

\\93\\

**Italian GNP growth 1890-1992:  
a unit root or segmented trend representation?**

by

Gian Paolo Caselli

Luca Marinelli

Aprile 1993

Dipartimento di Economia Politica  
Via Giardini 454  
41100 Modena (Italia)

## Introduction

After the seminal paper by Nelson-Plosser (1982) a lively debate developed in U.S.A on the issue of the existence of a unit root in us GNP series (see Summers, De Long (1988), Campbell, Mankiw (1987), Cochrane (1988), Christiano, Eichenbaum (1990), Christiano (1992), Rappoport, Reichlin(1989) Perron (1989)). Summing up the debate we may summarise three main positions:

A) Nelson and Plosser argue that the USA quarterly per capita GNP time series for the period 1945-1980 has a unit root and stress the importance of the technological factors (i.e., permanent component versus transitory one)<sup>1</sup> in the GNP *per capita* time series. This result deemphasises the importance of economic policy measures from the demand side. Christiano, Eichenbaum and Mankiw get roughly the same conclusions.

B) De Long, Summers (1988) object to this view on the basis of the analysis of a longer GNP *per capita* time series for the USA. They find that for the period (1890-1985) the USGNP series has a unique trend and does not exhibit a unit root; on the other hand, splitting the series in two sub samples (1860-1929 and 1945-1985, skipping the data for the 1929-crisis and the second world war period) the first part of the series has no unit root, while the second post WW series shows a unit root. Their conclusion was that in the first period the presence of a strong transitory component was due to the lack of keynesian-type policies, while in the second period the presence of a unit root confirmed that keynesian policies were effective in dampening the transitory component. Their point, therefore, stresses the importance of demand side policies.

C) Rappoport and Reichlin (1987, 1989) suggest that in presence of big shocks occurring infrequently, the representation of an economic time series with a DS model is inappropriate and that is more suitable to use a TS model with breaks. Perron (1989), in the same years, shows that the GNP series has not a

---

<sup>1</sup>For a comprehensive survey of the linkages between stochastic and deterministic trends and the decomposition of time series in permanent and temporary components see Lippi (1992)

unique trend, but presents two segmented trends in correspondence of the 1929 breakdown and of the 1973 oil shock. He claims that if the 1929 crisis and the slowdown in growth after 1973 are not realisations of an underline time-invariant stochastic process but can be thought as exogenous phenomena, "(...) then the conclusion is that the many macroeconomic time series are not characterised by the presence of a unit root. Fluctuations are indeed stationary around a deterministic trend function" Following Perron's suggestions we test the hypothesis whether the behaviour of the Italian GNP series from 1890 to 1990 is better represented by a unit root process or by a trend stationary model with breaks; our results are not only interesting from a statistical point of view, but also from an interpretative one. They shed some light on three important economic issues: the existence of different regimes of growth in the Italian economy during the last century, their time span, and last but not least, the importance of keynesian policies in the process of economic growth.

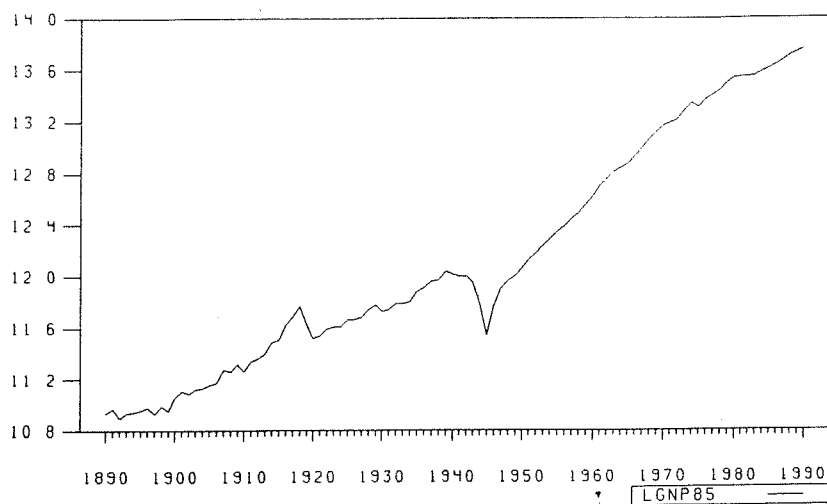
### **The existence of a segmented trend in Italian GNP series 1890-1992**

Inspecting the plot of the log of the Italian GNP series<sup>2</sup> (Figure 1), we see that the trend rate of growth changed infrequently suggesting that the underlying data generating process can not be represented by a random walk-like function. Moreover, this conviction is also supported by the examination of the plot of the first and second differences of the same series (Figure 2 and 3).

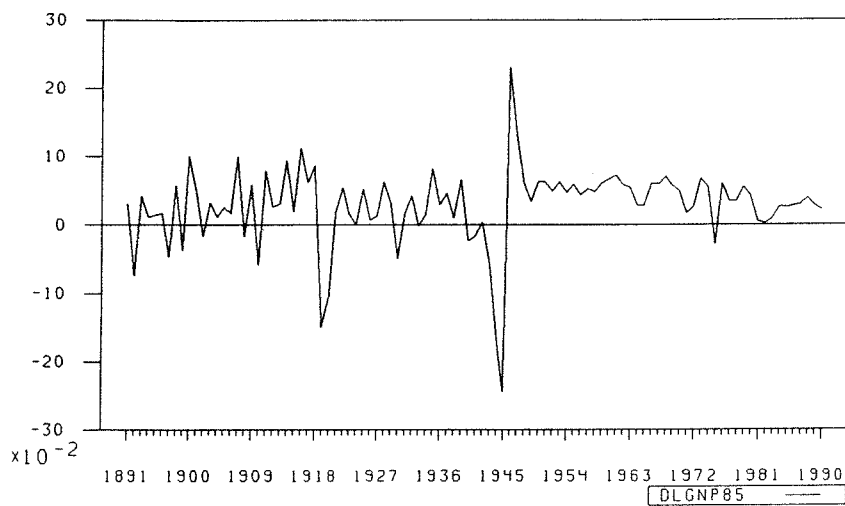
---

<sup>2</sup>The annual data are taken from the work by Rossi, Sorgato and Toniolo (1992). They revised the existing national account statistics for the period 1890 to 1990, taking into account new estimates of GNP for two benchmark years (1911 and 1951) recently produced. We thank the authors and specially Prof. Rossi for providing the data series. Statistical manipulations were performed by using RATS program, version n.3.02 1986-1988.

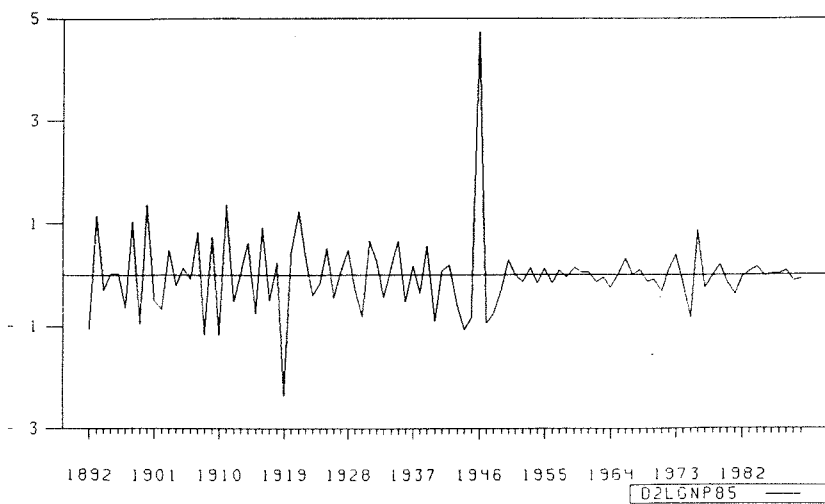
**Figure 1: The log of the Italian GNP**



**Figure 2: First differences of the log of Italian GNP**



**Figure 3: Second differences of the log of Italian GNP**



What clearly emerges is that the Italian economy was characterised by the same regime of growth for the entire period 1890-1939, as shown by the amplitude and frequency of accelerations which is different from the one in the subsequent sub period. Furthermore it is also different from the one after the 1973 oil shock.

These findings reinforce the idea that big changes occurred in the way of the economic machine worked, suggesting the existence of segmented trends in the Italian GNP series.

Perron (1989) demonstrated that in presence of such structural breaks a spurious unit root emerges, and it may not vanish even asymptotically. Consequently we used a TS model with breaks similar to the one proposed by Perron, with some modifications in order to take into account the specific features of the Italian economy during the 20th century.

Perron in his analysis of GNP behaviour put two break points in 1929 and 1973 for the simple reason that the two shocks are historically much more important than any other economic shocks in the economic history of the 20th century. His choice is made on a *a priori* ground.

In the economic growth of the Italian economy there are three great shocks: the two world wars which in any sense are also economic shocks and the first oil shock.

The two wars had different effects on the Italian economic system: while the first WW acted like an engine of growth of the Italian industrial sector for the entire period 1915-1918, the effects of the second WW were quite different. In particular the period 1943-1945 witnessed a great destruction of the Italian economic system, in particular its infrastructure. Starting from 1946 onwards the Italian economy experienced a structural change in its growth path, which was subsequently modified by the first oil shock.

### **The model and estimation results**

In the present section we proceed to test the trend-stationary model with the breaks as mentioned above. Let  $\{\tilde{y}_t\}$ , be the residuals from a regression of  $y_t$  on, respectively, a constant, a time

trend, a dummy indicating a change in the slope and a dummy that takes into account a change in the level of the series. Moreover, let  $\tilde{\beta}$  be the least squares estimate of  $\beta$  in the following regression:

$$\tilde{y}_t = \tilde{\beta}\tilde{y}_{t-1} + e_t \quad t = 1, 2, \dots, T \quad [1]$$

We proceed to test the null hypothesis  $\tilde{\beta} = 1$ . Perron (1989) provides the distribution of the statistics of interest, namely the normalised bias,  $T(\tilde{\beta} - 1)$  and the  $t$  statistic on  $\tilde{\beta}$ . The series  $\{\tilde{y}_t\}$  corresponds to the residuals we have been obtained from the following regression by using OLS

$$y_t = \alpha + \beta t + \gamma_1 DUM15 + \gamma_2 DUM16 + \gamma_3 DUM17 + \gamma_4 DUM18 + \gamma_5 DUM43 + \gamma_6 DUM44 + \gamma_7 DUM45 + \phi_1 LD46 + \phi_2 SD46 + \phi_3 SD75 + \xi_t \quad [2]$$

$$\xi_t = \theta^{-1}(L)\Theta(L)u_t = \tilde{y}_t$$

where the  $u_t$  are iid( $0, \sigma^2_u$ ),  $DUM_i$ ,  $i=15..18$  and  $43..45$ , represent the dummies used to eliminate the effects of the wars, while  $LD$  and  $SD$  are, respectively, the dummies introduced to capture the changes in the level and in the slope of the series occurred, respectively, in 1946 and 1975.

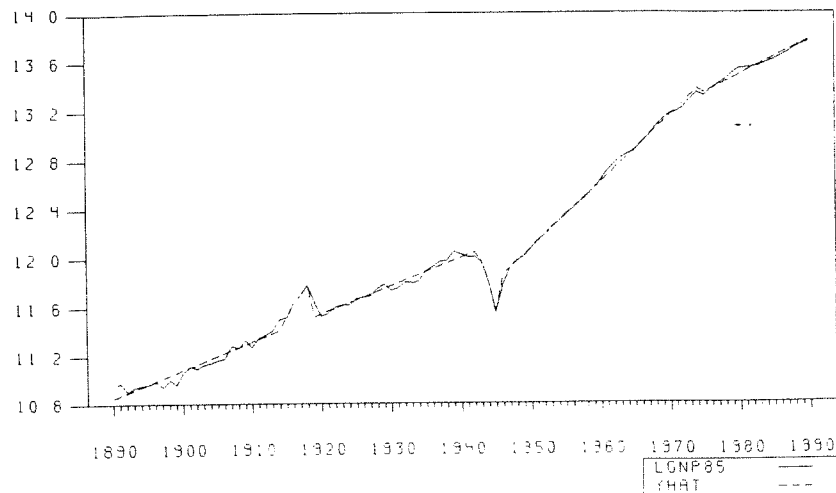
All the parameters of the regression are statistically significant and the *goodness of fit*, (i.e., the  $R^2$  statistic, corrected by the number of regressors ( $R^2\text{BAR}$ )), is 0.998. (see Table 1, Figure 4).

**Table 1:** Estimated value of the regression [2]

VARIABLE	COEFFICIENT	STAND. ERROR	T-STATISTIC
constant	10.826	0.10077E-01	1074.29
trend	0.2292E-01	0.32211E-03	71.173
DUM15	0.8813E-01	0.36285E-01	2.428
DUM16	0.1774214	0.36284E-01	4.889
DUM17	0.21642	0.36285E-01	5.964
DUM18	0.2803	0.36290E-01	7.723
DUM43	-0.1143	0.37317E-01	-3.063
DUM44	-0.2986	0.37394E-01	-7.987
DUM45	-0.5655	0.37473E-01	-15.091
LD46	-2.051	0.57879E-01	-35.431
SD46	0.3107E-01	0.85985E-03	36.141
SD75	0.61999E-02	0.25319E-03	24.487

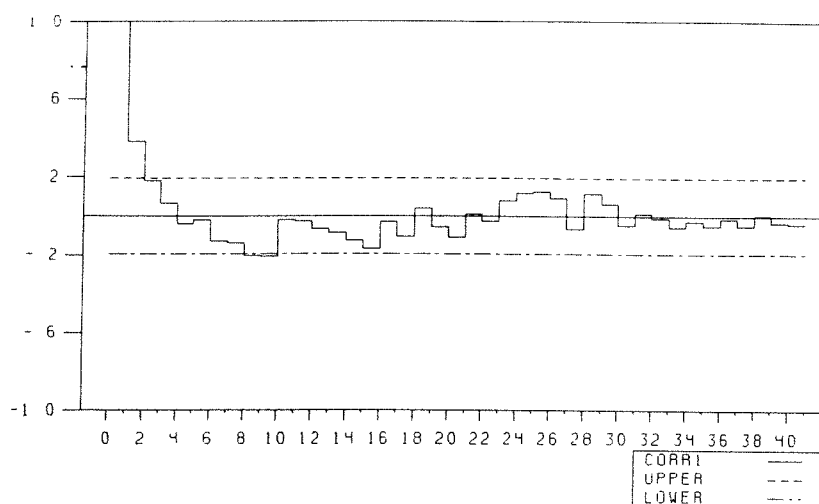
$R^2 = 0.9986$     $R^2\text{BAR} = 0.9983$     $RSS = 0.1174$     $DW = 1.1391$

**Figure 4:** Plot of the actual and fitted values of the log of the Italian GNP.



Then, we tested the stationarity of the residuals  $\{\tilde{y}_t\}$  applying both the graphical analysis of the correlogram, (see Box, Jenkins (1976)), and the standard Dikey-Fuller test methodology. The correlogram shows a substantial stationarity of the residuals, with serial correlation decaying quite quickly, even if they could not be considered as a white noise process (Figure 5), as we expected looking at the Durbin-Watson statistic reported at the end of Tab.1.

**Figure 5:** Correlogram of the residuals resulting from the regression equation [2]



Relating to equation [1] the value of  $\tilde{\beta}$  is 0.384 which results in a value of the statistics  $T(\tilde{\beta}-1)$  equals -61.6. Perron has tabulated the different critical values following the different models proposed (with a level change only, with a slope change only, with both a level and a slope changes). We can reject the null that the residuals of the regression [2] contain a unit root even taking the highest (in absolute terms) critical value contained in the tables proposed by Perron (-44.75).

By using a segmented trend we get a representation of the data coherent with the interpretation of important economic facts, in a satisfactory statistical method, i.e. at the same time capturing the first and second moment non-stationarity contained in the data.



We should note that by introducing a segmented trend the coefficient of the lagged GNP consistently reduces, passing from 0.949 to 0.395; in other words, the unit root is consistently reduced if we allow the model account for the breaks. In order to check how robust are the results obtained we carried over an *F-test* in view of test whether or not the introduction of a segmented trend in a model with a unit root, is able to reduce in a sensible way the sum of the squared residuals (RSS). To reject the null hypothesis of non-existence of a sensible reduction in RSS it must be shown that the introduction of the time variable contributes substantially to explain the behaviour of the time series. Indeed, usually the introduction of a time variable when the data generating process contains a unit root does not reduce the variance of the residuals.

The test is structured as follows. Let RRSS and URSS be the residual sum of squares, of, respectively, the restricted and unrestricted model. They can be written as

$$y_t = \alpha_0 + \beta t + \alpha_1 LD + \gamma y_{t-1} + \varepsilon_t \quad [3]$$

$$\varepsilon_t = iid(0, \sigma_\varepsilon^2)$$

for the restricted model, and

$$y_t = \alpha_0 + \beta t + \alpha_1 LD + \alpha_2 SD + \gamma y_{t-1} + v_t \quad [4]$$

$$v_t = iid(0, \sigma_v^2)$$

for the unrestricted model. We can write down the test as the ratio<sup>3</sup>

$$\tau(y) = \frac{RRSS - URSS}{URSS} \left( \frac{T - k}{m} \right) \approx F(m, k) \quad [5]$$

---

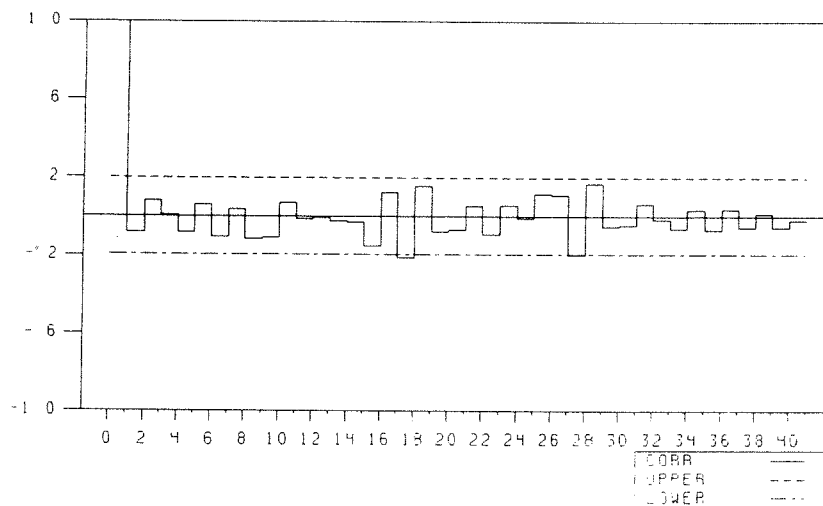
<sup>3</sup> For the formal derivation of the test, see Spanos (1986).

where  $m$  represents the number of restrictions,  $k$  is the number of variables involved,  $T$  is the sample size and  $LD$ ,  $SD$  are the dummies indicating, respectively, the changes in the levels and in the slopes.

The numerical value of the test statistic  $\tau(t)$  is 40.64, with  $m=3$  and  $k=13$ . Hence we strongly reject the possibility that the restricted and the unrestricted models may be equal, the size of the test is in fact  $\alpha=0.025$ . In other words, the segmented trend plays an important role in explaining the time behaviour of the series.

Again, to stress the robustness of our results compare the different forecasting performances of the model containing a unit root and the one with a segmented trend plus an autoregressive component. The introduction of an autoregressive component allows to entirely capture the serial correlation contained in the residuals of equation [2] (Figure 6).

**Figure 6:** Correlogram of residuals obtained by introducing an autoregressive component in equation [2]



In particular, we compare the absolute values of the forecast error one and two step ahead computed by estimating the models on the sub period 1890-1980. The numerical results show that the one step ahead forecast error when using the segmented trend model is ten times lower than the one we get by using a random walk process with drift. The better performance of the TS model is confirmed in

the two step ahead forecast experiment. In this case the value of the forecast error for the segmented trend model equals 0.021 while the value for the random walk is 0.026.

## UNIT ROOT TEST AND SEGMENTED TREND

In this section we show that applying the unit roots test on the entire sample and on the subsample, we get evidence in favour of segmented trend.

Adopting the simplest formulation of the Dickey-Fuller in order to test the presence of a unit root in the data, we compare the following alternatives

$$H_0: \quad y_t = y_{t-1} + \varepsilon_t$$

against the alternative

$$H_1: \quad y_t = \alpha + \beta t + \delta y_{t-1} + \varepsilon_t$$

where  $\varepsilon_t$  is a white-noise innovation and  $\delta$  is less than one. Following the literature, firstly proposed by Fuller (1976) and Dickey, Fuller (1979), we estimated three models: the first, containing only the autoregressive component; the second, containing both a drift and an autoregressive component; and finally, an equation containing both a linear trend, a constant and the autoregressive part. On the entire sample 1890-1990 and using the critical values tabulated in Fuller (1976), we accepted the null

hypothesis only when we include the trend and the constant (table 3) with a confidence of 95%. This is a rather weak result since we find the existence of a unit root only in one model.

**Table 3:** Estimated values for the unit root test  
In squared brackets the critical values; in round brackets the values of the  $t$ -statistic

	constant	trend	$y_{t-1}$	$t_{\beta}$
$\Delta y_t$	--	--	0.002340	4.963 [-2.24;1.64]
$\Delta y_t$	-0.03486 (-0.4423)	--	0.0052	0.79864 [-3.17;0.26]
$\Delta y_t$	0.5645 (1.810)	0.001743 (1.985)	-0.0517	-1.7612 [-3.73;-0.62]

Putting aside statistical weakness, if we split the series in two sub-samples (1890-1945 and 1946-1992) we accept the existence of the unit root only in the latter sub period, as long as we use the model with a trend and a constant (see table 4, a and b).

**Table 4:** Estimated values for the unit root test considering different sub-samples  
In squared brackets the critical values; in round brackets the value of the  $t$ -statistic.

a) Sub-sample 1890-1945

	constant	trend	$y_{t-1}$	$t_{\beta}$
$\Delta y_t$	--	--	0.000923	1.887 [-2.25;1.66]
$\Delta y_t$	0.4323 (1.540)	--	-0.0367	-1.5013 [-3.22;0.29]
$\Delta y_t$	-0.8324 (-0.6919)	0.002726 (-1.0810)	0.080399	0.723979 [-3.80;-0.58]

b) Sub-sample 1946-1992

	constant	trend	$y_{t-1}$	$t_\beta$
$\Delta y_t$	--	--	0.003593	8.2645 [-2.25;1.66]
$\Delta y_t$	0.5391 (6.1456)	--	-0.0379	-5.608 [-3.22;0.29]
$\Delta y_t$	1.4132 (3.999)	0.004389 (2.544)	-0.1327	-3.5136 [-3.80;-0.58]

These results support the idea proposed by DeLong and Summers (1988), that the effectiveness of 'fine tuning' economic policies in reducing temporary fluctuations -- policies widely adopted after the second world war -- allows the permanent part of the fluctuations to emerge with more evidence.

According to this realisation we report in Tab. 5 the sample variances of the first differences of the log of Italian GNP calculated for the three sub-periods 1890-1945, 1946-1974, and 1946-1992 as well as an *F-test*<sup>4</sup> to verify the null hypothesis that all sample variances are equals. To reject this hypothesis, as we do, implies, in our case, that the volatility of the Italian GNP has experienced a consistent reduction after the second world war, i.e. in the period when keynesian policies were implemented. We can agree with the economic conclusions proposed by De Long and Summer, but we deem them to be built on fragile statistical grounds. Further researches able to discriminate between temporary and permanent

<sup>4</sup>The general expression of an *F-test*, implemented to verify if two variances are significantly different, takes the following form:

$$\frac{s_x^2}{s_y^2} \approx F_{n-1, m-1, \alpha}$$

where  $s_i^2$ ,  $i=x,y$ , represents the sample variances of the two subsamples.  $n$ ,  $m$ , indicates the sample sizes and  $\alpha$  is the size of the test. i.e. the probability of rejecting the null hypothesis when true. We accept the null hypothesis that the two true

variances.  $\sigma_x^2$ ,  $\sigma_y^2$ , are equal when  $\frac{s_x^2}{s_y^2} \leq F_{(n-1, m-1, \alpha)}$ , and reject otherwise.

determinants of the fluctuations, of the same type proposed by Blanchard and Quah (1989), should shed more light on the robustness of their, and our, economic conclusions.

**Table 5:** Sample variances of the first differences of the log of Italiann GNP and *F-test* calculated for the different subperiods

YEARS	SAMPLE VARIANCES	NUM. OF OBSERVAT.
1890-1992	0.3303E-2	102
1890-1945	0.4374E-2	55
1946-1992	0.1376E-2	47
1946-1974	0.1471E-2	29
1975 1992	0.4211E-3	18
<i>F-test</i>		
HYPOTHESIS	SAMPLING VALUES	CRITICAL VALUES ( $\alpha = 5\%$ )
VAR(1890-1945) vs VAR(1946-1974)	2.9735	1.75
VAR(1890-1945) vs. VAR(1946-1992)	3.1788	1.64

To verify the idea that the finding of a unit root is statistically unsound we implemented the criteria recently proposed by Kwiatkowski *et al.*(1992). They perform tests based on the null hypothesis of stationarity around a linear trend, instead of a null of the presence of a unit root in the data. The test statistic, which is a *Lagrange Multiplier* (LM), takes the following form. Let  $\hat{\sigma}_\varepsilon^2$  the estimate of the error variance (the sum of squared residuals, divided by T) from the regression of  $y$  on an intercept and a time trend. Then define the partial sum process of the residuals as

$$S_t = \sum_{i=1}^t e_i \quad t = 1, 2, \dots, T \quad [6]$$

Then LM statistic becomes

$$LM = \sum_{t=1}^T S_t^2 / \hat{\sigma}_e^2 \quad [7]$$

Critical values under the null are supplied by Kwiatkowski *et al.* (1992). These analytical results hold under the hypothesis that the errors of the regression are independent and identically distributed (iid). However when the residuals are not iid the appropriate denominator of the LM statistic became a consistent estimate of the 'long run variance', defined by Kwiatkowski as

$$\sigma^2 = \lim_{T \rightarrow \infty} T^{-1} E(S_T^2)$$

which enters into the asymptotic distribution of the test statistics. As a consistent estimate of  $\sigma^2$ , denoted by  $s^2(l)$ , we adopted the following

$$s^2(l) = T^{-1} \sum_{t=1}^T e_t^2 + 2T^{-1} \sum_{s=1}^l (1-s/(l+1)) \sum_{t=s+1}^T e_t e_{t-s} \quad [7]$$

where  $(1-s/(l+1))$  correspond to a particular, and arbitrary weighting function. The specific function chosen represents the Barlett window, widely used in spectral analysis: it guarantees the non-negativity of  $s^2(l)$ ;  $l$  is the truncation lags. Then the test statistic becomes

$$\hat{\eta} = T^{-2} \sum S_t^2 / s^2(l) \quad [8]$$

Our results are showed in Table 6. It should be pointed out that the test presents a unattractive trade-off between correct size and power of the test, when the sample size ranges between 50 and 100. In particular, choosing  $l$  large enough to avoid size bias in the presence of realistic amounts of auto correlation will make the test have very little power. As we can see from the table, the values of the test statistics is fairly sensitive to the choice of  $l$ , and in particular it decreases as  $l$  increases. In the presence of large and persistent positive auto correlation in the series the denominator of [8] increases substantially as  $l$  increases. Kwiatkowski *et al.* (1992) found that a good compromise is reached when  $l=8$ . We calculated the test statistic for  $l=0$ ,  $l=1$  and  $l=8$ . As we expected, since the series under analysis is highly temporally dependent, the values of the statistic is very volatile depending on the fact that we did not correct for error auto correlation at all -- that corresponds to set  $l=0$ . But in this case iid errors are not plausible under the null hypothesis, and failing to allow for auto correlation is not recommended. Based on the estimated value for  $\tau$ , when  $l=8$ , we could not reject the null hypothesis of a trend-stationary GNP.

To strengthen the results and make them more comparable with those obtained in the standard Dickey-Fuller experiment above, we calculated the same statistics for the sub-periods 1890-1945 and 1946-1992. In both cases we could not reject the null hypothesis of trend stationarity, even with a size of 2.5% (critical value = 0.176).

**Table 6:**  $\hat{\eta}$  test for trend stationarity of the Italian Real GNP

Series	lag truncation parameter ( $l$ )		
	0	1	8
	$\hat{\eta}$ : 1% critical value is 0.216		
log of Real GNP 1890-1992	1.789	0.937	0.245
log of Real GNP 1890-1945	0.379	0.237	0.138
log of Real GNP 1946-1992	1.111	0.315	0.175



As we may see from Table 6, we can weakly reject the null hypothesis of trend stationarity over the sample 1890-1992. Hence the results seem to confirm the existence of a unit root in the data. However, by splitting the sample in two sub-periods, in both cases we cannot reject the null hypothesis of trend stationarity in any of the two subperiods. On one hand, this partially contradicts the previous findings shown in tab. 4 a), b), where we could not reject the null hypothesis of the existence of a unit root in the data. Secondly, we think that the fact that in the two sub-samples we accepted the trend-stationarity hypothesis while we rejected it in the full sample, could represent an indirect confirmation of the existence of, at least, two segmented trend in the data, with the residuals being stationary around them.

Since we cannot reject either the unit root hypothesis or the trend stationary one the appropriate conclusion should be that the data are not sufficiently informative to distinguish between these two hypothesis. However, in our opinion this also confirms the accuracy of the analysis firstly proposed by Rappoport, Reichlin (1989) and Perron (1989): adopting the approach implemented by Nelson, Plosser (1982), if the true data generating process from which the time series is drawn contains a segmented trend, the trend-stationary representation of such a time series is rejected much more often when true in favour of a representation containing a stochastic trend.

### **Concluding remarks**

From the analysis of the Italian GNP we found that a segmented trend is the best model that capture the non stationarity in the first and second moment present in the data. Hence the results obtained appear to strongly confirm the validity of the approach firstly proposed by Rappoport, Reichlin (1989) and Perron (1989). Moreover, we concluded that, on statistical ground, is not possible to discriminate between a trend-stationary representation and a difference-stationary one, if we based the test either on the traditional Dickey-Fuller approach or on the new one recently proposed Kwiatkowski *et al.* (1992). Both are performed specifying a non-segmented linear deterministic trend.

Using the segmented trend approach we accepted in the Italian GNP series the existence of two important breaks that allows us to detect three different trends over the entire period: 1890-1945, 1946-1974 and 1975-1992. It seems reasonable, from an economic point of view, to talk about three different regimes of growth for the three different periods. What we mean by *different regimes of growth* are different types of economic organisation, characterised by the implementation of different type of economic policies, the presence of dissimilar "*régimes salariaux*", a changed international environment: these kinds of exogenous different ways of organising the entire economic activity may be reflected in the statistical behaviour of the data (see the various works of the French regulation school, such as Aglietta (1976) Boyer (1986), Boyer and Mistral (1982)).

What we do emphasise is that although big changes in the underlying trend occur infrequently and take time in fully displaying their effects, we can detect with reasonable good precision the break points of these changes: they may be sudden and pervasive like the one after the second world war, or less pronounced like the one occurred after the first oil shock.

Our view is that the information given by the statistical methodology must be complemented by external informations, coming from economic history. By quoting Christiano (1992), the usual approach in choosing breaks in time series analysis is the following one:

"(..) In practice, researchers use a combination of data plots, consultations with colleagues, and formal techniques to select a break date, which is then tested for statistical significance (..)"

Criticising this approach, he finds that the only break-point that still look statistically significant for the GNP of U.S. is neither the 1973.2 oil shock, nor the 1966.1 tax-cut or the deregulation beginning in 1980.2, but the 1950.2 date. This may be sound or debatable from a statistical point of view, but the point at issue is: "What is a permanent shock?"

In our opinion, a big shock is the one which affects permanently the behaviour of economic agents in a lasting way; i.e., they remember it for quite a long time from its occurrence. This cannot be decided only by means of a statistical examination of the data, but also on a historical evidence..

The economic implications of choosing a segmented trend against a random-walk-like mechanism to represent the growth process, are that the greatest part of the changes in the economic system may be considered as a sort of "*by-product*" of cyclical fluctuations during which the economic system undergoes continuous changes along a growth path, described by a linear trend. At some historical point these changes are of such importance that, in presence of a big exogenous shock, they cause the underlying trend to shift upwards or downwards. In our opinion, the segmented trend representation is the best one available to depict such movements, at least for the Italian economy over the period 1880-1992.

To make historical examples, the growth of the Italian economy from the second post-war until the mid-seventies may be described as the alliance among the fordist mass methods of production, the Beveridge ideas on a social plan, and keynesian demand management policies. Such a framework describes a "regime of growth quite different from the previous one, 1890-1948. In this period there has been no substantial changes either in the economic system, in the enacted economic policies, or in the social framework.

The period 1949-1974 is also different from the following one, during which keynesian demand policies were questioned, the social system has been put under severe stresses and, from a technological point of view, the methods of production are quite different from the "Fordist" method of production.

### **Acknowledgements**

We thank all the members of the economics department of the University of Modena for the helpful comments and encouragement. Especially we thank Marco Lippi, Luigi Brighi, Carlo Grillenzoni, Mario Forni, Barbara Pistoresi and Federica Balugani.

- AGLIETTA, M. (1976),** *'Regulation et crises du capitalisme'* Paris-Colmann Levy;
- BLANCHARD, O.J., QUAH, D. (1989)** *'The Dynamic Effects of Demand and Supply Disturbances'* American Economic Review, september, 79(4): 655-673
- BOX, G.E.P, JENKINS, G.M. (1976),** *'Time series analysis: Forecasting and Control'* (Rev. Ed.), San Francisco: Holden Day;
- BOYER, R. (1986),** *'La theorie de la r gulation: une analyse critique'* Paris-La D couverte;
- BOYER, R., MISTRAL, J., (1982),** *'D cumulation, inflation, crise'* Paris, Presses Universitaires de France;
- CAMPBELL, J.Y., MANKIW, N.G. (1987),** *'Are output fluctuations transitory?'* Quarterly Journal of Economics, 102 857-880;
- CHRISTIANO, L.J. (1992),** *'Searching for a break in GNP'* Journal of Business and Economic Statistics, Vol. 3, N. 3, July;
- CHRISTIANO, L.J., EICHENBAUM, M. (1990),** *'Unit roots in real GNP: Do we know, and Do we care?'* Carnegie-Rochester Conference Series on Public Policy, 32, Spring, 7-61;
- COCHRANE, J.H. (1988),** *'How big is the random walk in GNP?'* Journal of Political Economy, 96, 893-920;
- DE LONG, J.B., SUMMERS, L.H. (1988),** *'On the existence and interpretation of a "unit root" in U.S. GNP'* NBER working paper series, n.2716, September;
- DICKEY, D.A., FULLER, W. (1979),** *'Distribution of the estimators for autoregressive time series with a unit root'* Journal of the American Statistical Association 74, 427-431;
- FULLER, W. (1976),** *'Introduction to Statistical Time Series'* -- New York: John Wiley and Sons;
- KWIATKOWSKI, D., PHILLIPS, P.C.B., SCHMIDT, P. YONGCHEOL, S. (1992)** *'Testing the null hypothesis of stationarity against the alternative of a unit root'* Journal of Econometrics, 54 -- 159-178;
- LIPPI, M. (1992),** *'Sulla discussione recente a proposito di teoria e misurazione del ciclo economico'* Rivista di Politica Economica, dicembre.

**NELSON, C., PLOSSER, C. (1982),** *'Trends and Random Walks in Macroeconomic Time Series'*  
Journal of Monetary Economics 10: 139-162;

**PERRON, P. (1989),** *'The great crash, the oil price shock, and the unit root hypothesis'*  
Econometrica, 57, 1361-1401;

**RAPPOPORT,P., REICHLIN,L. (1987),** *'Segmented trends and non-stationary time series'* EUI  
working papers N. 87/319.

\_\_\_\_\_ (1989), *'Segmented trends and non-stationary time series'* The  
Economic Journal, n.99, 168-177;

**ROSSI,N.,SORGATO,A.,TONIOLO,G. (1992),** *'Italian Historical Statistics: 1890-1990'*  
Dipartimento di Scienze Economiche - Università degli Studi di Venezia - "Nota di Lavoro" n.  
92.18;

## Materiali di discussione

1. Maria Cristina Marcuzzo [1985] "Joan Violet Robinson (1903-1983)", pp.134.
2. Sergio Lugaresi [1986] "Le imposte nelle teorie del sovrappiù", pp.26.
3. Massimo D'Angelillo e Leonardo Paggi [1986] "PCI e socialdemocrazie europee. Quale riformismo?", pp.158.
4. Gian Paolo Caselli e Gabriele Pastrello [1986] "Un suggerimento hobsoniano su terziario e occupazione: il caso degli Stati Uniti 1960/1983", pp.52.
5. Paolo Bosi e Paolo Silvestri [1986] "La distribuzione per aree disciplinari dei fondi destinati ai Dipartimenti, Istituti e Centri dell'Università di Modena: una proposta di riforma", pp.25.
6. Marco Lippi [1986] "Aggregation and Dynamics in One-Equation Econometric Models", pp.64.
7. Paolo Silvestri [1986] "Le tasse scolastiche e universitarie nella Legge Finanziaria 1986", pp.41.
8. Mario Forni [1986] "Storie familiari e storie di proprietà. Itinerari sociali nell'agricoltura italiana del dopoguerra", pp.165.
9. Sergio Paba [1986] "Gruppi strategici e concentrazione nell'industria europea degli elettrodomestici bianchi", pp.56.
10. Nerio Naldi [1986] "L'efficienza marginale del capitale nel breve periodo", pp.54.
11. Fernando Vianello [1986] "Labour Theory of Value", pp.31.
12. Piero Ganugi [1986] "Risparmio forzato e politica monetaria negli economisti italiani tra le due guerre", pp.40.
13. Maria Cristina Marcuzzo e Annalisa Rosselli [1986] "The Theory of the Gold Standard and Ricardo's Standard Commodity", pp.30.
14. Giovanni Solinas [1986] "Mercati del lavoro locali e carriere di lavoro giovanili", pp.66.
15. Giovanni Bonifati [1986] "Saggio dell'interesse e domanda effettiva. Osservazioni sul capitolo 17 della General Theory", pp.42.
16. Marina Murat [1986] "Between old and new classical macroeconomics: notes on Leijonhufvud's notion of full information equilibrium", pp.20.
17. Sebastiano Brusco e Giovanni Solinas [1986] "Mobilità occupazionale e disoccupazione in Emilia Romagna", pp.48.
18. Mario Forni [1986] "Aggregazione ed esogeneità", pp.13.
19. Sergio Lugaresi [1987] "Redistribuzione del reddito, consumi e occupazione", pp. 17.
20. Fiorenzo Sperotto [1987] "L'immagine neopopulista di *mercato debole* nel primo dibattito sovietico sulla pianificazione", pp. 34.
21. M. Cecilia Guerra [1987] "Benefici tributari del regime misto per i dividendi proposto dalla Commissione Sarcinelli: una nota critica", pp 9.
22. Leonardo Paggi [1987] "Contemporary Europe and Modern America: Theories of Modernity in Comparative Perspective", pp. 38.
23. Fernando Vianello [1987] "A Critique of Professor Goodwin's 'Critique of Sraffa' ", pp. 12.
24. Fernando Vianello [1987] "Effective Demand and the Rate of Profits: Some Thoughts on Marx,

- Kalecki and Sraffa”, pp. 41.
25. Anna Maria Sala [1987] “Banche e territorio. Approccio ad un tema geografico-economico”, pp. 40.
  26. Enzo Mingione e Giovanni Mottura [1987] “Fattori di trasformazione e nuovi profili sociali nell’agricoltura italiana: qualche elemento di discussione”, pp. 36.
  27. Giovanna Procacci [1988] “The State and Social Control in Italy During the First World War”, pp. 18.
  28. Massimo Matteuzzi e Annamaria Simonazzi [1988] “Il debito pubblico”, pp. 62.
  29. Maria Cristina Marcuzzo (a cura di) [1988] “Richard F. Kahn. A disciple of Keynes”, pp. 118.
  30. Paolo Bosi [1988] “MICROMOD. Un modello dell’economia italiana per la didattica della politica fiscale”, pp. 34.
  31. Paolo Bosi [1988] “Indicatori della politica fiscale. Una rassegna e un confronto con l’aiuto di MICROMOD”, pp. 25.
  32. Giovanna Procacci [1988] “Protesta popolare e agitazioni operaie in Italia 1915-1918”, pp. 45.
  33. Margherita Russo [1988] “Distretto industriale e servizi. Uno studio dei trasporti nella produzione e nella vendita delle piastrelle”, pp. 157.
  34. Margherita Russo [1988] “The effects of technical change on skill requirements: an empirical analysis”, pp. 28.
  35. Carlo Grillenzoni [1988] “Identification, estimation of multivariate transfer functions”, pp. 33.
  36. Nerio Naldi [1988] “Keynes’ concept of capital” pp. 40.
  37. Andrea Ginzburg [1988] “Locomotiva Italia?” pp. 30.
  38. Giovanni Mottura [1988] “La ‘persistenza’ secolare. Appunti su agricoltura contadina ed agricoltura familiare nelle società industriali” pp. 40.
  39. Giovanni Mottura [1988] “L’anticamera dell’esodo. I contadini italiani dalla ‘restaurazione contrattuale’ fascista alla riforma fondiaria” pp. 40.
  40. Leonardo Paggi [1988] “Americanismo e riformismo. La socialdemocrazia europea nell’economia mondiale aperta” pp. 120.
  41. Annamaria Simonazzi [1988] “Fenomeni di isteresi nella spiegazione degli alti tassi di interesse reale” pp. 44.
  42. Antonietta Bassetti [1989] “Analisi dell’andamento e della casualità della borsa valori” pp. 12.
  43. Giovanna Procacci [1989] “State coercion and worker solidarity in Italy (1915-1818): the moral and political content of social unrest” pp. 41.
  44. Carlo Alberto Magni [1989] “Reputazione e credibilità di una minaccia in un gioco bargaining” pp. 56.
  45. Giovanni Mottura [1989] “Agricoltura familiare e sistema agroalimentare in Italia” pp. 84.
  46. Mario Forni [1989] “Trend, Cycle and ‘Fortuitous Cancellations’: a Note on a Paper by Nelson and Plosser” pp. 4.
  47. Paolo Bosi, Roberto Golinelli, Anna Stagni [1989] “Le origini del debito pubblico e il costo della stabilizzazione” pp. 26.
  48. Roberto Golinelli [1989] “Note sulla struttura e sull’impiego dei modelli macroeconomici”

pp. 21.

49. Marco Lippi [1989] "A Short Note on Cointegration and Aggregation" pp. 11.
50. Gian Paolo Caselli and Gabriele Pastrello [1989] "The Linkage between Tertiary and Industrial Sector in the Italian Economy: 1951-1988. From an External Dependence to an Internal One" pp. 40
51. Gabriele Pastrello [1989] "François Quesnay: dal Tableau Zig-Zag al Tableau formule: una ricostruzione" pp. 48
52. Paolo Silvestri [1989] "Il bilancio dello stato" pp. 34
53. Tim Mason [1990] "Tre seminari di Storia Sociale Contemporanea" pp. 26
54. Michele Lalla [1990] "The Aggregate Escape Rate Analysed through the Queueing Model" pp. 23
55. Paolo Silvestri [1990] "Sull'autonomia finanziaria delle Università" pp. 11
56. Paola Bertolini, Enrico Giovannetti [1990] "Uno studio di 'filiera' nell'agroindustria. Il caso del Parmigiano Reggiano" pp. 164
57. Paolo Bosi, Roberto Golinelli, Anna Stagni [1990] "Effetti macroeconomici, settoriali e distributivi dell'armonizzazione dell'IVA" pp. 24
58. Michele Lalla [1990] "Modelling Employment Spells from Emilian Labour Force Data" pp. 18
59. Andrea Ginzburg [1990] "Politica nazionale e commercio internazionale" pp. 22
60. Andrea Giommi [1990] "La probabilità individuale di risposta nel trattamento dei dati mancanti" pp. 13
61. Gian Paolo Caselli e Gabriele Pastrello [1990] "The service sector in planned economies. Past experiences and future perspectives" pp. 32
62. Giovanni Solinas [1990] "Competenze, grandi industrie e distretti industriali. Il caso della Magneti Marelli" pp. 23
63. Andrea Ginzburg [1990] "Debito pubblico, teorie monetarie e tradizione civica nell'Inghilterra del Settecento" pp. 30
64. Mario Forni [1990] "Incertezza, informazione e mercati assicurativi: una rassegna" pp. 37
65. Mario Forni [1990] "Misspecification in Dynamic Models" pp. 19
66. Gian Paolo Caselli e Gabriele Pastrello [1990] "Service Sector Growth in CPE's: An Unsolved Dilemma" pp. 28
67. Paola Bertolini [1990] "La situazione agro-alimentare nei paesi ad economia avanzata" pp. 20
68. Paola Bertolini [1990] "Sistema agro-alimentare in Emilia Romagna ed occupazione" pp. 65
69. Enrico Giovannetti [1990] "Efficienza ed innovazione: il modello "Fondi e Flussi" applicato ad una filiera agro-industriale" pp. 38
70. Margherita Russo [1990] "Cambiamento tecnico e distretto industriale: una verifica empirica" pp. 115
71. Margherita Russo [1990] "Distretti industriali in teoria e in pratica: una raccolta di saggi" pp. 119
72. Paolo Silvestri [1990] "Legge Finanziaria. Voce dell'Enciclopedia Europea Garzanti" pp. 8
73. Rita Paltrinieri [1990] "La popolazione italiana: problemi di oggi e di domani" pp. 57
74. Enrico Giovannetti [1990] "Illusioni ottiche negli andamenti delle grandezze distributive: la scala



mobile e l'“appiattimento” delle retribuzioni in una ricerca” pp. 120

75. Enrico Giovannetti [1990] “Crisi e mercato del lavoro in un distretto industriale: il bacino delle ceramiche. Sez. I” pp. 150
76. Enrico Giovannetti [1990] “Crisi e mercato del lavoro in un distretto industriale: il bacino delle ceramiche. Sez. II” pp. 145
77. Antonietta Bassetti e Costanza Torricelli [1990] “Il portafoglio ottimo come soluzione di un gioco bargaining” pp. 15
78. Antonietta Bassetti e Costanza Torricelli [1990] “Una riqualificazione dell'approccio bargaining alla selezioni di portafoglio” pp. 4
79. Mario Forni [1990] “Una nota sull'errore di aggregazione” pp. 6
80. Francesca Bergamini [1991] “Alcune considerazioni sulle soluzioni di un gioco bargaining” pp. 21
81. Michele Grillo e Michele Polo [1991] “Political exchange and the allocation of surplus: a model of two-party competition” pp. 34
82. Gian Paolo Caselli e Gabriele Pastrello [1991] “The 1990 Polish Recession: a Case of Truncated Multiplier Process” pp. 26
83. Gian Paolo Caselli e Gabriele Pastrello [1991] “Polish firms: Pricate Vices Public Virtues” pp. 20
84. Sebastiano Brusco e Sergio Paba [1991] “Conessioni, competenze e capacità concorrenziale nell'industria della Sardegna” pp. 25
85. Claudio Girmaldi, Rony Hamaui, Nicola Rossi [1991] ”Non marketable assets and households' portfolio choices: a case study of Italy” pp. 38
86. Giulio Righi, Massimo Baldini, Alessandra Brambilla [1991] ”Le misure degli effetti redistributivi delle imposte indirette: confronto tra modelli alternativi” pp. 47
87. Roberto Fanfani, Luca Lanini [1991] ”Innovazione e servizi nello sviluppo della meccanizzazione agricola in Italia” pp. 35
88. Antonella Caiumi e Roberto Golinelli [1992] ”Stima e applicazioni di un sistema di domanda Almost Ideal per l'economia italiana” pp. 34
89. Maria Cristina Marcuzzo [1992] ”La relazione salari-occupazione tra rigidità reali e rigidità nominali” pp. 30
90. Mario Biagioli [1992] ”Employee financial participation in enterprise results in Italy” pp. 50
91. Mario Biagioli [1992] ”Wage structure, relative prices and international competitiveness” pp. 50
92. Paolo Silvestri e Giovanni Solinas [1993] ”Abbandoni, esiti e carriera scolastica. Uno studio sugli studenti iscritti alla Facoltà di Economia e Commercio dell'Università di Modena nell'anno accademico 1990/91” pp. 30