Business Cycles and Leading Indicators of Industrial Activity in India

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The identification of business cycles in India and construction of a composite leading indicator for forecasting the cyclical turning points have been the focus of this study. The cyclical analysis of monthly index of industrial production (IIP) in India applying the Bry-Boschan procedure indicates that there have been 13 growth cycles in the Indian economy with varying durations during 1970-71 to 2001-02. While the average duration of expansion has been 12 months, the recessions are characterised by relatively longer duration of 16 months. For the purpose of forecasting turning points of business cycle, a composite leading index (CLI) is constructed comprising non-oil imports, exports, US GDP, deposits of commercial banks, non-food credit of commercial banks, currency demand, money supply growth, prices of industrial raw materials, prices of manufactured products, treasury bill yield, stock prices, freight loading of the railways and cargo handled at the major ports. The CLI has been able to forecast the turning points of the reference series with a lead period of about 6 months.

Introduction

Since the 1970s, there has been a resurgence of interest in business cycles and growth cycles with the initial impetus coming from wide fluctuations in output and price arising from the oil price shocks. The work of Lucas (1977) and the emergence of neoclassical macroeconomics reinstated cyclical evolution as an integral element of the market economy. The leading indicator approach to study business cycles is essentially based on the view that economies experience business cycles with "expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals that merge into the expansion phase of the next cycle; this sequence of changes is recurrent but not periodic" (Burns and Mitchell, 1946). The leading indicator approach provides early signals of turning points in economic activity. This information is important for economists, business community and policy-makers to make a correct analysis of the economic situation for putting in place appropriate policy measures for stabilising output fluctuations. Early empirical work on leading indicator approach originated from National Bureau of Economic Research (NBER) in the 1930s. Since then the NBER developed numerous versions of its leading series over the years and constructed a Composite Index of Leading Indicators (CILI). The construction of CILI is based on the premise that an aggregate of the indicators will predict turning points more effectively than any one indicator alone as no single cause explains the cyclical fluctuations over a period of time in overall activity.

In the Indian context, the major sources of cyclical fluctuations in output prior to 1990s were supply shocks caused by monsoon failures or oil price shocks. But during the 1990s, cyclical fluctuations in economic activity, apart from being influenced by the supply shocks, were increasingly influenced by the internal dynamics of the economy. Relatively open trade regime and increased capital inflows have rendered the economy exposed to global trade cycles. The cyclical influences on the growth process in India, particularly in the latter half of the 1990s, are reflected in the indicators such as faltering pace of investment demand, sluggish pace of capital goods imports, relatively low requirement of bank credit, slowdown in currency expansion and evidence of high carrying cost of inventories. Such cyclical behaviour of the industrial production underlines the need for analysing the business cycles and predicting cyclical turning point as it remains an area of concern for the policy makers as well as the economic agents. In such a scenario, the coincident or the leading indicator approach has been widely used to track the phases of business cycles despite the criticism it has drawn for lack of sound theoretical foundations[1].

Against this background, the study explores the cyclical behaviour of the Indian economy that is getting increasingly integrated to the world economy. The study is divided into four sections. Section I reviews the evolution of the business cycle literature leading to emergence of leading indicators in explaining cyclical fluctuations. The evolution of business cycles in India is traced out in Section II. This section reviews the past literature on business cycles in India and attempts to provide an appropriate leading indicator of industrial activity in view of the recent structural changes in the Indian economy. The construction of a composite leading indicator is undertaken in Section III while Section IV outlines the concluding observations.

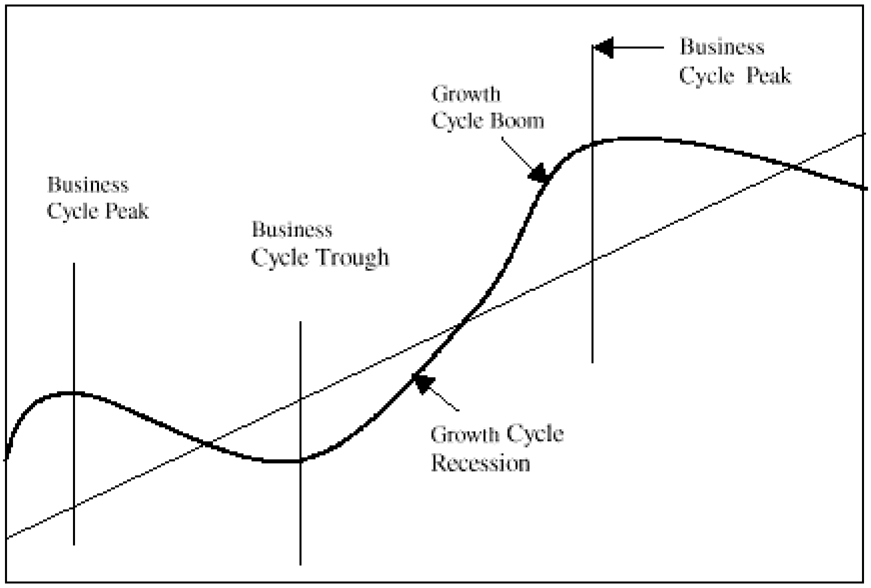
Section I
Business Cycles, Growth Cycles and Growth Rate Cycles

The classical business cycles are identified as recurrent phases of expansion and contraction in the levels of a large number of economic and financial time series[2]. Business cycles have been defined by Burns and Mitchell (1946) as “fluctuation found in aggregate economic activity of nations that organise their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle; this sequence of change is recurrent but not periodic; in duration business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar character with amplitudes approximating their own.” Thus, business cycles are characterised by fluctuations in the aggregate economic activity of market oriented economies with co-movement between many economic activities and persisting for more than one year. The characterisation of business cycle as a consensus of cycles in many economic activities is also highlighted by Moore (1982) and Zarnowitz and Boschan (1975). Moore (1982) observed: “No single measure of aggregate economic activity is called for in the definition because several such measures appear relevant to the problem, including output, employment, income, and trade, and no single measure is either available for a long period or possesses all the desired attributes”.

The essence of the business cycle definition given by Burns and Mitchell (1946) among others, is thus, reflected in the characterisation of business cycle by NBER (Appendix I) as recurrent sequences of alternating phases of expansion and contraction in the levels of a large number of economic time series. These cyclical fluctuations are persistent and reflected in great variety of time series such as consumption, investment, production, employment, prices, *etc.*, with the duration of a cycle lasting for several years. The expansion phase of the business cycle tends to be longer than the contraction phase due to general occurrence of upward long-term trend in economic time series in market oriented economies. In sum, the “classical” business cycles should have the expansion phase longer and larger than the contractions, but either phase must be persistent and pervasive enough to allow for significant cumulative and interactive effects and the sequence of up and down phases that constitutes the business cycle must be recurrent and not periodic (Zarnowitz and Ozyildirim, 2002).

During the decade of the 1960s, real decline in the economic activities in major industrial economies gave way to slowdowns in the pace of expansion. Frequently alternating periods of acceleration and slowdowns in growth rate raised questions about the practical use of classical business cycles in analysing cyclical movements in economic activities. Thus, the need for a concept of business cycle more in line with reality led to emergence of the concept of growth cycle (Mintz, 1969). The growth cycle is defined as the ups and downs through deviations of the actual growth rate of the economy from the long-run trend growth rate. The high growth phase in a growth cycle coincides with the business cycle recovery and the expansion mid-way, while the low growth phase is identical to the later phase of expansion leading to recession. While the business cycle contractions include only the absolute decline in economic activity, growth cycle contractions, in addition, include slowdowns. While the peaks in growth cycle approach tends to precede the business cycle peak, the turning point in the trend deviation series occurs where the slope of the series reflecting levels is equivalent to their long-term trend (Chart 1). Based on the trend-adjusted measure of economic activity, the formulation of growth cycle chronology was pioneered by Mintz (1969). Drawing from the Mintz's work, the OECD cyclical indicator system used the growth cycle or "deviation from trend" approach on the grounds that the essential cyclical similarities between series may be obscured by different long-term trends. However, keeping in view the precise determination of growth cycle dating, the criticism of the growth cycle approach is that while these are not hard to identify in a historical time series, their measurement on a real time basis is fraught with difficulties (Boschan and Banerji, 1990).

Chart 1 : Classical Business Cycle and Growth Cycle



Recognising the limitations of the growth cycle analysis as a tool for monitoring and forecasting business cycles, the use of growth rate cycles emerged to the fore to measure the series witnessing cyclical slowdowns although characterised by few actual cyclical declines (Layton and Moore, 1989). The growth rate cycles reflect the cyclical ups and downs in the growth rate of economic activity. The growth rate used in such cyclical indicators is the six month smoothed growth rate concept initiated by Moore (*op cit)* to dispense with the necessity of extrapolating the past trend, which was an essential requirement of growth cycle. The Economic Cycle Research Institute (ECRI) also followed the concept of growth rate cycle in order to monitor the economic activities in economies on a real time basis.

Changes in the nature and pace of the alternating phases of expansion and slowdown in economies, thus, led to the emergence of varied concepts of measurement of business cycles. The key feature of all these cyclical indicators is that they reflect co-movements and persistence with the indicators of production. While the business cycle and growth rate cycles were more suitable for real time monitoring and forecasting of economic activities, growth cycles were more suitable for historical analysis (Klein, 1998).

Measuring Business Cycles and Leading Indicators

The business cycle theory began to take a new shape in macroeconomic analysis from 1970s, around the time when major market economies were experiencing a greater variability in their real income growth rates, ending the period of sustained and almost uninterrupted growth enjoyed after the Second World War[3]. Growth theories in conjunction with business cycle approach led to adoption of leading indicator approach, particularly in the developed markets. Given the importance of industrial sector to the developed economies, the leading indicator analysis of industrial output is used for gauging economic conditions for the country as a whole (OECD, 1987). Industrial production or manufacturing output, data on which are mostly available on a monthly basis, have often been used as the reference series for leading indicator analysis.

The system of leading indicators received prominence with the growing interest of the policy makers, investors and business community on early signals of recession or recovery. The leading indicators approach to economic and business forecasting is based on the view that market oriented economies experience business cycles within which repetitive sequences occur and that these sequences underline the generation of the business cycle itself (Lahiri and Moore, 1991). After Mitchell and Burns's (*op cit*) seminal work on identifying business indicators in the 1940s, Moore (*op cit*) published a new list of 21 indicators of business cycle in 1950 classified in three groups – leading, coincident and lagging –according to their tendency to reach cyclical turns ahead of, at about the same time as, or later than business cycle peaks and troughs. Later on, the Organisation for Economic Co-operation and Development (OECD) formulated its own methodology to construct the series on leading indicators for the member countries (Appendix I). Recent research on the leading indicators has focussed on developing new methods based on the developments in economic theory and the time series analysis, formulating more advanced methods to test the forecasting reliability of the indicators, fine tuning the determination of timing of turning points of business cycle, *etc.*

Although the use of leading indicators of business cycle has attracted criticism for lack of sound theoretical foundation *a la* Koopmans (1947), a number of arguments have been advanced to defend the use of such approach to business cycle forecasting (De Leeuw, 1991). These include, among others, production time (gap between the decision to produce and actual production), ease of adaptation (certain dimensions of economic activity have lower costs of short-run variation than others), market expectations (some time series tend to be sensitive to anticipation about future economic activity), prime movers (fluctuations in economic activity are driven by a few measurable forces, such as monetary and fiscal policies) and change-versus-level (changes in economic time series generally turn up or down before levels). The first three of these rationales are recognised to be directly affecting industry decisions about production, orders, employment and inventories.

Different countries use a variety of leading indicators like average work-week, index of overtime hours, application for unemployment compensation, new companies registered, new orders, vendor performance, construction, stock prices, money supply, change in sensitive material prices, index of consumer expectations, *etc.* In the construction of a system of cyclical indicators, it is necessary to identify the past cyclical behaviour of the reference series, *i.e.*, the series whose future movements are to be predicted. For example, the OECD indicator system uses the index of total industrial production as the reference series. Once the cyclical behaviour of the reference series has been established, the next step is to select an economic time series whose cyclical movements typically predate those of the reference series. The series are evaluated on the basis of their relevance, cyclical behaviour and practical considerations. In order to determine how well these series meet criteria of being leading indicators, tests like peak-and-trough analysis, cross-correlations, and Granger causality are conducted. Once a set of leading indicators has been selected, these are compiled as a single composite index to reduce the risk of false signals and to provide a leading indicator with better forecasting and tracking qualities. The performance and forecasting ability of the composite leading indicator of business cycle can be evaluated in different ways. One is to examine the behaviour of the indicator in relation to the cyclical turning points of the reference series. Forecasting turning points is one of the main objectives of the leading indicator technique, because predicting the timing of cyclical turning points is one of the most challenging exercises in economic forecasting.

Section II
Measuring Business Cycles for India

Research on business cycles on the Indian economy was pioneered long back at the NBER to identify chronology of cyclical fluctuations in the Indian economy spanning 1890 through 1925 (Thorpe and Mitchell, 1926). The economists believed that even in the Indian economy which was dominated by agriculture, there were business cycles whose dates were worth determining. Later, business cycle fluctuations in the Indian economy have been analysed in terms of growth cycles, business cycles and reference cycle in some other studies, notably Chitre (1982, 1991), Nakamura (1991) and Hatekar (1994). The seminal work on growth cycles in India by Chitre (1982) involved construction of a diffusion and a composite index that comprised 15 indicators and identified five growth cycles during the period 1951-75. The reference cycle chronology, obtained through phases of high and low annual growth rates or deviations from the long-term trend, is the same. The coincident indicators for the Indian economy are identified by Nakamura (1991) using the net national product (NNP) reference cycle for the period 1965-83. Hatekar (1994) investigated stylised facts about the business cycle in the Indian economy for the period 1951-1985 using the Hodrick-Prescott filter. Although the cyclical behaviour of the economy over a wide spectrum of activities was reported, the number of turning points in the GDP cycle was too few to enable isolation of leading and lagging indicators.

The recent work in the business cycle analysis includes construction of an index of coincident economic indicators for the Indian economy since mid-1950s by Dua and Banerji (1999) to trace fluctuations in aggregate economic activity and determine the phases of business cycle. While the business cycles are found to average over six years, with recessions averaging just under a year, growth rate cycles have averaged less than three years in length, with average downturn lasting for two years. Regarding forecasting of cyclical turning points, Mall (1999) constructed a composite index of leading indicators (CILI), which was found to lead the IIP of manufacturing by two quarters. Further Dua and Banerji (2001) constructed a leading index to show that the growth rate of the leading index had an average lead of three months at growth rate cycle peaks, zero months at troughs and two months overall *vis-à-vis* the coincident index. The Reserve Bank (2002b) while recommending quarterly non-agricultural GDP as a reference series for business cycle analysis in India also suggested to look at other major activity variables, *viz.,* private consumption, industrial production and private corporate sales for determining the reference turning points. Further, it suggested improvement in database relating to a number of variables pertaining to business cycles as also emphasised testing competing paradigms on business cycles.

The identification of leading indicators of business cycle and constructing a composite index, which could represent the cyclical fluctuations in aggregate economic activity, largely remains an area of rigorous empirical investigation in the Indian case. The choice of variables needs to be ascertained from the viewpoint of their pervasiveness as well as economic relevance in causing cycles. The construction of leading indicators in India is constrained by non-availability of time series on a variety of economic variables, which are critical inputs in business cycles analysis in the industrial countries. Moreover, many critical indicators are not available at the desirable frequency, *e.g.,* monthly/quarterly frequency. Mostly the early stage indicators (*e.g.,* new orders, order books, construction approvals, *etc.*) and expectation sensitive indicators (*e.g.,* selling prices, economic situation, capacity utilisation, *etc.*) which are based on business tendency surveys are critical components of composite leading indicators of business cycles in the industrialised economies. In India, as there have not been any exhaustive business tendency surveys, the construction of credible leading indicator is further limited.

Notwithstanding these limitations, a composite index of business activities is attempted on the basis of available information on the economic/business indicators that can best predict the turning points of the business cycle. The selection of the variables has been based on their underlying economic dynamics in influencing the business activity.

Dating of Business Cycles in India

The dating of business cycles is done on the basis of monthly series of IIP, which is a representative reference indicator of the economic activities in India. The computation of cycles, recessions and expansions are based on the rules defined in the Bry-Boschan procedure (discussed in Appendix I). In total, during the period 1970-71 to 2001-02, 13 growth cycles of various duration have been identified (Table 1 and Chart 2). It is evident that while the average duration of recessions is higher at 16 months, expansions are of relatively shorter duration averaging at 12 months. Moreover, the average duration of the cycles is 27 months.

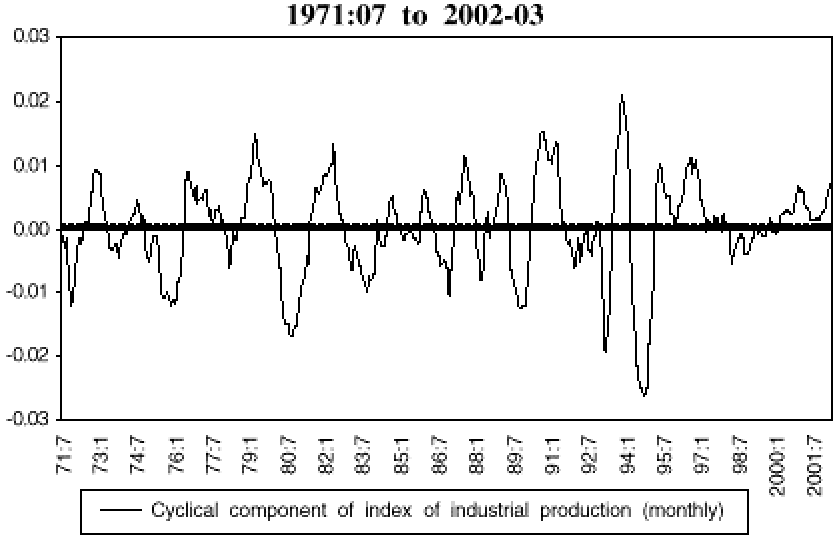
Table 1 : Growth Cycle Chronology for India : 1970-71 to 2001-02

(Period in months)

Peak (P)	Trough (T)	Expansion T/P	Recession P/T	Cycle Duration
	1971:11			
1972:12	1973:10	13	10	23
1974:7	1976:1	9	17	26
1976:8	1978:3	7	19	26
1979:3	1980:9	12	18	30
1982:5	1983:9	20	16	36
1984:9	1986:12	12	27	39
1987:7	1988:4	7	9	16
1989:1	1989:11	9	10	19
1990:9	1993:3	10	30	40
1993:11	1994:9	8	10	18
1995:5	1995:12	8	7	15
1996:8	1998:3	8	19	27
2000:11	2001:9	32	10	42
Average cycle		**12**	**16**	**27**
Median cycle		**9**	**16**	**26**

Changing amplitude and duration of business cycles in India provide important insights into the changing behaviour of business cycles. Endogenous cyclical mechanisms which are the major drivers of cyclical processes in free market economies were hampered in the pre-liberalisation period because of constraints imposed on the markets (Dua and Banerji, 2001). Indian economy has undergone significant structural changes over the past decade. Sectoral shifts in GDP with declining share of agriculture alongwith less susceptibility to monsoon failures have reduced the intensity of shocks arising from agriculture sector. However, as many of the distortions on functioning of the market mechanisms have been minimised/ removed, the amplitudes of the cycles generated by the internal dynamics of the economy are likely to be more pronounced.

Chart 2 : Cycles in the Industrial Production in India, 1971:07 to 2002-03



Furthermore, as the Indian economy has been opened up and is increasingly integrated with the rest of world, global business cycles are likely to reinforce the cyclical fluctuations in output[4]. It is evident that the average duration of cycles has remained almost unchanged during the post reform period as compared with the 1980s, however, the average amplitude has witnessed a rise. While the amplitude of the cycles became wide during the first half of the 1990s as compared to the earlier decade on account of a number of structural reforms in the economy and emergence of endogenous factors in causing cycles, it got muted subsequently with the economy entering a phase of relatively lower growth.

Section III
Construction of a Composite Leading Indicator (CLI)

The reference series

The first step in formulating a composite index of business cycle is the search of a reference cycle whose movements are to be mirrored in the specific cycles. A reference series in the business cycle analysis is the benchmark series that captures fluctuations in aggregate economic activity and is the series whose movements are to be forecasted. The empirical literature on business cycles reveal that the index of industrial production (IIP) is mostly chosen as the reference cycle to represent fluctuations in economic activity, and the variable to be forecasted. The underlying justification for this is the availability of IIP series at monthly/ quarterly frequency with minimum reporting lag, and also being representative of non-agricultural GDP and the business climate. Despite the fact that the relative contribution of the industrial production to GDP has somewhat declined in the past decade, the industrial production continues to constitute the more cyclical component of the aggregate economic activity. Although GDP series could be the ideal reference series, the GDP estimates on a higher frequency (quarterly) are available only for a short period, which is not adequate to analyse the business cycles. As the cyclical profiles of GDP and the industrial production have strong co-movement, the cyclical movements in IIP serve well as an indicator of the cycles in GDP. Moreover, the industrial sector in India has close sectoral linkages which is evident from the fact that within the services sector, producer services account for about 70 per cent of the value added. Chitre (2001) in his study on business cycles also admitted that the data on industrial production is the best to analyse business cycles in India. In most of the OECD countries where services sector accounts for more than 70 per cent of the total GDP, business cycles are mainly analysed using industrial production as the reference series.

Factoring availability and timeliness in to high frequency data as well as economic rationale, *viz.*, production time, ease of adaption, market expectations, prime movers, *etc.*, certain series have been identified as potential leading indicators. These are:

1. Yield on 91-day treasury bills (RTB) - Rapidly Responsive Indicator
2. Stock prices-BSE sensex (SENXCY) - Expectations Sensitive Indicator
3. WPI of primary goods (WPIPACY) - Expectations Sensitive Indicator
4. WPI of minerals (WPIMNCY) - Expectations Sensitive Indicator
5. WPI of fuel group (WPIFLCY) - Expectations Sensitive Indicator
6. WPI of industrial raw material (WPIIRCY) - Expectations Sensitive Indicator
7. WPI manufacturing (WPIMCY) - Expectations Sensitive Indicator
8. Non-oil imports (MNOLCY) - Expectations Sensitive Indicator
9. Money supply (M3CY) - Prime Mover
10. Currency demand (CWPCY)- Prime Mover
11. Scheduled commercial bank deposits (SCBDCY)- Prime Mover
12. Non-food credit (NFCCY) - Prime Mover
13. Exports (EXPRCY) - Prime Mover
14. US gross domestic product (USGPCY) - Prime Mover
15. Fiscal deficit (GFDCY) - Prime Mover
16. IIP of basic goods (IIPBCY) - Other Indicator
17. Freight loading of the railways (FRGTCY) - Other Indicator
18. Cargo handled (CARGCY) - Other Indicator
19. Food stocks (FDSTCY) - Other Indicator

These variables were tested for their cyclical properties *vis-à-vis* the reference series to filter out lagging and coincident indicators so that only leading indicators could be retained for the construction of a composite leading index. The indicators identified on the basis of above criteria have to ultimately pass the crucial test of cyclical sensitivity in terms of length and consistency of the lead of the indicator over the reference cycle at turning points. In terms of cyclical conformity, if the cyclical profiles of the indicator and reference series are highly correlated, the indicator will provide a guide, not only to the approaching turning points, but also to developments over the whole cycle. Further, emphasis has to be given to the absence of extra or missing cycles in comparison with the reference series and to smoothness, that is, how promptly a cyclical turn in the series can be distinguished from irregular movements. The indicator variables were taken on monthly frequency so the cyclical expansion/recession can be judged in the light of a set of simple decision rules for selection of turning points with duration defined in months.

Seasonal Adjustment and Cyclical Decomposition of the Series

Time series observed at quarterly and monthly frequencies often exhibit seasonal movements that recur every month or quarter. Seasonal adjustment refers to the process of removing these seasonal movements from a series and extracting the underlying trend and cyclical component of the series. Elimination of the seasonal element of the series is done by applying ratio to moving average method[5]. The main difference between X-11 and the moving average methods is that the seasonal factors may change from year to year in X-11, while the seasonal factors are assumed to be constant for the moving average method.

While segregating the seasonal and irregular elements is relatively easy and straightforward in time series analysis, detrending the trend cycle for deriving cyclical component is always a tricky issue. This is so because trend is a relatively stable component representing the long-term behaviour of the series, while cycle is a stochastic component and is unstable in the medium-term.

The cyclical components of the series are derived by using band-pass (BP) filter approach to measuring business cycles. The BP filter has been found to work quite well for wide frequency ranges and produces very smooth growth cycles similar to those of PAT (Phase-average-trend), whereas the HP filter at very high frequency (_) too produces growth cycles quite similar to the PAT but falls short on smoothness. Thus the variables considered in the analysis are passed through the BP filter to obtain a smooth cyclical component. The cyclical duration of each of the indicator series derived through spectral analysis[6] is given in Table 2.

Determination of Lead-Lag Structures of the Series

Analysing lead-lag structure between the cycles of the indicator series and the reference series assumes crucial importance for separating leading, lagging and coincident indicators. The cross-correlogram has been used to identify the possible lead-lag relationship between each of the indicator series and the reference series. The cross correlation coefficient at a lag between two stationary series, provides information about the impulse response function between them at different lags. Box and Jenkins (1976) suggested the use of the same to make some tentative estimate for multivariate forecast, which can be refined further by introducing the suitable lag operation at the final estimation process. If it is applied on the detrended, deseasonalised and smoothened series, it gives a fair idea about the strength and stability of the cyclical correspondence, on the one hand, and reduces the probability of false signal, on the other. As such, the identification process in terms of the lead structure of the leading indicator series *vis-à-vis* reference series is not only theoretically plausible but also turns out to be more precise in predicting the cyclical turning points.

The first approximation of the lead-lag structure between the reference series, *i.e.*, the IIP and those of the indicator series, passed through BP filter, could be obtained by the cross correlations computed up to 15 lags. Conventionally, the maximum value of coefficient is taken as lead or lag of the indicator in relation to a reference series.

Table 2 : Standardised Spectral Density Functions of the Reference and the Indicator Series (Sample: 1989M7 to 2002M3)

Series	Cycle	Estimates of Spectral Density*		
		Bartlett	Tukey	Parzen
IIPCY	24	7.1788	7.5876	6.5889
		-2.32	*-2.60*	*-1.92*
IIPBCY	24	8.9779	9.1005	7.1626
		-2.90	*-3.12*	*-2.08*
MNOLCY	24	8.248	8.5104	7.0745
		-2.67	*-2.92*	*-2.06*
EXPRCY	48	7.2161	7.5153	7.005
		2.41	*2.66*	*2.10*
USGPCY	48	8.6527	8.9303	8.1379
		-2.80	*-3.06*	*-2.37*
SCBDCY	24	9.5531	9.7734	7.7739
		-3.09	*-3.35*	*-2.26*
NFCCY	48	9.6524	9.7365	8.6836
		-3.12	*-3.34*	*-2.53*
CWPCY	48	7.5078	7.9158	7.4288
		-2.43	*-2.72*	*-2.16*
M3CY	24	9.3087	9.5723	7.6818
		-3.01	*-3.28*	*-2.23*
GFDCCY	40	5.9702	6.0029	5.3806
		-2.23	*2.37*	*-1.80*
WPIIRCY	48	9.8587	9.901	8.7931
		-3.19	*-3.40*	*-2.56*
WPIMCY	48	8.629	8.6468	7.762
		-2.79	*-2.97*	*-2.26*
RTB	44	9.8922	9.9117	8.7213
		-3.60	*-3.82*	*-2.85*
FRGTCY	24	6.1295	6.4035	5.5405
		-1.98	*-2.20*	*-1.61*
CARGCY	24	6.5061	6.717	5.587
		-2.10	*-2.30*	*-1.62*

Peak values of estimates are reported. The higher is the value, the more persistent is the effect of the corresponding cycle.
Note : Values in italics are standard errors.

However, this needs to be interpreted with some caution as they can be distorted by overlapping oscillations. The value of coefficient with different lags which fall in the 5 per cent significance band, are considered as leading/lagging. On the basis of the results of cross correlogram of various indicators with the reference series, the variables considered can be grouped as leading/lagging indicators (Table 3).

Table 3 : Leading/Lagging Indicators of IIP in India

(Period in months)

Leading Indicator	Lead	Lagging Indicator	Lag
MNOLCY	10	IIPBCY	7
EXPRCY	4	FDSTCY	7
USGPCY	10	WPIMNCY	6
SCBDCY	8		
NFCCY	8		

CWPCY	5
M3CY	10
WPIIRCY	6
WPIMCY	7
RTB	5
SENSCY	12
FRGTCY	9
CARGCY	11
Average	8.1
Median	8

All the signs of the correlation coefficient hold for the entire range of analysis except for a few false signals. The cyclical relationship holds over almost the entire range of statistically significant correlation coefficient across the cyclical duration, indicating the strength of cyclical correspondence of the individual leading indicator series with the reference series.

In order to further ascertain whether changes in the indicator series precede the variations in the reference series, Granger causality test was also performed. However, the choice of lag length poses a common difficulty in performing such tests. Further, visual inspection of the plots of each of the indicators series with the reference series was also used to ascertain the relevant series with appropriate lag length. The consistency of the lead of the indicator series over the reference series, particularly at the turning points becomes crucial for its inclusion in the index. In the ultimate analysis, the series that emerged as significant for compiling the composite index include non-oil imports, exports, US GDP, deposits of commercial banks, non-food credit of commercial banks, currency demand, money supply growth, prices of industrial raw material, prices of manufactured products, treasury bill yield, BSE Sensex, freight loading of the railways and cargo handled at the major ports. The plot of the cyclical component of the IIP with each of the leading series is given in Appendix II.

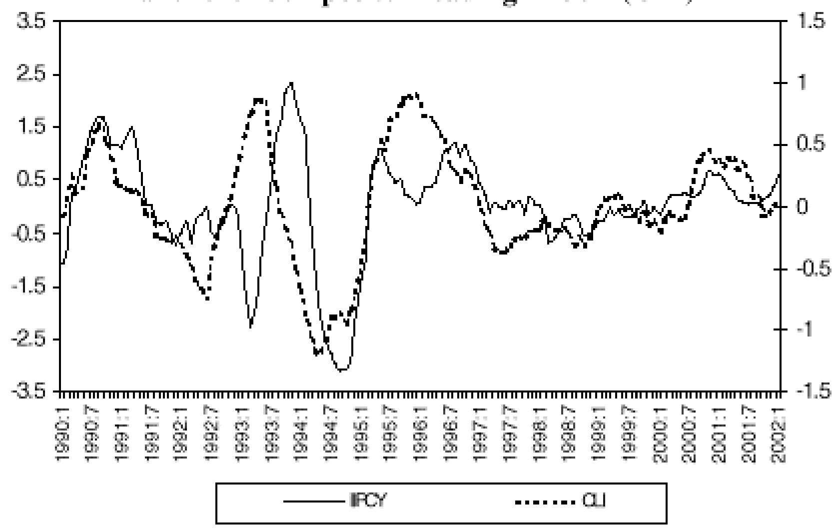
The Composite Leading Index (CLI) for India

One important objective of the leading indicator analysis is to make short-term forecasts of the reference series. Knowing whether the economy is heading for a recession or boom is important for policy making. Since the major interest is in stabilisation, any significant fluctuation has to be predicted and then dampened through policy intervention. As stated earlier, the essential feature considered for selecting a component of the CLI is that it leads the reference series with analogous cyclical behaviour. A single composite index reduces the risk of false signals that may sometimes arise from a particular series as also displays better tracking of the reference series apart from providing reliable forecasts. The monthly composite index was compiled for the period 1990:05 through 2002:03, using the previously mentioned indicator series having a lead ranging from 4 to 12 months without sacrificing their cyclical properties.

In the present analysis, the raw data series of the leading indicators were first adjusted according to their lag structure so that all of them behaved like a coincident indicator, notwithstanding the loss of some observations in this process. As the cyclical components across the series forming part of the CLI, have great degree of variability in their amplitude, aggregation into CLI without standardisation may lead to distortions in the latter. In order to avoid this problem, it is necessary to normalise the series prior to aggregation so that the amplitudes are standardised.

An unweighted index of these thirteen series is compiled to forecast the turning points of business cycles in India. The underlying idea for having an unweighted index is that the industrial sector is undergoing structural changes, which may result in rapid shifts in the relative importance of the indicators in forecasting the production cycles. The process of normalisation of each series used in the composite index does the job of smoothing. Thus, the normalisation process itself implies a weighting system. It may also be mentioned that in the OECD system too, equal weights are used to obtain the composite index for a country (OECD, 1997). The movements of the CLI, observed particularly since the early 1990s, reveal that it is able to capture the turning points of the IIP about six months in advance (Chart 3).

Chart 3 : Cyclical Component of IIP (IIPCY) and the Composite Leading Index (CLI)



The lead performance of the composite indicator during the reform period is set out in Table 4. The leading index has an average lead of 5.7 months at the business cycle peaks and 5.5 months at the trough. It can be observed that the indicator has maintained the lead at all the peaks of the growth cycles except one, in the post-reform period. At the troughs, the leading indicator has maintained a consistent lead. However, there has been some variability in the length of the lead in itself.

Table 4 : Lead/Lag Record of the Composite Leading Index for the Indian Economy

Growth Cycle		CLI		Lead (-)/Lag(+) in Months	
Trough	Peak	Trough	Peak	Trough	Peak
1993:3	1993:11	1992:8	1993:7	-7	-4
1994:9	1995:5	1994:6	1994:11	-3	-5
1995:12	1996:8	1995:8	1995:12	-4	-8
1998:3	2000:11	1997:7	2001:1	-8	+2
Average				-5.5	-5.7

Median	-5.5	-5.0

Section IV
Concluding Observations

The persistent slowdown in the economic activities globally has spurred debate on business cycles and considerable concern is raised about the deepening of the slowdown and prolonging of the onset of revival. The present slowdown in India is distinctly reflected in the deteriorating rates of capacity utilisation across the industries with average capacity utilisation rate for manufacturing estimated at about 75 per cent during the latter half of the 1990s[7]. The early indications of recovery from the phase of slow growth as reflected in a variety of economic/business indicators need to be interpreted cautiously.

The cyclical behaviour of the Indian economy shows that the economy has transited through thirteen growth cycles of various amplitudes and periodicity during the last three decades, with average duration of cycle approximating 27 months. While the recessions persist for the average duration of 16 months, the expansion phase is of relatively shorter duration averaging 12 months. This is in contrast to the general proposition that expansionary phase in the business cycle is larger than the contractionary phase. The explanation for this lies in that while in the earlier decade, periodic crop failures and consequent adverse demand shocks emanating from the agricultural sector were mainly responsible for longer recessionary phase; slowdown in public investment and growing infrastructural constraint also seem to have been the binding constraint on sustaining the expansionary phase of the growth cycle in the economy in recent decades.

As the economy has been increasingly exhibiting signs of upswing and downturn in economic activity, the need for predicting the cyclical behaviour has assumed significance. The approach of leading indicator of economic activity has been widely used to track the phases of business cycle and for deciding the appropriate timing for the use of the counter-cyclical policies to work towards macroeconomic stabilisation and thus, minimise the severity of the cyclical downturns. The composite index of leading indicators being multivariate in nature has been widely used as it predicts the cyclical turning points more effectively than any single indicator. The CLI is based on the premise that the cycle of each indicator component has its unique characteristics as well as features in common with other cycles, but no single cause explains the cyclical fluctuation over a period of time in overall activity. The performance of individual indicators will then depend on the strength of causal relation with the reference series. Accordingly, the multivariate approach adopted in this study is necessary to combine various signals for many possible causes of cyclical changes. The composite leading index compiled for India indicates that the index is able to forecast the cyclical turning points in the IIP series with a lag of 6 months.

The construction of a more robust composite leading index necessitates high frequency (*i.e.* monthly/quarterly) time series information on early stage indicators such as new orders, order books, construction, job vacancies, capacity utilisation, *etc.*, as also on rapidly responsive indicators such as profits, inventories (stocks), average hours worked, *etc.* In the Indian context, construction of a reliable composite leading indicator would essentially require information obtained from forward-looking questions of business surveys. Compared to the traditional quantitative statistical surveys, business tendency surveys collect qualitative information from business managers on their assessment of the current economic situation and their intentions/expectations for the immediate future. These surveys, known as consensus estimates, cover a range of variables selected for their ability to monitor the business cycle and include information not covered by quantitative statistics. Such surveys are conducted in all OECD member countries and have cost-effective means of generating timely information on short-term economic conditions. In the Indian context, on a limited scale, sample surveys by the National Council of Applied Economic Research (NCAER) and the Confederation of Indian Industry (CII) generate information on some variables but there is no adequate time series to assess the cyclical properties of such variables for inclusion in the composite index.

Notes

1. Koopmans (1947) in his celebrated critique "Measurement Without Theory" stated that the atheoretical NBER approach could never lead to inferences about the possible impact of stabilisation policies.

2. New Classical School of Macroeconomics in their business cycle analysis emphasised the importance of random impulses as the primary cause of cyclical fluctuation rather than specifying any particular internal or external factors.

3. Notable development in the business cycle theory during this phase was the emergence of the Real Business Cycle (RBC) theory in the early 1980s. The RBC emphasised technological shocks as the main factor causing cyclical fluctuations, and is considered to be the basic theoretical impetus behind the development of cyclical indicator approach of the present day business cycle analysis. The development of the RBC approach is found to be well integrated with its empirical counterpart – the time series analysis in econometrics, to provide further sophistication to the analysis of business cycle.

4. The empirical analysis (RBI, 2002a) on relationship between the domestic output and global business cycle reveals that causality between cyclical imports of advanced countries and India's exports is significant and strongly bi-directional. Further, cyclical output of advanced countries has unidirectional causal effects on cyclical output in India.

5. Ratio to moving average (multiplicative) first requires computation of the centered moving average of the yt series denoted as xt. Second, take the ratio rt = yt/xt. Third, compute the seasonal indices. For monthly series, the seasonal index for month m is the average of using observations only for month m. For quarterly series, the seasonal index for quarter q is the average of using observations only for quarter q. Then adjust the seasonal indices so that they multiply to one. This is done by computing the seasonal factors as the ratio of the seasonal index to the geometric mean of the indices. The seasonally adjusted series is obtained by dividing by the seasonal factors.

6. Spectral analysis enables examination of the underlying nature of cycles. A spectral density functions using 'Bartlett', 'Tukey' and 'Parzen' lag windows in the estimation of long run variances in time series over the frequency domain is fitted to ascertain the significance of the presence of cycles as well as to measure the duration and amplitude of the fluctuations. The window size is set to the default value of 2_n, where n is the number of observations.

7. Estimate based on the Minimum Capital-Output Ratio Measure developed by National Industrial Conference Board, USA.

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Appendix I : Measurement of Cycles and Estimation of Turning Points : Alternative Methodologies

As the leading indicators are of crucial significance to applied business cycle forecasting, there has been evolution of alternative methodologies to achieve more reliable forecasts about the turning points of the business cycles. The seminal contribution of Burns and Mitchell (1946) on the business cycle laid the foundation of empirical measurement of the business cycle in the sense that it provided a comprehensive definition of the empirical features of the business cycle of developed economies and developed methods for measurement. The analysis of business cycle in the market oriented economies is mainly rooted in the methodological approach developed by the National Bureau of Economic Research (NBER).

NBER Method of Dating Business Cycles Peaks and Troughs

The NBER method of determining cyclical turning points in a time series is based on the cycle dating criteria outlined in Burns and Mitchell (1946). The NBER method identifies peaks and troughs by observing clear changes in both the trend and the level of economic activity. An array of data series coincident with the aggregate economy are analysed and clustering of turning points in the series are used to set the dating of reference cycle. A distinction is made between a specific cycle and a reference cycle. A specific cycle is defined as a set of turning points observed in a time series, which may or may not correspond to overall business cycle turning points, but should meet the following criteria:

(i) The duration of the cycle must be at least 15 months, measured from either peak to peak or trough to trough;
(ii) If the peak or trough zone is flat, the latest value is selected as the turn;
(iii) Strike activity or other special factors generally are ignored, if their effect is brief and fully reversible.

As the business cycle dating of NBER is based on considerable judgement, attempts have been made to filter out false turning points from noisy data. The algorithm developed by Bry and Boschan (1971) is a scientific replication for selecting the turning points.

The Bry-Boschan procedure is based on a single reference series and translates NBER method into a set of simple decision rules: (i) A peak is followed by trough and a trough by a peak; (ii) Each phase (peak to trough or trough to peak) must have a duration of at least six months; (iii) A business cycle from peak to peak or trough to trough to have a duration of at least 15 months in order to distinguish business cycles from seasonal cycles; (iv) Turning points within six months of the beginning or end of the time series are eliminated as are peaks (troughs) within 24 months of the beginning or end of the series if any of the points after (before) are higher (lower) than peak (trough).

The OECD Methodology

The OECD secretariat has developed a leading indicator system for its member countries, which is used for analysing business cycles and for predicting cyclical turning points. The OECD leading indicator system uses the "growth cycle" or "deviation from trend" approach because essential cyclical similarities between the series may be obscured by different long-term trends. The underlying reasoning for such an approach is that in periods with very high long-term growth trends, the turning points in many level series are a poor guide as the cyclical fluctuations in economy are dominated by the trend - the situation prevalent in much of the early post-war period in many industrialised countries.

For constructing leading indicators of business cycle, it is essential to first trace out the past cyclical behaviour of the reference series. The next step is to select economic time series whose cyclical movements typically predate those of the reference series. The series considered are evaluated on the basis of criteria regarding economic relevance, cyclical behaviour and practical considerations on data frequency and timely availability. To determine how well a series meets the criteria of cyclical behaviour, peak and trough analysis and cross-correlation analysis are carried out. The method of trend estimation adopted by the OECD is a modified version of the Phase-Average Trend (PAT) method developed by the NBER. This method has been designed specifically to separate the long-term trends from the medium-term cycles, with the latter defined as per the criteria programmed in the Bry-Boschan routine for selection of cyclical turning points.

Under the PAT method, series is broken up into phases on the basis of cyclical peaks and troughs in the deviations of the series from its moving average. Then the mean for each successive phase of the series is computed and the results are smoothed by means of two item or three item moving averages. The PAT is approximated by connecting the mid points of these 'triplets' or 'doublets'. PAT method of removing trends is arbitrary like other methods. However, such multi-step approach generally requires a large number of observations.

Besides these, there are some other methods for measuring cycles such as Shiskin's Rule of Thumb, Markov Switching Model and other statistical filters of business cycles. The need for decomposition of the cyclical component of an economic time series has led to development of a variety of detrending and smoothing techniques. The detrending techniques commonly used are moving average, first differencing, removal of linear or quadratic time trends, Hodrick-Prescott filter and the band-pass filter, which measures cycles in a frequency domain.

The Hodrick Prescott (HP) Filter

The business cycle filter developed by Hodrick and Prescott (1980) to analyse post-war U.S. business cycles has grown dramatically in time series applications in the recent past. Technically, the Hodrick-Prescott (HP) filter is a two-sided linear filter. The seasonally adjusted time series are decomposed into trend and cycle components. The smoothed series are obtained by minimizing the variance of seasonally adjusted series around its trend component. The filter removes nonstationary components, *i.e.,* unit root, and as this filter is symmetric there is no phase shift. The HP filter has, of late, been used as a substitute for the PAT method, originally used at NBER for trend estimation.

The HP filter defines cyclic component of a time series y_t as:

$$Y_t^c = [\frac{l(1-L)^2(1-L)^2}{1+l(1-L)^2(1-L^{-1})^2}]y_t$$

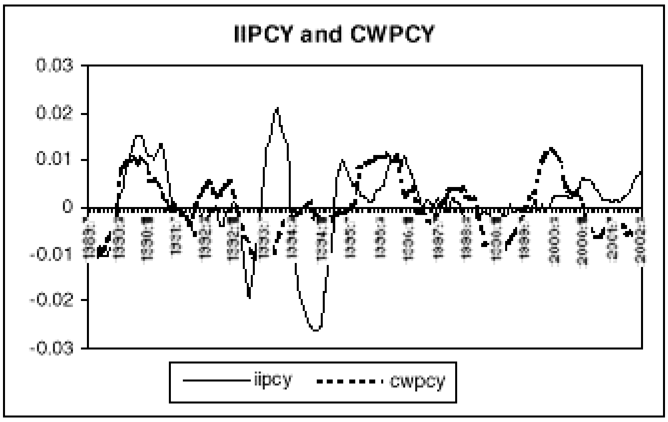
The larger the parameter λ, the smoother is the result. Hodrick and Prescott favour λ = 1600 for quarterly data and for monthly series the value assigned is λ = 14,400.

The Band Pass (BP) Filter

To isolate business cycle fluctuations in macro-economic time series, Baxter and King (1995) developed band pass filter, based on the definition of the business cycle suggested by Burns and Mitchell (1946). Relative to other perspectives on decomposing time series, the theory of spectral analysis of time series provides a rigorous foundation as it relies on the Spectral Representation Theorem, *i.e.,* any time series within a broad class can be decomposed into different frequency components.

The band pass is a linear filter, which eliminates very slow moving (trend) components and very high frequency (irregular) components. In other words, it is a linear transformation of data which leaves intact the components of data within a specified band of frequencies while eliminating all other components, *i.e.,* isolate fluctuations in the economic time series which persist for periods of two through eight years. Despite the wide use of conventional method separating trends from cycles to remove the linear trends from economic time series, growing evidence indicates presence of unit root which cannot be removed by such procedure of detrending. The BP filter detrends data in the sense that it renders stationary time series. Furthermore, while the Hodrick-Prescott filter and moving average produce significantly higher volatility measures, the BP filter eliminates the high frequency components apart from removing the unit root component from the data. Baxter and King recommended the Burns and Mitchell band pass filter for quarterly macroeconomic data, which admits frequency components between 6 and 32 variation while smooth high frequency irregular variation.

Appendix II : Cyclical Components of the IIP and the Leading Indicator Series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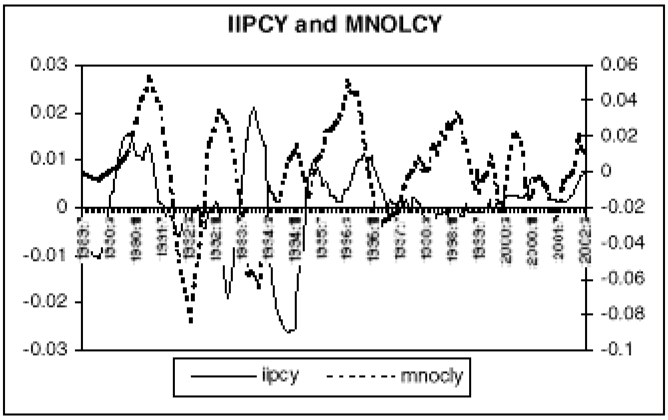
cwpcy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-0.08
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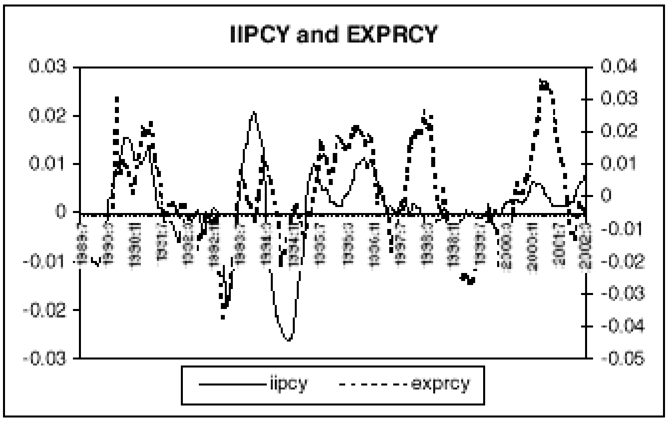
ipcy
mnocly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0
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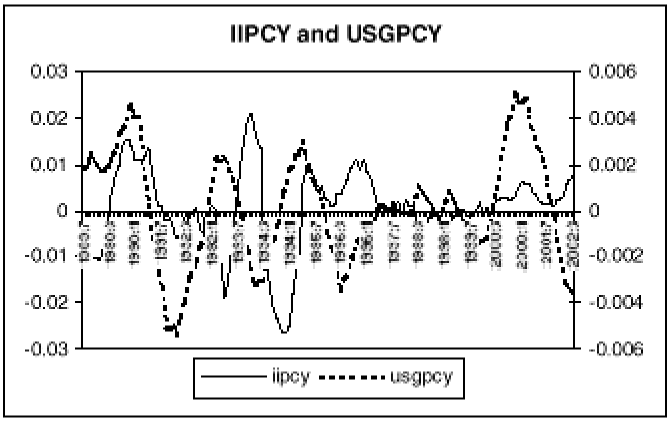
-0.04
-0.05
iipcy
exprcy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0
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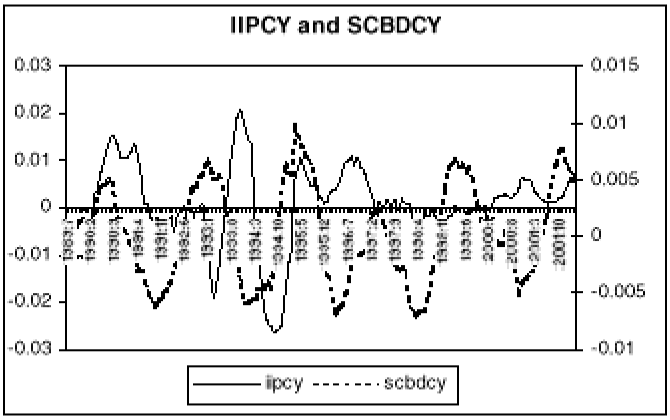
iipcy
usgpcy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0
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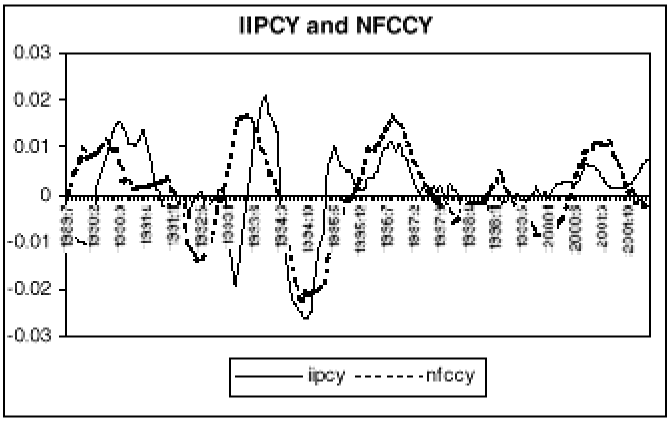
-0.01
iipcy
scbdcy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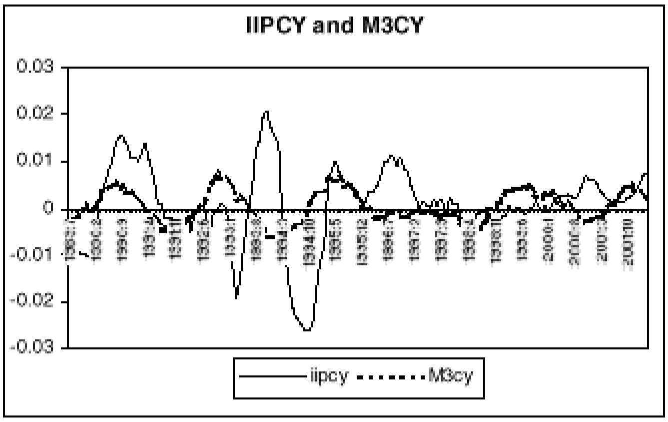
iipcy
nfccy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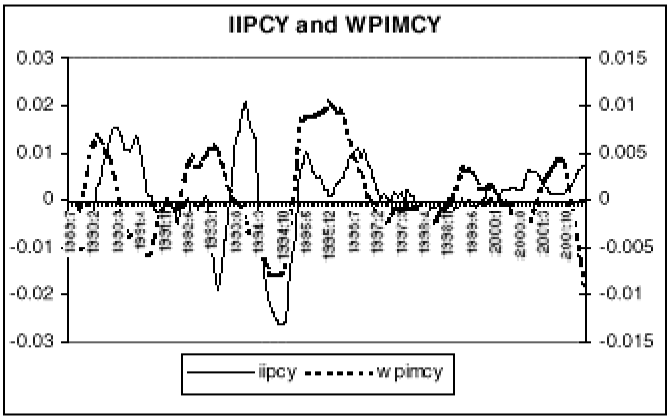
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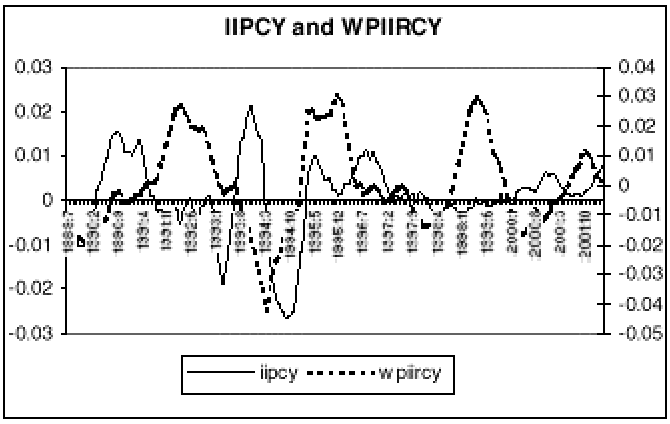
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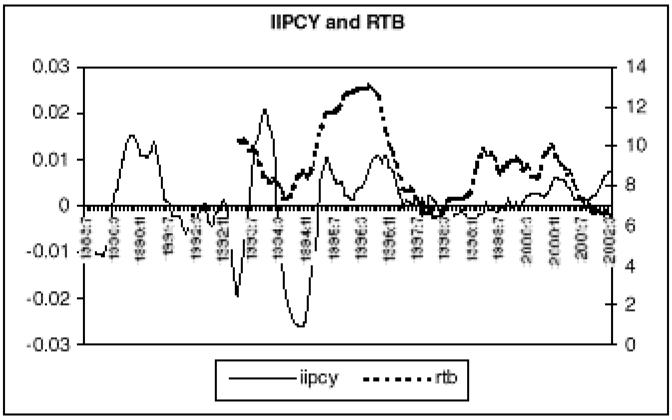
iipcy
wpiircy



IIPCY and RTB
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0.02
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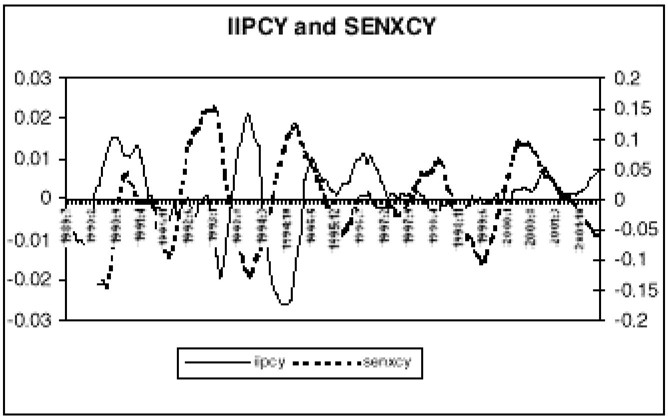
14
12
10
8
6
4
2
0
iipcy
rtb



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0
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0.2
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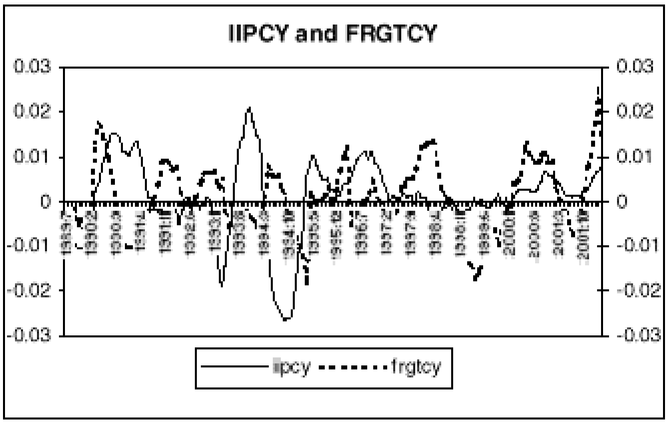
iipcy
senxcy



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0.03
0.02
0.01
0
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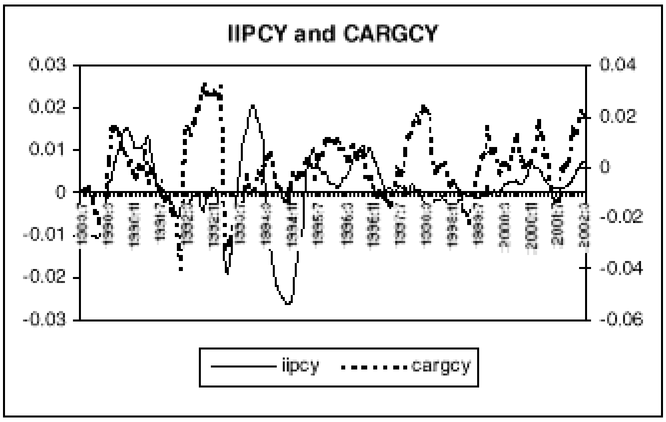
-0.02
-0.03
iipcy
frgtcy



IIPCY	= Cyclical Component of the IIP
IIPBCY	= Cyclical Component of the IIP Basic Goods
FDSTCY	= Cyclical Component of Food Stocks
MNOLCY	= Cyclical Component of Non-Oil Imports
EXPRCY	= Cyclical Component of Exports
USGPCY	= Cyclical Component of US GDP
SCBDCY	= Cyclical Component of Deposits of Commercial Banks
NFCCY	= Cyclical Component of Non-Food Credit
CWPCY	= Cyclical Component of Currency with Public
M3CY	= Cyclical Component of Money Supply
GFDCCY	= Cyclical Component of GFD
WPIPACY	= Cyclical Component of WPI of Primary Articles
WPIIRCY	= Cyclical Component of WPI of Industrial Raw Material
WPIMNCY	= Cyclical Component of WPI of Minerals
WPIFLCY	= Cyclical Component of WPI of Fuel Groups
WPIMCY	= Cyclical Component of WPI of Manufacturing
RTB	= Treasury Bill Rates
SENXCY	= Cyclical Component of BSE Sensex
FRGTCY	= Cyclical Component of Freight Loading of Railways
CARGCY	= Cyclical Component of Cargo Handled at Major Ports

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