# Portugal–EU Convergence Revisited: Evidence for the Period 1960–2003

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**Abstract**

*This paper uses the stochastic approach to convergence to investigate whether real per capita GDP in Portugal has been converging to the EU15 average. The estimation accounts for conditional convergence, transitional dynamics and up to two structural breaks. It is found that per capita GDP in Portugal has indeed converged to the EU15 average, but the pace of convergence has not been uniform along time. In particular, a slow down in the convergence process is identified in 1974. This result depends, however, as to whether the choice of this break-date is viewed as uncorrelated with the data. No evidence of acceleration in the speed of convergence is found after EC accession, in 1986. (JEL C32, O40)*

*Keywords: Income Convergence, The Portuguese Economy, Unit Root test*

## Introduction

After a secular trend of divergence, the Portuguese economy appears to have engaged in a convergence track towards the industrialised world. In the last four decades of the twentieth century, Portugal achieved the eighth highest growth rate of per capita GDP, among 98 nations for which comparable data is available [Summers and Heston, 1991]. This episode of fast economic growth allowed the country to reduce consistently its income gap *vis-à-vis* the most advanced nations.

Some may argue that such achievement is not impressive. Since Portugal departed from a low standpoint, higher growth rates would be expected anyway. This reasoning has a long tradition in economic thinking. Following David Hume [1758], economists have been arguing that transfer of technology, diminishing returns, and capital mobility provide poor economies with an impetus to catch up. A fact that has received large consensus in the economic profession, however, is that there is no systematic tendency for poor countries to grow faster than rich countries [De Long, 1988]. Although a number of poor countries have been able to join the club of more advanced nations, in the last century, most poor countries have remained poor.

This evidence lead economists to search for weaker definitions of convergence. According to the neo-classical growth model [Solow, 1956; Swan, 1956; Mankiw et al., 1992], convergence to the same level of per capita income (absolute convergence) should

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not hold in general. If economies differ in terms of fundamental parameters, such as the propensities to invest in physical or human capital, their balanced growth paths will be parallel (as implied by the assumption that technology spills over), but not necessarily coincident. Still, in this model, the steady-state levels of per capita output are independent of initial capital endowments. Thus, economies lying initially bellow their balanced growth path should exhibit faster growth than those economies having per capita income initially above their balanced growth paths (conditional convergence). Evidence of conditional convergence in large samples of heterogeneous countries has been found in many cross-country studies, including Mankiw et al. [1992].

Other authors have departed from the neo-classical growth model. Romer [1986] and Lucas [1988] showed that social increasing returns to scale associated to physical and human capital may actually cause divergence. Romer [1990] departed from the assumption of perfect competition to motivate innovation as a rent seeking activity. Other researchers have argued that the ability of a country to take opportunity of the world technological progress depends on a number of conditions that determine the economic environment and the structure of incentives in which individuals produce and invest [Klenow and Rodríguez-Clare, 2004; Easterly, 2001; Barro and Sala-i-Martin, 1997; Parente and Prescott, 1994; North, 1990]. Cross-sectional studies that depart from the basic neo-classical formulation to stress the role of policy and institutions include Barro [1991], Sala-i-Martin [1997], Sachs and Warner [1995, 1997], Hall and Jones [1999], and Rodrick et al. [2002].

An emerging view in the economics profession is that no one theory fits all. While some economies may be though as sharing the benefits of a common body of technical knowledge, many other are falling behind, constrained by institutional idiosyncrasies, bad policy, or geography. For a poor country, convergence is pretty much a matter of moving from the second case to the first.

A limitation of cross-section empirical tests is that they work with the null hypothesis that no countries are converging and the alternative hypothesis that all countries are.[1] This leaves out a host of intermediate cases. In particular, cross-country regressions cannot assess whether a particular country has been converging to another country or to a given group of countries. In alternative, some researchers have proposed tests for the convergence hypothesis based on time series data. The time-series approach focuses on the evolution of relative per-capita incomes by employing a stochastic definition of convergence: Two or more economies are said to converge if the long run forecast of per capita output differences tends to zero [absolute convergence, Bernard and Durlauf, 1995] or to a constant [conditional convergence, Evans and Karras, 1996].

This paper investigates whether per capita Gross Domestic Product (GDP) in Portugal has been converging to the EU15 average (defined as the average of the 15 countries that formed the European Union before last enlargement), using the stochastic approach to convergence. The analysis covers the period 1960–2003, and the empirical strategy consists of investigating the persistency of shocks to the series of the log of per capita GDP in Portugal relative to the EU15 average. If this series contains a unit root, then there will be no tendency for per capita GDP in Portugal to approach an equilibrium differential *vis-à-vis* the EU15 average. In that case, income levels will be drifting apart, even though in a particular period of time the respective time series looked like being approaching each other. If, on the contrary, income disparities have an error correcting representation, then the null of non-convergence is rejected.[2] The testing procedure includes a drift and a time trend so as to account for non-coincident steady states and transition dynamics.

Following Carlino and Mills [1993], the estimation method accounts for regime shifts, either impacting on the speed of convergence or on the equilibrium differential. As it is well known in the unit roots literature, when the sources of non-stationarity are well defined and infrequent, a segmented stationary representation may be superior to a non-stationary representation, where by nature, permanent shocks happen in every period [Perron, 1989]. In this paper, up to two *a priori* defined breaks in the intercept and in the slope are allowed for, in light with Rappoport and Reichlin [1989]. Taking into account the major events faced by the Portuguese economy along the last four decades, breakpoints are specified in 1974 (the April Revolution) and in 1986 (EC Accession). To address the criticism that structural breaks should not be imposed *a priori*, a recursive analysis allowing for changes in the break-date, in light of Perron [1997] and Banerjee et al. [1992], is also undertaken.

Barros and Garoupa [1996] used the stochastic approach to convergence to test for Portugal–European Community convergence in the period 1951–1993. The authors also addressed the question as to whether the pattern of convergence has changed over time. Running a simple Dickey Fuller test (no drift, no lags) to the series of per capita GDP in Portugal relative to an average of six European countries, the authors found evidence of convergence in the sub-periods 1951–1973 and 1986–1993, but they were not able to reject the non-convergence null in the sub-periods 1951–1960 and 1974–1985. This exercise has, however, important limitations. On one hand, by not including lags of the dependent variable, the model does not account for eventual asymmetries in the incidence of the business cycle. This fact becomes more serious if, as the authors did, unit root tests are performed over sub-samples. On the other hand, as it is well known, testing for unit roots over small samples may bias the results against rejection.

Lastly, but not the least, by imposing a zero drift and no trend in the Dickey Fuller test, the authors implicitly assumed absolute convergence (coincident paths) under the alternative. As noted by Bernard and Durlauf [1995, 1996] and Evans and Karras [1996], tests on stochastic convergence are only valid when the asymptotic distribution is closely approximated by the sampling distribution. This means that a unit root test with no drift will be only valid if economies are evolving along coincident long-run paths. In the presence of transitional dynamics or different steady states, results will be biased against convergence. The present exercise extends Barros and Garoupa [1996] in four directions. First, allowing for a drift and time trend, it captures the double possibility of Portugal being engaged in a transitional dynamics and of not having the same steady state as the European average. Second, allowing for structural breaks, it accounts for changes in the speed of convergence without the need to estimate over sub-samples. Third, by specifying an auto-regressive process to represent the business cycle it substantially reduces the risks of confounding trend behaviour and short-term dynamics. Fourth, a sequential testing procedure is implemented, so as evaluate the uncertainty concerning the choice of the break-date.

## First Look at the Data

To provide a frame of reference for what follows, Figure 1 contains plots of the logs of relative per capita GDP, in constant purchasing power parities (the data used are from the European Commission). Visual inspection of the data reveals that throughout the sample period per capita GDP in Portugal has approached the EU15 average. However,

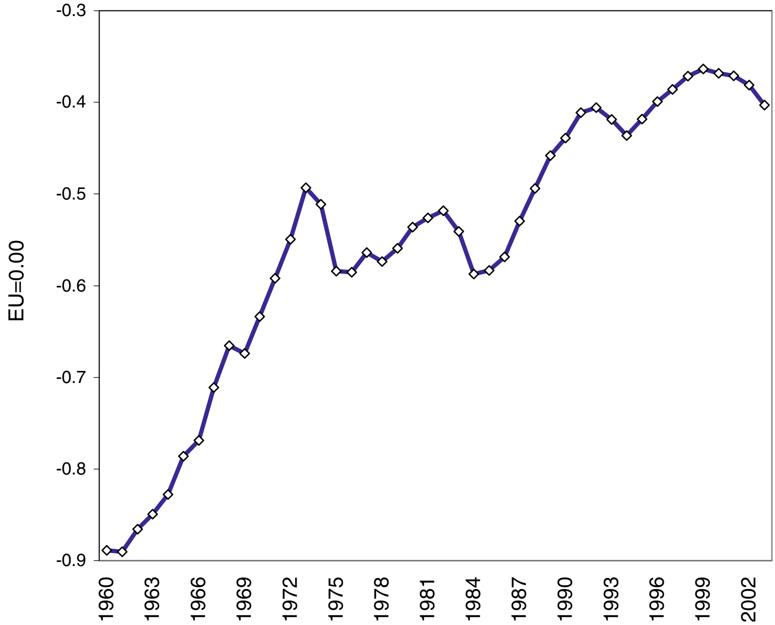


Figure 1. Real per Capita GDP – Portugal Relative to the EU15 Average (Constant PPS, Natural Logarithms). Source: Own calculations using data from the European Commission. PPS (Purchasing Power Standard) is an index of purchasing power parity. Notes: EU15 refers to the following countries: Austria, Belgium, Denmark, Finland, Germany, France, Greece, Holland, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, and United Kingdom.

such evolution has not been uniform along time. According to Figure 1, the income gap has widened in the aftermath of the 1974 April Revolution. The data also suggest a resume in the convergence process after EC accession in 1986.

It is worth noting that the series of per capita GDP in Portugal was hit in this period by two important demographic shocks. To see this, Figure 2 depicts the series of relative GDP and of relative population. Visual inspection of this data reveals that, while the series of relative GDP exhibits a clear upward trend along the sample period, the series of relative population exhibits a sharp decline until 1973 followed by an equally sharp recovery in the years after. These movements reflect (1) the massive emigration that took place at the time of the Ultramar War (1961–1974), and (2) the repatriation of Portuguese citizens from the ex-colonies after the 1974 Revolution. To the extent that this dramatic inversion in migration flows was not accompanied by contemporaneous movements in capital endowments, the series of relative per capita GDP was affected, at least temporarily.

## The Estimation Method

Portugal–EU convergence is investigated testing the existence of a unit root in the series of the log of relative per capita GDP. A drift and a time trend are included, so as to account for an equilibrium differential and transition dynamics. Up to two structural

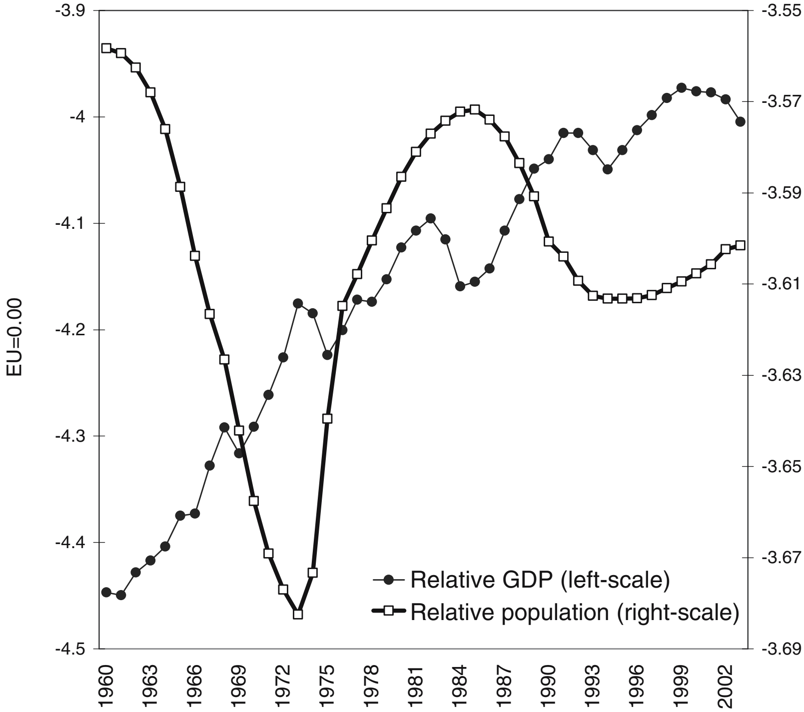


Figure 2. Real GDP (PPS) and Population – Portugal Relative to the EU15 Average (Natural Logarithms). Source: Own calculations using data from the European Commission. PPS (Purchasing Power Standard) is an index of purchasing power parity. Notes: EU15 refers to the following countries: Austria, Belgium, Denmark, Finland, Germany, France, Greece, Holland, Ireland, Italy, Luxembourg, Portugal, Spain, Sweden, and United Kingdom.

breaks are specified in the intercept and in the slope, so as to capture eventual changes in the convergence path. The general specification is as follows:

$$\Delta z_t = \alpha_0 + \alpha_1 D_1 + \alpha_2 D_2 + \beta_0 t + \beta_1 D_1 t + \beta_2 D_2 t + (\rho - 1) z_{t-1} + \sum_{j=1}^{k} \delta_j \Delta z_{t-1} + u_t \qquad (1)$$

where $z_t$ is the log of relative per capita GDP at time $t$, $D_i = 0$ if $t < T_i$ and $D_i$=1 if $t \geq T_i$ and $T_i = \{1974{,}1986\}$. Convergence is tested checking the significance of $\rho = 1$ (non-convergence) against $\rho < 1$ (stochastic convergence). The Carlino and Mills [1993] model corresponds to the particular case in which $\alpha_2 = \beta_2 = 0$ and $k = 1$; the model of Barros and Garoupa [1996] corresponds to the case with $\alpha_0 = \beta_0 = \alpha_1 = \beta_1 = \alpha_2 = \beta_2 = 0$ and $k = 0$.

Carlino and Mills [1993] set the truncation lag parameter $k$ equal to one. However, considerable evidence exists that data-dependent methods to select the lag length lead to test statistics having better properties than when a fixed $k$ is chosen *a priori*. This paper follows the $k = k(t\text{-stat})$ procedure, suggested by Campbell and Perron [1991]. In particular, the number of lags is chosen according to the significance of the last included lag (lower than 10 percent), starting from an upper bound of five lags. Autocorrelation is assessed by the LM statistic.

Whenever the endogenously chosen number of lags $k$ is equal to one, the impetus of catch-up is estimated by de-trending model (1) according to the Christiano [1992] transformation:[3]

$$z_t = \widetilde{\alpha}_0 + \widetilde{\alpha}_1 D_1 + \widetilde{\alpha}_2 D_2 + \widetilde{\beta}_0 t + \widetilde{\beta}_1 D_1 t + \widetilde{\beta}_2 D_2 t + \widetilde{u}_t, \tag{2}$$

where $\widetilde{u}_t = \left[1 - (\rho + \delta)L + \delta L^2\right]^{-1} u_t$ is a zero-mean covariance-stationary process and $L$ is the lag operator. The remaining coefficients in (2) relate to those in (1) according to $\alpha_i = \widetilde{\alpha}_i(1-\rho) + \widetilde{\beta}_i(\rho - \delta)$ and $\beta_i = \widetilde{\beta}_i(1-\rho)$. In these cases, non-linear least squares estimation is used, so as to obtain directly in the output the coefficients and the $t$-statistics of the equivalent representation, (2). The remaining cases are estimated with OLS.

## Estimation with Exogenous Structural Breaks

The estimation results with *a priori* defined structural breaks are displayed in Table 1. The $t$-statistic testing for $\rho = 1$ is denoted ADF. The critical values for each model are displayed in the legend. The table also displays the slopes and the changes in the slope of the transformed equation (2), as well as the corresponding $t$-ratios.

In order to provide a benchmark for our results, unit roots are first investigated without trend breaks. The corresponding results are displayed in Column I of Table 1.

TABLE 1
Dickey Fuller Tests for Stochastic Convergence with and without Exogenous Trend Breaks

| | I | II | III |
|---|---|---|---|
| | None | 1974 | 1974 |
| Discontinuities | | | 1986 |
| ADF | 0.84 | 0.62 | 0.59 |
| | ***−2.62*** | *−4.29*** | *−3.39* |
| Impetus of catch-up | | | |
| First segment | 0.008 | 0.034 | 0.035 |
| | ***3.9***** | *8.1**** | *8.5**** |
| (+) Break 1 | | −0.026 | −0.032 |
| | | *−5.9**** | *−5.8**** |
| (=) Second segment | | 0.060 | 0.066 |
| (+) Break 2 | | | 0.004 |
| | | | *0.8* |
| (=) Third segment | | | 0.071 |
| Adjusted $r^2$ | 0.295 | 0.507 | 0.529 |
| S.E. of regression | 0.0224 | 0.0187 | 0.0183 |
| Lags used ($k$) | 1 | 1 | 1 |
| LM(SC,2) | 4.00 | 0.45 | 2.09 |
| Included observations | 42 | 42 | 42 |

Notes: $t$-ratios in italic. (***), (**) and (*) denote significance at 1 percent, 5 percent, and 10 percent, respectively. Critical values for the unit root test without discontinuities are from MacKinnon [1991]: −3.96 (1 percent), −3.43 (5 percent), −3.13 (10 percent). The critical values for the unit root null with structural breaks are from Rappoport and Reichlin [1989]: −4.73 (5 percent), −4.08 (1 percent) in the model with two segments; −5.45 (1 percent) and −4.76 (5 percent) in the model with three segments. LM(SC, 2) denotes the Breusch–Godfrey test for the null of no serial correlation of order 2.

The endogenously chosen number of lags is $k = 1$. The value of the ADF statistic obtained, $-2.62$, is, however, insufficient to reject the unit root null.

The estimation results with a structural break in 1974 are in Column II. When this break is accounted for, the null of no-convergence is rejected at the 5 percent significance level. The two slope coefficients are significant at the 1 percent level, with the impetus of catch up declining from 3.4 percent per annum before the Revolution to 0.6 percent per annum after the Revolution. These results are favourable to the view that the 1974 Revolution constituted a major shock with long run asymmetric incidence in the series of per capita GDP.

Column III displays the estimation results with two breaks, 1974 and 1986. In this case, the value of the ADF statistics is $-3.39$. This is not low enough to reject the no-convergence null (the 5 percent critical value is $-4.76$). Moreover, the change in the slope in 1986 is not significant.

Thus far, the results point towards convergence after controlling for the 1974 break-point. However, no change in the speed of convergence is identified after EC accession, in 1986.

## Sequential Testing for Stochastic Convergence

Testing for unit roots with exogenously imposed break-dates has been subject to criticism on the grounds that the choice of the break-points may not be independent from the data. This is an important problem because the distribution of the test statistic depends upon the extent of the correlation between the choice of the break points and the data. In alternative, Zivot and Adrews [1992], Banerjee et al. [1992], and Perron [1997] proposed data-dependent methods to choose the break-date [in the context of stochastic convergence, see Loewy and Papell, 1996].

As argued before, in the case of Portugal, there are historical reasons to regard the choice of 1974 and 1986 break points as independent from the data. These dates were chosen on the basis of well-defined political events that influenced significantly the course of policy and institutions in Portugal. Moreover, there was no systematic attempt to choose the break-dates so as to maximise the chances of rejecting the unit root null. There is, however, validity to the argument that it is only *ex post* (after looking at Figure 1) that we guessed a structural break in 1974.

To account for both perspectives, it is useful to investigate how robust the results are when one takes the extreme view where the choice of the breakpoint is effectively made to be perfectly correlated with the data. To do so, the following test procedure is adopted: Considering the model with one break ($\alpha_2 = \beta_2 = 0$), the break-date in *D1* is allowed to vary sequentially in the neighbourhood of 1974 (from 1967 to 1977). The corresponding ADF statistics, the significance of the slope change ($\beta_1$) and the LM test for residual auto-correlation are displayed in Table 2. The left-hand side of Table 2 displays the results with $k = 1$, which are kept for comparative purposes. The right hand side displays the results with $k = k(t\text{-stat})$.

To some extent, the sequential test points to the robustness of the 1974 Revolution as the main idiosyncratic shock affecting the series of relative per capita GDP in Portugal. As shown in Table 2, regardless the approach in respect to the truncation lag parameter, the break-year that minimises the $t$-statistic for the null of no-convergence is 1974. Moreover, the 1974 break-point is also the one for which the significance of the change in the slope is maximised. Finally, higher values of the LM statistic in most other cases point to misspecification of the corresponding break-dates. However, the evidence achieved is not strong enough to overcome the criticism that the choice of the 1974

TABLE 2
Sequential Dickey–Fuller Tests for Stochastic Convergence

| Model with two segments | $k = 1$ | | | $k = k(t\text{-stat})$ | | | |
|---|---|---|---|---|---|---|---|
| Break date | ADF | LM(SC,2) | $t - \beta 1$ | $k$ | ADF | LM(SC,2) | $t - \beta 1$ |
| 1967 | −3.84 | 2.55 | −0.4 | 1 | −3.84 | 2.55 | −0.35 |
| 1968 | −3.24 | 5.24* | −1.6 | 1 | −3.24 | 5.24* | −1.59 |
| 1969 | −3.20 | 5.69* | −1.9* | 1 | −3.20 | 5.69* | −1.86* |
| 1970 | −4.02 | 2.16 | −1.5 | 5 | −3.51 | 0.2 | −0.3 |
| 1971 | −3.63 | 4.03 | −2.3** | 5 | −3.05 | 0.4 | −1.4 |
| 1972 | −3.53 | 5.71* | −2.6** | 5 | −3.04 | 2.7 | −1.7 |
| 1973 | −3.55 | 7.82** | −2.8*** | 4 | −2.03 | 2.8 | −2.3** |
| 1974 | −4.29 | 0.45 | −3.8*** | 1 | −4.29 | 0.45 | −3.81*** |
| 1975 | −4.05 | 2.37 | −3.1*** | 1 | −4.05 | 2.37 | −3.1*** |
| 1976 | −2.21 | 4.73* | −1.2 | 1 | −2.21 | 4.73* | −1.16 |
| 1977 | −3.16 | 3.64 | −2.2* | 1 | −3.16 | 3.64 | −2.16* |

Notes: (***),(**) and (*) denote significance at 1 percent, 5 percent, and 10 percent, respectively. Perron [1997] finite sample ($T = 70$) critical values for sequential unit root tests with one discontinuity are: −5.29 (10 percent), −5.59 (5 percent), −6.32 (1 percent). LM(SC, 2) denotes the Breusch–Godfrey tests for the null of no serial correlation of order 2.

break date could be correlated with the data. Comparing the estimated $t$-ratio (−4.29) with the Perron [1997] critical values displayed in the legend of Table 2, one is not able to reject the unit root null.

Extending the sequential test to two structural breaks, varying the date of the second breakpoint from 1983 to 1993 while holding fixed the first breakpoint in 1974, no evidence of a second break was found. The minimum value of the ADF statistic occurs in 1988, but the corresponding value (−4.39) is not low enough to reject the null, even using the Rappoport and Reichlin [1989] critical values (critical values for sequential testing with two discontinuities, available in Ben-David et al., [2003], are significantly lower). Moreover, the 1988 change in the slope is not significant, and the model displays autocorrelation, suggesting misspecification.[4]

## Conclusions

This paper uses the stochastic approach to convergence to investigate whether real per capita GDP in Portugal has been converging to the EU15 average. The results obtained are somehow mixed, depending on the perceived correlation between the choice of the breakpoint and the data: If the choice of the 1974 break is viewed as independent from the data, then the non-convergence null is rejected; if, however, the choice of a structural break in 1974 is viewed as suggested by visual inspection of Figure 1, then the no convergence null is not rejected.

In the case at hand, there are historical reasons to regard 1974 as a candidate for break point that is independent from the data. The April Revolution constituted a major shock that affected the course of economic policies and institutions in Portugal. At the macroeconomic level, financial discipline and monetary orthodoxy were substituted by large fiscal deficits, financial repression, and nominal instability. On the real side, government intervention has increased dramatically, namely through the nationalisation of large companies, that turned the State virtually monopolist in important industries, including the banking system. In the years following, political instability, price controls, and substantial changes in the legal framework gave rise to important distortions and reduced significantly the adaptability of factor markets. The 1974 Revolution also marked the end of political repression and of the Colonial War, the building up of a participative democracy and a sudden inversion in migration flows, as explained above. All in all, a change in the pace of convergence could be anticipated without looking at the data. The empirical results happen to confirm this guess.

As far as the 1986 breakpoint is concerned, no statistical significance was found. This result is somehow disappointing. With no question, EC membership had a positive impact on the course of policies and institutions in Portugal. At the macroeconomic level, sounder fiscal policies, financial liberalization, central bank independence, and the adoption of a consistent macroeconomic policy framework aiming at nominal stability were necessary steps to participate in the EMS and to join the first wave of EMU. On the real side, the steps that led to the adoption of the Single Market in 1993, including the removal of trade barriers, the dismantling of monopolies through privatisation and infrastructure building financed by large amounts of structural funds constituted substantial improvements in the economic environment. In general, the implementation of the Acquis Communautaire and the contact with European policies and institutions have impacted positively on habits and on the quality of domestic decisions. According to the theory, one would expect these changes to have a positive impact on growth. Apparently, they did not.

## Footnotes

[1] Moreover, it has been demonstrated that cross-section tests on convergence have important pitfalls [Friedman, 1992; Quah, 1993; Evans and Karras, 1996].

[2] The implied assumption is that productivity shocks have a uniform long run impact across countries. Bernard and Durlauf [1995] also work with a less restrictive concept, requiring only the existence of common stochastic trends. In the bi-variate case, this corresponds to the case in which the series of per capita GDP are co-integrated with co-integrating vector $[1, -\lambda]$, where $\lambda$ is not necessarily equal to 1. This means that cointegration is a necessary but not sufficient condition for stochastic convergence.

[3] The transformation is only valid when $k = 1$ and the roots of the characteristic equation $\lambda^2 - (\rho + \delta)\lambda + \delta = 0$ lie inside the unit circle of the complex plan [see Lebre de Freitas, 1992, for details]. In all regressions of Table 1, these conditions happen to be satisfied.

[4] These results are available from the author upon request.

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