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"Portugal-EU convergence revisited: evidence for the period 1960-2003"

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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.

Key Words: Unit root test, Income convergence, The Portuguese Economy.

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Abstract

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1. 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 XX century, Portugal achieved the 8th highest growth rate of per capita GDP, among 98 nations for which comparable data is available (Pen World Tables, Summers and Heston, 1991). This episode of fast economic growth allowed the country to reduce consistently its income gap vis-à-vis the industrialised world.

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 (see, for example, 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 remained poor.

This evidence led some authors to propose 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 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 technological progress is equally available across countries), 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 a large sample of heterogeneous countries has been found in many cross-country studies, including Mankiw, Romer and Weil (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 (among others, Easterly, 2002, Barro and Sala-i-Martin, 1997, Parente and Prescott, 1994, Abramowitz, 1996, 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 (1996), Sachs and Warner (1995, 1997), Hall and Jones (1999), 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 technological pool, many other are falling behind, constrained by domestic 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 output 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, Ben-David, 1993, 1996) or to a constant (conditional convergence, Evan and Carras, 1996).

The empirical strategy consists of investigating the persistency of shocks to the series of relative per-capita income. If this series contains a unit root, then there will be no tendency for per capita income levels to evolve each moment in time so as to approach an equilibrium differential. In that case, income levels will be drifting apart,

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

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].

Barros and Garoupa (1996) used this procedure to test for Portugal-EC convergence in the period 1951-1993. They 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 Portuguese per capita GDP relative to an average of six European countries, the authors found evidence of convergence in the periods 1951-1973 and 1986-1993. For the sub-periods 1951-1960 and 1974-1985, they were not able to reject the non-convergence null. 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. For example, since the period 1986-1993 meet two bottoms and only one pick, it should not be a surprise not to obtain convergence in this particular sub-period. Moreover, as it is well known, testing for unit roots over small sub-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) – see also Evan

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[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 incomes are co-integrated with co-integrating vector $[1, -\lambda]$ where λ is not necessarily equal to 1. This means that cointegration is a necessary but not sufficient condition for stochastic convergence.

and Carras (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 the economies are evolving along coincident long-run paths. In the presence of different steady states, transitional dynamics or "catching up", results will be biased against convergence.

This paper tests whether the Portuguese economy has been converging to the EU average in the period 1960-2003, following the empirical strategy of Carlino and Mills (1993). These authors distinguish two conditions for convergence: (i) shocks to relative per capita GDP should be temporary, and (ii) countries having per capita GDP initially below their compensation differential should exhibit faster growth than those countries having per capita GDP initially above their compensation differential.

The estimation method accounts for changes in the speed of convergence. 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). For example, if there is a regime shift impacting on the speed of convergence or on the steady state level of per capita output, by constraining the model to follow a single trend, such one-time change could be mistakenly interpreted as a source of divergence.

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, breakpoints are specified in 1974 (the April Revolution) and in 1986 (EC Accession). The impetus of "catch up" is estimated by de-trending the model with the Christiano (1992) transformation. 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.

The method extends Barros and Garoupa (1996) in four directions. First, allowing for a drift and time trend, it captures the double possibility of Portugal (i) being engaged in a transitional dynamics and of (ii) 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.

We find evidence of convergence after controlling for the 1974 breakpoint. However, no change in the speed of convergence is identified after EC accession, in 1986. The sequential test points to the robustness of the 1974 Revolution as the main idiosyncratic shock affecting the series of relative per capita GDP, but the corresponding evidence is not strong enough to overcome the criticism that the choice of this break date could be correlated with the data.

The paper proceeds as follows. Section 2 describes the data used. Section 3 presents the empirical strategy. Section 4 displays the results with up to two *a priori* defined structural breaks. Section 5 presents the results of a sequential test that determines endogenously the date of the structural break. Section 6 concludes.

2. The data used

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, AMECO). Visual inspection of the data reveals that throughout the sample period per capita GDP in Portugal has approached the EU average. However, such evolution has not been uniform along time. According to Figure 1, the gap vis-à-vis the European Union has widened in the aftermath of the 1974 April Revolution. The data also suggests a resume in the convergence process after EC accession in 1986.

To understand what's behind the series in Figure 1, we depict in Figure 2 the series of relative GDP and of relative population. Visual inspection of these figures suggests a quite distinct behaviour. Indeed, while the series of relative GDP exhibits a clear upward trend and some short term volatility related to the business cycle, the series of relative population looks trend-less and persistent. Comparing to Figure 1, it appears that much of the time series properties of relative per capita GDP are inherited form population movements. The main population movements in Portugal were: (1) the massive emigration that took place at the time of the *ultramar* war (1961-1974); (2) the repatriation of Portuguese citizens from the ex-colonies after the 1974 Revolution and (3) statistical smoothness, because annual population data are interpolated from regular census. In respect to (3), it is important to observe that the 1992 census was a problematic one: because it occurred during a holiday time, it gave rise to an estimate of the population size that was substantially lower than that anticipated by previous forecasts and, most probably, lower than the actual values. As shown in Figure 2, the population series bounces back in 1992 to rise again in the years after. According to our knowledge, the statistical implications of the 1992 census have not been conveniently addressed by the official statistics. To the extent that this constitutes a measurement error, estimates of per capita GDP around 1992 will be overestimated.

3. The estimation method

Portugal-EU convergence is investigated testing the existence of a unit root in the series of log of relative PCGDP. A drift and a time trend are included, so as to allow for an equilibrium differential and transition dynamics. Up to two structural breaks are also allowed for, so as to capture eventual changes in the convergence path. The general specification is as follows:

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

where z_t is the log of relative PCGDP 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 lag length *k* equal to one. However, considerable evidence exists that using data-dependent methods to select the truncation lag parameter *k* leads to test statistics having better properties than if a fixed *k* is chosen a priori. We follow the k=k(t-stat) procedure, suggested by Campbell and Perron (1991). More specifically, the number of lags is chosen according to the significance of the last included lag (lower than 10%), starting from an upper bound of 5 lags. Autocorrelation is assessed by the LM statistic.

The "impetus of catch-up" is estimated de-trending model (1) according to the Christiano (1992) equivalent representation:

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

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 other coefficients in (2) relate to those in equation (1) according to $\alpha_i = \widetilde{\alpha}_i (1 - \rho) + \widetilde{\beta}_i (\rho - \delta)$ and $\beta_i = \widetilde{\beta}_i (1 - \rho)$. The transformation requires *k=1* and the roots of the characteristic equation $\lambda^2 - (\rho + \delta)\lambda + \delta = 0$ to lie inside the unit circle of the complex plan (see Freitas, 1992, for further details). Estimation uses non-linear least squares, so as to obtain directly in the output the coefficients and t-statistics of the equivalent representation, (2).

4. Estimation with exogenous structural breaks

The estimation results with *a priori* defined structural breaks are displayed in Table 1. We denote for ADF the t-statistic testing for $\rho = 1$. The corresponding critical values in 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, we first investigate unit roots without trend breaks. The corresponding results are displayed in Column I of Table 1. The endogenously chosen number of lags is *k=1*. The value of the ADF statistics obtained, -2.62, is insufficient to reject the unit root null.

Estimates with one structural break are in Column II. The results suggest that the 1974 Revolution represented a shock with long run asymmetric incidence. When such break is accounted for, the null of no-convergence is rejected at the 5% significance level. The two slope coefficients are significant at the 1% level, with the pace of convergence declining from 3.4% before the Revolution to 0.6% after the Revolution.

Column III displays the estimation results with two breaks, 1974 and 1986. In this case, the null of no-convergence is not rejected. Moreover, the 1986 change in the slope is not significant.

Thus far, the results are favourable to the convergence hypothesis, after accounting for a break change in 1974. However, there is no evidence of a acceleration in the pace of convergence after EC accession, in 1986.

5. 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 Andrews (1992), Banerjee et al., (1992) and Perron (1997) proposed data-dependent methods to choose the break-date.

As argued before, for the case at hand, 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 the data) that we guessed a structural break in 1974.

To account for both perspectives, it is useful to investigate how robust the results are when we take the extreme view where the choice of the breakpoint is effectively made to be perfectly correlated with the data. To do so, we proceed as follows. Considering the model with one break ($\alpha_2 = \beta_2 = 0$), we let the date of the structural break in *D1* to vary sequentially in the neighbourhood of 1974 (from 1967 to 1977). The corresponding ADF statistics, the significance of the slope change (β_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-stat). As shown in the table, in both cases the break-year that minimises the *t*-statistic for the no-convergence null is 1974. Moreover, the 1974 break is also the one for which the significance of the change in the slope is maximised. The higher value of the LM statistic is most other cases points to misspecification.

A problem exists, however, in that sequential testing requires higher critical values for the ADF statistic. Comparing the estimated t-ratio (4.29) with the Perron (1997) critical values displayed in the legend of Table 2, one cannot reject the unit root null. This finding raises a critical question concerning the Portugal-EU convergence hypothesis: if the choice of the structural break is viewed as uncorrelated with the data, then null of non-convergence 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 cannot be rejected[3].

[3] Extending sequential testing 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 its value (-4.39) is not 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 of course more demanding). Moreover, the slope change in 1988 is not significant and a significant LM test for autocorrelation points to misspecification. These results are available from the author upon request.

6. 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 specification of the structural break in 1974 is considered as correlated with the data, then the non-convergence null cannot be rejected. If, however, the choice of the 1974 break is viewed as independent from the data, then the non-convergence null is rejected.

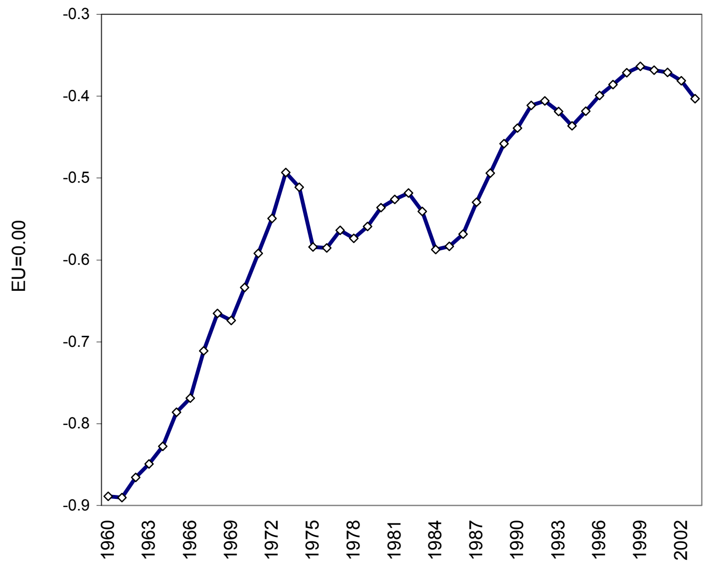
In the case at hand, there are historical reasons to regard 1974 as a candidate for break point that is independent from the data. The April Revolution constituted a major shock that affected the course of economic policies and institutions. At the macroeconomic level, financial discipline and monetary orthodoxy were substituted by large fiscal deficits, seigniorage, financial repression and nominal instability. On the real side, government intervention has increased dramatically, namely through the nationalisation of large companies, with the state becoming virtually monopolist in some important sectors, including the banking system. In the years that followed the revolution, political instability, price controls and substantial changes in the legal framework generated important distortions and impacted negatively on 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 welfare state and an inversion in population flows, as explained in Section 2. All in all, a change in the pace of convergence could be anticipated, even 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, privatisations and infra-structure building financed by large amounts of structural funds allowed for substantial improvements in the economic environment. In general, the implementations of the Acquis Communautaire in a number of areas and the contact with European policies and institutions have impacted 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.

FIGURE 1

Real per capita GDP– Portugal relative to the EU average

(constant PPS, natural logarithms, EU=0.00)



Source: Own calculations using data from the European Commission. PPS (Purchasing Power Standard) is an index of purchasing power parity.

FIGURE 2

Real GDP and Population - Portugal relative to the EU average

(Natural logarithms, EU=0.00)

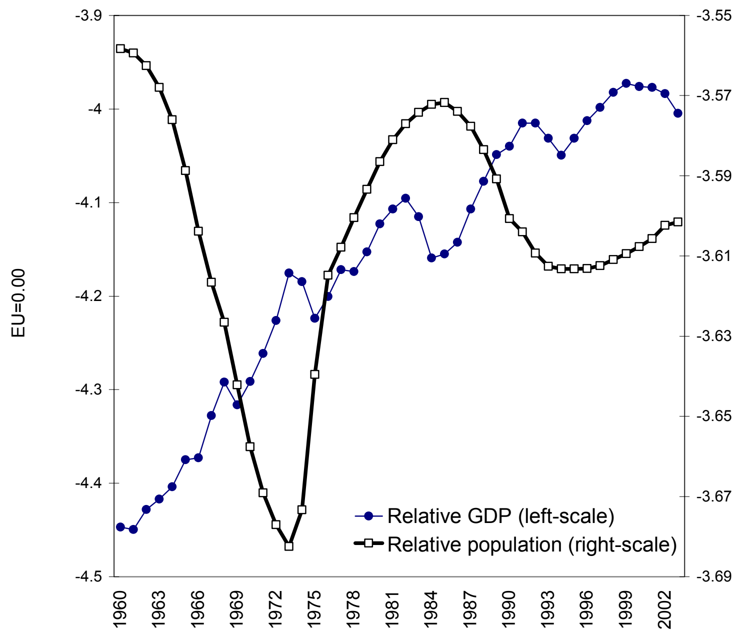


TABLE 1

Dickey Fuller tests for stochastic convergence with and without exogenous trend breaks

	I	II	III
Discontinuities	none	1974	1974 1986
	0.84	0.62	0.59
ADF	*-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-squared	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%, 5% and 10% respectively. LM(SC, 2) denotes the Breusch-Godfrey test for the null of no serial correlation of order 2. Critical values for the unit root test without discontinuities are from MacKinnon (1991): -3.96 (1%), -3.43 (5%), -3.13 (10%). The critical values for the unit root null with structural breaks are from Rappoport and Reichlin (1989): -4.73 (5%), -4.08 (1%) in the model with two segments; -5.45 (1%) and -4.76 (5%) in the model with three segments.

TABLE 2

Sequential Dickey-Fuller tests for Stochastic Convergence

Model with two segments	*k=1*			*k=k(t-stat)*			
Break date	ADF	LM (SC,2)	t-β1	k	ADF	LM (SC,2)	t-β1
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: t-ratios in italic. (***),(**) and (*) denote significance at 1%, 5% and 10% respectively. LM(SC, 2) denotes the Breusch-Godfrey tests for the null of no serial correlation of order 2. Perron (1997) finite sample (T=70) critical values for sequential unit root tests with one discontinuity are: -5.29(10%), -5.59 (5%), -6.32 (1%).

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