Complete or Partial In‡ation Convergence in the EU?

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Abstract

This paper has one primary aim: to analyze whether there exists evidence in favor of in‡ation convergence ¡ complete convergence ¡ or common trends ¡ partial convergence ¡ within the European Union (EU). The analysis is done in a bivariate and multivariate framework, for traded and non-traded in‡ation rates, using sequential unit root tests, common trends analysis, and cointegration tests that allow for structural breaks. The results suggest that there is a di¤erent behavior between traded and non-traded in‡ation rates. In the bivariate framework, there is much stronger evidence of complete convergence for traded in‡ation rates than for non-traded in‡ation rates. In the multivariate framework, the complete convergence is only presented in the most tradeable in‡ation rate and there is a small number of common trends for the rest of traded in‡ation rates that suggests evidence of partial convergence in terms of long-run relationships. Finally, neither complete nor partial convergence is presented in the non-traded in‡ation rates.

Keywords: convergence, common trends, structural breaks, traded and non-traded in‡ation rates, European Union.
JEL Classi…cation: C22, C32, E31, F15.

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1 Introduction

In economic terms, the European Monetary Union (EMU) implies the adoption of a single monetary policy which is committed to price stability. The irrevocable …xing of the exchange rates within EMU means that the participants will forge a mechanism of economic adjustment on an enduring basis. Since the Maastricht Treaty (1992), in‡ation convergence is a criterion for the passage to the …nal stage of EMU[1]: only member states that meet the "economic convergence criteria" will join EMU.

Previous literature usually analyzes in‡ation convergence between European countries using two di¤erent formal tests for convergence. The …rst test examines convergence estimating time-varying coe¢cient models, using the Kalman …lter (Hall, Robertson, and Wickens, 1992; Holmes, 1998). The second test is based on cointegration analysis and intends to examine the common stochastic trends in the data series (Koedijk and Kool, 1992; Caporale and Pittis, 1993; Hafer and Kutan, 1994; Thom, 1995; Holmes, 1998, Mills and Holmes, 1999). These papers suggest that the Exchange Rate Mechanism (ERM) may have installed a degree of in‡ation discipline among its members. The empirical …ndings show the existence of partial convergence of in‡ation rates in the sense that there is evidence of cointegration but with more than one single common trend. In a recent contribution, Camarero, Esteve, and Tamarit (2000) analyze convergence using the Kalman …lter and some unit root tests allowing for structural breaks to assess the existence of convergence. They obtain evidence of catching-up (weak convergence), but not long-run convergence between prices of the peripheral and core countries (Italy, Spain, and the United Kingdom) in the EU.

In this context, our research attempts to answer whether the European Monetary System (EMS) experience has been a signi…cant trend in the reduction of in‡ation for European countries. In other words, it tries to investigate whether there exists evidence in support of in‡ation convergence and common trends within the European Union (EU). To address this, we adopt the formal de…nition of convergence and common trends provided by Bernard and Durlauf (1995). For these author, countries $q = 1; :::; n$ converge ¡ complete convergence ¡ if the long-term forecasts of in‡ation rates for all countries are equal at a …xed time t. In addition, countries $q = 1; :::; n$ contain a common trend ¡ partial convergence ¡ if the long-term forecasts of in‡ation rates are proportional at a …xed time t. These two de…nitions have a natural testable counterparts in the cointegration literature.

This paper di¤ers in several dimensions from previous research. In the …rst place, we use one aggregate and seven disaggregate in‡ation rates by sectors in contrast with previous literature. We consider of great interest to di¤erentiate between traded and non-traded in‡ation rates. As traded sectors are more internationally integrated than non-traded sectors we hope that there is more evidence of convergence for traded in‡ation rates than for non-traded ones.

In the second place, we analyze the evidence of convergence and common trends in a bivariate and multivariate framework. To do that, we estimate bivariate models -with Germany as the reference country- and multivariate models, for each in‡ation rate, using the maximum likelihood method by Johansen (1988, 1992).

[1] A maximum in‡ation rate of 1.5% above the rate of the member states with the lowest in‡ation.

In the third place, we allow for the possibility of structural breaks in our analysis in order to examine the potential effects of instability on the process of inflation convergence in the EU. To address this, in the bivariate framework, we consider the possibility of structural breaks at an unknown date in the cointegrating relationships using the Hansen and Johansen's (1993) instability test. On the other hand, in the multivariate framework, we introduce the possibility of structural breaks by analyzing the stochastic behavior of the estimated common trends. We use a set of sequential statistics for detecting changes in the order of integration of the series.

The rest of the paper is organized as follows. Section 2 presents the formal definition of convergence and common trends. Section 3 describes the econometric methodology. Section 4 presents the data set. Section 5 reports the main empirical findings and, finally, Section 6 concludes the paper.

2 The Formal Definition of Convergence and Common Trends

We adopt the formal definition of convergence and common trends provided by Bernard and Durlauf (1995), for a bivariate and a multivariate framework. These authors distinguish between the concepts of convergence, complete convergence – definitions 2.1 and 2.1' –, and common trends, partial convergence – definitions 2.2 and 2.2'.

In a bivariate framework, definition 2.1 say that countries i and j converge if the long-term forecasts of inflation rates for both countries are equal at a fixed time t:

$$\lim_{k \to \infty} E\left(\dot{p}_{i,t+k} - \dot{p}_{j,t+k} \mid I_t\right) = 0 \tag{1}$$

In a multivariate framework, definition 2.1' say that countries $q = 1, ..., n$ converge if the long-term forecasts of inflation rates for all countries are equal at a fixed time t:

$$\lim_{k \to \infty} E\left(\dot{p}_{1,t+k} - \dot{p}_{q,t+k} \mid I_t\right) = 0 \qquad \forall q \neq 1 \tag{2}$$

Both definitions can be tested from the unit root/cointegration literature. We concentrate in the cointegration techniques. For example, in order to countries i and j convergence, under definition 2.1, their inflation rates must be cointegrated with cointegrating vector $[1, -1]$.

On the other hand, in a bivariate framework, definition 2.2 say that countries i and j contain a common trend if the long-term forecasts of inflation rates are proportional at a fixed time t:

$$\lim_{k \to \infty} E\left(\dot{p}_{i,t+k} - a\,\dot{p}_{j,t+k} \mid I_t\right) = 0 \tag{3}$$

In a multivariate framework, definition 2.2' say that countries $q = 1, ..., n$ contain a single common trend if the long-term forecasts of inflation rates are equal at a fixed time t:

$$\lim_{k \to \infty} E\left(\dot{p}_{1,t+k} - a_q' \dot{\mathbf{p}}_{t+k} \mid I_t\right) = 0 \tag{4}$$

where

$$\dot{\mathbf{p}}_t = \begin{bmatrix} \dot{p}_{2,t} & \dot{p}_{3,t} & \cdots & \dot{p}_{q,t} \end{bmatrix}$$

These definitions have a natural testable counterparts in the cointegration literature. For example, in order to countries i and j have a common trend, under definition 2.2, their inflation rates must be cointegrated with cointegrating vector $[1; -a]$. In this sense, we are interested in the possibility that there are a small number of stochastic trends affecting inflation rates which differ in magnitude across countries.

3 Econometric Methodology

In this section we describe the econometric methodology in three steps: 1) univariate time-series properties of the data; 2) analysis of convergence and common trends in a bivariate framework; and 3) analysis of convergence and common trends in a multivariate framework.

3.1 Step 1: Unit Root Analysis

To analyze the stochastic behavior of our data set we consider the possibility of structural breaks. In recent years, several articles have considered the effects of structural breaks on existing procedures for the detection of unit roots and, in particular, in the augmented Dickey-Fuller test, ADF. Researchers have considered a wide variety of rolling, recursive, and sequential testing procedures. Banerjee, Lumsdaine, and Stock (1992) and Montañés (1996a, 1996b) show that sequential procedures are generally more powerful in testing for non-stationary series since they use all the sample information at once (they have good power against stable and unstable stationary alternatives). Thus, in this paper we only concentrate on sequential tests. The sequential procedure generally used in the literature is based on the ADF unit root test, and selects the "supremum" (minimum) of the sequence of ADF t-statistics for all possible break points in the sample. Then we use the traditional ADF test together a set of three sequential statistics (based on the traditional ADF statistic) to test for the unit roots.

The sequential version of the ADF test usually considered in the literature (Banerjee, Lumsdaine, and Stock, 1992, Zivot and Andrews, 1992, Perron and Vogelsang, 1992, and Montañés, 1996a, 1996b) estimates the following set of regressions,

$$\Delta Y_t = \mu + \mu' D_{\tau t} + \delta Y_{t-1} + \sum_{i=1} \gamma_i \Delta Y_{t-i} + \varepsilon_t \tag{5}$$

where

$$D_{\tau t} = \begin{cases} 0 & \text{if} \quad t<[\tau T] \\ 1 & \text{if} \quad t>[\tau T] \end{cases} \qquad \tau \in (0;1) \tag{6}$$

is a dummy variable that selects the last $(1-\tau)\%$ observations of the sample, and $[.]$ indicates the integer part. For each possible break point in the sample, indexed by τ[2], two statistics are computed from regression (3): t_δ, the standard t-statistic for the unit root null hypothesis, $\delta = 0$, and $|t_{\mu'}|$, the absolute value of the t-statistic for the null hypothesis $\mu' = 0$, a test for stability in the stochastic trend first introduced by Banerjee,

[2] In general, the search for possible break points is restricted to a subset that excludes those at both extremes of the sample, because of the increased variance in parameter estimates caused by approximate multicollinearity. Following a common practice (Banerjee, Lumsdaine, and Stock, 1992) we restrict our search to the subset $\tau \in [.15; .85]$ that implies a symmetric sample trimming of 15%.

Lumsdaine, and Stock (1992). In addition, these authors consider a second test for a broken trend, $\left|t_{(\theta)}\right|$, the absolute value of the t-statistic for the null hypothesis $\theta = 0$ in the restricted regression:

$$\Delta Y_t = \mu + \theta D_{\tau t} + \sum_{i=1} \gamma_i \Delta Y_{t-i} + \varepsilon_t \qquad (7)$$

equivalent to the $|t_\theta|$ statistic computed in regression (3) under the unit root constraint $\alpha = 0$.

The set of regressions provides a sequence of values $|t_\theta|(\tau)$, $t_\alpha(\tau)$, $\left|t_{(\theta)}\right|(\tau)$, from which Banerjee, Lumsdaine, and Stock (1992) suggest computing the "supremum". Thus, there are three statistics labelled $\mathrm{Sup}\,|t_\theta|$, $\mathrm{Inf}\,t_\alpha$, $\mathrm{Sup}\left|t_{(\theta)}\right|$, each with its potential break point estimator.

The sequential unit root test $\mathrm{Inf}\,t_\alpha$ (renamed as INFADF) is the one most commonly considered in this literature and its behavior is well known. See, for example, Banerjee, Lumsdaine and Stock (1992), Zivot and Andrews (1992), and Montañés (1996a). The unrestricted and restricted sequential trend break statistics, $\mathrm{Sup}\,|t_\theta|$ and $\mathrm{Sup}\left|t_{(\theta)}\right|$ (renamed as SUPMU and SUPMUR, respectively) were initially proposed by Banerjee, Lumsdaine, and Stock (1992) and applied empirically by these authors and Banerjee, Dolado, and Galbraith (1990).

3.2 Step 2: Bivariate Framework

To study the evidence of convergence and common trends between two inflation rates in the bivariate context, choosing Germany as the reference economy due to its central role in the Exchange Rate Mechanism (ERM)[3], we use the maximum likelihood method by Johansen (1988, 1992) and maximal-eigenvalues or λmax and Trace statistics. In addition, the Schwarz information criteria is used to determine the order of the VARs, and to further verify the correct specification of the models a Hosking (1980) statistic, based on the estimated residuals, is implemented[4].

There has been evidence in favor of convergence (definition 2.1) if the inflation rates between countries i and j are cointegrated with cointegrating vector $[1; -1]$, and evidence in favor of a common trend if their inflation rates are cointegrated with cointegrating vector $[1; -a]$.

To detect structural breaks in the cointegrating vectors we use the instability test by Hansen and Johansen (1993). This statistic is a recursive test that can be applied to the maximum likelihood method by Johansen (1998, 1992). The Hansen and Johansen's instability statistic tests the null hypothesis of cointegration without structural breaks against the alternative hypothesis of cointegration with structural breaks.

A vector X with q variables $I(1)$, which dynamic can be represented by a VAR model of order k, has the next error correction model (ECM) representation

[3] In many studies, Germany is considered as an "anchor" role in the ERM.

[4] The Hosking statistic is a multivariate extension of the better-known Ljung-Box statistic applied to univariate series. It is distributed asymptotically as a χ^2 with the degrees of freedom being determined by the dimension of the system, the number of lags estimated in the VAR, as well as the number of lagged residual used to compute the statistic.

$$\Delta X_t = \alpha\beta' X_{t-1} + \Gamma Z_t + \varepsilon_t; \qquad t = 1, \ldots, T \tag{8}$$

$$Z_t = (\Delta X_{t-1}, \ldots, \Delta X_{t-k+1}, D_t, 1)'; \qquad \Gamma = (\Gamma_1, \ldots, \Gamma_{k-1}, \Phi);$$

where D is a set of seasonal dummies, β is the cointegrating vector and α is the adjustment coefficient.

Regressing ΔX_t and X_{t-1} on Z_t, we obtain the residuals R_{0t} and R_{1t}. Hansen and Johansen suggest to fix the short-run dynamic and so, they use the filtered variables. From these residuals, they define $S_{ij} = \Sigma R_{it} R'_{jt}$, that allow to obtain the associated eigenvalues and eigenvectors,

$$1 > \hat{\lambda}_1 > \ldots > \hat{\lambda}_p > 0; \qquad \hat{V} = (\hat{v}_1, \ldots \hat{v}_p);$$

as result of solving the equation,

$$\left| \lambda S_{11} - S_{10} S_{00}^{-1} S_{01} \right| = 0 \tag{9}$$

Finally, these eigenvalues and eigenvectors allow to estimate the cointegrating vectors matrix, β; and to determine its rank, r, from the statistics by Johansen.

With the determined rank for all sample, Hansen and Johansen (1993) obtain the following recursive statistic,

$$HJ(t) = t \sum_{i=1}^{t} \ln \left| \frac{1 - \hat{\rho}_i(t)}{1 - \hat{\lambda}_i(t)} \right|; \qquad t = T_0, \ldots, T \tag{10}$$

where $\hat{\lambda}_i(t)$ are the eigenvalues (without restrictions) obtained from equation (9) for the subsample $1, \ldots, t$, while $\hat{\rho}_i(t)$ are the eigenvectors obtained for the same sample from,

$$\left| \rho \beta' S_{11}(t) \beta - \beta' S_{10}(t) S_{00}^{-1}(t) S_{01}(t) \beta \right| = 0; \qquad t = T_0, \ldots, T \tag{11}$$

imposing the restriction that the cointegrating vectors matrix in the subsample $1, \ldots, t$ is equal to β, the cointegrating vectors matrix in the full sample.

For every potential break point in the sample ($t = T_0, \ldots, T$), the $HJ(t)$ is a maximum likelihood test that compares the eigenvalues with and without restrictions in the cointegrating vectors. Under the null hypothesis, the statistic $HJ(t)$ is distributed as a χ^2 with $(p - r)r$ degrees of freedom. For break points at unknown dates, Hansen and Johansen compute the "supremum" of all calculated $HJ(t)$, SupHJ, with its potential break point estimator, NsupHJ.

3.3 Step 3: Multivariate Framework

In this framework we try to analyze the evidence of convergence and common trends between the inflation rates by sectors in the EU. To address this, we proceed as follows. Firstly, we estimate multivariate models for each inflation rate, for our set of European countries[5] (q = Germany, Belgium, Spain, France, Netherlands, Italy and United

[5] Except for those countries in which the inflation rates are stationary series.

Kingdom), using the maximum likelihood method by Johansen (1988, 1992) and the maximal-eigenvalue or λmax and Trace statistics. For testing convergence (definition 2.1') we estimate these multivariate models imposing that there are $q - 1$ cointegrating vectors and each of them is $[1; -1]$. To test this restriction, we use the LR statistic $[\chi^2(q - 1)]$. If we do not obtain evidence in favor of convergence, then we will turn to test for the number of common trends (definition 2.2'). Again, as in the bivariate framework, the Schwarz information criteria is used to determine the order of the VARs, and the Hosking (1980) statistic is implemented.

Second, we estimate the common trends using Gonzalo and Granger's (1995) methodology. These authors develop a way of estimating common long-memory components of a cointegrated system. Estimation is done from a fully specified error correction model.

Finally, we introduce in our multivariate analysis the possibility of instability: we analyze the evidence of common trends and test whether they turned from a non-stationary, I(1), to stationary, I(0), series after a structural break point. If this occurs, it could be interpreted as much stronger evidence in favor of convergence. To achieve this, we analyze the stochastic behavior of common trends using a set of recent sequential statistics for detecting changes in the order of integration of the series by Fernández and Peruga (1999)[6]. These authors consider the following set of regressions:

$$\Delta Y_t = \mu + \gamma_1 D_{\tau t} Y_{t-1} + \gamma_2 [1 - D_{\tau t}] Y_{t-1} + \sum_{i=1} \delta_i \Delta Y_{t-i} + u_t \qquad (12)$$

Regression (9) simultaneously considers both subsamples resulting from the division of the sample and tries to test simultaneously the null hypothesis of a unit root against the alternative hypothesis of stationary series in both subsamples. In this sense, for example, the time series could be integrated of order one in a subsample and integrated of order zero in the other. For each possible structural break in the sample, two statistics are computed: t_{γ_1}, t_{γ_2}. These test for a unit root in the first and second subsample, respectively. The set of regressions provides a sequence of values, from which Fernández and Peruga suggest computing the "supremum" and the mean resulting four statistics labelled: $Supt_{\gamma_1}$ (renamed as SUP1) with its potential estimator of the break point, $NSupt_{\gamma_1}$, $Meant_{\gamma_1}$ (renamed as MEAN1), $Supt_{\gamma_2}$ (renamed as SUP2) with its potential estimator of the break point, $NSupt_{\gamma_2}$, and $Meant_{\gamma_2}$ (renamed as MEAN2).

4 The Data

The data that we use are non-seasonally adjusted monthly data of annual inflation rates[7] for one aggregate consumer price index and seven disaggregate consumer price indexes for Germany (GER), Belgium (BEL), Spain (SPA), France (FRA), the Netherlands (NED), Italy (ITA), and the United Kingdom (UK)[8].

[6] An empirical application of these sequential statistics can be seen in Morales and Peruga (1999) and Fernández and Sosvilla (2001).

[7] The annual inflation rates are computed as $\ln(p_{it}) - \ln(p_{it-12})$; where p_{it} denotes the consumer price index in t for country i.

[8] We consider the United Kingdom in our analysis although this country has limited participation in the ERM.

The aggregate price index, P, covers the period 1976:1 – 1999:8. The data is obtained from International Financial Statistics (International Monetary Fund). The disaggregated indexes are supplied by Eurostatistics (Eurostat). These are: food less drinks and meals (P1); clothes, footwear including repairs (P2); rent, fuel and power (P3); household goods and service (P4); transport and communications (P5); recreation and education (P6); and other goods and services including drinks and meals (P7). Initially, we consider P1, P2, and P4 as traded price indexes and P3, P5, P6, and P7 as non-traded price indexes. The disaggregate price series for Spain, supplied by Eurostat, show a de…nition change in 1992. We take these from the Instituto Nacional de Estadística. The de…nitions of the indexes are the same as in Eurostat.

The annual in‡ation rates from the disaggregate price series cover the period 1977:1-1998:4 for P1, P2, P3, and P4 for all countries and the period 1977:1-1995:7 for P5, P6, and P7 for all countries[9].

5 Results

5.1 Unit Root Analysis

The numerical results from the unit root analysis for every in‡ation rate[10] show that most of the in‡ation rates are …rst-order integration series, except the in‡ation rates of Spain and the Netherlands for P1 and the infaltion rate of United Kingdom for P2 which are stationary series. Moreover, there is no evidence of structural breaks in the in‡ation rates.

5.2 Bivariate Framework

Tables 1-3 report the results of cointegration, convergence, common trends and structural breaks in the bivariate framework, for each in‡ation rate. For the aggregate in‡ation rate P (Table 1), three bivariate models out of six present evidence in favor of cointegration. For Germany-Belgium and Germany-Netherlands the in‡ation rates are cointegrated and we accept the null hypothesis that the cointegrating vector is [1; ¡1]. Then, this result suggests evidence in favor of convergence. For the bilateral relationship Germany-Italy we …nd evidence of a common trend. In addition, we …nd evidence of cointegration with structural breaks for Germany-Netherlands and Germany-Italy. The break points are located in 1977:10 and 1976:11, respectively.

For the traded in‡ation rates (Table 2), the evidence is as follows. For the the in‡ation rate P1, food less drinks and meals, we …nd evidence of cointegration in all bivariate models except for Germany-France. The convergence is accepted for the bivariate models Germany-Netherlands and Germany-United Kingdom. Moreover, the instability is presented only in the bivariate model Germany-Italy in 1978:7. On the other hand, for the in‡ation rate P2, clothes, footwear including repairs, we …nd evidence of cointegration for three models out of …ve. The convergence is accepted in the bivariate models Germany-Spain and Germany-Netherlands and there is evidence of cointegration with structural breaks in the bivariate model Germany-Italy. The estimated break point is

[9] The sample size di¤ers slightly between indexes due to data availability.

[10] The numerical results from the unit root analysis are available upon request.

located in 1980:11. Finally, for the in‡ation rate P4, household goods and services, there is evidence in favor of cointegration in …ve out of six models and a cointegrating vector [1; ¡ 1] is accepted in all of them. There is only evidence of cointegration with structural breaks in the bivariate model Germany-Netherlands, where the break point is located in 1980:11.

On the other hand, for the non-traded in‡ation rates (Table 3) we have the next results. For the in‡ation rate P3 we …nd evidence in favor of cointegration in three out of six bivariate models and there is evidence of convergence in any of them. There is evidence of cointegration with structural breaks for the bivariate models Germany-France and Germany-Italy, with the break points located in 1980:3 and 1978:9, respectively. For the in‡ation rate P5 we …nd evidence of cointegration in four out of six bivariate models and the convergence is presented in all of them. There is instability in the bivariate models Germany-Netherlands and Germany-Italy, with the break points located in 1978:11 and 1978:7, respectively. For the in‡ation rate P6 there is evidence of cointegration only in two out of six bivariate models. The convergence is presented in one of them. Finally, for the in‡ation rate P7 we …nd evidence of cointegration and convergence only in one out six bivariate models. There is no evidence of instability neither for P6 nor for P7.

In short, in this bivariate framework, for the traded in‡ation rates, there are twelve out of sixteen bivariate models with evidence in favor of cointegration. In addition, there is evidence of convergence in nine out of those twelve cointegrating models. However, there are only ten out of twenty-four bivariate models with evidence of cointegration for non-traded in‡ation rates and the convergence is presented in six out of those ten bivariate models. Then, these results suggest that there is a di¤erent behavior between traded and non-traded in‡ation rates in the EU. There is a much stronger evidence of convergence for traded in‡ation rates than for non-traded in‡ation rates. Moreover, from the analysis of cointegration with structural breaks we can point out that the breaks points, mostly located between the end of 1978 and 1980, could capture the second oil crisis.

5.3 Multivariate Framework

Table 4 presents the numerical results for testing convergence. We observe that convergence is rejected in all in‡ation rates except for the in‡ation rate P1. This is a hopeful result because the in‡ation rate P1 can be considered as the most tradeable in‡ation rate. Having failed to …nd evidence for convergence, we turn to test for the number of common trends. Table 5 presents the results. We observe that there is more than a single common trend in all in‡ation rates (obviously, except for P1). Moreover, we …nd less common trends for traded in‡ation rates than for non-traded in‡ation rates.

In short, these results suggest that there is a di¤erent behavior between the traded and non-traded in‡ation rates, i.e. the number of stochastic trends a¤ecting traded in‡ation rates is smaller than the number of stochastic trends in the non-traded in‡ation rates. Moreover, there is only evidence of convergence for the most tradeable in‡ation rate, P1, and that there is a strong evidence of common stochastic elements for the rest of traded in‡ation rates. So, we identify a small number of common trends in the traded in‡ation rates that suggests there has been some partial convergence in terms of long-run relationships between EU in‡ation rates.

On the other hand, we introduce the possibility of structural breaks in this multivariate context. After estimating the common trends using Gonzalo and Granger's (1995) methodology, we analyze whether they turn from a non-stationary into a stationary series after one structural break. If this occurs, we could interpret it as stronger evidence in favor of convergence. Table A1 (Appendix) exhibits the numerical results from the ADF and INFADF unit root tests and the four sequential statistics SUP1, MEAN1, SUP2, and MEAN2 for detecting changes in the order of integration of the series, for all of the estimated common trends. These results are summarized in Table 6. For the aggregate in‡ation rate, P, the sequential statistics show that two common trends (called CF1P and CF2P) out of four change from I(1) series to I(0) series. These breaks occur in 1984:4 and 1984:7, respectively. For the in‡ation rate P1, the common trend CF1P1 changes in a stationary series in 1990:1. For P2, only 1 out of 3 common trends changes to I(0) series. The break takes place in 1993:10. For P3 and P4 neither of the common trends change to stationary series. However, 3 common trends out of 6 for P5 change to stationary series in 1992:12, 1986:2 and 1985:12, respectively. For P6 we …nd that 1 common trend out of 6 changes to I(0) series in 1983:11 and …nally, for P7 only 1 common trend out of 5 change to stationary series in 1984:11.

In summary, the evidence of this section is coherent with partial convergence in the Bernard and Durlauf´s (1995) sense. Several factors could explain our results of partial convergence. Di¤erences in in‡ation may occur over short periods of time due to country-speci…c factors (e.g., di¤erent price developments, tax changes, liberalization measures, administrative price changes), statistical factors (e.g., di¤erent weights used in the construction of the Harmonized Index of Consumer Price), "erratic" factors (e.g. weather conditions, di¤erent numbers and timing of national holidays can create "noise" in measurement of in‡ation rates), and economic factors (e.g., trade patterns, production structures, tax system, …nancial markets, di¤erent institutional structures). These factors imply that common shocks may a¤ect countries in a diverse way. On the other hand, after 1992, the Single Market project in Europe has eventually led to the elimination of barriers to trade in goods, services, and trends production within Europe. The completion of the internal market and increased cross-border price transparency contributes to the elimination of the existence of substantial price di¤erentials, but this is a slow process and di¤erences remain over long periods of time.

In addition, the evidence in favor of convergence -complete or partial- is stronger between traded than between non-traded in‡ation rates: there is more evidence of convergence in sectors that are more internationally integrated. These di¤erences in in‡ation rates between traded goods and services (which are less easily tradeable) can be explained because countries with higher levels of economic development tend to have higher price levels for non-traded goods and services: a general increase in wages as a result of productivity gains in the traded goods sector will raise the cost of producing non-traded goods and services. This leads to a higher relative price increase for non-traded goods and services. Convergence between both sectors normally takes place gradually but it could be much slower if di¤erences in price levels among participating countries are more marked.

When we analyze whether the common trends present evidence of a change in their order of integration, we …nd that 9 common trends out of 34 change to stationary series. We …nd that the structural break points appear in the 1980s and at the beginning of 1990s. During the 1980s there were major realignments in the ERM[11] and in early the 1990s there took place speculative crises in the ERM[12]. In addition, following to Caporale and Pittis (1993) and Holmes (1998), the "hard-EMS" period starts in April 1986.

6 Concluding Remarks

In this paper we have analyzed whether there exists evidence in favor of convergence and common trends for a set of European countries, using one aggregate (1976:1-1999:8) and seven disaggregate (1977:1-1998:4) in‡ation rates.

The results suggest that there is a di¤erent behavior between traded and non-traded in‡ation rates. In the bivariate framework, there is much stronger evidence of complete convergence for traded in‡ation rates than for non-traded in‡ation rates. In the multivariate framework, the complete convergence is only presented in the most tradeable in‡ation rate and there is a small number of common trends for the rest of traded in‡ation rates that suggests evidence of partial convergence in terms of long-run relationships. Moreover, neither complete nor partial convergence is presented in the non-traded in‡ation rates. Several factors such as taxes, market structure, and national preferences could explain our results of partial convergence. The existence of sticky downwards wages could explain partially the di¤erences in in‡ation rates between traded goods and services.

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[11] In October 1981, February 1982, March 1983, April 1986, and January 1987.

[12] Italy and the United Kingdom left the ERM in September 1992 and there was the subsequent widening of the permitted bands of exchange rate ‡uctuation to § 15% for the remaining members.

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