CDE
March, 2001

Centre for Development Economics

A Leading Index for the Indian Economy

Pami Dua
Department of Economics, Delhi School of Economics, Delhi, India
and Economic Cycle Research Institute, New York
Fax: 91-11-7667159
Email: dua@cdedse.ernet.in
&
Anirvan Banerji
Economic Cycle Research Institute, New York
Fax: 001-212 5579874
Email: anirvan@businesscycle.com

Working Paper No. 90

Abstract

Over the last few decades, the Indian economy has experienced both classical business cycles and the cyclical fluctuations in its growth rate known as growth rate cycles. In the years since the liberalization of the economy began, these cycles have been driven more by endogenous factors than by exogenous shocks. From the point of view of both policy-makers and businesses, therefore, it is important to find a way to predict Indian recessions and recoveries, along with slowdowns and speedups in growth. This paper adopts a classical leading indicator approach to the problem.

In earlier work, we had used the classical NBER approach to determine the dates of Indian business cycles and growth rate cycles. These dates were used as the reference chronology against which to evaluate the performance of potential leading indicators for the Indian economy.

The indicators selected were combined into a composite index of leading economic indicators, designed to anticipate business cycle and growth rate cycle upturns and downturns. Given the paucity of suitable data for the Indian economy, the construction of such a leading index constitutes a significant advance. It also confirms that the durable sequences of leads and lags seen in free market economies are now also evident in the Indian case, permitting useful forecasts of cyclical turning points.

Acknowledgments

The authors are grateful to the Centre for Development Economics, Delhi School of Economics and the Economic Cycle Research Institute, New York, for research support. The authors are also grateful to Geoffrey H. Moore for his early encouragement and guidance, and to Vikas S. Chitre for invaluable help in the initial stages of the project. Mi-Suk Ha, Shuchita Mehta and Manish Agarwal provided competent research assistance.

1. INTRODUCTION

Of late, the Indian economy has been in the international spotlight more than usual, for a number of reasons. One of them is continued optimism about liberalization of the Indian economy, which began in earnest in 1991. Also, international access to Indian markets is poised to increase dramatically.

Besides, the Indian economy has been growing at a pace of about 6% over the past year after sidestepping much of the Asian crisis because of its insular nature. In fact, GDP growth rose to 8.6% in 1995-96, and has not fallen below 5% since the 1991 crisis. Thus, over the last few years, India has been one of the fastest-growing Asian economies, with its 1999 GDP surpassing those of Korea and Australia. India's GDP in terms of purchasing power is already the fourth largest in the world, after China, the U.S. and Japan.

Another reason for the increased attention to the Indian economy is the phenomenal growth of the Indian Information Technology (IT) sector, whose output has been doubling every 18 months. Notably, India already has a global market share of almost 20% in software development and customized software, and is the developing country with the best prospects for leadership in the IT sector.

With the increasing importance of the economy of India, which just passed the one billion mark in population, monitoring Indian economic cycles is now of more interest. An earlier paper (Dua and Banerji, 1999) established the dates of Indian business cycles and growth rate cycles, with the help of a coincident index created for the purpose. In this paper, we introduce a leading index for the Indian economy, designed to anticipate those cycles.

The index of leading economic indicators is a composite of different indicators that collectively predict future economic activity. It is designed to peak and trough earlier than the coincident index that measures current economic activity. It is therefore a very important and useful forecasting and planning tool for policymakers, financial analysts, financial investors, and businesses. Together with the coincident index (Dua and Banerji, 1999), it can help to better monitor the Indian economy and provide early warning signals of future economic activity.

Section 2 describes the indicator approach to business cycles and distinguishes between classical, growth, and growth rate cycles. Section 3 discusses the construction of the leading index. Section 4 analyzes the Indian business and growth rate cycles. Section 5 examines the Indian leading index and the following section reflects on the usefulness of the leading index pre and post liberalization. The last section concludes the paper.

2. INDICATOR APPROACH TO MONITORING AND PREDICTING BUSINESS CYCLES, GROWTH CYCLES, AND GROWTH RATE CYCLES

Leading, Coincident, and Lagging Indicators

The indicator approach to macroeconomic measurement has a long and successful history. This approach works because in a market-oriented economy, in cycle after cycle, economic indicators reach turning points in a known sequence. Basically, leading indicators turn before coincident indicators, which turn before lagging indicators.

The National Bureau of Economic Research (NBER), formed in 1920 to address measurement problems in economics, pioneered research into understanding the repetitive sequences that underlie business cycles. Wesley C. Mitchell (1927), one of the founders of the NBER, first established a working definition of the business cycle and he along with Arthur F. Burns (1946) characterized it later as follows:

> *"Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize 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 changes 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."*

To examine these repetitive sequences, the indicator approach consists essentially of classifying economic indicators into leading, coincident and lagging categories and then

combining the relevant components into corresponding composite indexes. The coincident index comprising of indicators that measure current economic performance is then used to represent the level of current economic activity. Examples of such indicators include measures of output, income, employment, and sales. These help to date peaks and troughs of business cycles.

The leading index, on the other hand, combines series that tend to lead at business cycle turns and provides a summary measure of what can be expected in the near future. Leading indicators generally represent commitments made with respect to future activity or are factors that influence such commitments. Examples are placement of new orders, intentions to build, and changes in profitability.

The lagging index, a composite of indicators that reach their turning points after the peaks and troughs of the coincident indicators, helps to clarify and confirm the underlying pattern of economic activity identified with the help of coincident and leading indexes. For instance, the levels of stocks, installment credit outstanding, and interest rates depict previous changes in the economy.

As noted above, to track business cycles, a composite index of a group of economic time series that show similar characteristics (timing) at business cycle turns but represent different activities or sectors of the economy is preferred to individual series. This is because the composite index represents a broad spectrum of the economy. Furthermore, the performance of an individual series may vary over different business cycles. Specifically, the components that perform best in each cycle may vary and it is not possible to gauge beforehand which of the variables is better for each turning point. Moreover, a composite index also reduces the measurement error associated with a given cyclical indicator. As noted by Moore (1982):

> *"Virtually all economic statistics are subject to error, and hence are often revised. Use of several measures necessitates an effort to determine what is the consensus among them, but it avoids some of the arbitrariness of deciding upon a single measure that perforce could be used only for a*

limited time with results that would be subject to revision every time the measure was revised."

Furthermore, Zarnowitz and Boschan (1975) point out that some series *"prove more useful in one set of conditions, others in a different set. To increase the chances of getting true signals and reduce those of getting false ones, it is advisable to rely on all such potentially useful (series) as a group."*

The emphasis in the indicator approach thus is on the concerted nature of the upswings and downswings in different measures of economic activity. In fact, the business cycle is a consensus of cycles in many activities, which have a tendency to peak and trough around the same time (Niemira and Klein, 1994, p.4). For each coincident series, a specific cycle, that is, a set of turning points can be determined. A reference cycle chronology can then be determined based on the central tendency of the individual turning points in a set of coincident economic indicators that comprise the coincident index. This reference chronology helps to date recessions as well as to identify leading indicators and their historical leads.

Classical Cycles, Growth Cycles, and Growth Rate Cycles

The above discussion describes "classical" business cycles that measure the ups and downs of the economy with absolute levels of the variables entering the coincident index. A second National Bureau definition of fluctuations in economic activity is termed a growth cycle. A growth cycle traces the ups and downs through deviations of the actual growth rate of the economy from its long-run trend rate of growth. In other words, a speedup (slowdown) in economic activity means growth higher (lower) than the long-run trend rate of growth.

Economic slowdowns begin with reduced but still positive growth rates and can eventually develop into recessions. The high growth phase coincides with the business cycle recovery and the expansion mid-way while the low growth phase corresponds to expansion in the later stages leading to recession. Some slowdowns, however, continue to exhibit positive growth rates and result in renewed expansions, not recessions. As a result, all classical cycles associate with growth cycles, but not all growth cycles associate with classical cycles. Growth

cycle chronologies based on trend-adjusted measures of economic activity were first developed by Mintz (1969, 1972, 1974). Burns and Mitchell noted the following about growth cycles:

> *"If secular trends were eliminated at the outset as fully as are seasonal variations, they would show that business cycles are a more pervasive and a more potent factor in economic life...For when the secular trend of a series rises rapidly, it may offset the influence of cyclical contractions in general business, or make the detection of this influence difficult. In such instances [the classical business cycle method] may indicate lapses from conformity to contractions in general business, which would not appear if the secular trend were removed."*

Following Mintz's work, when the OECD developed leading indicators for its member countries it decided to monitor growth cycles. Growth cycle analysis also formed the basis for the international economic indicators (IEI) project (Klein and Moore, 1985) started at the NBER in the early 1970s.

Of course, growth cycles, measured in terms of deviations from trend, necessitated the determination of the trend of the time series being analyzed. The Phase Average Trend (PAT), calculated by averaging business cycle phases, was used as the best trend measure by the OECD as well as in the IEI project, in order to measure growth cycles. However, one problem with the PAT (Boschan and Ebanks, 1978) as a benchmark for growth cycles is that it is subject to frequent and occasionally significant revisions, especially near the end of the series.

In other words, while growth cycles are not hard to identify in a historical time series, it is difficult to measure them accurately on a real-time basis (Boschan and Banerji, 1990). This is because the trend over the latest year or two is not accurately known and must be estimated, but the PAT estimates tend to be very unstable near the end (Cullity and Banerji, 1996). More generally, any measure of the most recent trend is necessarily an estimate and subject to revisions, so it is difficult to come to a precise determination of growth cycle dates, at least in real time.

This difficulty makes growth cycle analysis less than ideal as a tool for monitoring and forecasting economic cycles in real time, even though it may be useful for the purposes of historical analysis. This is one reason that by the late 1980s, Moore had started moving towards the use of *growth rate cycles* for the measurement of series which manifested few actual cyclical declines, but did show cyclical slowdowns (Layton and Moore, 1989).

Growth rate cycles are simply the cyclical upswings and downswings in the growth rate of economic activity. The growth rate used is the "six-month smoothed growth rate" concept, initiated by Moore to eliminate the need for the sort of extrapolation of the past trend needed in growth cycle analysis. This smoothed growth rate is based on the ratio of the latest month's figure to its average over the preceding twelve months (and therefore centered about six months before the latest month). Unlike the more commonly used 12-month change, it is not very sensitive to any idiosyncratic occurrences 12 months earlier. A number of such advantages make the six-month smoothed growth rate a useful concept in cyclical analysis (Banerji, 1999). Cyclical turns in this growth rate define the growth rate cycle.

The growth rate cycle is related to Mintz's earlier work on the "step cycle" except that the former is based on the smoothed growth rate as mentioned above. Also, in concept, the growth rate cycle does not suggest that the growth rate passes through "high growth" and low growth steps, but moves, instead, from cyclical troughs to cyclical peaks and back again. At the Economic Cycle Research Institute (ECRI), headed by Moore, growth rate cycles rather than growth cycles are used as the primary tool to monitor international economies in real time. The growth rate cycle is, in effect, a second way to monitor slowdowns in contrast to downturns. Because of the difference in definition, growth rate cycles are different from growth cycles. Thus, what has emerged in recent years is the recognition that business cycles, growth cycles and growth rate cycles all need to be monitored in a complementary fashion. However, of the three, business cycles and growth rate cycles are more suitable for real-time monitoring and forecasting, while growth cycles are more suitable for historical analysis (Klein, 1998).

In this paper we examine the performance of the leading index with respect to the classical business cycle and the growth rate cycle of the Indian economy. The classical

business cycle as well as the growth rate reference chronologies are obtained from our earlier work – Dua and Banerji (1999).

3. METHOD FOR CONSTRUCTING THE LEADING INDEX

The leading index provides valuable information about the future path of the economy, combining information from several economic series and collectively forecasting future movements in the economy. Each series in the leading index contains some information about the future turning points but it is unlikely that the individual series will show identical turning points. The combined information in the leading index produces better predictions about future turning points than any one of the individual series in the index can generate on their own.

The construction of the leading index follows well-developed procedures developed by National Bureau of Economic Research researchers Geoffrey H. Moore (Founder of Economic Cycle Research Institute, New York) and Julius Shiskin in the 1950s. The various steps of the classical approach are outlined below.

- ***Determination of reference chronology based on coincident indicators:***
  - ***Classical Business Cycles***
    - The cyclical turning points of the coincident indicators are first determined.
    - The composite coincident index is constructed using the NBER methodology.
    - The cyclical turning points of the coincident index are then determined.
    - The business cycle peak and trough dates are selected based on the consensus of turning point dates of coincident indicators.
    - The coincident index turning points are used to resolve ties.
  - ***Growth Rate Cycles***
    - The cyclical turning points of the smoothed growth rates of the coincident indicators and of the coincident index are used.

The reference chronology is already reported in Dua and Banerji (1999). Hence we proceed to the next step of constructing the leading index.

- ***Leading Index***
    - Based on economic theory, empirical observation in other economies, and the special characteristics of the Indian economy, some variables are expected to lead the cyclical movements of the Indian economy. To verify whether or not they actually lead, their cyclical turning points are compared to the reference chronology. If the lead is significant and consistent, and the data are available in a regular and timely manner, the variable can be considered a satisfactory leading indicator and selected to be part of the leading index.
    - The selected leading indicators are then combined into a composite leading index for the Indian economy using the NBER procedure. The leads of the index with respect to the reference chronology are determined by examining the consensus of turning point dates of the leading indicators.
    - This is done both for the classical business cycle as well as the growth rate cycle.

Determination of Turning Points

The choice of turning points is made by mechanical procedures supplemented by rules of thumb and experienced judgment. The initial selection of turning points employs a computer program based on the procedures and rules developed at the National Bureau of Economic Research (see Bry and Boschan, 1971). The selection of a turning point must meet the following criteria: (1) at least five months opposite movement must occur to qualify as a turning point; (2) peaks (troughs) must be at least fifteen months apart; (3) if the data are flat at the turning point, then the most recent period is selected as the turning point. These rules of thumb trace their roots to Burns and Mitchell (1946) and continue to be applied by the Economic Cycle Research Institute (ECRI). Finally, turning points must pass muster through the experienced judgment of the researcher. Turning points can be rejected because of special one-time events that produce spikes in the data, indicating turning points. Experienced judgment also excludes non cyclical exogenous shocks.

A specific cycle, that is, a set of turning points for each series is thus obtained. For the leading index, the lead is then determined based on the central tendency of the individual turning points in a set of leading economic indicators. Leads for the highs and lows of the growth rate cycle are derived from the growth rates of the leading indicators.

Construction of the Composite Leading Index

The construction of the index follows the traditional NBER methodology with some modifications. The basic steps involve transformation of each series, standardization of each transformed series using standardization factors, and combination of the standardized series into a raw index. The raw index is adjusted for trend and finally rebased.

First, the logarithm is computed for each component series for which such a transformation will result in the "stationarity of cyclical amplitude" (Boschan and Banerji, 1990). Amplitude stationarity requires invariance of cyclical amplitude measured over complete cycles. Where amplitude stationarity is not a concern, including for series that are growth rates or include negative quantities, the log transformation is not performed.

To prevent the more volatile components from dominating the index, the series are then divided by the standardization factor, which is the standard deviation of the detrended trend-cycle component of the series over a number of whole cycles.

Next, the standardized series are averaged with equal weights across all components in the index. The process of scaling the series to prevent more volatile series from dominating the index implicitly provides a weighting scheme in the index. The trend adjustment is then performed for this series by multiplying it by a suitable factor that scales the trend up or down to match the target trend, which is often the GDP trend over a whole number of cycles. The antilog of this series is then calculated.

The modified procedure now used at ECRI makes two notable changes to the traditional procedure (see Boschan and Banerji, 1990). First, the new method ensures that the standardization factor measures only the cyclical amplitude. The old method lumped together trend, cycle, and irregular components, so that a high-trend cyclical component would be deemphasized compared with a trendless component for no good reason. Also, the new method uses a multiplicative trend adjustment instead of the traditional additive trend adjustment, which shifts turning points in the raw index. This method ensures that the final index turning points are the same as that of the raw index. Cullity and Banerji (1996) show

that the ECRI method outperforms the traditional procedure as well as the OECD method using the same set of indicators.

4. INDIAN ECONOMIC CYCLES

Most early theories of business cycles are endogenous, i.e., concentrating on the internal relations of the economic system. Some later theories have paid more attention to exogenous shocks and their propagation. It is amply clear from an examination of the phenomenon in a variety of economies, however, that business cycles are driven by a combination of endogenous and exogenous factors.

Even in the 1700s in England, bad harvests tended to adversely affect the demand for manufactured goods from small farmers, depressing the wages of industrial workers and leading to recessions resulting from the propagation of these shocks within an increasingly interdependent economic system. Ashton (1959) compiled a reference chronology of cyclical turning points for 18th century England. In some ways, until recent decades, recessions in the Indian economy were analogous to those experienced in 18th century England, which were driven mainly by weather and wars before the industrial revolution of the 1780s.

As noted in our earlier paper (Dua and Banerji, 1999), over the last four decades, India has experienced six business cycle recessions characterized by pronounced, pervasive and persistent declines in output, income, employment and trade. These are as follows:

- November 1964 to November 1965
- April 1966 to April 1967
- June 1972 to May 1973
- April 1979 to March 1980
- March 1991 to September 1991
- May 1996 to February 1997

However, until the 1970s, these recessions were triggered in large part by the failures of monsoons, which were critical factors in an economy where agriculture accounted for over

40% of GDP. The agricultural sector continued to play an important role in determining economic growth until the early 1990s. The 1991 recession was caused by an unprecedented macroeconomic crisis, also triggered by an exogenous shock, the Gulf crisis. It was not until 1996-97 that there was a recession that could be traced in greater measure to endogenous factors.

However, the dominance of the agricultural sector and its susceptibility to weather-related shocks were not the only circumstances favouring exogenous shocks over endogenous mechanisms as a driver of the Indian business cycle. The government also dominated the "commanding heights of the economy." In fact, for the first four decades after India's independence in 1947, the government owned roughly half of the economy's productive capacity.

Myriad regulations and rampant distortions of the free market hemmed in even the private sector. Such distortions took the form of controls on prices and interest rates and extensive licensing procedures for the establishment of new factories or expansion of existing capacity. Generally, there were major barriers to entry and exit in most industries, including the difficulty of laying off any part of the labour force regardless of profitability.

This was not merely a mixed economy, with a large role for government-owned productive capacity - the issue was the extent of the controls and distortions that pervaded the operation of even the private sector. This was, after all, an economy where "the prices of almost every item, from automobiles to *zarda*, (had) been tampered with" by government controls, which also extended to extensive entry and exit barriers in industry (Basu, 1992).

Under such circumstances, the endogenous cyclical mechanisms that are the major drivers of cyclical processes in free market economies were clearly hampered in their operation. Thus, the market mechanisms that underlie the rationale for the functioning of leading indicators, which are linked to the normal antecedents of cyclical processes in market economies, were severely distorted. Therefore, it was questionable to begin with whether any leading indicators could be expected to perform creditably during the early decades after India's independence.

However, the Indian economy has undergone profound changes in recent years. By the late 1990s, the agricultural sector accounted for only 25% of the GDP, down from 40% in the late 1970s. Meanwhile, the spread of irrigation also made agriculture far less dependent on rainfall, and the creation of substantial buffer stocks of foodgrain made the economy far less vulnerable to crop failures. Thus, the economy as a whole became much less susceptible to weather-related shocks.

Separately, especially after the crisis of 1991, the Indian economy began a far-reaching process of liberalization, which continues to unfold. As a result, many of the extreme distortions of free market mechanisms have already been substantially mitigated. Under such circumstances, it is far more likely that leading indicators would start to function in the expected fashion.

Of course, while leading indicators lead at business cycle turning points, their deviations from trend also lead at growth cycle turning points, while their growth rates lead at growth rate cycle turning points. A chronology of growth cycles for the Indian economy for 1951-75 was established by Chitre (1982).

However, as discussed in the last section, because growth cycles are based on deviations from trend, monitoring growth cycles in real time requires the determination of the current trend, which is an uncertain exercise, and thus of dubious value. Therefore, for the purpose of real time monitoring rather than historical analysis, growth rate cycles, based on the smoothed growth rates of the underlying variables (Banerji, 1999) are more useful.

Our earlier paper (Dua and Banerji, 1999), which established a business cycle chronology for the Indian economy, also identified an Indian growth rate cycle chronology as follows:

- February 1962 to November 1962
- November 1963 to November 1965
- April 1966 to March 1967
- February 1969 to February 1974
- February 1976 to December 1979

- November 1980 to November 1981
- April 1982 to November 1983
- August 1984 to October 1987
- June 1988 to March 1989
- March 1990 to September 1991
- April 1992 to October 1993
- September 1994 to February 1997

The business cycle and growth rate cycle turning points represent the targets that leading indicators and their growth rates, respectively, are meant to forecast.

5. AN INDIAN LEADING INDEX

The obvious approach to the identification of leading indicators for the Indian economy is based primarily on their empirical ability to forecast past economic cycles. However, as we have discussed in the previous section, the structure of the Indian economy and the likely relationships between leading indicators and the Indian economic cycle have undergone profound changes over the last couple of decades. Therefore, any approach based on historical data fitting is likely to be doomed to failure. Even if the performance of any such indicators appeared to be good over past decades, it is doubtful that such performance would persist, given the structural shifts outlined in the previous section.

The alternative would be to identify a robust set of leading indicators that are likely to work in any free market economy. Fortunately, such an approach is feasible.

This approach is based on the findings of Klein and Moore (1985) and Moore and Cullity (1994) that demonstrate that leading indicators selected on the basis of an understanding of the key drivers of economic cycles consistently work in a great variety of market economies. Moore and Cullity showed that the first-ever list of leading indicators of recession and recovery (Moore, 1950), which Moore had picked 50 years ago based on economic rationale as well as empirical performance between 1870 and 1938, had continued to work very well in the second half of the 20th century, not only in the U.S., but also in 10 other economies ranging from Germany to Japan, Korea, Taiwan and New Zealand. Without

the soundness of the economic rationale, it would be difficult for the same indicators that worked in the post Civil War U.S. economy to continue working in late 20th century Korea, which is so different structurally. Similar results were obtained by Klein and Moore in their International Economic Indicators project started at the NBER in the 1970s, and at the Economic Cycle Research Institute (ECRI), founded by Moore, where an updated list of leading indicators is in use. Recent work at ECRI in New York on an even more diverse group of countries has confirmed the effectiveness of such an approach.

Accordingly, as in the case of every other country examined by ECRI, we selected roughly equivalent indicators, instead of choosing the indicators according to the degree of statistical fit. This approach was made possible by our extensive experience in analyzing economic cycles in a wide variety of international economies, and choosing the most robust indicators, or those that work in all countries covered.

Following this practice of using comparable indicators across countries, we constructed an Indian Leading Index .

The composite index construction procedure was that used at ECRI. The design of this procedure was based on a detailed review of the issues that concern composite index construction (Boschan and Banerji, 1990), so that it incorporates the strengths and avoids the weaknesses of a variety of approaches used around the world in past decades.

As Chart 1 and Table 1 show, the leading index had an average lead of 12 months at business cycle peaks, zero months at troughs and six months overall. As Chart 2 and Table 2 show, the growth rate of the Indian Leading Index had an average lead of three months at growth rate cycle peaks, zero months at troughs, and two months overall. These cyclical peak and trough dates were determined on the basis of the classical algorithm (Bry and Boschan, 1971) developed at the National Bureau of Economic Research (NBER).

A closer look suggests that the leads were rather elusive until recent years (shaded cells). Until the early 1990s, the leading index was roughly coincident with business cycles, while the leading index growth rate was roughly coincident with growth rate cycles. However, a clear pattern of leads has emerged in the last few years.

This experience is consistent with the logic of leading indicators, which is predicated upon the existence of a free market economy. In the case of India, where the government had long distorted the free market, such an assumption had questionable validity until economic liberalization began in the early 1990s. Also, in earlier decades, a dominant agricultural sector vulnerable to the vagaries of the monsoon made crop failures the key cause of recessions. It is difficult for leading indicators to predict cyclical turns caused primarily by such exogenous shocks.

Under such circumstances, it is understandable that the leading indicators did not lead in a systematic manner, and also exhibited a number of extra cycles. However, a close look at Chart 2 suggests that virtually all these extra cycles corresponded to smaller, roughly contemporaneous fluctuations in the Indian Coincident Index introduced in Dua and Banerji (1999), most of which did not exhibit the pronounced, pervasive and persistent declines that mark true cyclical downturns.

What is clear is that the Indian economy grew at a relatively staid and steady pace in the decades after independence, and recessions, which were caused mainly by bad monsoons, were relatively shallow. Such behaviour was consistent with a command economy, where the role of endogenous free market processes was limited and government action tended to smooth out cycles.

6. LEADING INDICATORS IN A CHANGING ECONOMY

The Indian economy has changed profoundly in recent decades. The agricultural sector, which accounted for over 50% of GDP until the early 1960s and over 40% of GDP until the late 1970s, represented just 25% of GDP by the end of the 1990s. Meanwhile, the spread of irrigation reduced the vulnerability of agriculture to the vagaries of the monsoon, while a sustained nationwide build-up of buffer stocks of foodgrain broke much of the linkage between crop failures and economic downturns. As a result, the Indian economy is now far less dependent on good monsoons to sustain growth than it was earlier.

Separately, liberalization began in earnest in 1991 after a balance of payments crisis. By the late 1990s, the economy had been partially liberalized and the leading indicators began

to show consistent leads, as in other free market economies (Table2). In fact, the average lead of the Indian leading index growth rate in the two most recent growth rate cycles (shaded cells) has improved to five months.

How much liberalization does it take, then, for leading indicators to start working? It seems, based on our results, that after 1993 a sufficient degree of liberalization had occurred for the leading index to show consistent leads. Consider the statistics shown in Table 1c.

The percentage of the time the leading index growth rate shows leads at growth rate cycle turns has almost doubled to 100%. Meanwhile, the median lead has increased by 3.5 months and 11.5 months respectively at business cycle troughs and peaks, while it has increased by 2.5 months and 5.0 months respectively at growth rate cycle troughs and peaks. Does this mark a true shift in the behaviour of the leading index, or is it just a statistical fluke?

It is important to note that it is not a simply a change in the relationship of the leading index with the coincident index that is at issue here. The question is whether there is a change in the behaviour of the leading index at business cycle and growth rate cycle *turning points*. This is because the primary purpose of a leading index is to anticipate cyclical turns in the economy, not necessarily to forecast economic conditions at other times.

Unfortunately, there is a very limited number of turning points that can be examined – just six each at growth rate cycle peaks and troughs until 1993, and two each after 1993. With such a small number of data points, it is not feasible to perform a parametric statistical test that requires the estimation of parameters.

It is, however, possible to perform an appropriate nonparametric test (the randomization test for two independent samples) that works for small samples of this sort (Siegel, 1956). Despite the very small sample sizes, the changes between pre- and post-liberalization performance are significant at the 0.067 level for growth rate cycle troughs, and at the 0.200 level for growth rate cycle peaks. While more stringent significance levels are normally used in statistical analysis, it is notable that even such levels of significance were obtained given a sample size of just two in each case in the post-1993 period. While not

conclusive, this test therefore suggests, at least tentatively, that there was a shift in cyclical behaviour in the early 1990s. In other words, the expected leads of the leading index do seem to be emerging in the post-liberalization era.

7. CONCLUSIONS

The foundation for this research was the determination of business cycle and growth rate cycles for the Indian economy, based on a traditional NBER-type approach. This earlier research involved the creation of an index of coincident economic indicators, and the determination of the reference chronologies based on a consensus of the turning points of this index and its components.

An obvious approach might have been to start with a plausible set of leading indicators, and check what worked well in predicting past cyclical turns. The problem, however, was that the Indian economy had undergone major structural changes in recent years, and past performance might have very little implication for future success.

Instead, we adopted a different approach inspired by the work of Klein and Moore (1985) and Moore and Cullity (1994), as well as more recent work at ECRI on a wider variety of economies, on robust sets of leading indicators. This work showed that, based on an appreciation of the key drivers of the business cycle, it was possible to identify leading indicators that were robust enough to work in a variety of market economies. Such sets of roughly equivalent indicators are monitored monthly by ECRI for 16 countries including both developed and developing economies, and have been shown to have good historical as well as real time performance. This was the robust set of indicators used for India.

Since the Indian economy has been undergoing major structural changes in the liberalization process, we believe that pre-liberalization performance may not be relevant to the future success of the index. Instead, our approach has been to focus on the array of robust leading indicators that work consistently in other market economies, and show that these are now working in the Indian economy.

Clearly, what we are assuming by following this approach is that the new Indian economy has more cyclical features in common with other market economies than with its own earlier incarnation. Our consistent success in a variety of other market economies gives us the confidence to adopt this approach. The results are consistent with this view – after all, these same indicators work in country after country and also in the new Indian economy – but do not work in pre-liberalization India.

Our procedure is at clear variance with more data-driven approaches. In any case, there simply is not enough data in the post-liberalization period to try to fit the data in a way that is likely to work in the future – and such an approach is risky, given the structural shifts. In effect, what we have is an "out-of-sample" test for these same indicators that we have used in many other countries, and it works in the period where it should be expected to.

Our results provide an indirect window into India's progress towards a market economy. In a sense, the emergence of leads since the mid-1990s is evidence that the free market is starting to dominate the Indian economy. In this liberalized economy, it may be expected that in spite of their indifferent record before the mid-1990s, the leading index and its components will successfully anticipate future cycles in the Indian economy.

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Table 1
Lead/Lag Record of Indian Leading Index against Indian Business Cycle Chronology

Indian Business Cycle		***Indian Leading Index***			
Turning Points		***Turning Points***		***Lead (-) / Lag (+) in Months***	
Troughs	***Peaks***	***Troughs***	***Peaks***	***Troughs***	***Peaks***
		7/1977		extra	
	4/1979		2/1979		-2
3/1980		6/1980		3	
			4/1982		extra
		6/1983		extra	
			2/1985		extra
		4/1986		extra	
			3/1987		extra
		10/1987		extra	
	3/1991		12/1989		-15
9/1991		9/1991		0	
	5/1996		9/1994		-20
2/1997		12/1996		-2	

	Troughs	***Peaks***
	Overall	
Average	0.0	-12.0
	-6.0	
Median	0.0	-15.0
	-2.0	
Percent Lead	50	100
	75	

Table 2
Lead/Lag Record of Indian Leading Index Growth against Indian Growth Rate Chronology

Indian Growth Rate Cycle		***Leading Index Growth Rate***			
Turning Points		***Turning Points***		***Lead (-) / Lag (+) in Months***	
Troughs	***Peaks***	***Troughs***	***Peaks***	***Troughs***	***Peaks***
	2/1976		7/1975		-7
		4/1977		extra	
			3/1978		extra
		9/1978		extra	
			1/1979		extra
12/1979		12/1979		0	
	11/1980		1/1981		2
		5/1981		extra	
			4/1982		extra
2/1983		6/1983		4	
	8/1984		2/1984		-6
		6/1984		extra	
			1/1985		extra
		4/1986		extra	
			3/1987		extra
10/1987		10/1987		0	
	6/1988		6/1988		0
3/1989		2/1989		-1	
	3/1990		12/1989		-3
		7/1990		extra	
			3/1991		extra
9/1991		9/1991		0	
	4/1992		4/1992		0
7/1993		10/1993		3	
	4/1995		9/1994		-7
		7/1995		extra	
			4/1996		extra
2/1997		12/1996		-2	
	1/1998		7/1997		-6
10/1998		7/1998		-3	

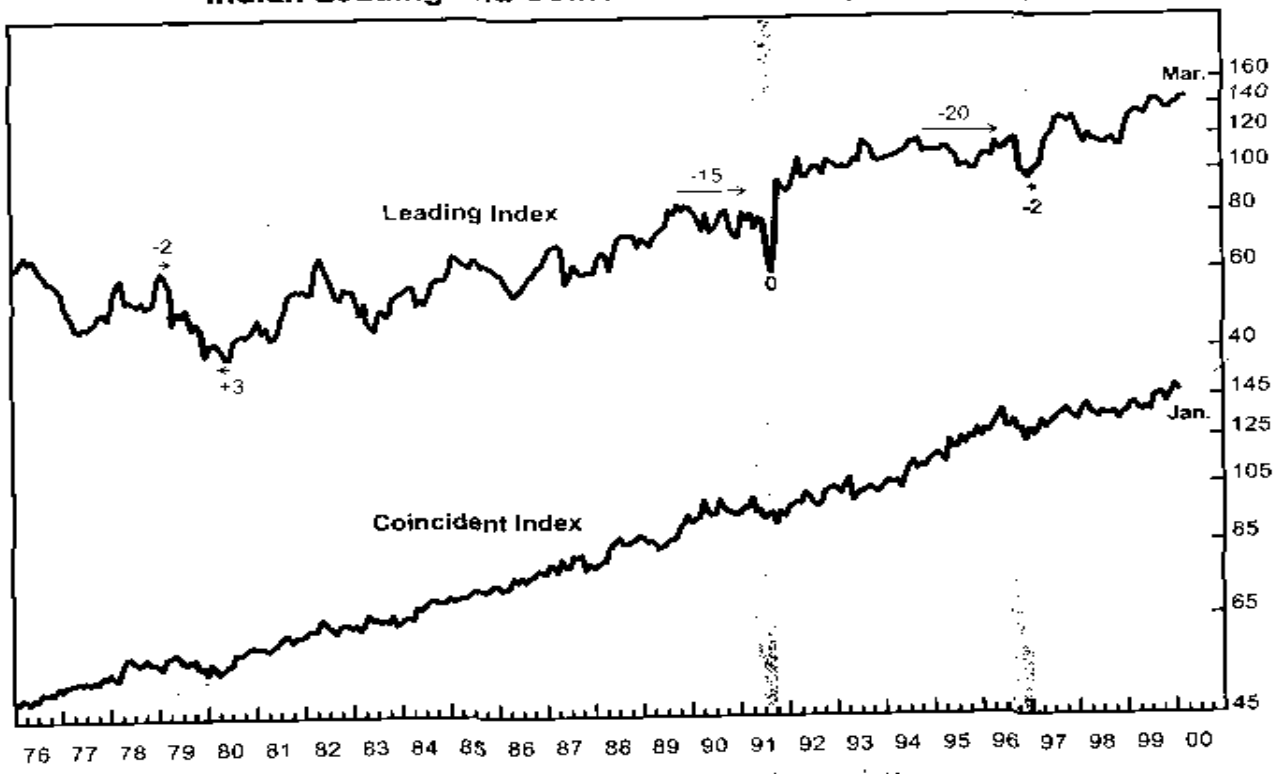
	Troughs	***Peaks***
	Overall	
Average	0	-3
	-2	
Median	0	-4.5
	-0.5	
Percent Lead	56	75
	66	
Average, 1994-99	-3	-7
	-5	
Median, 1994-99	-2.5	-6.5
	-4.5	
Percent Lead, 1994-99	100	100
	100	

Table 3
Lead(-)/Lag(+) of Indian Leading Index at Cyclical Turning Points Until 1993 and Later

Period	*Median Lead at Business Cycle*		*Median Lead at Growth Rate Cycle*		*Percent Lead at Growth Rate Cycle*	
	Troughs	*Peaks*	*Troughs*	*Peaks*	*Troughs*	*Peaks*
1993 and earlier	+1.5	-8.5	0.0	-1.5	42	67
After 1993	-2.0	-20.0	-2.5	-6.5	100	100

Chart 1

Indian Leading and Coincident Indexes (1992 = 100)



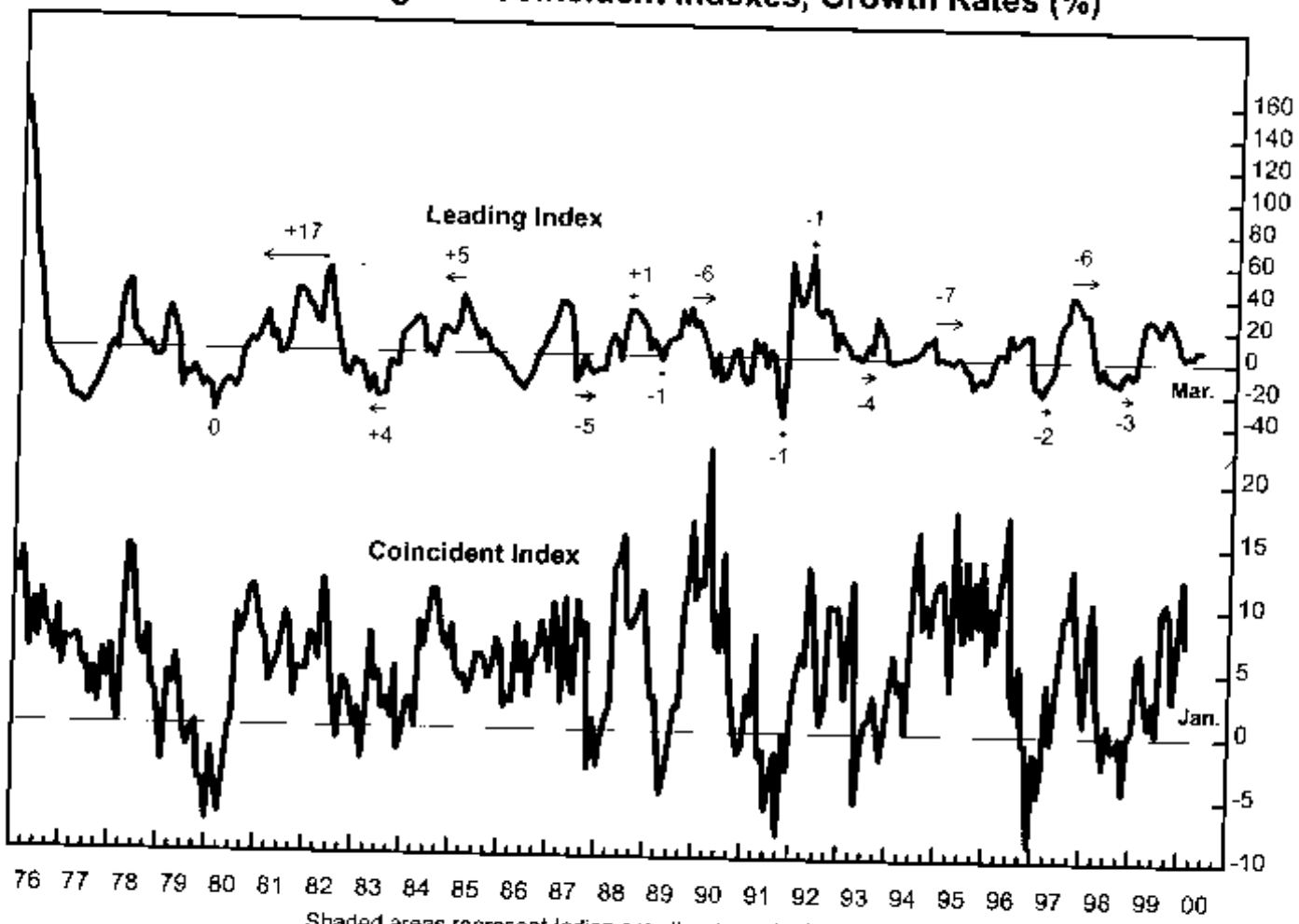
Shaded areas represent Indian *business cycle recessions.*

(Leads are indicated with a minus sign)

25

Chart 2

Indian Leading and Coincident Indexes, Growth Rates (%)



Shaded areas represent Indian growth rate cycle downturns.

(Leads are indicated with a minus sign)