	0.045	(5.39)			52.19
IPI	1983-86	0.044	(1.83)	0.37	2.44	
	1986-90	0.017	(1.02)	0.17	2.51	
	1990-93	0.012	(1.74)	0.15	1.58	
	1983-93	0.010	(1.99)	0.29	1.11	
	1983-93*	0.010	(1.33)			41.11
SPI	1983-86	0.037	(6.58)	0.65	1.91	
	1986-90	0.018	(3.79)	0.38	2.74	
	1990-93	0.047	(7.40)	0.75	5.33	
	1983-93	0.037	(6.92)	0.93	3.01	
	1983-93*	0.033	(5.59)			51.85

Notes: *Restricted estimation. β and t-ratios are expressed in absolute values. Larger R^2 values imply that the deviations from the average pattern, which is described by β, will be smaller. White indicates the White Heteroskedasticity Test. LR indicates the log likelihood ratio as applied in Barro and Sala-i-Martín [1992]. Critical values at 5 percent are 5.99 for the White test and 7.82 for the Chow test.

Table 1 shows that except for the IPI series in the period 1990-93, where β is not statistically significant at 5 percent, all other estimates are significantly different from zero and smaller than one, indicating that convergence was taking place during the period. Convergence developed faster in the last sub-period for the CPI and SPI series, as opposed to the IPI series, where convergence in that period was weak.

SUR

A more general version of (4) is estimated in which not only the intercepts, but also the slopes are allowed to vary across countries.[7] Wald tests were carried out on both the null hypotheses of jointly non-significant intercepts and of common slope, giving values leading to the non-rejection of the nulls, as shown in Table 2. The implication is that for this group of countries, there are no long-run differences in inflation rates exhibiting a common slope.

TABLE 2
Wald Tests (1983-93)

Wald Tests	NWA			MC		
	CPI	IPI	SPI	CPI	IPI	SPI
(1)	2.81 (0.09)	0.18 (0.67)	0.02 (0.89)	3.02 (0.08)	0.26 (0.61)	3.69 (0.06)
(2)	6.21 (0.40)	11.9 (0.06)	7.98 (0.24)	5.93 (0.55)	9.41 (0.22)	12.2 (0.09)
(3)	6.08 (0.30)	10.6 (0.06)	7.63 (0.18)	0.01 (0.93)	2.78 (0.84)	2.02 (0.15)

Notes: p-values are in parentheses. (1) represents a test over the joint significance of the intercept on (4). (2) represents a test of the null hypothesis of common slopes across countries. (3) is a test of the null hypothesis of a common slope for core countries and a common slope for peripheral countries.

TABLE 3
SUR Estimates
Differences Computed Relative to NWA

Price Index	Year	β	t-ratio	LM	White	Q
CPI	1983-86	0.084	(8.05)	1.87[a]	2.64	0.27
	1986-90	0.074	(12.4)	10.1	3.56	0.22
	1990-93	0.014	(1.21)	8.48	3.56	0.44
	1983-93	0.056	(5.55)	7.33	3.60	0.41
IPI	1983-86	0.062	(4.65)	6.73	2.60	0.33
	1986-90	0.099	(2.89)	6.49	2.63	0.54
	1990-93	0.034	(4.06)	10.1	4.14	0.41
	1983-93	0.088	(3.48)	13.1	4.65	0.17
SPI	1983-86	0.032	(2.42)	1.86[a]	3.30	0.40
	1986-90	0.071	(4.59)	6.97	2.49	0.52
	1990-93	0.052	(2.38)	6.65	2.95	0.42
	1983-93	0.053	(4.97)	4.96	5.15	0.41
Differences Computed Relative to MC						
CPI	1983-86	0.074	(7.92)	2.22[a]	3.84	0.55
	1986-90	0.052	(5.78)	5.98	3.26	0.75
	1990-93	0.014	(1.89)	83.2	3.32	0.55
	1983-93	0.060	(6.86)	7.53	2.14	0.37
IPI	1983-86	0.060	(9.90)	9.04	3.24	0.34
	1986-90	0.090	(7.42)	8.94	2.32	0.42
	1990-93	0.038	(1.97)	8.58	4.54	0.39
	1983-93	0.086	(4.84)	5.00	1.45	0.68
SPI	1983-86	0.027	(2.93)	1.77[a]	4.20	0.41
	1986-90	0.057	(4.26)	8.44	2.72	0.46
	1990-93	0.053	(3.95)	5.30	1.84	0.53
	1983-93	0.051	(6.10)	4.56	4.51	0.57

Notes: β and t-ratios are expressed in absolute values. LM is the LM autocorrelation test with four lags. White represents the White Heteroskedasticity Test. Q shows the p-values of the Ljung-Box test for the null of white noise residuals. These values are the average of those of the individual equations in the system. Critical values at 5 percent are 9.49 for the LM test and 5.99 for the White test. [a] is the DW test.

Next the constants are eliminated, and a common slope is imposed and estimated by SUR.[8] The results can be seen in Table 3.

When estimating autoregressive processes with roots close to unity, Marriott and Pope [1954] proved that ordinary least squares estimates of the parameter in such processes are biased downwards by $2\rho/T$ when there are no constants.[9] This means that the estimates in Table 3 are biased upwards in absolute values. Hence, the SUR estimates of CPI and SPI over the whole period have some characteristics of the NLS estimates.

Leaving aside the sub-period estimates, where short sample size leads to low efficiency, the main discrepancy between NLS and SUR estimations arises in the IPI estimate for the whole period (0.026 against 0.088 in NWA, and 0.010 against 0.086 in MC). It is hypothesized that this is due to the fact that the SUR estimation used all the information available, which is incorporated into the final estimate of β. Figure 1 shows that there were long periods in which dispersion decreased continuously (high β), but were followed by abrupt halts in the process of convergence. Since rises occurred less often than declines, a high β is produced. However, the initial and final dispersions were not very different (they were remarkably similar in the period 1990-93), and the NLS estimates reflect this fact.

The test in the last row of Table 2 allows the consideration of the possibility of splitting the whole set of countries into core, or hard-EMS, and peripheral, or soft-EMS, in order to investigate a possible dual behavior. The SUR estimation was applied imposing two different slopes, one for the core countries and one for the peripheral countries.[10] As above, the intercepts were not significant. The results are shown in Table 4.

TABLE 4

Core Countries Versus Peripheral Countries (1983-93)

	NWA			MC		
Price Index	Core Countries	Peripheral Countries	Test Value	Core Countries	Peripheral Countries	Test Value
CPI	0.075	0.070	0.36	0.083	0.049	3.11
	(7.22)	(7.14)	(0.55)	(4.97)	(5.12)	(0.07)
IPI	0.087	0.075	0.28	0.072	0.043	2.09
	(4.18)	(3.52)	(0.59)	(3.95)	(3.33)	(0.15)
SPI	0.065	0.056	0.24	0.078	0.048	1.83
	(4.84)	(3.71)	(0.62)	(4.05)	(3.23)	(0.17)

Notes: The test value shows the Wald test for common slope across the sets of countries. Figures in parentheses are the t-ratios except for the test value case, where they are the p-value.

Although the estimates of the slopes for the core countries are higher than for the peripherals, the null of identical slopes cannot be rejected at the 10 percent significance level. In any case, the estimates show that convergence seemed to develop at a faster rate in the core countries than in the peripheral countries.

Conclusions

This paper has proved the existence of a generalized process of convergence in inflation rates between eight of the EMS countries over the 1983-93 period. The main purpose of this study has been to apply some techniques used in the literature of output growth convergence to assess the deflationary process followed by the EMS countries in pursuing inflation convergence. Rather than checking for the fulfillment of the Maastricht Criterion, a notion of convergence has been used based on differences and dispersion between inflation rates, which decreased over time. One of the interesting features of this study has been to show that SUR estimation is also valid for checking convergence; it has the advantage of allowing for both a direct test of convergence over the intercepts, and also comparing different behavior between countries.

The results obtained show that a general convergence within the EMS countries took place; the different techniques used here confirm this finding. The main discrepancy arises in the IPI estimate for the whole period. According to the NLS estimates, convergence evolved faster for the CPI and SPI than for the IPI, which is in accordance with the σ-convergence analysis, and in contrast to the SUR estimation. Even though most of the convergence process took place after 1993, the EMS laid the foundations to reach it. However, these foundations were deeper in the core than in the peripheral countries. Hence, additional restrictive policies had to be implemented in the peripheral countries (and in Germany after reunification) in order to meet the Maastricht Criterion.

To conclude, it must be noted that convergence is not just an issue of inflation. What actually matters today in Europe for the poorest countries in the EMU is the issue of real convergence, which is beyond the scope of this paper.

Footnotes

[1]The eight countries under consideration are Germany, France, Belgium, the Netherlands, Denmark, Italy, the United Kingdom, and Spain. The data source for the CPI comes from the General Index of the Eurostat. The data source for the SPI is from the Hotels, Pubs, and Restaurants Index of the Eurostat. With respect to an index of producer prices, the Total Index from the Mean European Indicator was chosen to represent the IPI. Data are quarterly from 1983:1 to 1994:1.

[2]A coefficient of -0.10, for example, would indicate that one-tenth of the initial deviation of the inflation rate from the leading country has been eliminated in country j.

[3]In line with Symons [1995], the initial period $t = 0$ and the fact that the constant is conditional on $D\pi_{j0}$ are taken as given. The data cannot be considered as a realization of a stationary vector process commencing in the distant past because of the presence of some countries which are many standard deviations from the assumed long run mean.

[4]Under stationarity, the differentials are $\kappa_j \equiv E(\pi_{jt} - \bar{\pi}_t) = E(\pi_{jt-1} - \bar{\pi}_{t-1})$; from (3), it is obtained that $\kappa_j = (\alpha_j - \bar{\alpha})/\beta$. If $\alpha_j - \bar{\alpha} = 0$, then $\kappa_j = 0$ for all j.

[5]The hard-EMS, or core countries, are Germany, the Benelux, Denmark, and France, and the soft-EMS, or peripheral countries are Italy, Spain, and the United Kingdom.

[6]According to these authors, the whole period can be split into three sub-periods (1983-86, 1986-90, and 1990-93), which roughly coincide with different stages in the lifetime of the EMS. In the first period, realignments were infrequent; they disappeared completely during 1986-90. The last overall realignment in the 1980s took place in March 1985, coinciding with the recovery of the U.S. dollar. Finally, in the third period, the inception of the free movement of capital, along with some external shocks, provoked several currency devaluations.

[7]When estimating convergence towards NWA, one equation is dropped to avoid the risk that the dependant variable and one regressor may become redundant.

[8]Some tests were applied (DW and LM for autocorrelation, LM and White for heteroskedasticity, Ljung-Box Q for non-autocorrelation in the residuals, and Ramsey's RESET) to be sure about any possible misspecification in the system. In Table 3, some of the tests are presented in averaged terms.

[9]ρ is the autoregressive parameter in $z_t = \rho z_{t-1} + v_t$, with $t = 1, ..., T$ and z_0 fixed.

[10]An alternative approach is to estimate both sets of countries separately. In that case, the final results do not differ significantly from those shown in Table 4.

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