Working Paper No. 249

CYCLICALITY IN INDUSTRIAL GROWTH IN INDIA:
AN EXPLORATORY ANALYSIS

R. Anandaraj

CENTRE FOR DEVELOPMENT STUDIES
THIRUVANANTHAPURAM
APRIL 1992

Cyclicality in Industrial Growth in India: An Exploratory Analysis

A review of the literature on industrial growth in India, shows that barring a few studies [e.g., Raj (1976, 1984), Shetty (1978)], industrial growth has been interpreted by merely fitting statistical models like exponential function, dummy variable regression, kinked exponential function and quadratic function to the observed time series data without any exploratory analysis. And such statistical exercises have often led to misleading conclusions about the industrial growth process under different policy regimes. There is a need, therefore, to clarify the basics of the methodologies underlying the interpretations. This is especially so in the light of the changing policy regimes since the mid-seventies.

In this paper, we have made an attempt in this direction by re-examining the celebrated hypothesis of "relative deceleration in industrial growth since mid-sixties". This hypothesis has two variants, namely (i) the existence, and (ii) the persistence, of relative deceleration in industrial growth since the mid-sixties. The first variant has examined, whether relative deceleration in growth since mid-sixties existed or not, and if so, the second variant has examined how long did the downward trend in growth continue. The reason for making such a distinction here between the "existence" and "persistence" of the industrial deceleration hypothesis is that in a recent debate

between Snigdha Chakrabarti and Ashok Rudra (hereafter, CR) and Partha Ray (hereafter, Ray) the former failed to detect any tendency of general industrial retardation!

The paper is organized into six sections. A critical review of the recent debate between CR and Ray has been undertaken in section I. In section II, we have tried to reformulate the hypothesis of the persistence of industrial retardation with the help of the business cycle theory. The method of analysis employed in this study is introduced in section III. In section IV, we have re-examined the existence of retardation hypothesis with CR's data. In section V, an attempt has been made to test both the variants of the retardation hypothesis with the NAS data. Section VI contains concluding observations with an alternative hypothesis of cyclicality in growth.

I. Industrial Retardation Hypothesis

A striking finding of CR is that "a careful review of the relevant data does not lend support to the hypotheses of industrial retardation...". This observation is in contrast to the general consensus among those involved in the industrial stagnation debate since 1976. Indeed, CR claim that "We do not, however, interpret our results as suggesting that these economists[1] were all wrong in their interpretation of data. Our

very different results refer to a very different time comparison and ...for those time comparisons the authors were entirely right about their judgment". The critique offered by Ray is that "CR neglect the whole of the 1950s and arrive at trends that the earlier authors could not find" and that, therefore, CR conclusions were "...unacceptable because the time frame... was entirely different".

In short, it may be said that the crux of the difference in the findings of CR and Ray lies precisely on the question of periodization of the uninterrupted time series data. Regarding this question, Ray has asserted that "...if one sees the data on industrial production carefully (index or otherwise) one gets three distinct breaks, viz, Period I: 1950-51 to 1964/65, Period II: 1965-66 to 1979-80, Period III: 1980-81 to present date. The first period is characterized by relative growth, the second period by stagnation followed by the third period of further growth". In reply to Ray, CR (1991) have argued that "we are strongly opposed to any method that involves starting off with assumed breaking points" but "...we believe that whether there is a tendency for deceleration or not has to be extracted from the entire time series data".

We fully agree with CR's argument, but not at all, with the method by which they have analysed the entire time series data. In fact, CR themselves have not justified the rationale

for choosing the growth curve of the order of second degree polynomial functional form, that is semi-log quadratic function (of the form $\ln Y_t = a + bt + ct^2$). Further, it is quite evident from CR's exercise that they have also used some kind of a priori information to fix the order of the degree of the functional form rather than extracting the periodicity in growth from the entire time series data. Therefore, their criticism against the other analysts (including Ray) about a priori periodization applies equally to their own study.

A point needs to be emphasised here. In fact, CR (1998) overlooked the relative importance of the effects on trend (growth) of other built-in components of the time series model viz, seasonality, cyclicality and irregularity. It was not that they were not aware of the relative importance of the effects of cycle on trend. In fact, they did make such statements as that "the task of distinguishing between trend movements and cyclical movements poses one of the trickiest of statistical problems"[2] and is "stretching far beyond the reaches of elementary descriptive statistics of curve fitting"[3]. However, these passing statements are not sufficient enough to justify their choice of quadratic function in estimating trend movements of industrial output/value added. Further, their assumption that the switching over from the downswings in trend to the upswings over a long span of time period usually leave the secular trend unaffected cannot be taken for granted. This is true when

periodicity of the swings is of equal order. Otherwise, the swings in trend have a significant bearing on the secular trend.

Suppose, the trend has a longer period of downswings with smaller period of upswings, then the trend is likely to get dampened from the equilibrium level (steady state) to the extent of the degree of disequilibrium in periodicity and amplitude of the swings. The reverse is the case when the upswings in trend are longer than the downswings. Consequently, it becomes imperative to know the nature and periodicity of the cyclical movements before one chooses a method of analysing growth that would provide the unbiased estimates of the trend. It may be recalled here that CR ignored the effects of cyclical movements on the movements in trend. We, therefore, disagree with CR's statistical exercise, where neither have they incorporated cyclical movements in some way or other in the analysis of movements in trend, nor given relative importance to the effects of cycle in interpreting the observed drift in secular trend through time series analysis. In contrast, there is much to commend on some earlier studies which have at least recognised implicitly the very existence of cyclical movements in growth by interpreting the deceleration in industrial growth since the mid-sixties through different methods of sub-period analyses.

II. Hypothesis of Persistence of Industrial Retardation

One cannot refute the disagreement among the earlier studies about the persistence of relative deceleration in growth since the mid-sixties. This has come about largely because the earlier analysts had chosen alternative methods of trend fitting on a priori considerations, and not the analysis of cyclical movements in growth. This has led us to formulate the second variant of our hypothesis, that is, the persistence of industrial retardation.

It is well documented in the business cycle theories[4] that the persistence of swings in growth is a reflection of cyclicality but the periodicity is the special case of persistence. In other words, one can say that the average length of a cycle is a question of "persistence" and the variability of cycle lengths (phases) refers to a question of "periodicity". Since our interest here is to identify length of the downswing in trend, we use rather loosely the term "persistence" to mean the periodicity of the downward trend. The reason is simple. The first variant of the hypothesis (that is, the existence of industrial retardation) has been concerned with an examination to see whether there was a downward drift in trend since the mid-sixties. Then, it becomes apparent that the hypothesis can be statistically examined with the help of the analysis of cyclicality in growth.

As a prelude, Raj (1984) had attempted to study the cyclicality in industrial growth in India with the use of the graphical method of plotting three-year moving averages of annual percentage changes in gross value added, sector-wise. He observed that industrial growth in India depicted a cyclical pattern with a cycle length of roughly 7 to 8 years and also noted that the industrial growth cycle followed agricultural growth cycle with a time-lag of 1 to 2 years. Using average annual growth rates for each of 8-year periods identified, namely 1952/53 to 1959/60, 1960/61 to 1967/68, 1968/69 to 1975/76, 1976/77 to 1983/84, he advanced the view that ".....there has been possibly some increase in the rate of growth of industrial output since the middle of the 1970s raising it closer to the levels achieved in the 1950s and 1960s" [Raj:1984, p.1982]. Interestingly, it may be noted here that Raj's study is the second one that observed the sign of recovery in growth after the mid-seventies, preceded by Patnaik and S.K. Rao (1977) and followed by Alagh (1986). However, this did not draw adequate attention among the scholars, who debated the 80's recovery in industrial growth. Hence, we here propose to extend Raj's contribution with a detailed investigation on cyclicality in industrial growth.

III. Method of Analysis

Before presenting our methodology and results of the investigation of cyclicality in growth, we may introduce the problems mostly encountered in applied econometric work (using yearly data) with the help of the following standard semi-log linear model for the exponential growth function,

$$\ln Y = \alpha + \beta \text{ Time} + u, \quad \text{---------- (1)}$$

where ln Y_t is an (n x 1) dependent variable (in log scale) vector, Time is an (n x 1) independent variable vector, α and β are the model parameters of intercept and slope respectively, and u is an (n x 1) error vector. The ordinary least squares (OLS) will yield unbiased maximum likelihood estimates of model parameters when the error component, u, follows normal distribution with zero mean and variance, σ^2. But it has been often confirmed in applied econometric work that the distribution of errors follows, in most cases, non-normality. And a standard criticism of applied econometric work with non-normality in errors is that large residuals or "outliers" can exert considerable influence on parameters estimates because the OLS minimizes the sum of squared errors giving undue weights to large residuals.

However, a recent econometric work[5] has shown that the OLS, even with the non-normality of errors, still gives the best linear unbiased estimator of the model parameter, b, and unbiased consistent estimator of variance, s^2. In addition, it is also maintained that neither b nor s^2 is efficient or asymptotically efficient, since the maximum likelihood estimator is nonlinear. Interestingly, we can argue here that a critique of the inadequacy of OLS with non-normality in errors to satisfy the efficiency criterion (being one of the large sampling properties) may not, though undeniably important in case of forecasting, be a serious issue in small sampling like our analysis of discerning cyclicality in growth.

Moreover, a recent study on detrending crop yield data with nonnormal errors by Swinton and King (1991) has empirically demonstrated that a set of robust regression (RR) techniques[6] suggested in recent statistical literature to estimate the more efficient trend co-efficients with a view of automated means of controlling influential outliers have often failed, regardless of sample size, to yield co-efficient estimates that are significantly different from the OLS co-efficient estimates. In fact, they have shown that trend co-efficient estimates of all RR techniques lie within one OLS standard error of the OLS estimate. Therefore, they have argued that, as an easy and practical method of fitting trend to time series data with nonnormal errors, the OLS is preferred to the RR techniques of the Multivariate t

(MULTIT), the least absolute error (LAE), the trimmed mean (TRIM), the five quantity-weighted regression quantile (FIVEQUAN), the Gastwirth weighted regression quantile (GASTWIRTH) and the Tukey tri-mean weighted regression quantile (TUKEY).

We maintain in our analysis that the unbiased estimates of linear trend through the OLS method with nonnormal errors depict on the average only the equilibrium (constant) rate at which the series has either grown or declined over time. And they (estimates of linear trend) do leave completely the movements in growth or swings in trend unaccounted for. Consequently, we strongly suggest that the analysis of movements in growth that uncover cyclical fluctuations with irregularity (if any) is extremely important, either, to choose the appropriate method of trend fitting to track the actual growth pattern or to provide a meaningful interpretation of the estimated growth with required qualifications for the left out effects of cyclicality in the analysis of trend fitting. In light of this, we may now set out the methodology followed in the present study.

A simple method of univariate approach to time series has been attempted in this paper: (i) to characterize the nature and length of the cyclical movements in growth, and (ii) to estimate growth rates for periodicity of the cycles identified. In other words, we identify, first, change in the structure and then

analyse the growth within the structures identified. Following Jan Tinbergen's interpretaion that the nature of the cyclical movements depends as much on the structure as on the random shocks, we have analysed the growth performance alongwith structural change assuming that growth and structural change are complementary rather than independent.

In the first stage, the observed time series data is detrended by merely fitting the exponential trend stationary model as given in equation (1). Then, following Jan Tinbergen's method of discerning cyclicality in growth, the detrended series is expressed in its own standard deviation. This normalisation procedure, which scales down the detrended series, helps us only to compare cyclical-irregular movements of different time series. Consequently, irregular movements in the detrended series are yet to be eliminated for characterising cyclical movements. These irregular movements cannot be isolated easily from the detrended series for the plausible reason that the nature and type of irregularity existed in any time series for that matter is, first of all, strenuous to characterize empirically. However, we have employed a conventional technique of test of randomness for detecting the presence of irregular movements in the detrended series.

This random test is based on the analysis of number of turning points in a series[7]. Though the roubustness of this test

is subject to question, certainly it helps us to know whether the detrended series have randomness or not. As Jan Tinbergen argued, factors underlying the turning points are of two types, namely (i) endogeneous and (ii) exogeneous. The endogeneous factors that are essentially the prima facie causes of changes in the economic structure has effected in generating turning points (or drifts) in growth path. And this gives rise to the formation of cycles in growth. The exogeneous factors are treated as a manifestation of random shocks in the growth analysis. In light of these, we have excluded turning points corresponding to the turning points of the cycles in testing the randomness.

If the detrended series are found to have randomness, then we have utilized moving average method to control the random effects on cyclicality. But the choice of appropriate moving average method is recognised as one of the trickiest statistical problems in applied statistics. Nevertheless, three year moving average method (though it is subject to question), which has been proposed in the elementary descriptive statistics, is used in the present study for controlling irregular movements in the detrended series because of the lack of a universally accepted method of characterizing any type of irregular movements. Thus, the detrended series has been smoothened for discerning cyclical movements (or cyclicality) empirically in our method of analysis.

In the second stage, we have relied on the graphical method of plotting the smoothened detrended series against time for visual inspection of the very existence and periodicity of the cyclicality in growth. Then the uninterrupted time series are periodized according to phases of the cycles identified. Thus, we have tried to control the effects of cycles on growth.

However, the period-wise data is not free from irregular movements. The irregular movements that are suspected to be influential ones are expected to affect both magnitude and sign of the period-wise growth rates.[3] Since large outliers in the end points of the series have a tendency to exert their influences on slope of the series, we have used three year moving average method to smoothen the period-wise time series data for controlling the influential effects of the irregular movements on trend. Thus, we rely on the method of analysis of cyclicality in growth to choose an appropriate method of trend fitting, from amongst the available alternative methods, in order to seek a meaningful explanation for the growth process that the industrial sector has undergone since 1951/52.

IV. Testing Retardation Hypothesis with CR's Data

We have tried to test the first variant of the retardation hypothesis by using the very same data of CR study. CR have used the data on physical output of industries furnished in statistical abstracts, both monthly and yearly issues. The time period covered was 25 years, from 1961 to 1985. Based on the sign and significance of the co-efficient of the quadratic term in the analysis of quadratic trend fitting, CR grouped the sample industries, as under three categories, viz., steady growth, acceleration in growth and deceleration in growth. Out of seventeen sample industries, they found that nine industries showed a steady growth, six industries a decelerating growth and two industries an accelerating growth. On the basis of this relative differential performance of growth for the period chosen, CR contended that one was not justified in talking about retardation in general, though deceleration did mark certain individual industries.

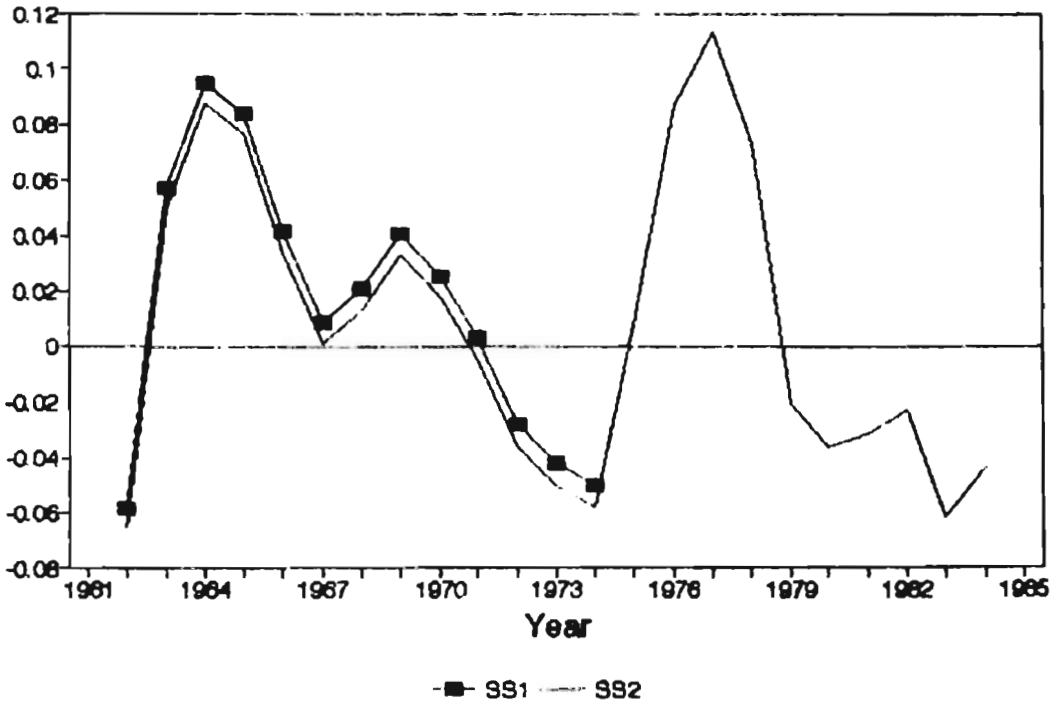
In connection with CR's study, two analytical questions need clarifications: (i) Whether CR's sample industries have cycles in growth or not and if so, is there a downswing in trend since the mid-sixties ?; and (ii) whether the cycle responds to different sample sizes, that is periods of analysis. Towards answering these questions, we used a test of randomness which has shown that all the normalised detrended series have rando

influences. Then, the normalised detrended series are smoothened for controlling irregular movements by reference to three year moving average method.

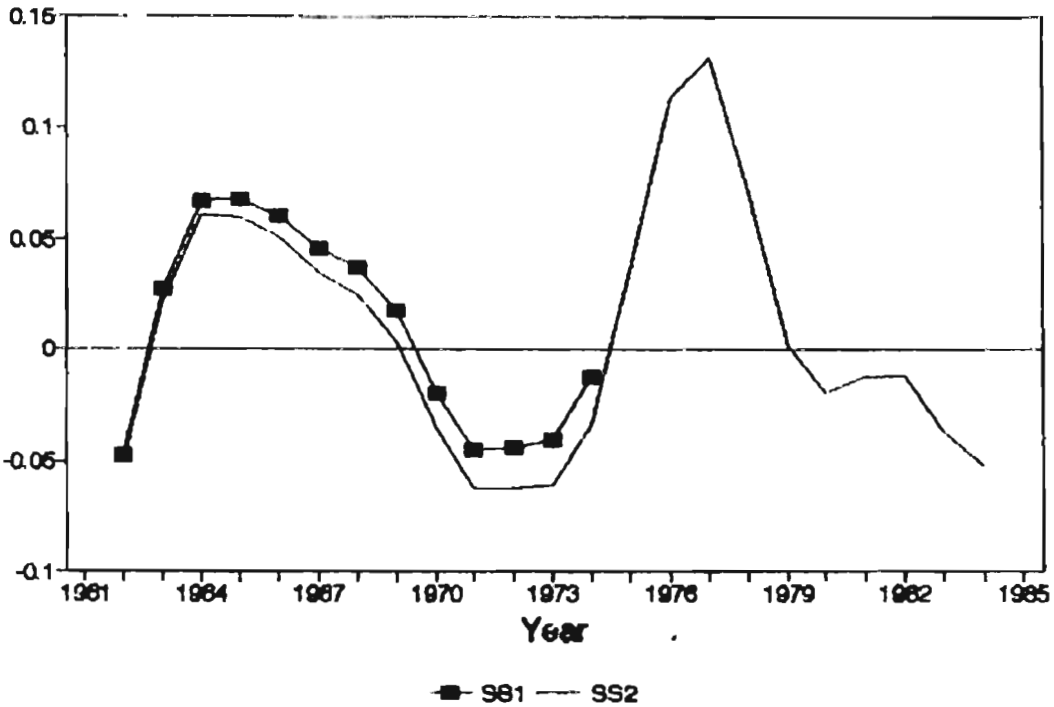
Graphs 1.1 to 1.6 present the output cycles of few industries from each category. It may be seen that periodicity of the cycles perceived are not of equal order in all the industries. It is observed that the uneven phases of the cycles identified in all these industries have a tendency to cancel out each other leaving the growth unaffected. This is precisely because of the existence of more than one cycle, that is, roughly two to three cycles, in the physical output growth of all these industries, except for sugar where more than three cycles with the periodicity of 3 to 4 years are found to persist.[3]

It is evident from the graphical analysis of cycles that there has been a relative deceleration in growth of output of basic goods and capital goods industries like finished steel, pig iron and power driven pumps around mid-sixties. A similar pattern is observed too in case of the consumer durables like refrigerators (domestic) and cars. Thus, it does not mean that other sample industries belonging to the steady growth category have not marked any downswing in trend. Certainly, the phenomenon of relative deceleration in growth has been observed for other steady growth industries but for different periods, not around the mid-sixties.

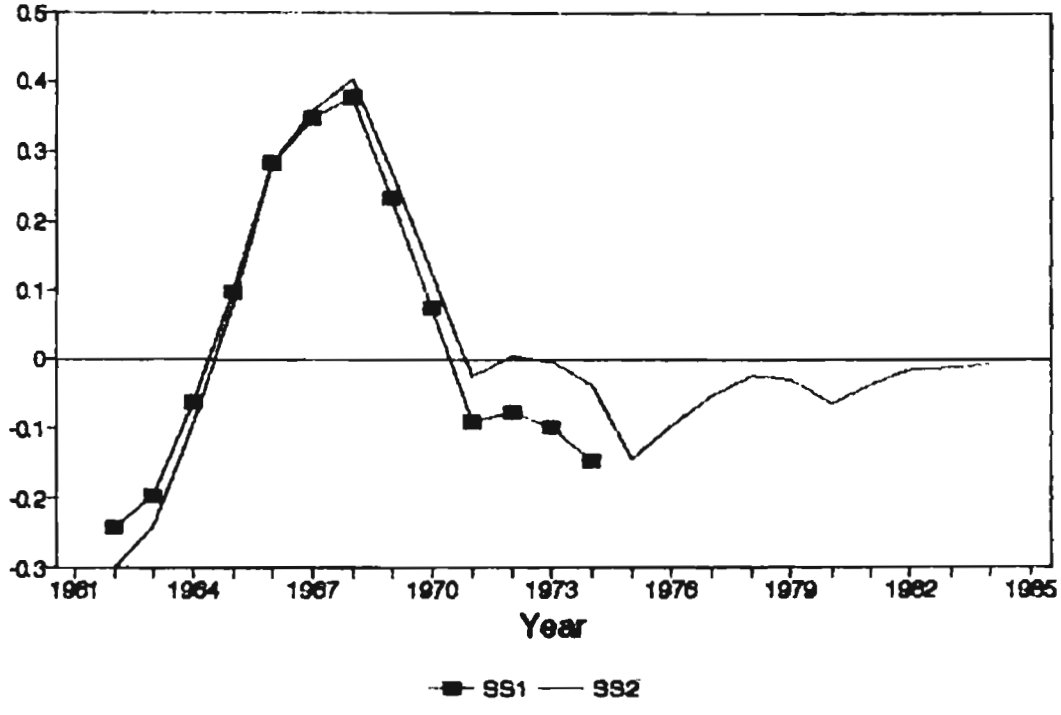
Graph 1.1
Output Cycle of Finished Steel- CR



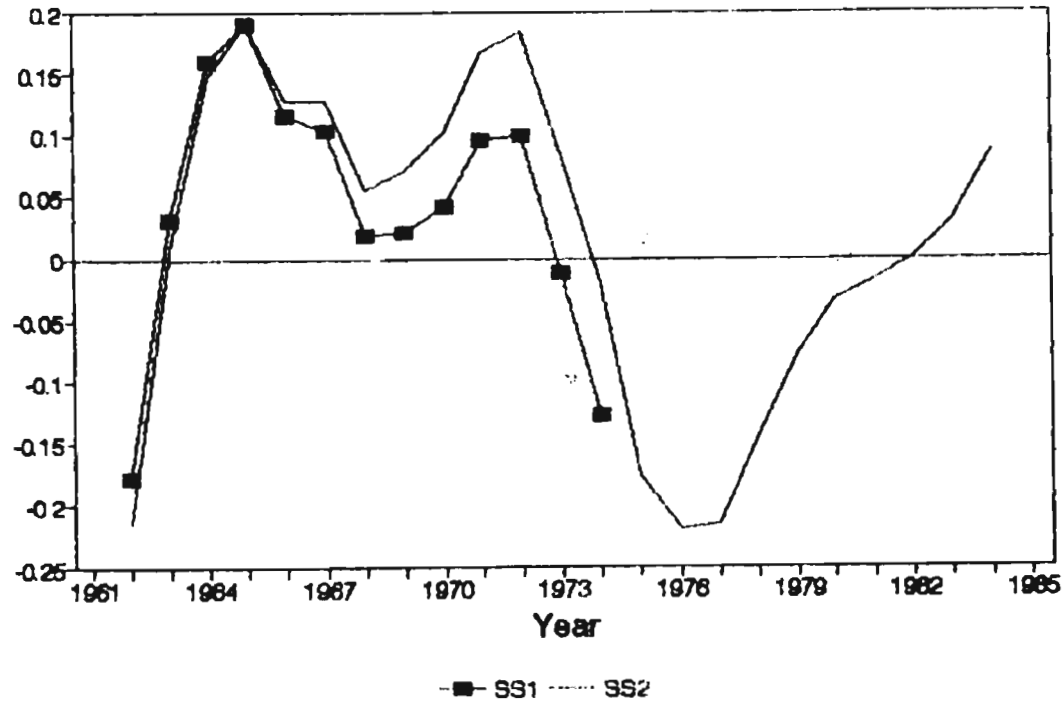
Graph 1.2
Output Cycle of Pig Iron- CR



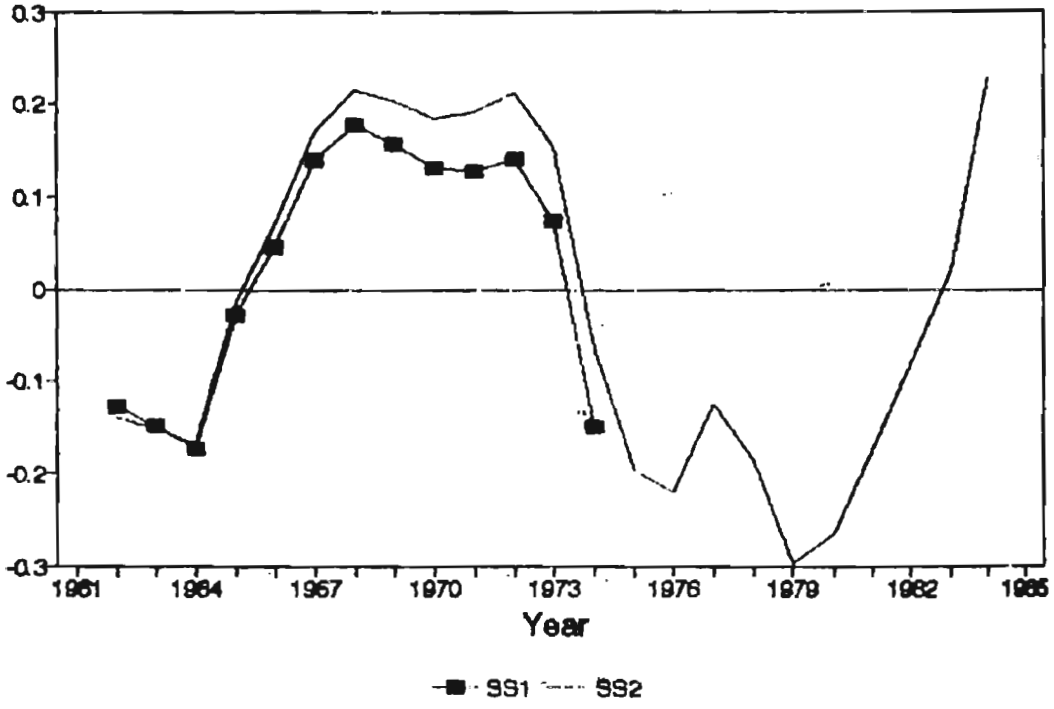
Graph 1.3
Output Cycle of Power Driven Pumps- CR



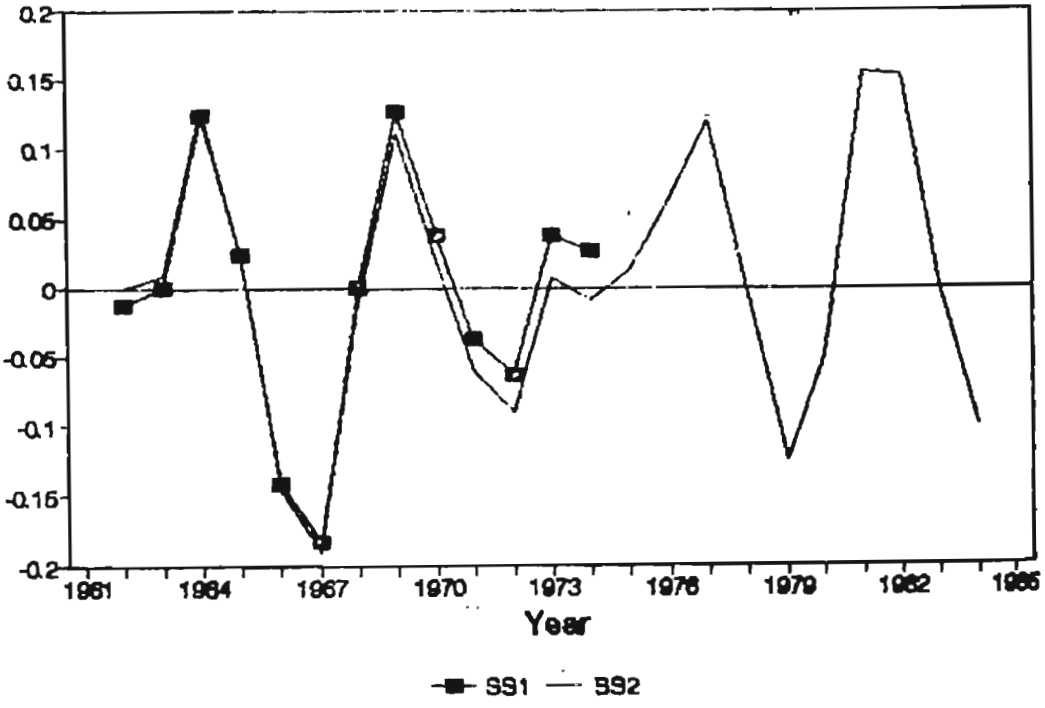
Graph 1.4
Output Cycle of Refrigerators - CR



Graph 1.5
Output Cycle of Car - CR



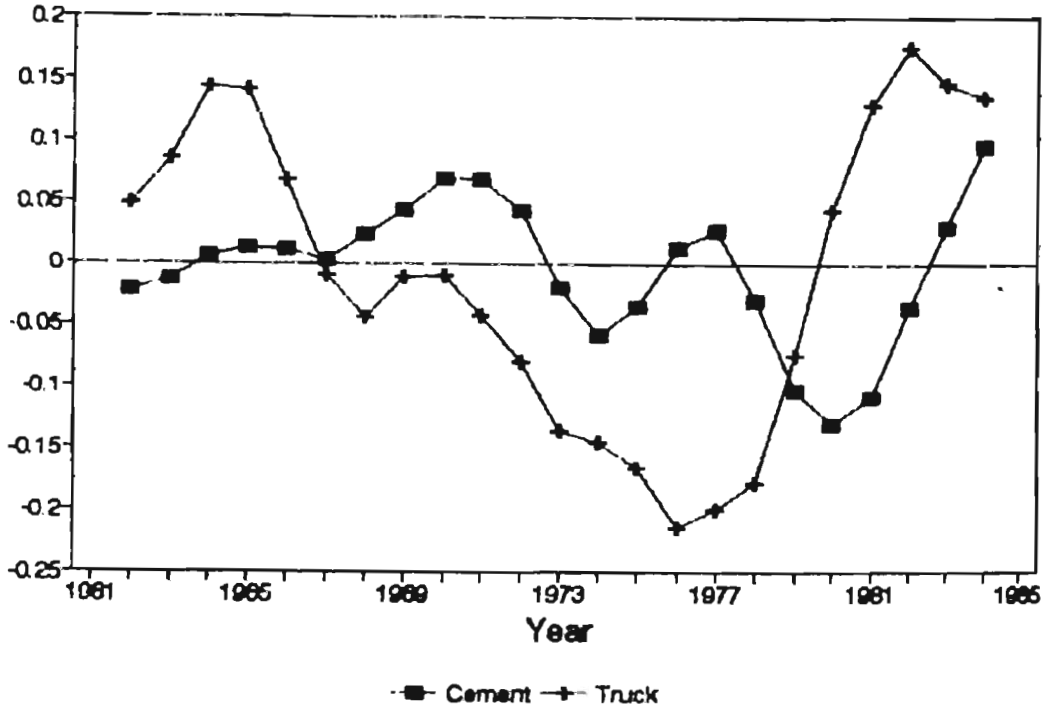
Graph 1.6
Output Cycle of Sugar - CR



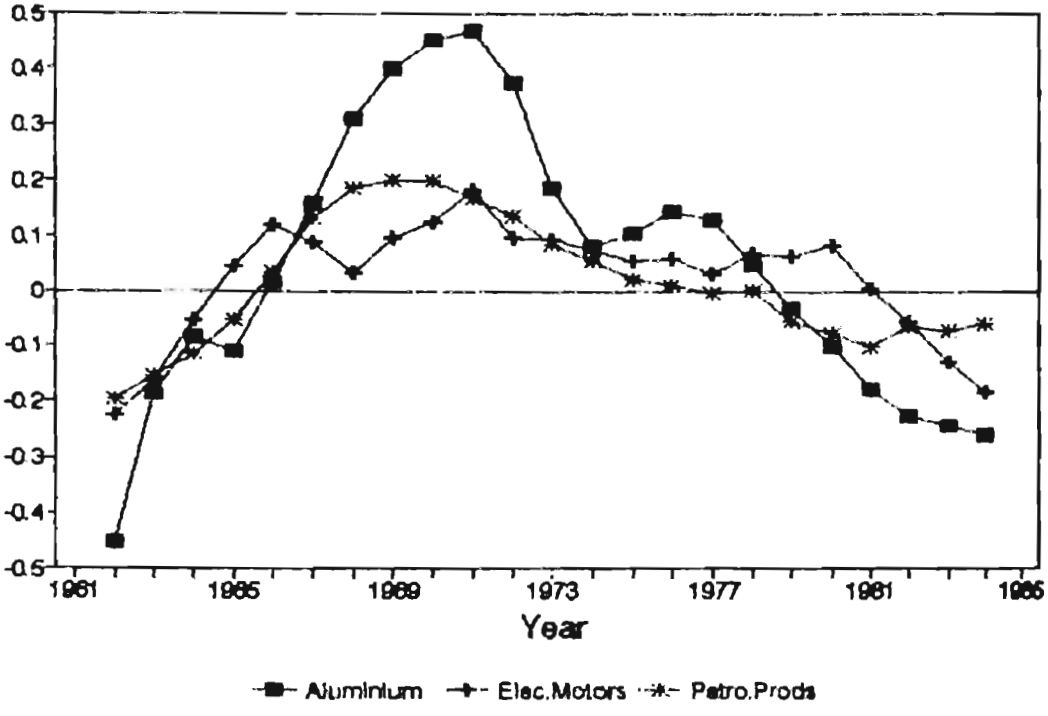
Now let us turn to CR's contention that choosing different periods can give rise to different results: "...if instead of taking data upto 1985 we stopped at some earlier date we might also obtain very different results consistent with the hypothesis of deceleration"[10]. Following our method of analysis and using CR's data, we have carried out the sensitivity analysis of cyclicality in growth for different sample sizes, SS1 (1961 to 1975) and SS2 (1961 to 1985). It is seen from the graphs 1.1 to 1.6 that there is hardly any divergence in output growth cycles between the two sample sizes chosen except for some variations in levels. This amounts to arguing that cyclicality in growth remains unaffected by sample size. Obviously, it contradicts CR's assertion that "...what appears to be a trend movement may change to a cyclical movement with increased accumulation of data and vice versa". And the invariance of cyclicality in growth to sample size makes our method of analysing growth a robust one.

Apart from this, we have also analysed the output cycles of the two accelerating and a few decelerating industries for further confirmation of the hypothesis of industrial retardation since mid-sixties. They are presented in graphs 2.1 and 2.2. The graph 2.1 shows that even the growth accelerating industries have relative downswing in growth of output from mid-sixties to late seventies. The same pattern has been observed in graph 2.2 for the growth decelerating industries. Therefore, on the basis of visual inspection of the movements in growth, it may be

Graph 2.1
Output Cycles of Accelerating Group- CR



Graph 2.2
Output Cycles of Decelerating Group- CR



inferred that there has been a general tendency for the existence of industrial retardation since mid-sixties. This generalisation is limited to CR's sample of industries only.

Since these sample industries are highly disaggregated to the level of product based industries, it is extremely difficult to arrive at an estimate of the aggregate growth. Moreover, these seventeen sample industries account for about 18 per cent of the total value added in the manufacturing sector. Hence, we have not made an attempt here to re-estimate the true growth for CR's sample industries.

V. Testing Retardation Hypothesis with NAS Data

As mentioned earlier, we cannot place our confidence on CR's small sample size, though the source of data is new for this kind of analysis, for testing the existence of general industrial retardation since the mid-sixties. For this purpose, we have used the two-digit industry data from the National Accounts Statistics (NAS). However, there appears to be some comparability problems in compiling the NAS data till the present date for generating uninterrupted time series. Therefore, we have used the old series with 1970/71 as the base and our study is restricted to the period, 1951/52 to 1984/85.[11]

Following our method of analysis, the detrended series on net value added at 1970-71 prices, for registered manufacturing sector as a whole as well as two-digit industries, are tested for randomness. The results of test of randomness for the study period, 1951/52 to 1984/85. are presented in the first two columns of Table 1. The expected mean of turning points, E(p), is estimated to be 21 and the lower limit (LL) and Upper limit (UL) of the interval set by $3\sigma_p \pm E(p)$ are turned to be 14 and 28. It follows from these limits that detrended series, which have an observed turning points (p_o) below the lower limit (LL), may be inferred to be free from random influences. In light of this, we try to interprete the results of the test of randomness for all the detrended series, both at the disaggregated level and at the aggregate level. It is apparent that the observed turning points (p_o) reported in the second column of the table 1 are all found to be below the lower limit (14) of the interval (14-28). It may be inferred, thus, that the detrended series are subject to systematic influences. Based on the results of the test of randomness, we have, therefore, decided to use the normalised detrended series, not adjusted for irregular movements, for discerning cycles in growth.

The normalised detrended series on aggregate net value added is plotted on a graph to characterize the nature of the systematic influences. Graph 3 suggests that industrial growth in India during the period under study has followed a cyclical

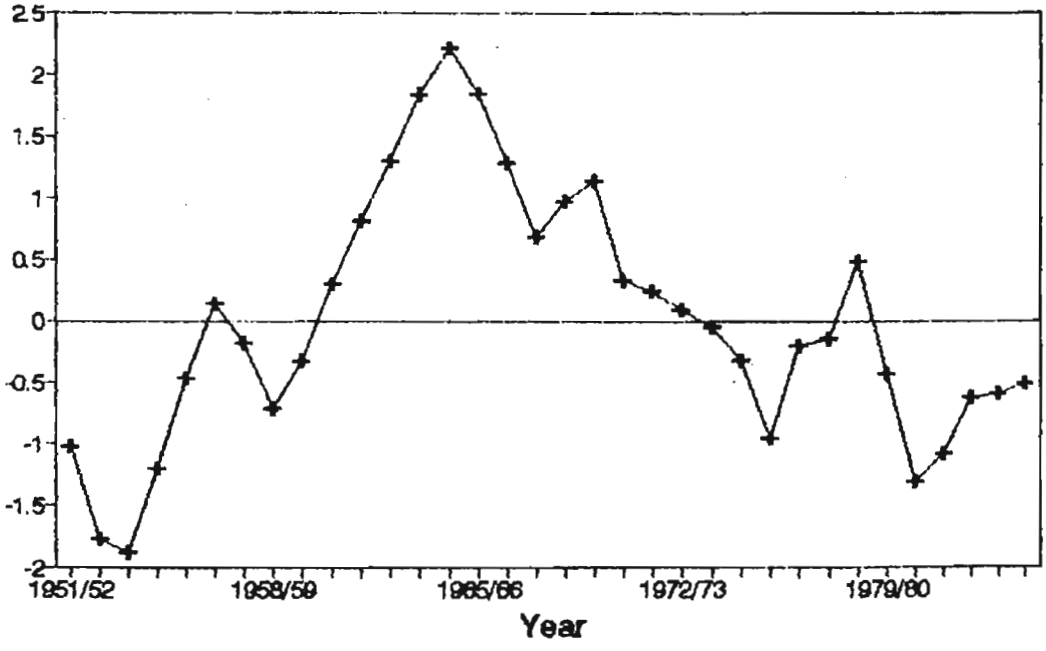
Table 1: Test of Randomness for the entire period and Observed Turning Points for sub-periods

(in numbers)

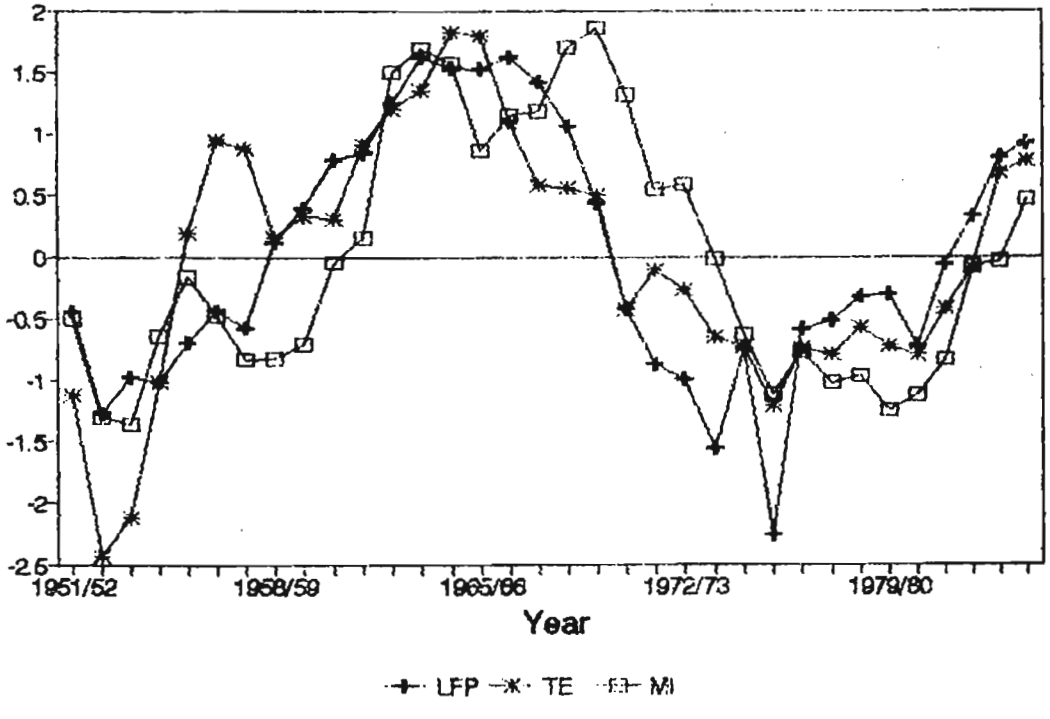
Industry Groups	Test of randomness 1951/52 to 1984/85		Period-wise Observed Turning Points (p_o)			
	E(p) and LL - UL	p_o	1951/52 to 1964/65	1964/65 to 1975/76	1975/76 to 1980/81	1980/81 to 1984/85
Food Products	21, 14-28	11	5	4	1	1
Beverages, Tobacco, etc.,	21, 14-28	11	3	4	3	1
Textiles	21, 14-28	7	4	2	0	1
Wood, Furniture etc.,	21, 14-28	9	4	2	2	1
Papers and Printing	21, 14-28	8	1	4	1	2
Leather and Fur Products	21, 14-28	7	5	2	0	0
Rub, Petro, Coal etc.,	21, 14-28	11	4	5	1	1
Chemicals, etc.	21, 14-28	12	7	3	1	1
Non-metallic Min. Prodts.	21, 14-28	8	3	2	1	2
Basic Metal Industries	21, 14-29	9	3	3	2	1
Metal Products	21, 14-28	11	5	4	2	0
Non-Electrical Machinery	21, 14-28	11	5	4	1	1
Electrical Machinery	21, 14-28	12	4	5	1	1
Transport Equipment	21, 14-28	10	5	2	3	0
Miscellaneous Industries	21, 14-28	10	4	3	3	0
MANUFACTURING SECTOR	21, 14-28	6	3	2	1	0

Notes: (i) E(p) is the expected mean of p where p is the number of turning points;
(ii) p_o is the observed turning points;
(iii) LL and UL refer to lower limit and upper limit respectively.
(iv) Figures in boxes are the turning points that have relatively higher amplitudes which in turn is suspected to have a significant bearing on the respective period-wise growth rates.

Graph 3
Cyclicality in Value Added



Graph 3.1
Group I : Cyclicality in Value Added



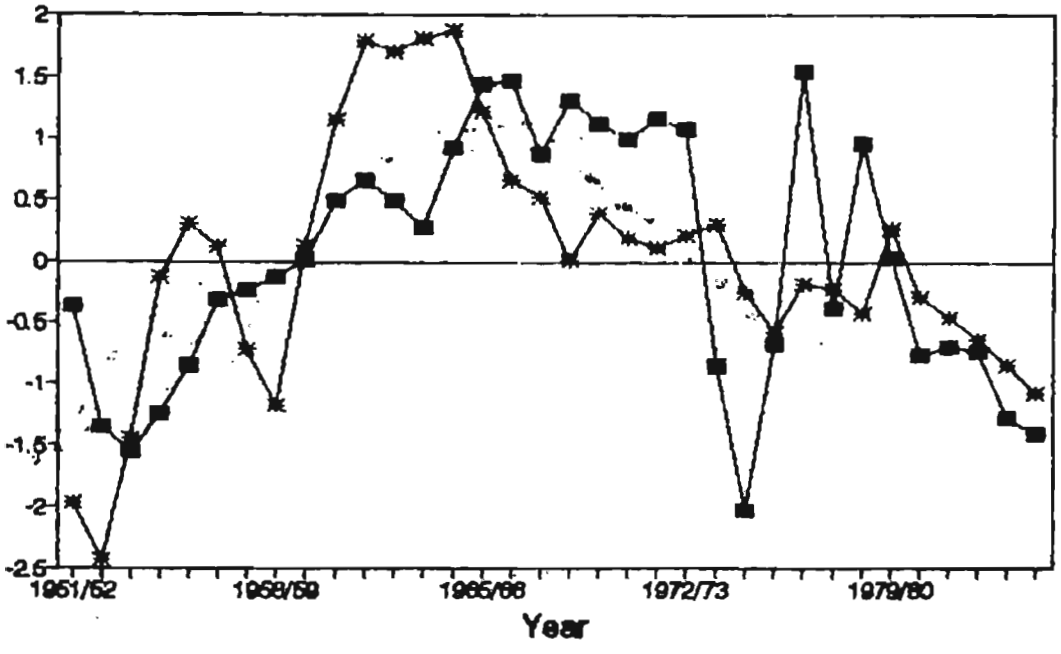
pattern. The analysis of cyclicality in growth points to broadlyfour phases of industrial growth during the study period. The first phase covering the period 1951/52 to 1964/65 shows an increasing trend. The second phase consisting of the period 1964/65 to 1975/76 witnesses a declining trend. The third phase relating to the period 1975/76 to 1980/81 confirms an upward trend. Finally, the fourth phase comprising the period of 1980/81 to 1984/85 appears to have registered acceleration in growth. However, the length of the cycles observed in growth of net value added seems to be declining.

The same exercise has been extended to 2-digit NIC industry groups. The industry level analysis of visual inspection confirms that the declining phase of the cycle across the industries had set in around mid-sixties. The inter-industry differences in the cyclical movements in growth of net value added appear to be well-pronounced in the period after 1964/65. This shows an interesting pattern which explains, to some extent, factors underlying the cyclical movements in the observed time series on aggregate net value added in registered manufacturing sector during the study period. Hence, the industries showing broadly similar pattern in cyclical movements have been classified into five groups.

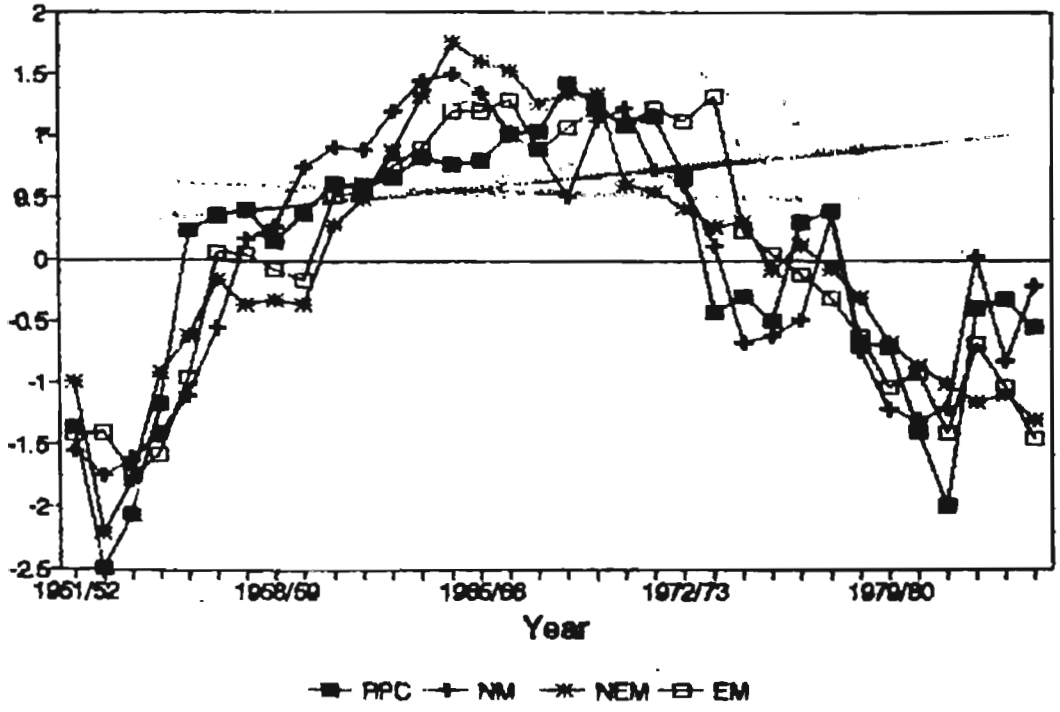
The cyclical movements in growth of these five groups of industries are presented separately in four graphs 3.1 to 3.5.

It is seen from the graph 3.1 that the first group (Leather and Fur products [LFP], Transport equipment [TE] and Miscellaneous industries [MI]) indicates an upward trend after 1975/76. Graph 3.2 reveals that the second group (Beverages, Tobacco, etc.,[BT] and Metal products [MP]) which shows a sign of an increase after mid-seventies, faces a decline since 1980/81. Graph 3.3 tend to suggest that the third group (Rubber, Petroleum, Coal etc.,[RPC], Non-metallic mineral products[NMP], Non-electrical machinery[NEM] and Electrical machinery[EM]) has a declining trend from 1964/65 upto 1980/81 and an increasing trend since 1980/81. One can also notice from graph 3.4 that the declining trend continues upto the end of the study period [1984/85] right from 1964/65 in the fourth group of industries (Wood, Furniture, etc.[WF], Paper and Printing, etc.[PP], Chemicals, etc.[Chemi.] and Basic metal industries[BMI]). However, it is interesting to note from graph 3.5 that the fifth group of industries, namely, Food Products [FP] and Textiles [Text.] have followed a growth pattern that is quite different from that of other industries. Apparently, it is found that these two industries, which showed a declining trend from mid-sixties to early seventies, have recovered in growth since the early seventies but one of them, that is, textiles [Text] has followed a declining trend after 1980/81. This may possibly be due to the linkages between agricultural sector and industrial sector. But this is an issue which we do not take up in this paper.

Graph 3.2
Group II: Cyclicality in Value Added

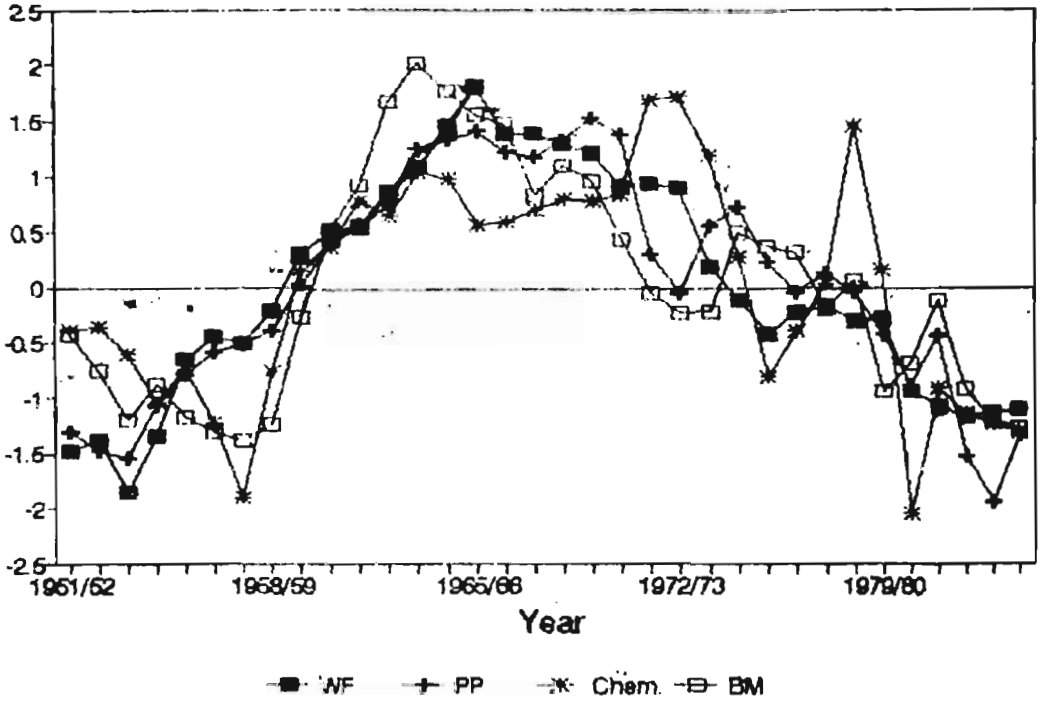


Graph 3.3
Group III: Cyclicality in Value Added



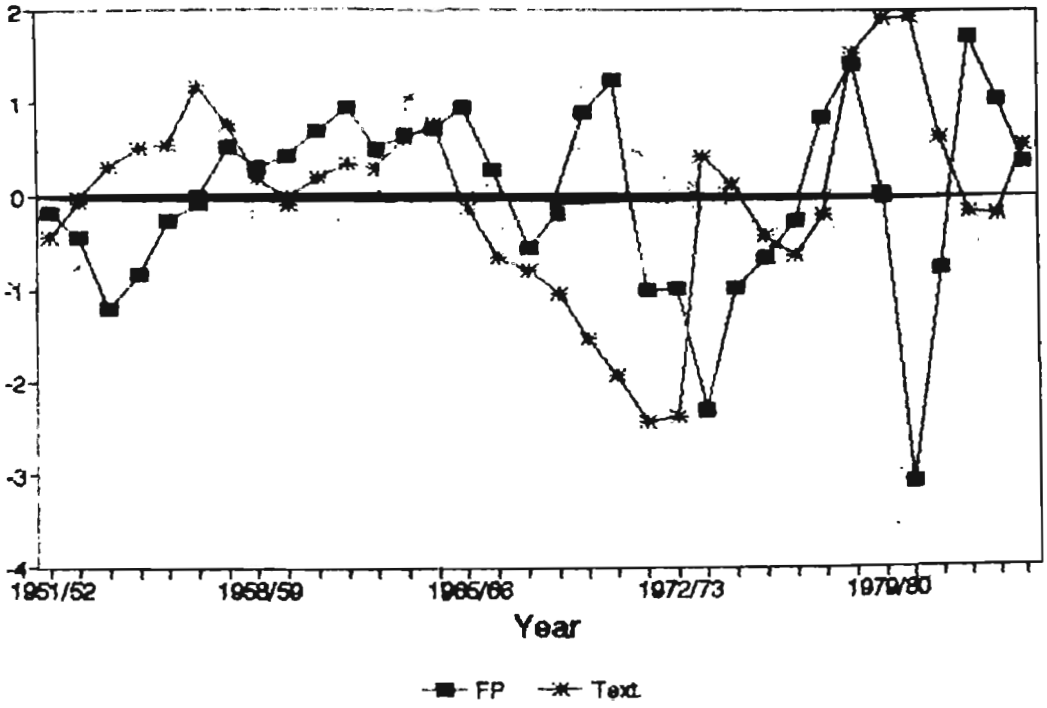
Graph 3.4

Group IV: Cyclicality in Value Added



Graph 3.5

Group V: Cyclicality in Value Added



What we observed from the industry level analysis is that the occurrence of the cycle seems to be near regular confirming broadly the persistence of cyclicality in growth of aggregate net value added; but lengths of the cycle are distinct across the groups. Hence, we postulate that there is a strong element of cycle in growth of industrial net value added in India but not with equal periodicity.[12] However, the analysis of cyclical movements in growth, regardless of the level of aggregation, suggests approximately four sub-periods corresponding to the observed phases of the cycles. Accordingly, the study period has been divided into four sub-periods, such as 1951/52 to 1964/65, 1964/65 to 1975/76, 1975/76 to 1980/1981 and 1980/81 to 1984/85.

Moreover, the sub-period analysis of number of turning points, p_0, across industries has detected random influences in sub-periods more than one (as may be seen from the table 1). Interestingly, it may be inferred that both the first period (being the acceleration in growth) and the second period (being witnessed as deceleration in growth) have gone through more fluctuations in growth when compared to the later periods, particularly the period after 1980/81. And also, amplitude of the irregular movements (as may be seen from the graphs 3.1 to 3.5) across the industries is found to increase from the pre-1975/76 period to the post-1975/76 period. It is important to note here that both the industries of Wood, Furniture, etc. and Chemicals, etc. (as indicated by boxes in Table 1) have

internalised major shocks, in terms of fluctuations with high amplitude, in growth. Hence, both the uneven periodicity and existence of random influences within some of the phases of the cycles perceived does not enable us to go in for parametric estimation of alternative methods of the OLS trend fitting (like the kinked/dummy exponential function).

Instead, we have followed non-parametric approach to cyclicality in growth in the present study. Following our method of analysis, each sub-period time series data is first smoothened for controlling the effects of irregular movements on sub-period growth rates by reference to three year moving averages. Then, the simple method of computing percentage changes has been used to calculate annual growth rates for the smoothened time series data within the sub-periods. And these annual growth rates are further averaged to find out the magnitudes of the growth rates for each of the sub-periods. Thus, these period-wise growth rates have been calculated to endogenise static effects of the cyclical fluctuations on growth in computing the actual growth, both at the aggregate level and at the two-digit industry level, for the registered manufacturing sector in India.

Industrial Growth Pattern: Aggregate Level

It is seen from Table 2 that value added growth rate for the manufacturing sector as whole, declined from 7.81 per cent (during 1951/52 to 1964/65) to 3.42 per cent (during 1964/65

to 1975/76). Then, it increased to 5.33 per cent (during 1975/76 to 1980/81) and further rose to 7.05 per cent (during 1980/81 to 1984/85). It brings out clearly three striking features of industrial growth process which occurred over the last three and a half decades ending 1984/85. They are:

(i) A marked deceleration in growth of net value added in the registered manufacturing sector has begun after mid-sixties, especially 1964/65, as pointed out by earlier studies.

(ii) The relative deceleration (or stagnation) in growth of aggregate net value added has come to an end by 1975/76 and then onwards, recovery in growth is noticed.

(iii) The recovery in growth of aggregate net value added is evident during the sub-period (1975/76 to 1980/81) and the later period after 1980/81 has witnessed a steady increase in growth of aggregate net value added.

These results, obviously, contradict the findings of earlier studies (including CR's study) except Patnaik and Rao (1978), Raj (1984) and Alagh (1986) on the issue of <u>persistence of the relative deceleration (or stagnation)</u> in growth of industrial output. As pointed out by Raj (1984), the recovery in industrial growth since the mid-seventies appears to have not reached the level of growth in net value added achieved during the pre-stagnation period. However, our findings, from the aggregative level analysis of cyclicality in growth, support the observation made by Raj (1984) that industrial growth in India follows a cyclical pattern. Besides, the industry level analysis of growth pattern has been attempted here to find out the sources of cyclicality in growth of aggregate value added.

Table 2

Period-wise Average Annual Growth Rates for the registered Manufacturing Sector at 1970-71 Prices (in per cent)

Industry Groups	Weight 1970	1951/52 to 1984/85	1951/52 to 1964/65	1964/65 to 1975/76	1975/76 to 1980/81	1980/81 to 1984/85
		Trend Values				
Recovery After 1975/76						
Food Products	7.87	3.94	5.12	1.65	2.28	12.87
Leather and Fur Products	0.66	-1.30	5.45	-11.98	4.90	11.70
Transport Equipment	7.16	3.95	12.30	-3.50	5.80	16.33
Miscellaneous Industries	5.48	6.03	12.50	0.72	4.69	16.41
Group I	21.17		9.49	-0.75	4.18	14.64
Recovery After 1975/76 but Deceleration Since 1980/81						
Beverages, Tobacco, etc.,	2.91	4.31	7.13	-0.76	3.31	0.48
Textiles	17.54	2.42	2.86	2.44	8.52	-0.69
Metal Products	2.78	3.96	10.11	1.06	5.05	0.39
Group II	23.23		4.29	1.86	7.43	-0.41
Recovery After 1980/81						
Rub, Petro, Coal etc.,	3.79	7.94	13.66	4.67	-0.03	16.71
Non-metallic Min. Prodts.	3.35	6.14	10.16	3.42	1.88	9.35
Non-Electrical Machinery	5.69	11.73	21.91	5.72	4.05	8.63
Electrical Machinery	5.35	11.76	16.06	10.25	7.21	10.06
Group III	18.18		16.25	6.38	3.70	11.11
Deceleration Since 1964/65						
Wood, Furniture etc.,	0.91	4.47	13.56	-2.35	1.59	3.11
Papers and Printing	4.39	4.78	8.29	3.39	2.04	-0.10
Chemicals, etc.	10.76	7.91	9.16	7.34	8.67	8.43
Basic Metal Industries	8.35	6.83	11.46	3.90	2.45	1.36
Group IV	24.43		9.96	5.07	5.07	4.48
MANUFACTURING SECTOR		5.38	7.81	3.42	5.33	7.05

Industrial Growth Pattern: Industry Level

As far as the industry level analysis is concerned, the cyclical growth pattern varies distinctly across the major industry groups. The period-wise growth rates for the 15 two-digit industries are given in Table 2. The relative deceleration in growth during the period 1964/65 to 1975/76 has been witnessed by all industries regardless of groups, confirming the same observation at the aggregate level. It is also seen from Table 2 that the period after 1975/76 documents a mixed pattern of industrial growth among the industry groups. Group I accounting for about 21.17 per cent of total value added in registered manufacturing sector has experienced recovery since the mid-seventies and maintained the tempo of growth till the end of study period. On the other hand, deceleration in growth of net value added continued upto 1984/85 right from 1964/65 in the case of Group IV, contributing 24.43 per cent of total value added. As an interlude, it is important to qualify that growth rate of two industries belonging to the group IV (Wood, furniture etc. and Chemicals, etc.), which have been observed to show recovery after the mid-seventies (in the boxes of the table 2), has been interpreted here as decelerating since mid-sixties for the obvious reason that the three year moving average method chosen has failed to smoothen the major shocks in terms of large amplitude. However, an opposite pattern has been observed between the sub-periods 1975/76 to 1980/81 and 1980/81 to 1984/85

in Groups II and III having a share of 41.41 per cent of the total value added. One more interesting thing that can be noticed from Table 2 is that, though a shift in the composition of growing industries from Group II to Group III between 1975/76 to 1980/81 and 1980/81 to 1984/85 has resulted in bringing down growing industry group's share in total value added by 5.05 per cent (from 44.4 per cent to 39.35 per cent), the growth in net value added of the growing industries of Group I after 1980/81 is maintained. Obviously, this mutual periodical-shift between these two Groups after 1975/76 could have possibly constrained the overall growth at the aggregate level to reach the level of growth of the pre-stagnation period.

Moreover, by looking at the industrial growth pattern in terms of its nature and specific characteristics, we find that recovery during 1975/76 to 1980/81 is mainly contributed by the consumer goods industries. On the other hand, capital goods industries seem to have raised the share in aggregate value added of the growing industries from 17.73 per cent (during 1975/76 to 1980/81) to 46.25 per cent in the eighties mainly because of recovery in growth of non-electrical machinery and electrical machinery industries after 1980/81 along with the transport and equipment industry, which had shown recovery in growth since 1975/76. Such grouping of industries brings out a striking feature of industrial growth process after 1975/76, particularly after 1980/81, that the growth in the eighties is equally

accounted for by the growth of both consumer goods and capital goods industries rather than consumer goods industries alone. This, in turn, confirms that the late 70's recovery in growth was mainly contributed by the growth of consumer goods industries.

However, Table 2 shows that textiles industry, which is large in size (and traditional in nature) accounting for about 17.54 per cent of the total net value added within the consumer goods industries, has faced deceleration after 1980/81 falling sharply from 8.52 per cent (during 1975/76 to 1980/81) to -0.69 per cent (during the period after 1980/81). This could be the principal cause of the near stagnation observed at aggregate level after 1980/81. On the other hand, the prolonged deceleration in growth since 1964/65 is mostly confined to industries of basic goods and intermediate goods nature like, chemicals and basic metal industries along with consumer goods industry of papers and printing.

On the basis of results presented in this section, we strongly believe that retardation in growth since mid-sixties existed <u>in general</u> across the board upto the mid-seventies, but afterwards its persistence was found to be of selective nature. In fact, there has been a clear indication of recovery in industrial growth after mid-seventies at the aggregate level. However, the recovery in growth at the aggregate level has not reached the level of growth experienced by the pre-stagnation

period. This is because of the mutual periodical shift between two groups of industries from recovery to retardation in growth. Moreover, some industries, which are of basic goods and intermediate goods nature, have revealed a relative deceleration in growth upto the end of study period. Despite the differential pattern of growth observed at the industry level, we argue that recovery in industrial growth has certainly set in around the mid-seventies, though not across the board.

VI. Concluding Observations

Following univariate approach to the analysis of cyclicality in growth, we have attempted in this paper to discern the industrial growth pattern using two sets of data - CR's data for the period 1961 to 1985 and NAS data for the period 1951/52 to 1984/85. CR's data has been used mainly to ascertain whether there is any tendency of general industrial retardation since mid-sixties or not. Our analysis with CR's data documents graphically that there was industrial retardation in those industries for which CR had observed a steady and accelerating growth.

Moreover, our finding (based on the NAS data) has confirmed the earlier analysts' assertion that there was a relative deceleration in industrial growth since mid-sixties. And the slow down in growth has been observed to be a general

phenomenon upto mid-seventies but not so evident across the industries after mid-seventies. Hence, our results clearly contradict CR's finding that there was no evidence on general industrial retardation, particularly during the period 1964/65 to 1975/76. Moreover, our findings with the solid statistical base have also disproved the earlier analysts' disbelief about Raj's (1984) observation of the marked sign of recovery in industrial growth since mid-seventies. Nevertheless, we have also observed that some industries, which belonged to the fourth group, witnessed a chronic deceleration in growth upto the end of the study period right from mid-sixties.

In sum, the present study confirms that industrial sector in India has a tendency to follow cyclicality in growth. Further, the periodical shift in growth pattern of groups of industries (being empirically found among the industry groups) is perhaps one of the main sources of the persistence of cycles in growth of aggregate value added at the sectoral level.

Acknowledgements:

I am grateful to Dr. K. Pushpangadan, Thiru. D. Narayana, Dr. T. M. Thomas Isaac and Thirumathi. Mridul Eapen for my discussions with them during the work in progress and to Prof. K. K. Subrahmanian, Prof. T. N. Krishnan, Dr. K. Nagaraj and Dr. V. K. Ramachandran for their valuable comments. Also I wish to place on record my sincere thanks to all my friends for their help and moral support. However, I alone am responsible for any errors that still remain.

Endnotes

1. CR refer these economists to those who took part in the industrial stagnation debate from Raj to Ahluwalia.

2. CR (1990), p.2205

3. CR (1991), p.2068

4. For details, see Jan Tinbergen and J.J. Polak (1950) and Andrew Britton (1986).

5. For details, see Judge et al (1988).

6. For details, see Judge et al (1988).

7. For details, see A.L. Nagar and R.K. Das, p.351.

8. For details, see Swinton and King (1991).

9. Interestingly, it can be argued that the sugar industry (being one of the agro-based industries) might have endogenised, vis-a-vis supply linkage, the agricultural growth cycle. Since this is beyond the scope of the present study, we do not look into the linkage aspect of the growth cycles here.

10. CR (1990) p.2205

11. Regarding the non-comparability between old series with base 1970/71 and revised new series with base 1980/81, the NAS:sources and Methods has pointed out clearly the changes that have been made in the revised series. From 1980/81 onwards the NAS presents data with 1980/81 as the base. With respect to value added data for the manufacturing sector, two important changes, which have some bearing on industrial growth pattern, have been noticed. First, shifting the base from 1970/71 to 1980/81 that has resulted in more weights to fast growing industries and less weights to slow growing industries (as pointed out by Chandrasekhar (1988), Kurian (1989) and Nagaraj (1989)) makes the two series non-comparable. Secondly, the revised series with base 1980/81 giving data on value added in gross terms, rather than in net terms, can pose consistency problem when one combines the revised series along with old data series on value added in net terms. Apart from these, data on gross value added for the years after 1985/86 given in the revised series (with

base 1980/81) are blown figures since the latest Annual Survey of Industries (ASI) data were available upto 1984/85 at the time of this work initiated.

12. Raj also argued in his paper (1984) that industrial growth in India followed a cyclical pattern.

References

Ahluwalia, I J (1985), Industrial Growth in India: Stagnation Since The Mid-Sixties, Oxford University Press, New Delhi.

Alagh, Y K (1985), 'Some aspects of Planning Policies in India'. Three lectures delivered at the Govind Ballabh Pant Social Science Institute, Allahabad, 1985.

Anandaraj R (1990), 'On Analysing Industrial Performance in India: A Critique and Reformulation', Seminar presented at the Centre for Development Studies, Trivandrum, January 1990, mimeo.

Britton, Andrew (1986), The Trade Cycle in Britain, 1958-1982, Occasional Paper No.39, The National Institute of Economic and Social Research, Cambridge University Press.

Central Statistical Organisation, National Accounts Statistics, different years, New Delhi.

----------, Statistical Abstract, Monthly and Annual issues, different years, New Delhi.

Chakrabarti, Snigdha and Ashok Rudra (1990), 'Where Is the Industrial Retardation ?', Economic and Political Weekly, September 29.

---------- (1991), 'Industrial Retardation', Reply to Partha Roy's Discussion Paper, Economic and Political Weekly, August 31.

Chandrashekhar C P(1988), 'Aspects of Growth and Structural Change in Indian Industry', Economic and Political Weekly, Special Number, November.

Croxton, F.E., and D.J. Cowden (1947), Applied General Statistics, Prentice-Hall, New York, and Pitman.

Judge, George G., R. Carter Hill, W.E. Griffiths, Helmut Lutkepohl, and Tsoung-chao Lee (1988), Introduction to the Theory and Practice of Econometrics, 2nd ed. New York, John Wiley & sons.

Nelkar Vijay, L and Rajiv Kumar (1990), 'Industrial Growth in the Eighties: Emerging Policy Issues', Economic and Political Weekly, January 27.

Nurlen, C T (1989), 'Indian Economy in the 1980s and on to the 1990s', Economic and Political weekly, April 15.

Nundle S (1989), 'Growth, Acceleration and Fiscal Constraint', Mainstream, September 9.

Nagar, A.L., and R.K. Das (1986). Basic Statistics, 2nd ed., Oxford University Press.

Nagaraj R (1989), 'Growth in Manufacturing Output since 1980: Some Preliminary Findings', Economic and Political weekly, July 1.

Partha Ray (1991), 'Durability and Time Frame of Industrial Retrogression', Economic and Political Weekly, May 11.

Prabhat Patnaik and S K. Rao (1977), '1975-76: Beginning of the End of Stagnation?', Social Scientist, January-February.

Raj, K N (1976), 'Growth and Stagnation in Indian Industrial Development', Economic and Political Weekly, November 26.

--------- (1984), 'Some Observations on Economic Growth in India over the Period 1952-53 to 1982-83', Economic and Political Weekly, October 13.

Ray Chaudhuri, Uma Dutta (1988), 'New Series on National Accounts Statistics: Some Comments', Economic and Political Weekly, July 23.

Shetty, S L (1978), 'Structural Retrogression in the Indian Economy since the Mid-Sixties', Economic and Political Weekly, Annual Number, February.

Swinton, Scott M., and Robert P. King (1991), 'Evaluating Robust Regression Techniques for Detrending Crop Yield Data with Nonnormal Errors', American Journal of Agricultural Economics, vol 73 (2), May, pp. 446-451.

Tinbergen, Jan and J.J. Polak (1950), The Dynamics of Business Cycles, The University of Chicago Press, Chicago.